

Adolescent Health and Wellbeing

Current Strategies
and Future Trends

Alessandro Pingitore
Francesca Mastorci
Cristina Vassalle
Editors

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ISBN 978-3-030-25815-3 ISBN 978-3-030-25816-0 (eBook)
<https://doi.org/10.1007/978-3-030-25816-0>

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The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Foreword

Adolescence is an extraordinary, in many aspects, magical age of life in which the perception of oneself changes dramatically; the body is transforming and the quality of relationships is changing, emotions are multiplied and complicated.

Probably, the trigger of change is represented by the hormonal tsunami that around age 12–13 begins the physical transformation and the upsetting of the nervous networks of emotional regulation. The sudden moments of excitement or anger, the vertiginous oscillation of humor, and the uncontrolled reactions are the most obvious result.

Actually, many imaging studies have shown that the brain of adolescents cannot be considered as an older infant brain or as a younger adult organ; on the contrary, it is a reality in itself, in many ways still mysterious, characterized by great flexibility and an explosive increase in the number of connections between the brain regions. Particularly, during puberty the limbic system that is driving emotions under the hormonal stimulus is strongly activated and rapidly consolidated, while the prefrontal cortex that controls impulsivity matures much later, in general when it reaches the age of 20.

Adolescence is therefore, by definition, the age of misalignment of the contrast between instinct and reasoning, between thought and impulsiveness. The brain of adolescents is not, however, a faulty organ and not even an adult “immature” organ; evolution has simply shaped it to function differently from that of a child or of an adult: just a point of passage necessary to move from one stage of life to another.

This apparent evolutionary disharmony of the individual, on the one hand, makes teenagers more likely and vulnerable to risk, on the other hand allowing them to adapt more easily to the environment, thereby transforming a fragility into a life, active force.

Winnicott provocatively claimed that “Adolescence is a normal ‘disease’; the problem is rather about adults and society, if they are healthy enough to be able to bear it”.

Unfortunately, despite these acquisitions have been known for a long time we are increasingly distant from an adolescence that we are led to see very different from that experienced by us adults and usually already reworked or removed. Furthermore, to understand fully the situation experienced by today’s adolescents, it is not enough to refer to one’s own life experience, because society has changed profoundly in

social organization and interpersonal relationships and the condition of adolescents is the most direct reflection.

A greater understanding of adolescents' way of thinking could help parents, teachers and society in general to distinguish typical attitudes of age from those that are not strictly physiological, but the road ahead seems to be still very long.

Even talking about health is not easy. In the past, the concept of health was simple, almost elementary, based on a negative affirmation: "healthy is he who has no illness" or "health is absence of disease". This simplified conception began to waver in the late nineteenth century when the development of medical sciences allowed recognizing, through new techniques and tools, the existence of pre-symptomatic diseases, that is before an affected person realizes it by continuing to consider itself healthy. Moreover, the development of knowledge also in the field of social, political, and economic sciences with their implications for human health has progressively imposed a new conception of health then synthesized into the art. 1 of the WHO Statute.

Today, we know that health is a dynamic condition of physical, mental and social well-being and not just a mere absence of illness or infirmity. The impact of the new concept has been enormous in the field of culture, science and health policies.

The positive affirmation of health as physical, mental and social well-being of the person, compared to the traditional, negative concept of health as absence of disease, caused a sort of earthquake in the field of medicine, which has been almost exclusively for centuries, with rare exceptions, in the study and diagnosis of diseases and now had to address leading issues as the predisposition and prevention but in particular the promotion of health and good quality of life.

But when should we take the preventive educational approach? So far all major public health interventions are proposed only starting from the adult age (from 18 years onwards), i.e. limiting adolescent action to the simple/simplistic correction of wrong habits such as sedentariness, smoking and consumption of alcohol and drugs; all this because ultimately it is still rooted and clearly prevails in our vision the old concept of health as absence of diseases that translates into everyday life in a negativist and sanctioning approach (i.e. "not doing that" or "this is wrong") rather than positive and growing incentive to well-being.

Several studies have shown that exogenous factors, that is external to the individual, that affect human health are numerous but still need to be done within the framework of the correct interpretation. These factors belong to all the components of the total environment, that is, to the physical, chemical, biological, social, economic environment; they continually interact with each other, forming a very complex system of unstable relationships and balances that are difficult to embrace.

Not only that, an equally complex system of unstable reactions and equilibrium that affect health depends on endogenous factors, that is, internal to the individual, in turn dependent, only partly from genetic influences.

Given the complexity of the issue, it is increasingly necessary to undertake a new multidisciplinary methodological study approach that considers the various

dynamics in the ecosystems of biological, cultural, psychological, medical, sociological, economic, demographic, behavioral, and political interactions concerning young people.

Without all these considerations, what should be done to try to understand the mechanisms that underlie the well-being of an adolescent or, alternatively, how a “non-physiological” malaise can be translated into predisposition to adult-life diseases?

Putting together the dual complexity, of adolescent lifetime and that of the concept changed over time of health, could turn out to be a “mission impossible” but the authors of this book, even aware of the enormous difficulties, have bravely decided to throw themselves into this great challenge by engaging in a problem that until today has been faced only partially without a holistic vision, thus creating the basis for a new way of concretely conceiving the proactive, synergistic relationship between science, health, and society.

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Preface

With the growing awareness that non-communicable conditions, such as obesity and diabetes, heart disease, and cancers, are impacting adult health status, adolescence is being increasingly recognized as an important period to target programmatic intervention and a sensitive window in which is determined one-third of the total disease burden during adulthood. Following this increasing recognition of the life-course impacts of the unhealthy behaviours in adolescence, the book “Adolescent Health and Wellbeing—Current Strategies and Future Trends” was born as a rib of the AVATAR project, the acronym for “A new purpose for promotion and eVALuation of healTh and well-being Among healthy teenageRs”. This project is based on the idea that the human being is a complex dynamic network in which all the units, organs and systems, work together obtaining a result that is not the simple algebraic sum of the single unit functions, but has global properties that are the expression of their integration. This is particularly true in the context of adolescence, a period of extraordinary changes, in which several factors, including lifestyle habits, emotional status, social context, and cognitive abilities, can influence well-being perception and health status. Two of the keywords of this book are, therefore, well-being and health, despite during adolescence the burden of well-being and health is underestimated/neglected, as this age is considered as a healthy period.

However, adolescence may be considered a period of health risk taking: unhealthy behaviours not only affect the health within this period, but also characterize its status later in life, underpinning the need of preventive strategies in terms of prevention of the chronic degenerative diseases that will develop during adulthood.

At the same time, adolescence is a dynamic, sensible, and flexible period of knowledge and adaptation to target health interventions, so that adolescents can adopt and maintain positive lifestyle choices to improve their present and future well-being. In this view, strategies, including health-promoting skills, positive health behaviours, and social connection with family, school, and community, are recommended to reduce the likelihood of health-jeopardizing behaviours. Despite this, programs and tools to assess and to enhance resilience, happiness, social involvement, self-esteem, and sociability are lacking.

In this context, the book offers a careful and updated review of the discussions about the widespread changes during adolescence from the perspective of promotion, prevention, and intervention, including: (1) the physical, social, cognitive, and emotional changes; (2) the role of environment (schools, families, peers, and the

mass media) in influencing the healthy behaviors of adolescents and young adults; (3) the potential role of e-Health technology in health and behavioral interventions for adolescents, with focus on possible future trends.

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Primordial Prevention: General Aspects

Abstract

Chronic degenerative diseases, including cardiovascular diseases, neurodegenerative diseases, and cancer, are one of the most significant public health challenges facing today's adolescents, aged 10–24 years, which now account for more than 25% of the worldwide population. Globally, chronic degenerative diseases have remained the leading cause of mortality and morbidity, with clinical signs usually present during adult age. However, early alterations may occur during adolescence, making this period particularly pivotal for implementing preventive interventions (Chap. 1).

To date, some projects, mainly related to school environment, have been experimented to target food intake and diet quality as well as physical activity, although much can be further done in this context. Other preventive strategies (especially those regarding psycho-emotional aspects) are mainly directed towards adolescents with mental disorders rather than the healthy ones. However, the World Health Organization defines health as “a state of well-being in which the individual realizes his or her own abilities, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community”, supporting therefore the necessity of preventive interventions in healthy adolescent population before it is too late.

One-third of the total disease burden in adults and two-thirds of premature death are related to behaviours originating early in life (childhood and adolescence). However, in view of the available evidences and according to Foetal Programming Hypothesis, this time window can be extended to include also the prenatal period, in which the development constitutes a critical time for shaping adult behaviour setting the basis for vulnerability or protection to disease in adulthood (Chap. 2).

In particular, during adolescence, the existence of modifiable risk factors, namely smoking, alcohol intake, diet, physical activity, obesity, perception of stress, emotional arousal, increases the chances of having a pathological risk profile in adulthood. Nowadays, a large and increasing number of studies have demonstrated that engaging in physical activity and reducing sedentary behaviour

(Chap. 3) and in dietary habits (Chap. 4) may enhance young people's health. This makes it necessary the possible lifestyle monitoring also through biomarkers assessment including nutrition and dietary components (Chap. 5).

Therefore, the prevention during this "sensitive window" of age is of the utmost importance for researchers, health professionals, and policymakers for a number of reasons: (1) adolescence is a period of risk taking which can have drastic consequences on adult health; (2) preventive programs during adolescence shape the habits during adulthood; (3) directing adolescence allows for maximal improvement of an individual's health and that of his/her children.



Preventive Primordial Strategies: Times Are Changing

1

Morena Lari, Irene Traghella, and Cristina Vassalle

1.1 Introduction

During the past 20 years, the elderly population has increased dramatically in Western countries, making elderly's care a major public health problem that requires new strategies to improve prognosis, life's quality, and health costs. Increasing data evidenced that chronic degenerative diseases, including cancer, neurodegenerative disease, and especially cardiovascular (CV) disease, which remain the more frequent cause of morbidity and mortality, may be prevented from early life with adoption of correct lifestyle behaviors [1].

Specifically, promotion of CV health should ideally begin postconception and continue throughout the course of life. To this purpose, the American Heart Association (AHA) introduced as 2020 Strategic Impact Goal the concept of "ideal cardiovascular health" (iCVH): "to improve the cardiovascular health of all Americans by 20% while reducing deaths from cardiovascular diseases and stroke by 20% by 2020" [2]. The definition of iCVH considers the simultaneous extent of four health behaviors concerning smoking habit, body mass index (BMI), physical activity, and diet and includes three health biomarkers (total cholesterol, blood pressure, and fasting glucose) [2] (Fig. 1.1).

Nonetheless, as health cannot be defined only as disease absence, but rather a state of complete physical, mental, and social well-being, especially critical in children and adolescents, the inclusion of psychological well-being in the interdisciplinary CV prevention research and strategies should help to develop and test new more effective preventive tools [3].

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© Springer Nature Switzerland AG 2019

A. Pingitore et al. (eds.), *Adolescent Health and Wellbeing*,

https://doi.org/10.1007/978-3-030-25816-0_1

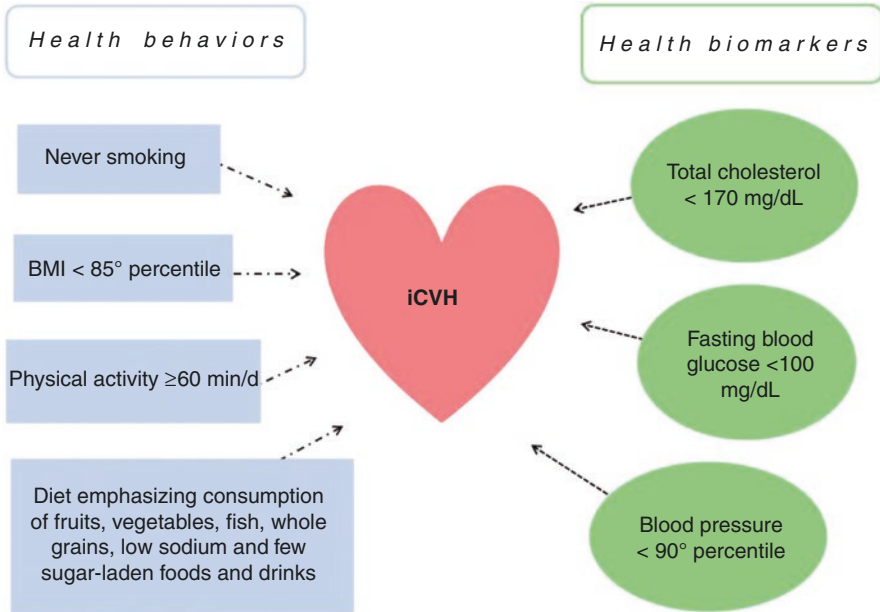


Fig. 1.1 Health behavior and biomarker iCVH components

Screening and identification of children and adolescents at higher risk and healthy lifestyle implementation should be considered as a global strategy, which require cooperation between multiple entities, including families, schools, health care, and research practitioners and institutions. In particular, given the central role of school in young people education and development of preventive approaches, effective interventions should include school-based strategies. For example, it is conceivable that the development of school-based Internet platforms, using a “user-friendly language” specifically targeted for user age, in order to educate children and adolescents to assess their health status, encourages healthy behavior adoption and evaluates the efficacy of interventions.

This and subsequent chapters will discuss aspects related to sociodemographic (e.g., socioeconomic status, gender), behavioral (e.g., self-esteem, friendship, and peer influences), personal (e.g., academic achievement), and environmental (television, media, Internet tools, and social network), evaluating also risk determinants still generally neglected in clinical preventive cardiology. Moreover, issues regarding the identification and evaluation of cardiovascular health biomarkers in children classified as having poor or intermediate cardiovascular health will be discussed.

1.2 CV Disease Primordial Prevention

In general, the stages of CV prevention include primordial (the prevention of risk factor development before their onset), primary (the prevention of cardiovascular disease among individuals presenting risk factors and as such at CV risk, before any

evident sign of clinical CV disease, or CV event occurrence), and secondary (the prevention of recurrent disease and complications in patients already diagnosed for CV disease).

As majority of children retain iCVH at birth, unfortunately during childhood, and adolescence, very few do not present any cardiometabolic risk factor, especially when considering overweight/obesity related to sedentary lifestyle and unhealthy diet. As an example, data from the World Health Organization (WHO) were obtained in children (6–9 years) living in 12 European countries participating in the WHO European Childhood Obesity Surveillance Initiative [4]. Findings evidenced that up to 57% of boys and 50% of girls are overweight and up to 31% of boys and 21% of girls are obese (WHO growth reference) [4]. The analysis also suggests the presence of a north–south gradient with the highest level of overweight/obesity found in southern European countries, especially in Italy [4]. In particular, for Italy, some types of behavior associated with obesity (e.g., low physical activity and high television/screen time) and maternal perception of their children obtained worst results in southern regions of the country than in central or northern regions [5]. Nonetheless, more recent encouraging data observed in Tuscany, a central Italian region, evidenced a significant decrease in the prevalence of overweight/obesity in children from 2002 to 2012 (32% versus 26%, $P < 0.001$ on using International Obesity Task Force-IOTF criteria and 38% versus 34%, $P < 0.001$ on using WHO criteria for overweight including obesity; and 10% versus 7%, $P < 0.001$ on using IOTF criteria and 13% versus 11%, $p < 0.05$ on using WHO criteria for obesity) [6]. The authors hypothesize that this reduction is probably related to a series of regional and local actions that have taken place in many sectors of society, evidencing the importance of public health initiatives, official nutrition recommendations, and dietary guidelines, as well as school programs.

It is common that tastes and behaviors related to health or risk of CV disease frequently begun and established in childhood or adolescence, affecting maintenance of iCVH status into adulthood. For example, smoking often establish during adolescence. Moreover, although smoking habit is less a problem in children, passive smoking may be more diffuse in childhood. Different findings suggested that smoking habit and passive smoking in childhood and adolescents appear correlated to acute and chronic respiratory impairment, to CV risk factors through many mechanisms (i.e., dyslipidemia, impaired endothelial function, increased arterial stiffness, oxidative stress, induction of adhesion molecule expression, macrophages, and platelets), and also to increased risk for cancers in adulthood [7–10]. In particular, a scientific statement from the AHA evidenced that passive smoking exposure is related to changes in vascular tone/stiffness and structural vascular changes and impaired cardiac autonomic function, as well as changes in heart rate variability in children, and that childhood passive smoking exposure is associated with clustering of cardiometabolic risk factors, such as obesity, dyslipidemia, and insulin resistance [11]. In this context, the estimation of cotinine levels remains the most objective measurement to assess the exposure level of active and passive smoking habit in these age ranges.

The use of electronic cigarettes is also notably growing between adolescents, and although there are still insufficient scientific data to evaluate its contribution to CV risk, this aspect remains to be further evaluated in future studies [12]. Also dietary

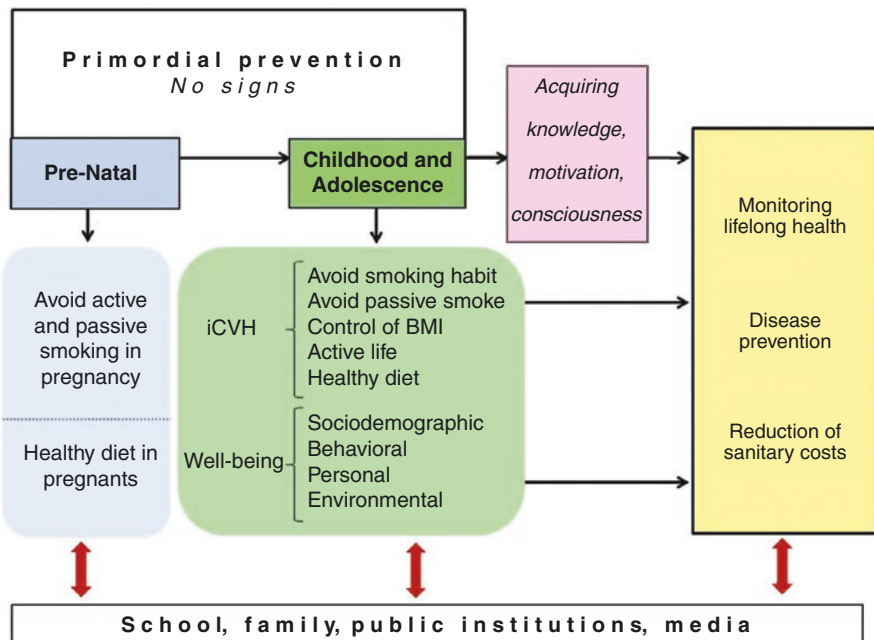


Fig. 1.2 Primordial prevention strategy

and physical activity habits are acquired during childhood and may worsen during lifelong. Learn how to maintain acceptable levels of CV health through childhood is quite simple, whereas adopt and achieve sustained lifestyle changes in adults is more difficult. Therefore, acquire knowledge, motivation, and consciousness—consolidated through a coordinated and comprehensive contribution of school, family, public institutions, and media—in children and adolescence may help to reach and maintain an acceptable iCVH and well-being lifelong, preventing development of diseases later in life, and also reducing sanitary costs (Fig. 1.2).

1.3 Challenges in iCVH Assessment and Data Interpretation in Childhood and Adolescents

CV risk factors can be measured in children and adolescents, and clinical care guidelines encouraged the inclusion of this population to identify and treat subjects at risk as early as possible [13, 14]. It is true that many risk determinants critical for adults retain the same importance for increased risk in children or adolescents, and generally, a child or an adolescent who presents abnormal risk biomarkers and lifestyle behaviors is likely to maintain and even worse these characteristics across older ages in the long term. Conversely, a child or an adolescent cannot be simply considered a “small adults” to which apply to a limited

extent results observed in adults, as numerous biological differences must be considered, including a lower sympathoadrenal activity and an immature hormonal system. Moreover, there are differences related to race and gender that may be more important after puberty. Other characteristic, such as specific territorial peculiarities, related to geographical, social, and religious aspects, must be also taken in account in the interpretation of data. Moreover, there are some determinants less considered in the assessment of risk, including genetic predisposition, stress, sleep hours, psycho-emotional factors, and meal timing and number, which are generally underestimated in the actual assessment of CV risk, although emerging as important determinants especially in children and adolescents. In any case, as risk in younger ages is essentially related to incorrect lifestyle habit, the first-line interventions are focused on diet modification, active life, body weight maintaining, and absence of smoking [13, 14]. However, as children and adolescents develop over time, the assessment of iCVH and risk presents some challenges, because risk biomarkers, such as lipid profile, glucose, BMI, and blood pressure, change continuously with age and gender. Moreover, other parameters, such as required energy intake, may be affected by multiple factors specific for each subject, such as age, gender, growth stage, body weight, and type and level of exercise of the specific child or adolescent. Thus, a unique threshold to assess risk across childhood or adolescence would be not appropriate. BMI is widely used to screen children and adolescents for overweight and obesity and is an easy metric parameter. In this case, the use of percentiles, based on age and sex from a standardized population, is generally used to monitor growth and development [15]. According to these charts, a BMI <85th percentile is ideal for CV health, whereas overweight is defined as an age/sex-specific BMI between 85th and 95th percentile and obesity when BMI \geq 95th percentile. Nonetheless, these thresholds may be imperfect because based on percentiles from general cohorts rather than on the relationships with outcomes. Moreover, although BMI result highly correlated with adiposity, the use of BMI as a measure of weight status has been criticized, especially in children and adolescents, because BMI may be affected by skeletal structure and muscle mass [16]. Instead, dual-energy X-ray absorptiometry provides highly reliable estimates of lean mass, fat mass, and percent body fat, whereas skinfold thicknesses and bioelectric impedance have been applied with success to estimate percent body fat in research settings [14].

At present, there is a clear lack of evidence regarding the most important aspect, which is the effectiveness of preventive interventions in young people in reducing adverse outcomes in the long term, for the difficulties to plan and organize longitudinal studies from childhood to adulthood. Nonetheless, the Bogalusa Heart Study (postmortem evaluation, 204 subjects 2–39 years of age) clearly demonstrated tracking of risk factors (e.g., BMI, lipids, and blood pressure) in early ages into adulthood atherosclerosis degree [17]. Accordingly, Bogalusa Heart Study results were substantially confirmed by findings observed in the most recent Pathobiological Determinants of Atherosclerosis in Youth (PDAY) Study (postmortem evaluation, 2876 cases, 15–34 years) [18].

1.4 Health Initiatives and Interventions

There are many examples of family, school, community, and public health initiatives launched at national and international levels to assess and decrease CV risk factors in childhood and adolescence. Between exemplary examples, the Health Ahead/Heart Smart program is a pioneering project used in schools since the 1980s, which aimed to improve school and student nutrition and to increase physical activity among participants, facing general health, nutrition, exercise, psychosocial development, and self-esteem building by addressing multivariate issues, such as drug, alcohol, and tobacco use, violent behavior, and including take-home activities to encourage family interaction and discussion, and assessments at the end of each lesson [19].

The School Health Policies and Programs Study (SHPPS), the most complete assessment of school health programs in the United States, reported school health policies across following components: health education, physical education and activity, health services, mental health and social services, nutrition services, healthy and safe school environment, faculty and staff health promotion, and family and community involvement [20–22]. SHPPS may represent an important resource for school and public health-care professional and researchers, policymakers, and all those who care about youth health and well-being [22]. However, it did not provide information on the impact or effectiveness of specific policies, it did not assess students' perceptions of the programs and services available to them, and all data were collected via interviews [22].

There are different meta-analyses including studies worldwide, and they focused on school-based interventions concerning obesity prevention in childhood and adolescence [23–28]. Specifically, student populations from the United States, Canada, Australia, Chile, Sweden, the United Kingdom, Greece, Taiwan, Thailand, Israel, Egypt, Germany, China, Switzerland, Belgium, Ireland, Spain, Brazil, France, the Netherlands, India, Singapore, Italy, Russia, Finland, Turkey, and Norway were evaluated for the analysis. Health profiles in children and adolescents may greatly vary between countries and within nations. Accordingly, the comparison between different environments presents many challenges, for example, related to different geographical, cultural, religious, and socioeconomic characteristics, but also to other study characteristics, such as to different follow-up times, endpoints, or delivering tools used for interventions. Nonetheless, a meta-analysis based on 32 school-based obesity prevention studies (52,109 students, 5–18 years) evidenced that most effective interventions in reducing BMI are those involving more comprehensive content, family support, and duration longer than 1 year [28]. More recent data suggested better results for combined strategies including diet–physical activity interventions delivered in schools with both family and community involvement [29].

Although presenting many challenges, the evaluation of cost-effectiveness of lifestyle interventions to prevent CV risk is another important aspect to consider. Data in this field suggested that the cost-effectiveness balance is particularly positive when applied to lifestyle preventive interventions conducted with the involvement of schools, as schools offer a reliable vehicle to deliver health interventions to all children and adolescents [30].

1.5 Focus on the Italian Scholar System

Referring to Italy, the framework to build the school curriculum is given by *Indicazioni nazionali per il curricolo della scuola dell'infanzia e del primo ciclo d'istruzione* [31]. School institution has the task, among all, to “teach to be” and provide adequate instruments to develop an open and aware identity. Centrality of the identity is strictly linked to a global idea of subject, which has to create society in a continuative relation with other people. “Promotion and development of every subject urges promotion and development of other people in a mutual way: everybody learns better in a relation with others. Live together in society is not enough, the society has to be built together” (p. 6). In this context, the *Profilo dello studente* (*Student's profile*) provides to take “care and respect for self, as requirement of a healthy and correct lifestyle” at the end of Primary and Lower secondary education for pupils. This is one of the tasks related to primordial prevention, which the Italian educative and formative system has to reach through a path running from Preschool education. Here, pupils from 3–5 years old should become aware of correct alimentary style and personal hygiene through informal, routine, and ordinary life activity promoting psychophysical wellness.

In Primary education (age 6–11) within the Italian system, Natural Science as school subject establishes “awareness of body structure and growth [...] using intuitive models” to develop key competences, taking care of own health and even having “care attitude toward school environment shared by pupils” (p. 55) respecting and appreciating the value of social and natural environment. From a holistic point of view on society and knowledge, people’s wellness comes from here: not only “a healthy mind in a healthy body” idea, but “healthy body in healthy world.” In physical education, pupil “recognize some essential principles related to his own psychophysical wellness related to personal care, a correct alimentary regime and a prevention from using substances that cause addiction” (p. 63). For the last year of Primary education, among learning tasks, there are “awareness of physiologic functions (cardiorespiratory and muscular) and their changes in relation with physical exercise” (p. 64).

During different stages of school, actions could be more addressed and deepened: as an example, at the end of Italian Lower secondary school, one of the Biology learning task is to “develop care and control of own health through correct alimentation; to consciously avoid damages from smoke and drugs” and “assuming behaviors and personal choices which are ecological sustainables” (p. 57). In the same stage, one of the expected competencies in Physical education is to recognize, search, and apply behaviors that promote wellness related to a healthy lifestyle and to prevention.

The 2018 *Indicazioni nazionali e nuovi scenari* is called to give a guidance in a sociocultural and historical context continuously changing, going toward an “higher engagement for sustainability, European and global citizenship, and social cohesion” (p. 3) [32]. A scenario showed by the UN *Sustainable Development Goals*, “a plan of action for people, planet and prosperity” (p. 6), that directly involves School in its fourth goal “Ensure inclusive and equitable quality of education and promote lifelong learning opportunities for all individuals” [33]. As found on 2018 *Indicazioni*

nazionali e nuovi scenari, Italian school is actively engaged in reaching 17 goals, including “Ensure healthy lives and promote well-being for all subjects at all ages” (goal 3).

All these aspects can be developed in a myriad of specific projects, built in an interdisciplinary point of view as a complex and fluid society: teachers may use all these advices every day in their didactical projects. To this scenario greatly contribute what each adult (in the school, family, and society around children and adolescents) can do with their behavior as educational model.

1.6 Examples Focused on the Italian School Experiences

In Italy, the project in Milan Area is a large pioneering study ($N = 12,354$ students from kindergarten to high school), which gives a picture of obesity prevalence, including a study subgroup for obese individuals with a specific program of secondary dietary prevention [34]. The nutritional education intervention significantly reduced the prevalence of overweight and obesity from 32% to 25% in kindergarten, from 33% to 28% in primary schools, from 33% to 29% in middle schools, from 33% to 29% in high schools [34].

The EAT project was a two-school-year project, including three schools ($n = 5262$ adolescents) in the urban area around Milan in the North of Italy assigned to the intervention group, and three schools ($n = 5225$ adolescents) to the control group. Intervention (2 years), focused on school environment (alternative healthy food vending machines, educational posters) and individual reinforcement tools (school lessons, textbook, text messages, pedometers, reusable water bottles), was demonstrated effective to reduce the incidence of obesity and overweight (significant decrement of BMI z-score and waist-to-height ratio) and to improve student dietary habits [35].

In the middle-Italy city of Bologna, a 4-month intervention (from October 2008 to February 2009; 209 students, 9–10 years) project was held [36]. It involved both the school and the family environment, using informative and motivational lessons for children, teachers, and also parents, with focus on the importance of healthy living and practical advises. This project also utilized telephone contacts with the parents, which allowed monitoring of ongoing habit changes and reinforce motivation. After 8-month follow-up, BMI improvement and an increase of 3 h of the time spent in outdoor activities were observed in the intervention group.

Another Italian project is the “Stradella” project, which involved 280 students (15 years) in the suburban area of the city of Modena [37]. The characteristic of this project is that it focalized only on the role of the teachers, without the involvement of student families. Specifically, teachers were trained on a specific program dealing with cardiovascular risk factors and given practical advice on nutrition [34]. These issues became an integral part of the school curriculum of biology. In the student intervention group, during the 6-month follow-up, an improvement of lipid profile was observed [34]. Moreover, evaluation of food diaries showed reductions in the intake of snacks, sweet beverages, cheese, and cured meats [37]. Instead, another

study, held in 4500 children (6–10 years), was focused on professionally guided programs of physical education in 24 primary schools located in the metropolitan area of Parma, Italy [38]. Results indicated that conditional and coordinative motor abilities (speed, trunk flexibility, long jumping, somersault, and Harre circuit test) all improved in children [38].

The project “Kaledo” is particularly intriguing as it utilized a board game specifically created for middle and high schools to promote use of Mediterranean diet [39]. A total of 3110 subjects (9–19 years old) from 20 schools from the cities of Naples and Salerno (Campania, Southern Italy) were included in the project [39]. Students in the intervention group were subjected to weekly 15- to 30-min play sessions, during which they learn about the concept of energy balance and how to make correct choices about food [39]. At 6 months, significant improvement in the field of “knowledge of nutrition,” “healthy diet and not,” “dietary habits,” and “physical activity,” as well as a significant reduction in BMI z-score in the intervention group was obtained [39].

The Italian “let’s go with fruit” project was designed to respond to the low fruit and vegetable consumption, with the main objective of increasing fruit and vegetable consumptions at school level, and taken in middle and high schools in five Italian regions (Tuscany as coordinator, Apulia, Campania, Marche, and Sicily; $n = 1793$ students) [40]. Interventions include the distribution of fruit and vegetables in classrooms, informative campaigns, visit to didactical farms, and creation of school vegetable garden.

Educational tools (book and DVD) such as “Forchetta e scarpetta” and “Open mind” were used to inform and drive students toward a healthy lifestyle. Specifically, “Forchetta e scarpetta,” edited by the project “OKKIO alla Salute,” consists of following different educational units: breakfast, fruit and vegetables, healthy eating, sedentary, and movement [41]. “Open mind” included three different educational units: healthy diet, consumption of fruits and vegetables, and physical activity [42]. They were also accompanied by handbooks for teachers. An innovative solution to improve healthy diet was supply of fruits and vegetables through vending machines. Results confirmed that students eat less than the amount of fruits and vegetables recommended by the International guidelines, but intervention (3 months) increased consumption of fruits and vegetables.

An important role in prevention is retained by physical activity: *Sport di classe* (*Class sport*) is a Miur and Coni (the Italian Olympic committee) project to spread physical education and motor activity in Primary school [43].

Each school institution could take part in national and regional initiatives or even promote their own ideas: here is not possible to analyze each school didactical projects, but we can take as an example the 2017/2020 *Piano triennale dell’offerta formativa* (Ptof, *Triennial plan of formative courses*) of Istituto comprensivo Don Milani, in Viareggio (Lucca, Toscana) [44]. Among its goals expressed in Ptof, we can find “wellness with oneself and with others, also in the school and in the community to form conscious, autonomous, responsible citizens” (p. 8). As an example, Lower Secondary School elaborated the project *Unplugged*, based on the study of social influence described in the *Eu-Dap* in order to make pupils aware of risks from

alcohol, tobacco, and drugs. Among the disciplinary didactical units, there is *Giochi sportivi (Sportive games)* in order to get used to usual sportive practical to promote healthy lifestyles and *Laboratorio alimentare* to promote dietary behaviors. At last, particularly interesting is *Urban Green Garden Hi-tech* in order to get pupils used to knowledge and adopt correct health behaviors and sustainability.

1.7 Pitfalls and Margins of Improvement

Although available data obtained at national and international levels are extremely important, as they can serve as a basis for implementing prevention and health intervention plans, there is still a large margin of improvement and the need to join better experiences of each single project. Being the school a privileged place for health promotion interventions and a way to reach majority of youngsters, these projects must see in the school the cornerstone of all interventions to promote health, although without forgetting family role and other parties (teachers, psychologists, healthcare and researchers, and institutions) working together in a multidisciplinary team.

Actual lifestyle assessment and interventions have primarily addressed on dietary and physical activity behaviors. Nonetheless, the addition of further aspects pertaining to the psychoemotional status rather than to sleep habits and well-being may better define individual risk. Generally, programs are adapted to the sociocultural area where they are designed and implemented and cannot be easily transferred without considerable efforts from a setting to another one (e.g., data obtained in rural area or small cities into an urban area). Thus, future projects would be modifiable or at least interpretable taking in account variables related to contingent reality. Other pitfalls include the fact that many available projects are affected by limited observation time, and long-term improvement in blood biomarkers (e.g., lipid profile) or BMI, when included in the projects, was not followed up. When using dietary diaries, another point to consider is the under-reporting of food intake. These aspects are important to clear also in view of the existence of a consistent percentage of the students, which did not achieve prefixed outcomes, expressing a lack of acceptance or adherence to the programs. Often, no indicators of agreement and satisfaction of participants are collected and analyzed in available preventive strategies, which would be added in future programs. It is critical to understand why these children and adolescents failed to adhere to preventive programs. Moreover, most of actual programs targeted on lifestyle assessment and interventions for young people utilized traditional education tools (e.g., written educational materials and teaching through speech). However, it must be considered the extreme diffusion and familiarity of the computerized and Internet technology among young people. Technology such as Web-based tools has begun to be utilized in lifestyle interventions with promising results, especially in young people, although more data are needed to determine in which ways new technological devices as well as social media can be

used to assess and affect health behaviors and encourage prevention since younger ages [36]. Moreover, in these perspectives, it must be considered that for the current generation of teachers, the use of digital media may be a challenge, and they could need formation in this field.

In any case, it is time to develop more innovative Web-based tools to be tested in the assessment of lifestyle habits, social context, emotional status, and mental skills in adolescents, through an integrated index of the best indicators of well-being. The project “AVATAR,” that we are implementing in Italian schools belonging to the Italian school network “RETE ULISSE, Scuole insieme per la ricerca scientifica e l’innovazione didattica,” is an attempt to satisfy these requests with the development of a Web-based tool for the improvement of the adolescents’ well-being and correct lifestyle through a dynamic and personalized interface which provides an immediate automated feedback that will allow monitoring of progresses [45]. In fact, the progresses of the student’ well-being may be monitored during time, providing an immediate automated feedback at different level by students, teachers, and parents [45]. Another important aspect to consider is the fact that during childhood and adolescence, a game could be an effective educational tool to learn, and that a fun, dynamic, and personalized Web/mobile platform to stimulate an active and dynamic approach can be developed according to the characteristics of the student group (e.g., according to age), as evaluated in the Kaledo project [39]. In fact, children and adolescents are highly familiar with technology, and methods in education could provide and take advantage by play-based learning. Gamification may render preventive strategies more accessible, fun, and impactful through healthcare game, and relationship with health and prevention concepts through a Web interface can be more dynamic, attractive, and targeted to the user. In addition, gamified tools may also make healthy regular activities easier to adopt and maintain.

1.8 Conclusion

Although clearly regarding more adult subject health, CV risk factors—such as smoking, unhealthy eating habits, lack of physical activity, and overweight/obesity—may occur and develop as a result of assumed behaviors since childhood. Increasing evidence demonstrated the possibility to change adulthood disease risk in children and adolescents preventing the incidence of risk factors from early ages. Nonetheless, medical care could not only deal with lifestyle evaluation but also promote a comprehensive well-being state—including the psychological domain—to achieve positive health, especially in this particular population. In this context, the Guideline on the Management of Blood Cholesterol, just released by the American College of Cardiology/American Heart Association Task Force, recommends to everyone a healthy lifestyle throughout the course of life; this reduces the risk of atherosclerotic cardiovascular diseases at any age [46]. In particular, a healthy lifestyle in younger people is advised, which can reduce the development of

risk factors, and therefore represents the basis for reducing atherosclerotic risk [46]. As abnormal lipids are relatively common in children and adolescents (approximately 1 in 5), universal pediatric lipid screening is recommended between 9 and 11 years, then again around 17–21 years [46].

Pioneering findings from longitudinal studies such as Bogalusa Heart Study need to be confirmed in improved programs, providing cooperation between schools, families, and public and health community. In particular, an important role must be played by the policy decision makers at national, regional, and local levels to favor plans that discourage unhealthy behaviors and encourage healthy lifestyle and well-being, contributing to healthy choices and good opportunities of the citizens, especially the youngest generation. For example, behind education and promotion of physical activity and a healthy diet, institutional interventions aimed to reduce food marketing and facilitate healthy products also by an economical point of view might facilitate healthy lifestyle adoption.

The lessons from past experiences and the exploitation of new technologies must be implemented in future plans, with the involvement of different society sectors and multidisciplinary professional figures, thus maximizing the benefits for an effective preventive strategy (Fig. 1.3). The value of the scientific community and health-care professional contribution may be critical in terms of data collection and

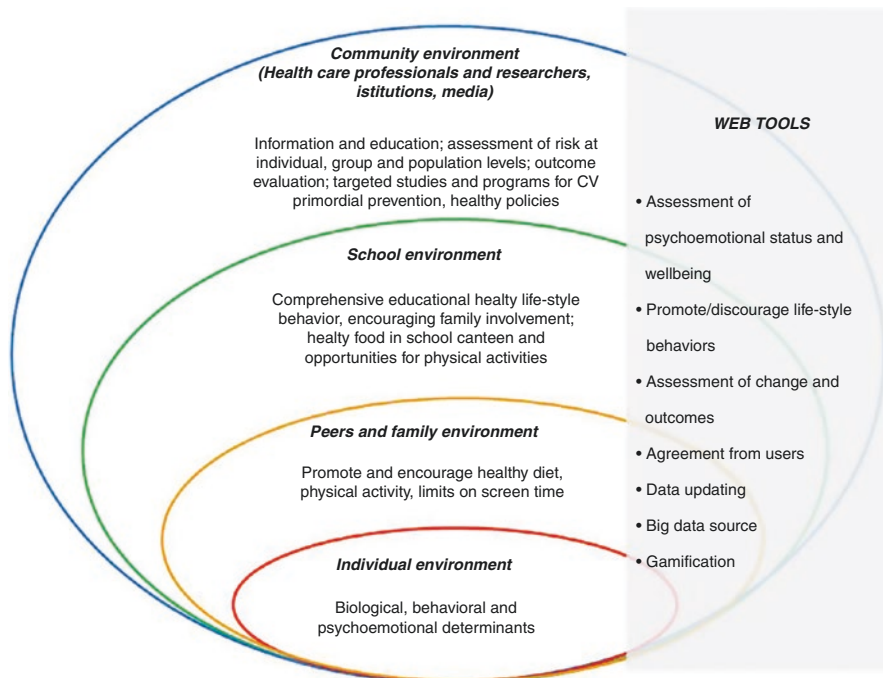


Fig. 1.3 Multiple environmental levels contributing to primordial prevention and WEB tool facilitating role

interpretation, to identify key biomarkers and indicators that would allow the most appropriate and cost-effective tools and preventive and interventional targeted strategies. In this scenario, school retains a central critical position, representing a first-line role to develop and test primordial prevention programs and to facilitate screening, identification, and intervention in children and adolescents at CV risk, encouraging them and their families to beneficial lifestyle changes. However, quality of results depends on teacher update, classroom sizes, introduction of digital technologies in scholar programs, and close collaboration with the local community context, all aspects difficult to achieve in many actual scholastic realities. In any case, comprehensive and targeted health education programs would be included at all levels and across all traditional school subjects. Digital technologies and global communications, extremely familiar to the youngest generations, are opportunities for training and education, engagement, and inclusive programs for children or adolescents belonging to minority or socially disadvantaged groups, which may facilitate cooperation across institutional, scholar, health, and research sectors, as well as develop positive peer influences and relationships. As such, new technologies must be incorporated in learning projects, providing an environment for their work, facilitating peer assessment through commenting, assessing students' perceptions of the programs and services available, and encouraging their standard achievement. In this context, gamification may render preventive strategies more relevant, motivational, accessible, and fun for the Web generation. Moreover, Web technology also facilitates data collection, assessment of lifestyle and well-being, update and analysis of data during time, and agreement from stakeholders.

Acknowledgment The authors thank Luigi Serrapica for his precious secretarial assistance and English style editing.

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Fetal Programming of Adult Disease in a Translational Point of View

2

Francesca Mastorci and Jacopo Agrimi

2.1 Introduction

Chronic degenerative diseases (CDD), such as cardiovascular disease (CVD), cancer, mental illness, diabetes, and chronic respiratory diseases, originated from a combination of genetic, physiological, environmental, and behavioral factors, including but not limited to body composition, metabolic function, and obesity risk, are the leading causes of death in Western countries [1]. Smoking, lacking of physical activity, obesity, high cholesterol or abnormal blood lipids, diabetes, and emotional stress are well-recognized risk factors for CDD morbidity and mortality [2]. However, research over the last 20 years has shown that adult lifestyle is not the whole story. More recently, a growing body of literature underlined the role of additional risk factors: the fetal programming.

The idea that childhood events, mainly linked to poverty and thus to nutritional deficit, may have long-lasting effects on the later development is well established as early as the 1960s [3], emphasizing the deleterious outcomes on subsequent mental health, disability, and behavioral problems. Decades later, Barker and colleagues shifted the focus to prenatal rather than childhood events [4], showing that birth weight is predictive of chronic disease in adulthood. According to this perspective, it has been identified an association between anthropometric parameters at birth and diseases in later life, bringing to the notion that the maternal environment influencing growth and development not only in short term but predisposing offspring to the resilience or vulnerability in adulthood.

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2.2 The Fetal Programming Hypothesis

2.2.1 The Role of Undernutrition

The evidence linking prenatal environment, in particular, early nutrition, to health in adulthood, determines a pivotal cornerstone in health promotion and public health programs. Epidemiological, pathological, and risk factor data demonstrate that childhood and youth are susceptible stages of life because adulthood chronic diseases are entrenched in early life, and social determinants of health and many conventional risk factors start to accumulate in childhood and progresses during the life course [5]. Almost 25 years ago, Barker and coworkers described the association between reduced birth weight and a number of pathological conditions later in life, mainly focusing on cardiovascular diseases [6]. This is reflected in Barkers' *developmental origin of adult disease* hypothesis that suggests how adverse influences in early phases of development, even during intrauterine life, can result in permanent changes in physiology and metabolism, resulting in increased disease risk in adulthood [7]. In particular, Barker thought that undernutrition of the fetus during critical periods of development became permanent and would be maladaptive in the structure and physiology of the fetal body, increasing the risk of diseases in later life, an example of the biological phenomenon known as "programming." With this term, we mean a process by which a stimulus or negative event during critical time windows of development has lasting effects on the structure or functions of body systems, due to a permanent cell memory. Programming is a result of the cells and tissues plasticity, which allows the embryo or fetus to respond to their environmental changes. For many cellular types, plasticity is a short-time characteristic, while for others represent the adaptive capacity of the prenatal period that persists throughout life.

According to Barker's hypothesis, because of the link between birth size and health in adulthood, the programmed fetus remained permanently vulnerable to later systemic disease. In particular, it has been demonstrated that intrauterine insults, such as undernutrition, hypoxia, and exposure to toxins, increased the vulnerability to develop endocrine and metabolic abnormalities, type 2 diabetes mellitus, insulin resistance, hypertension, and ischemic heart disease [6, 7].

Behind this increased risk appears to be the relationship between neonatal mortality and low birth weight, and the assumption that malnourishment during intrauterine period can determine a series of changes at the fetus and placenta level—changes that induce new metabolic regulation latent until adulthood. To explain how prenatal environment influences fetal development and the susceptibility to adulthood, Barker and Hales advance the *thrifty phenotype* theory that stated that the offspring may remain well protected as long as the environment is poor, responding to the nutritional condition with an adaptive mechanism, but when environment improves, the susceptibility to disease increases [8]. In other words, an early preconditioning may become harmful or have a damaging effect on the specific risk to develop a specific disease(s).

In line with Barker's hypothesis, a Finnish study, for example, showed that rate of growth in infancy influences the risk of CVD; in particular, death from CVD was highest in men who were low birth weight and accelerated weight gain during childhood [9].

Also, results from the Dutch Famine Birth Cohort Study, though a historical disaster which happened at the end of World War II, offer a unique opportunity to study the effects of undernutrition during gestation on health in later life, also because it occurred in a previously well-nourished population [10].

It has been abruptly circumscribed both in time and place, and the type and degree of nutritional deprivation during the famine has been accurately described. All these characteristics allow the Dutch famine to be considered as a unique "experiment of history" to be tested the fetal origins hypothesis. These results demonstrated that offspring experiencing maternal malnutrition early in gestation, at the age of 50 years, suffer from an increased incidence of coronary artery disease, hypertension, and in women, also obesity and poorer self-reported health [11]. Moreover, at age 58, these subjects, both males and females, reported an increased risk of breast cancer, higher stress responsiveness, and poorer cognitive function [12].

However, the long-term effects of intrauterine malnutrition depend from timing during gestation and on the tissue and systems undergoing critical periods of development. For example, the kidney may be most vulnerable during the phase of nephrogenesis, while the brain may remain vulnerable for much longer because extensive growth and development of neural pathways extend into childhood. In particular, what has emerged is that children suffering malnutrition during first trimester experience high probability of cardiovascular diseases, while in second trimester of pulmonary disease, and at the end of gestation, of behavioral disorders such as depression, antisocial behavior, and schizophrenia in adulthood [13] (Fig. 2.1).

Furthermore, the findings of this study also suggest that maternal undernutrition may permanently affect health in later life without altering the size of fetus at birth, opening for fetal origin hypothesis a new perspective. In other words, the fetus might be able to adapt in the short/medium term, but the induced systemic diseases could be the price to pay for adaptations to an unfavorable intrauterine environment.

2.2.2 The Long-Term Effect of Maternal Obesity

Together with undernutrition, fetal overnutrition, another form of malnutrition, due to gestational diabetes mellitus, maternal obesity, or excess weight gain during gestation, has also been associated with inadequate fetal growth and subsequent development of CVD during adulthood.

Obesity is a significant and growing concern for public health worldwide that affects both adults and children. In pregnancy, obesity is responsible for complications such as gestational diabetes, intrauterine growth restriction, infants born large,

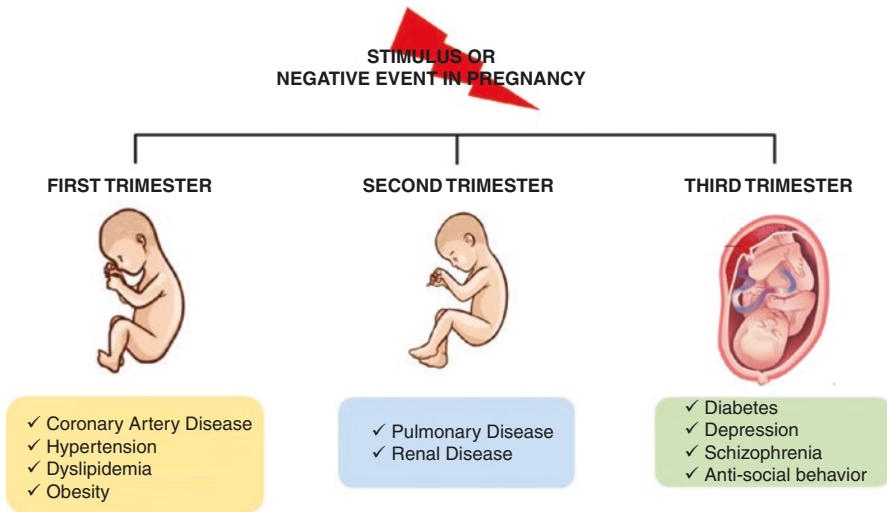


Fig. 2.1 Long-term effects of intrauterine malnutrition

increased Cesarean sections, and other obstetric intervention [14]. Given the effects in the short term, is pivotal understanding how maternal obesity may affect the outcomes of child from the perinatal period to adult age. Generally, maternal obesity is linked to macrosomia, considered a risk factor for obesity and metabolic syndrome later in life [15]. Growing Up Today Study, a cohort American study of over 14,000 adolescents who were born large for gestational age (LGA), showed that these infants were associated with an approximately 50% increase in the risk of overweight at age 9–14 years [16]. Another study conducted on Danish military conscripts indicated that BMI (body mass index) at ages 18–26 correlated with birth weight [17], suggesting that intrauterine environment plays an important role in the later development of obesity.

Maternal obesity in the context of the fetal programming has long been studied also in animal models in which it has been evaluated the impact of different types of diet, highlighting that high-fat diet leads to poor glycemic control and augmented adiposity in offspring [18]. In a study by Sasson et al. [19], pregestational exposure to high-fat diet caused growth-restricted fetuses, without long-term effects on adult weight. However, a changed gene expression of several imprinted genes in the placenta has been found, suggesting an epigenetic alteration in the germ line also involved in the inflammatory processes at the placenta level [19]. An altered maternal–fetal interface due to inflammatory state can lead to detrimental effects, explaining long-term effects on the fetus. In particular, children born from obese mothers have an almost twofold increased risk of death before the first year of life [20]. Also, another serious consequence in pregnancies involving obese women is preterm delivery with possibility of brain damage and elevated fetal concentrations of IL-6 and infiltration/activation of neutrophils and monocytes.

Generally, clinical and epidemiological data clearly show that both genetic and environmental factors contribute to the improved susceptibility to obesity and its associated comorbidity [18]. In particular, the effects of maternal obesity on the fetus, and thus during adulthood, are multifactorial, involving genetic, epigenetic, hormonal, inflammatory, and metabolic alterations (Fig. 2.2). Identifying the risk factors for maternal obesity will allow clinicians to intervene during critical time windows in fetal period, in order to attenuate the effects on adulthood.

2.3 Prenatal Stress

If, initially, fetal programming was almost exclusively linked to the birth weight as a consequence of under- or overnutritional intrauterine environment, recently has been examined the interface between biological, behavioral, and social processes during pregnancy, according to a translational perspective, with a focus on the effects of maternal stress on fetal development, and subsequent health outcomes.

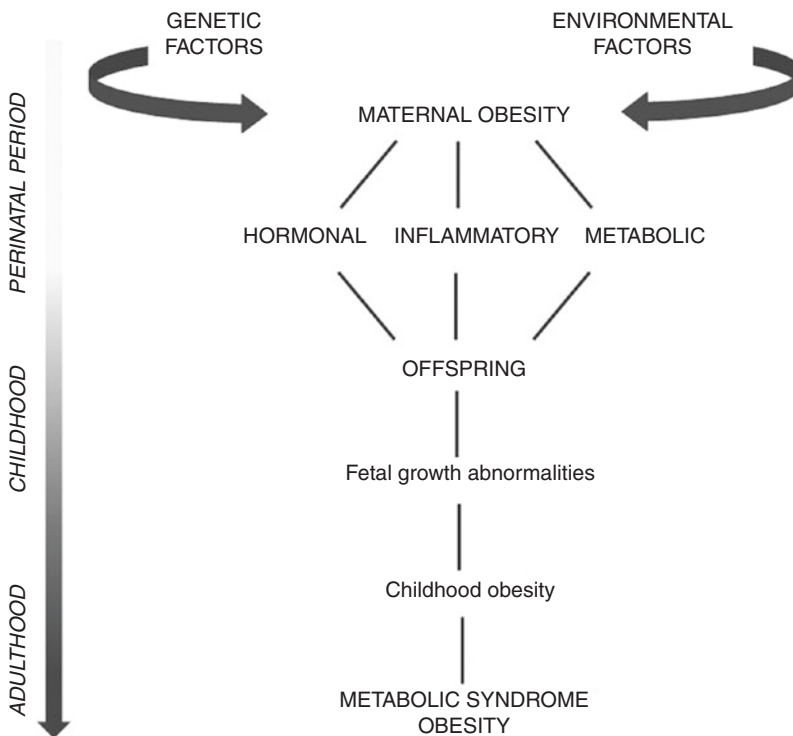


Fig. 2.2 The multifactorial effects of maternal obesity

2.3.1 Animal Models of Stress During Fetal Period

Animal models have been widely used to investigate the relationship between adverse environment during fetal life and vulnerability to psychosomatic/psychological disorders in adulthood, as they offer the opportunity to separate the role of prenatal stress from other morbidity risk factors. In addition, by studying the effects of prenatal stress in experimental animals, one can induce a psychosocial stress condition in the mothers during gestation in a systematic and reproducible manner, control the timing highlighting the different impact of a stressor according to differences in fetal age, and evaluate the interaction of the mother with her offspring in a controlled environment.

Thanks to this type of standardized approach, it is possible to evaluate the effects of the prenatal stress on the behavioral, biological, and physiological profile of the offspring: undoubtedly, this kind of procedures would be invasive and unethical if applied to human beings. Furthermore, the huge quantity of environmental variables to which a human mother is subjected during gestation does not allow a clear understanding of the qualitative and quantitative influence of stress on the health of her future offspring. This topic had already caught the scientific community's attention more than 50 years ago, as evidenced by the pioneering works of Thompson [21, 22], in which were developed the first animal experimental models to understand the effects on offspring behavior of prenatal maternal stress. According to a translational perspective, countless scientific papers testify how the stress suffered by mothers during gestation leads, as consequence, to behavioral deficits in the offspring during adulthood [23]. As widely discussed in this chapter, this observation is in line with the human model: the offspring of women exposed to acute and prolonged stress have an increased risk to develop several kinds of psychopathologies [24]. In animal models, restraint is one of the most employed experimental paradigms to induce a stress condition during gestation [25]. Anxiety and depression-like behavior are some of the most commonly observed outcomes in both young and adult rats who have undergone prenatal stress as proved by validated behavioral tests such as open field and elevated plus maze [26–28]. Nevertheless, the mood domain is not the only one to be involved; in fact, stress during the prenatal period is able to impair memory and cognition as well, leading to a serious decline in synaptic plasticity, as evidenced by numerous studies performed on rodents [29–31]. Finally, prenatal stressed mice show a decrease in social interaction behavior, which is recognized as a risk factor for the development of schizophrenia [32, 33]. The pathological behavior of offspring exposed to prenatal stress correlates with multiple aberrations of brain physiology and biochemistry. Among the many brain areas involved in these disease processes, the hippocampus seems to play a pivotal role. In fact, in most of the studies conducted on the topic, a structural or functional modification of this cerebral structure has been observed [26, 28, 34, 35]. At the molecular level, among the multiple factors involved in the pathophysiological processes related to prenatal stress, of relevance are the corticosteroids. Indeed, the overexpression of this hormone in mothers subjected to stress leads to an increased incidence of psychiatric diseases in the offspring [29, 36]. Another key molecule is

brain-derived neurotrophic factor (BDNF), which is downregulated in mice subjected to prenatal stress. This phenomenon is even more evident in crucial brain structures, such as the prefrontal cortex and the hippocampus [32, 35, 37], which strongly supports the neurodevelopmental hypothesis of pathophysiology of several psychiatric disorders [23].

2.3.2 Behavioral Long-Term Implications

Stress, in particular psychosocial stress, is experienced by more than 80% of pregnant women, although psychophysiological stress responses are progressively attenuated with advancing gestation. Prenatal stress induced by exposure to social, physical, or environment distress during pregnancy has been linked to many alterations in neurotransmitter systems, neuroendocrine function, and behavioral responses in the offspring with structural and functional consequences evident at different life ages, from neonatal stage to adulthood [38].

As for other type of insults, also the nature and severity of effects due to prenatal stress seem to be influenced by the timing of stressors during gestation. Retrospective and prospective studies have supported the notion that prenatal development is characterized by sensitive time windows in which organisms are more or less vulnerable to stressful events [39]. In this regard, human studies show that offspring from mothers who suffered from hostile conditions during their first trimester exhibit modest effects, while if exposed during the third trimester, babies reveal long-lasting consequences, such as low birth weight, heart malformation, hearing loss, and skeletal abnormalities [40]. In particular, outcomes in later life also include behavioral alterations interesting stress responsiveness and onset of psychopathologies [41]. Unlike maternal under- or overnutrition, the short-term effects of maternal stress are small; on the contrary, long-term consequences of maternal stress exposure seem to be dire, and mainly due to excess of glucocorticoids.

There is good agreement from human and animal studies that stressful condition during fetal programming induces adverse neurobehavioral outcomes later in life, including social, emotional, and cognitive alterations [42, 43]. According to this perspective, several studies have investigated the early and long-term outcomes of maternal psychological stress on the health of offspring. During childhood, a higher incidence of developing autism was found in prenatally stressed children [31, 44]. In adults, prenatal stress is mainly linked to depression, anxiety, and schizophrenia [31]. Studies conducted on mothers that self-reported elevated levels of anxiety during pregnancy indicated that their infants were more irritable and showed a higher incidence of feeding problems than those of nonanxious mothers [45]. In the Avon Longitudinal Study of Parents and Children (ALSPAC), in addition, higher maternal levels of anxiety and depression predicted sleep disorders in the children at 18 and 30 months of age [46]. Furthermore, antenatal maternal psychological stress was associated with emotional problems at the age of 4 years [47]. Other studies have focused on the consequences of prenatal stress from cognitive and motor development point of view. The Amsterdam Born Children and their Development

(ABCD) study showed that children of mothers, who were highly anxious during pregnancy, had lower reaction time to a reaction time task [48]. Some studies that have followed children born to mothers stressed during pregnancy at different ages, up to 17 years, reported, in 8- and 9-year olds, attention deficit hyperactivity disorder (ADHD) symptoms, externalizing problems, and self-reported anxiety [49]. In addition, during adolescence, those born to mothers highly anxious during pregnancy reacted more impulsively in a cognitive task and they responded faster, but made more errors than adolescents of low anxious women [50], suggesting that child's brain functionality is related to its mother's anxiety during pregnancy.

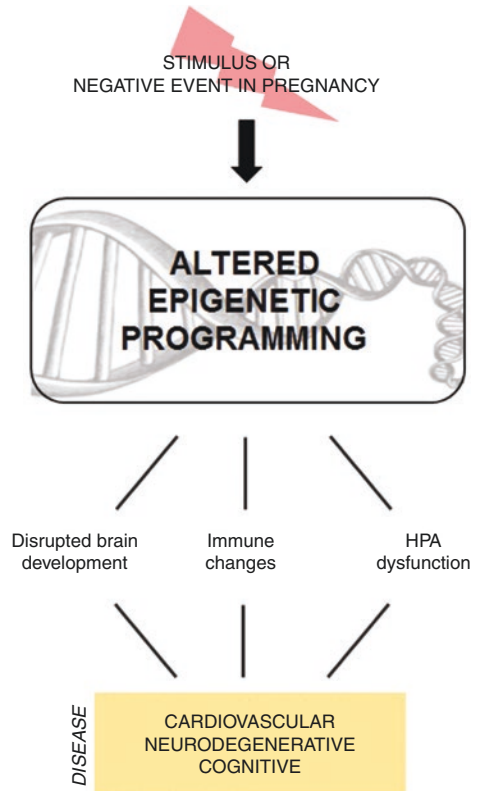
Stressful events are not related only to personal life, such as adverse conditions in the home or workplace, but can result from a wide range of natural or man-made disasters, including earthquakes, floods, freezing storms, war, and terrorist acts [31].

In this field, several studies have investigated the long-term consequences of natural disaster occurring during pregnancy on health of the offspring. In Project Ice Storm, 150 children were followed, who were in utero during a period of freezing rainstorms in Canada which caused power outages for weeks, until adolescence. Exposure during mid-gestation seemed to have strongest cognitive effects that persisted until 5 years old [51], while who experienced Chernobyl disaster during fetal development exhibited later in life a double risk of having depression symptoms and ADHD [52]. Exposure to beneficial experiences, such as environmental enrichment (EE), is one of the most powerful strategies to promote neuroplasticity and behavioral performance at any time in life. A small number of studies, especially in animal models of prenatal stress, have used EE to treat consequences of prenatal stress in order to reverse alterations induced in utero [53]. EE strategies have also been successfully applied to the human population. Although enrichment in a complex human environment can hardly be standardized, a number of studies have shown that specific countermeasures promote endocrine, neuronal, and behavioral functions, such as exposure to mindfulness meditation, music lessons, or physical activities. Since negative experience linked to stress during fetal life is linked to epigenetic modifications, EE may provide a suitable approach to reverse stress-associated epigenetic changes through beneficial experience, for higher risk populations.

2.4 Potential Mechanisms in Fetal Programming of Adult Disease

During developmental programming, nongenetic factors in correspondence of sensitive windows are transmitted to the fetus in order to change developmental trajectories, and thus, their organization and function are increasing or protecting the risk of disease (Fig. 2.3). Human and animal studies indicate that negative event or uncontrolled conditions in utero or during early life may increase the risk of chronic degenerative disease and psychological disorders during adulthood, arguably via altered epigenetic regulation and glucocorticoids pathways.

Fig. 2.3 Possible mechanisms in fetal programming of adult disease



2.4.1 Epigenetics as the Mediator of Fetal Programming of Adult Disease

Although the Developmental Origins of Health and Disease hypothesis and thrifty phenotype theory have tried to explain how the fetal programming can influence the development of diseases in adulthood, it is still unclear how early plasticity makes the body adaptive toward the adverse environment. A growing body of evidence suggests that epigenetic variation induced in early life has emerged as a prime candidate to be the mediator of such effects, with implications for neurobiological functioning and behavior. Epigenetics is usually defined as the study of heritable changes in gene expression that are not due to changes in DNA sequence. Epigenetic mechanisms regulate many biological properties of cells and tissues by altering gene expression, and they rapidly respond to environmental factors.

In particular, epigenetic mechanisms, such as miRNA expression, DNA methylation, and histone modifications, are prone to changes in response to stressful experiences and hostile environmental factors and may be responsible of the fetal basis of adult disease [54]. Recent human epidemiological and animal model data have suggested that early plasticity, in cells and tissues, is mediated by epigenetic adaptations that occur during fetal life in response to environmental stimuli. These results explain how the environmental inputs, adverse or comfortable, during early period might produce an inherited epigenetic modification with long-term consequences according to a mechanism defined phenotypic plasticity, that is, the ability of a genotype to produce distinct phenotypes when exposed to different environments throughout its ontogeny.

In other words, epigenetic abnormalities are a sort of memory of exposure to inappropriate environment, from chemical, nutritional, or nonchemical point of views, linking early life to many age-associated chronic pathologies, such as obesity, type 2 diabetes, cardiovascular disease, osteoporosis, neurodegenerative, and cognitive disorders [55].

There are several epigenetic mechanisms during the developmental programming of adult diseases in addition to the maternal diet. Hypoxia, for example, is a common intrauterine stress. Usually, a fetus might experience hypoxia condition in different situations, such as pregnancy at high altitude, pregnancy with anemia, placental insufficiency, and heart disease. Animal model of prenatal hypoxia has delineated a possible link between fetal hypoxia and increased risk of cardiovascular disease in the offspring [56], but results from human studies are partly unknown.

Another epigenetic mechanism involved is due to maternal cigarette smoking. The adverse consequences have been well described in epidemiological studies, including intrauterine growth restriction, sudden infant death syndrome, and cardiovascular disease in offspring, and thus enhancing the susceptibility to develop it during adulthood [57]. So far, there is an important aspect to consider in epigenetic field related to the possibility to inheritance of developmental programming of adult disease. According to this notion, an increasing number of epidemiological studies show that the effects of negative events during intrauterine life can be transmitted to subsequent generations, without further exposure to the same insult. The possible explanation of the transgenerational epigenetic inheritance effects induced by prenatal environment could be found in changes in the epigenome during development that either induce chromosomal alterations or involve epigenetic modification maintained through germ cell maturation [58]. In line with this view, findings obtained in the “Dutch famine” study demonstrated that women who were severely undernourished during the first trimester of pregnancy gave birth to babies who were on average of normal birth weight, but they were prone to give birth to smaller babies in the next generation, suggesting a transgenerational epigenetic inheritance [59]. The introduction of the new knowledge on epigenetic programming by early-life negative factors into the modern paradigm of causality of chronic degenerative diseases

will shift attention toward the prevention of diseases during adulthood to primordial preventive strategies during the early stages of life.

The application of such preventive approaches during early-life sensitive time windows is likely to be particularly promising. If one could modify the epigenetic patterns altered by exposure to stress or through specific epigenome-targeted interventions, then it would be possible to correct the compromised genetic patterns in order to prevent the chronic pathologies and to improve human health and well-being (Fig. 2.4).

2.4.2 Glucocorticoid Excess and the Developmental Origins of Disease

The mechanisms by which adverse maternal conditions affect the health of the offspring have been hypothesized to have an impact on programming of biological stress systems through maternal stress hormones, with special focus on the role of maternal glucocorticoids in the programming of the fetal brain development. A large number of animal and epidemiological studies have revealed that the long-term effects of early-life stress are mediated by alterations in the maternal and fetal hypothalamic–pituitary–adrenal (HPA) axes, exposing the fetal environment to an excess of glucocorticoids.

High levels of maternal cortisol during pregnancy, in fact, negatively correlate with offspring's birth weight, suggesting that an excess of glucocorticoids can bypass the placental barrier altering maternal–fetal interface. In turn, deficiencies in the barrier enzyme, increasing fetal glucocorticoid exposure, can also arise in concurrence with maternal stress.

Programming of the HPA axis has been proposed to be linked to the inactivation of the 11 beta-hydroxysteroid dehydrogenase (HSD), now known to be 11 β HSD type 2 (HSD2), involved in the protection of the developing fetus from the adverse effects of excess maternal glucocorticoids [60]. From a physiological point of view,

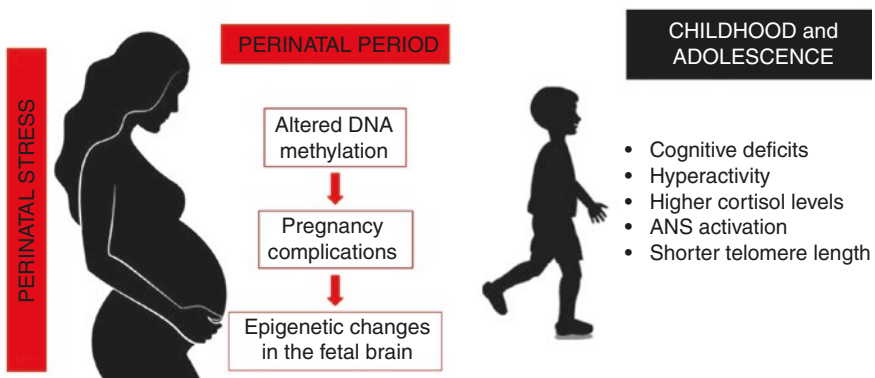


Fig. 2.4 Long-lasting epigenetic effects

the fetus is usually protected against higher maternal cortisol levels due to inactivation of 11β -HSD2. Degeneration of its activity may result in the augmented cortisol transplacental passage, which, in turn, may reduce fetal growth. Maternal stress and other type of fetal adverse conditions, such as low protein diet and hypoxia, may decrease 11β -HSD2 activity. A large body of experimental studies and human epidemiological data have investigated fetal programming of the HPA axis by maternal stress. A study conducted on pregnant women survivors to the September 11 World Trade Centre collapse showed that 1-year-old offspring had lower cortisol levels at awakening and at bedtime [61]. In the ALSPAC study, children born of mothers with higher levels of anxiety and higher cortisol, at 10 years old exhibited higher levels of awakening cortisol [46], while during adolescence reported flattened cortisol daytime profile, associated with depressive symptoms in females [62].

Little attention has been directed to the other systems involved in the stress response, such as the autonomic nervous system (ANS). Maternal stress, and thus, higher circulating levels of cortisol, may lead to the increased release of catecholamines with the following increase of blood pressure and heart rate; changes which, in turn, affect the development of the fetal nervous system, although the results are still unclear. Other potential mechanisms due to maternal stress can be involved on brain structure, as the one connected to the telomere length. A study, in fact, demonstrated that 25-year-old offspring of mothers who had experienced a severe stressor during pregnancy showed shorted telomere length than a control group [63]. Shorter telomere length is associated with advancing chronological age and also increased disease morbidity and mortality [64].

2.5 Conclusion

Adverse life events experienced by the pregnant mother and her reactions to them can produce alterations in the fetal environment, which, in turn, may have profound and long-term consequences on the offspring physiology and behavior. This is an adaptational mechanism of the fetus to changes in the environmental signals that it receives during early life to ensure its survival and prepare itself for next life. In particular, according to *thrifty phenotype* theory, when there is a change in the intra-uterine environment, the fetus makes adaptations to ensure its survival. If the hostile environment persists beyond the point of reversible adaptation, the fetus is forced to make an irreversible adaptation that will result in long-term alterations from physiological and metabolic point of view.

In detail, according to the Developmental Origins of the Adult Disease, environmental influences during fetal programming have been shown to increase the susceptibility to the noncommunicable diseases (NCDs) and alterations that represent major public health problems across the globe, including obesity, diabetes, CVD, respiratory diseases, immune and autoimmune diseases, neurodevelopmental and neurodegenerative dysfunctions, cancers, depression, and psychiatric disorders. The nature and magnitude of these effects depend on when the stressors take place during gestation, with clear windows of higher susceptibility. The timing of these

events during pregnancy is critical in determining associated long-term negative outcomes; in particular, early stress is related to adult coronary heart disease, mid-gestation to pulmonary and renal disease, and late gestation to behavioral consequences, such as depression, schizophrenia, and antisocial personality. In light of this, it is important to underline whether this susceptibility can occur without an immediate physical change, such as changed birth weight, but also result in subtle functional alterations, including epigenetic changes, that lead to altered biochemical mechanisms which will be evident at a later time in the life course. In fact, a latent period often occurs between the prenatal influences and subsequent manifestation of disease or dysfunction, sometimes lasting years or decades. Furthermore, another pivotal aspect of fetal programming of adult disease is the dual mode of transmission, both multigenerationally and transgenerationally.

In line with a translational perspective, multidimensional approach is required, including molecular and cellular studies, besides the availability of reliable animal models. In the context of human research, the need of prospective, longitudinal, and follow-up studies, ideally starting before conception and extending through pregnancy childhood, adolescence and beyond, is highlighted.

In conclusion, although preventive strategies to reduce NCDs have been focused mainly in adulthood and addressed to four factors, diet, physical activity, tobacco use, and alcohol consumption, new evidence suggests that more attention is required for stress-related maternal/placental/fetal endocrine and immune processes. This could represent a potentially candidate mechanism for clarifying the common biological pathway for mediating the long-term outcomes of prenatal stress. Interventions, during critical windows of developmental plasticity, to foster an integrative approach aimed to the study and understand of the interplay between nutrition, stress, and environmental factors, could have important effects in reducing vulnerability to diseases from childhood to adulthood.

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Physical Activity, Sedentary Behaviour and Mental Health in Young People: A Review of Reviews

3

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3.1 Introduction

According to the World Health Organization (WHO), mental health is crucial to the overall well-being of individuals and societies. In many cultures, unfortunately, mental health and mental disorders are often overlooked or, at least, neglected in comparison to physical health. However, mental disorders are one of the main causes of disability in developed countries [1]. The prevention of mental health disorders not only depends on the absence of psychological ill-being but also on the presence of psychological well-being [2]. In this chapter, the term psychological ill-being will be used to represent either preclinical psychological states (e.g. high levels of negative affect and stress) or clinically diagnosed mental health disorders such as depression and anxiety. Psychological well-being is the combination of positive affective states and functioning with optimal effectiveness in personal and social life [2]. There is overlap among common indicators of psychological well-being. Thus, the umbrella term of ‘psychological well-being’ will be used to describe positive indicators of mental health such as self-esteem, self-concept, perceived appearance, and the affective and cognitive dimensions of subjective well-being (i.e. positive affect and life satisfaction).

Both childhood and adolescence are stages of the human lifespan characterized by brain plasticity [3, 4], identity development [5] and the establishment of behavioural patterns, which might affect mental health [6]. In addition, in this period, young people experience increased autonomy for making decisions that may influence their mental health status, which highlights the importance of prevention during this period of life. Public health institutions in the area of mental health have focused on encouraging early help seeking, rather than equipping young people

with the skills to preserve their mental health. Indeed, there is a need for literature identifying what actions youths can undertake in their daily lives in order to lower their risk of mental health disorders.

Despite compelling evidence suggesting that physical activity plays an important role in health [7], a substantial proportion of young people do not meet the recommended levels of physical activity [8, 9]. Specifically, physical activity has been routinely linked to a variety of mental health benefits. For instance, a 2011 review of reviews showed the potential and beneficial effect of physical activity on mental health in children and adolescents [10]. In the last few years, several systematic reviews and meta-analyses have been published [11]. However, these have been focused on a particular mental health outcome [12–17], on specific physical activity or exercise practices [18, 19], on specific age ranges [20, 21] and on mechanisms (i.e. neurobiological, psychosocial and behavioural mechanisms) [22] explaining the relationship between physical activity and mental health or context (e.g. leisure-time physical activity, school sport) [23], making it difficult to obtain the overall picture.

Furthermore, youths are now remarkably exposed to screens, achieving exposure times never seen before [24]. The *American Psychological Association* [25] and the *American Pediatric Society* [26] recommend that parents and caregivers limit on the time and the type of media use. In addition, they suggest caregivers make sure that media does not take the place of adequate sleep, physical activity and other behaviours essential to health. However, more evidence is needed to support these recommendations in young people [27]. In this context, a vast of separate systematic reviews and meta-analyses have investigated the role of sedentary behaviour, especially recreational screen time (e.g. watching television, computer/Internet use and video gaming) in the mental health of young people [28–36]. However, robust conclusions have not been established so far due to inconsistencies in the literature.

The aims of this chapter, therefore, are (1) to provide an updated synthesis of findings on the effects and associations of physical activity and sedentary behaviour with mental health in young people, (2) to identify gaps in knowledge and (3) to suggest directions for future research. For these purposes, we performed a comprehensive and methodological review of systematic reviews and meta-analyses focused on the role of physical activity and/or sedentary behaviour on psychological ill-being (i.e. depression, anxiety, stress or negative affect) and/or psychological well-being (i.e. perceived appearance, self-concept, self-esteem, positive affect, happiness and life satisfaction) in young people. A detailed description of the main methods and results used to retrieve the available information on this topic is available in the supplemental material. Specifically, a detailed description of the search strategy, a summary of systematic reviews and/or meta-analyses investigating the relationship between physical activity and/or sedentary behaviour and mental health outcomes, and the results of the risk of bias assessment can be found in Tables 3.1, 3.2, and 3.3, respectively. Moreover, a flow chart illustrating the results of the selection process is shown in Fig. 3.1.

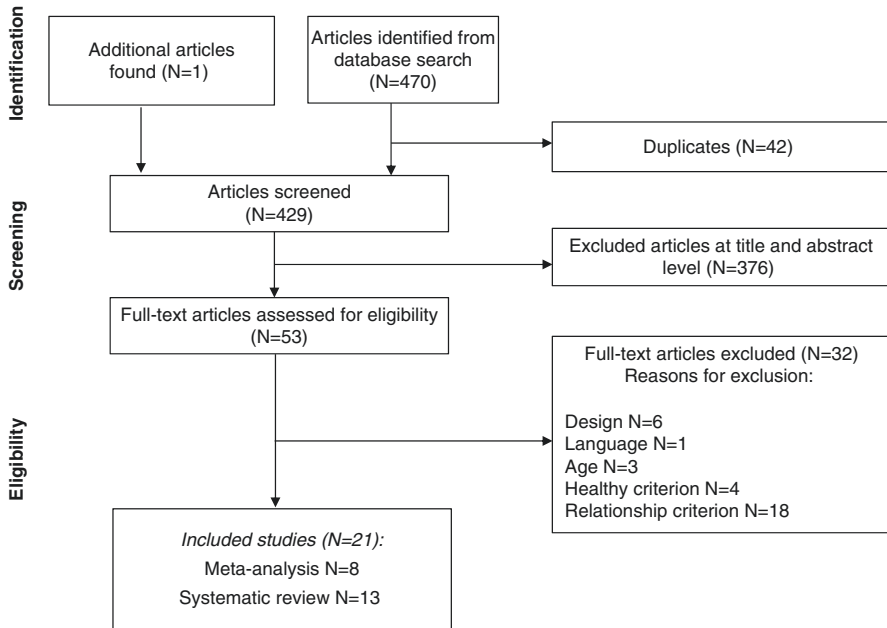


Fig. 3.1 Flow chart showing the results of the selection process

3.2 Physical Activity and Psychological Ill-Being in Young People

Summary

Researchers have been primarily interested in identifying modifiable factors (e.g. physical activity) associated with psychological ill-being symptoms in youths, with the focus on depression. Existing evidence suggests that higher levels of physical activity are related to lower depression, with a small-to-moderate significant mean effect size in youths (see Sect. 3.2.1). Although previous literatures have shown that higher levels of physical activity are related to lower levels of anxiety, stress and negative affect, we found minimal evidence in our review (see Sect. 3.2.2). A summary of the associations between physical activity and psychological ill-being outcomes is shown in Fig. 3.2.

3.2.1 Physical Activity and Depression

Depression is a major human health concern. Globally, it is responsible for more ‘years lost’ to disability than any other condition [37]. Consequently, most of the studies on physical activity and mental health have focused exclusively on reducing and preventing depressive symptoms.

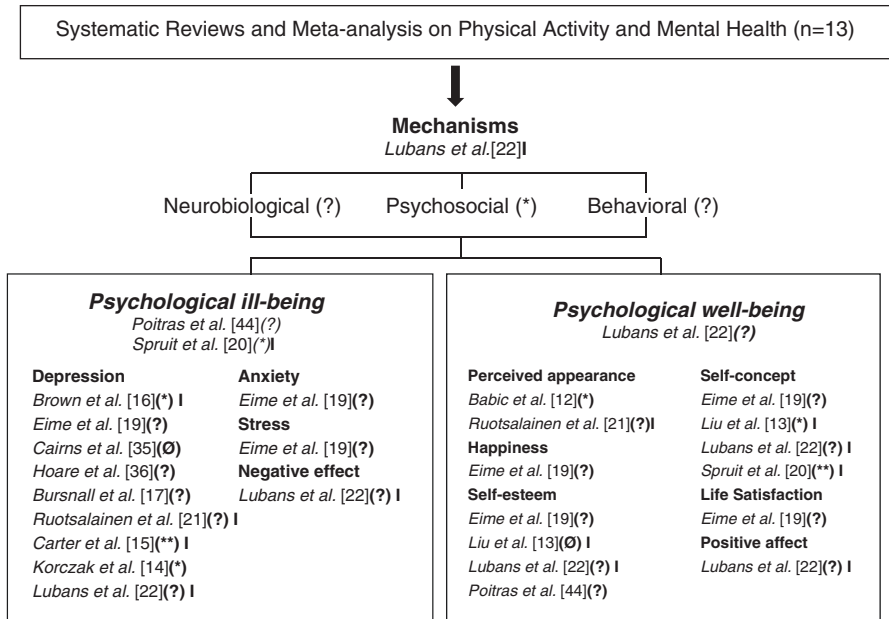


Fig. 3.2 Relationships summary between physical activity and mental health outcomes. (*) = low evidence, (**) = moderate evidence, (***) = strong evidence, (?) = unclear evidence, (Ø) = no significant association/effect, I = reviews included only intervention studies

Korczak et al. [14] synthesised observational, mostly cross-sectional, studies, concluding that physical activity and depression were negatively associated in young people. The association was moderated by study design (stronger associations in cross-sectional versus longitudinal designs), type of depression measure (stronger associations for self-reported versus interviewed depression) and type of measure of physical activity (stronger associations emerged with more informative measures including, for instance, frequency and intensity versus only one of this characteristics). In 2011, Biddle et al. [10] underlined that evidence base was limited, suggesting that experimental designs of high quality were required. In their recent update [11], they found a small improvement in trial quality.

Experimental evidence suggests that exercise interventions are effective for reducing depression, yet the effect size fluctuates across reviews. In 2006, Larun et al. [38] summarised findings provided by intervention studies, suggesting that the effect of exercise on depression was moderate. In a similar review published in 2013, Brown et al. [16] concluded that the effect of exercise on reducing depression was small. Most recently, Carter et al. [15] concluded that the effect size of exercise for reducing depressive symptoms was moderate. Interestingly, the latter review pointed out that the effectiveness of exercise on depression was not significant in high-quality studies. This finding was also reported by Ferguson et al. [27], who

suggested that studies in which researchers used unstandardised outcome measures and poor-quality methods produced higher, potentially, inflated effect sizes.

Overall, physical activity has a small–moderate significant effect on depression in young people. However, it is important to take into account important moderators, such as age, sex, social risk factors and level of depression at baseline. For instance, it seems that physical activity has a stronger positive effect on children with unknown social risk factors compared with those with social risks (e.g. low income). A possible explanation for this might be that children from low socio-economic environments might be exposed to many more risk factors for depression (e.g. poorer nutrition and other lifestyle behaviours). Similarly, in trials with exclusively clinical samples, exercise showed a larger beneficial effect on depression in comparison to those from the general population. These findings are not surprising and highlight the importance of conducting and reporting moderation analyses to determine the effect of health promotion interventions in both general young population and those at risk of poor mental health.

Finally, those interventions focused exclusively on reducing depression (with no additional outcomes) were more effective than those including secondary outcomes [16]. Therefore, it seems plausible that specific interventions, rather than generic ‘one-size-fits-all’ approaches, are needed in order to reduce depression among children and adolescents. Until robust evidence from well-designed randomised controlled trials (RCTs) is available, educational and health institutions may collectively consider these findings when designing physical activity interventions for decreasing depressive symptoms in youths.

3.2.2 Psychological Ill-Being Outcomes with Minimal Evidence in Relation with Physical Activity: Anxiety, Stress and Negative Affect

In comparison to depression, less attention has been paid to anxiety, stress and negative affect. However, these negative indicators might also have a serious impact on young people’s health. For instance, anxiety has been shown to be linked to other serious diseases, such as increased risk of cardiovascular disease and cancer [39].

Biddle et al. [11] concluded that literature on physical activity and anxiety in young people remains small and fragmented. They suggested that there is a relationship between physical activity and anxiety, although further work is required. For instance, the scarce evidence already available in the literature suggests that participation in team sports has a positive effect on anxiety in young people [40]. With regard to stress, a longitudinal study found that involvement in school sport during adolescence was a significant predictor of lower stress in young adulthood [41]. In addition, Martikainen et al. [42] found that objectively measured physical activity was associated with diurnal hypothalamic–pituitary–adrenocortical axis activity, which, in turn, was related to lower psychosocial stress in children. Lastly, a RCT conducted in obese and morbidly obese adolescents showed that physical exercise therapy did not reduce negative affect after 8 weeks, 14 weeks and 28 weeks [43].

In summary, more research is required to determine the link between physical activity, anxiety, stress and negative affect in young people. Given the current state-of-the-art, even observational studies may be worthy to suggest whether physical activity is associated with anxiety, stress and negative affect. Experimental studies testing the effectiveness of exercise interventions for reducing these psychological ill-being outcomes in young people are needed.

3.3 Physical Activity and Psychological Well-Being in Young People

Summary

The relationship between physical activity and psychological well-being outcomes (i.e. perceived appearance, self-concept, self-esteem, positive affect, life satisfaction and happiness) has been investigated in seven reviews [12, 13, 19–22, 44]. Evidence suggests that higher levels of physical activity are related to better global self-concept and perceived appearance, with a small-to-moderate significant mean effect size (see Sects. 3.3.1 and 3.3.2). The association of physical activity with self-esteem is unclear due to the inconsistencies in the findings of different studies [19, 22, 44] (see Sect. 3.3.3). Lastly, only a few studies have shown that higher levels of physical activity are related to higher levels of happiness, life satisfaction and positive affect (see Sect. 3.3.4). Relationship summary between physical activity and psychological well-being outcomes is shown in Fig. 3.2.

3.3.1 Physical Activity and Global Self-Concept

Global self-concept is the term used to describe an individual's awareness of their qualities and limitations. In other words, global self-concept is a person's perceptions of himself or herself, namely, what a person thinks about himself or herself [45]. Perceived appearance (sometimes referred to as perceived physical attractiveness), perceived fitness (typically aerobic and muscular fitness) and perceived competence (sport and movement skill competence) are sub-domains of physical self-concept [46], which, in turn, generalise to global self-concept. Thus, in this chapter, findings related to global self-concept are shown in this section and findings related to perceived appearance are shown in Sect. 3.3.2.

A small-to-moderate effect of physical activity on global self-concept has been consistently demonstrated in two meta-analyses [13, 20]. First, Liu et al. [13] showed a small but significant positive effect of physical activity interventions on global self-concept. Then, Spruit et al. [20] showed that there was a significant small-to-moderate effect of physical activity interventions on global self-concept, which has been corroborated in diverse studies, regardless of the participants' characteristics (i.e. proportion of males and proportion of youth from ethnic minority groups). However, the study settings [13] and the type of physical activity programmes (sport vs. exercise) [20] might moderate the effect of physical activity on self-concept in youths.

For instance, Liu et al. [13] revealed stronger effects in studies which involved school- and gymnasium-based interventions, compared with family-, clinic- and detention facility-based interventions [13]. Thus, implementing physical activity interventions in daily life settings seems relevant among youth. In settings such as schools, youths potentially experience a higher level of autonomy compared with clinic-based settings, which, in turn, may increase enjoyment and, therefore, enhance global self-concept levels. Thus, although there is emerging evidence on the association between physical activity and self-concept [13], high-quality school-based physical activity interventions are warranted [47].

On the other hand, Spruit et al. [20] showed that none of the sample characteristics (i.e. sample type, proportion of males and proportion of youth from ethnic minority groups) moderated the effect of physical activity interventions on global self-concept [20]. In addition, no moderating effects were found for the type of intervention, the duration and frequency of the intervention, whether the intervention consisted of team or individual physical activities, and whether or not the instructor/therapist had any pedagogical background. However, they found a significant moderating effect of the type of physical activity (sports vs. exercise) implemented in the intervention. Specifically, larger effects on global self-concept were found when the intervention consisted of exercise (typically aerobic). One possible explanation is that participation in aerobic-based activity is important for maintaining a healthy body weight, which might enhance global self-concept via the mechanism of improved physical appearance. Alternatively, exercise interventions often focus on generating a minimum level of physical exertion, which may release endogenous opioids and interact with other neurotransmitters [22]. Thus, exercise may be more strongly related to the sense of 'feeling well about yourself' than sports activities, which are also focused on the social environment and the competitive element. They proposed that the sports element of winning a game can lead to increased self-concept, whereas losing the game may have adverse effects on global self-concept. In line with these findings, Lubans et al. [22] explained that competitive sport environments can be intimidating for young people with low levels of movement skill competency.

To sum up, in order to promote global self-concept through physical activity engagement, interventions in youth daily life settings may be recommended. In addition, it is important to take into account that exercise interventions might be more effective than sport-based interventions, particularly in populations with low levels of physical self-concept (i.e. perceived competence, perceived fitness and perceived appearance). However, youths who feel good about themselves and their abilities, being resilient when they lose the game, might also experience benefits on global self-concept from participating in sport programmes. Therefore, well-designed school-based physical activity interventions, attending to the individual physical self-concept (i.e. perceived competence, perceived fitness and perceived appearance) of youths, are needed to improve global self-concept at these ages.

3.3.2 Physical Activity and Perceived Appearance

Perceived appearance is defined as subjective perceptions and attitudes that people have about their own physical body attributes (e.g. body shape). Poor body image is an important concern for youth. Of note, approximately one third of adolescent boys and two thirds of girls are dissatisfied with their appearance [48], which consequently may have a negative impact on their overall mental health [49].

Babic et al. [12] conducted a systematic review studying the link between physical activity and physical appearance in young people. They found a significant, yet weak association between physical activity and perceived appearance ($r = 0.12$, $p < 0.001$). Interestingly, age was found to significantly moderate this association, with the strongest associations found in young adolescents. Sex and study designs were not significant moderators.

Adolescents with overweight or obesity reported lower levels of perceived appearance compared to their normal-weight counterparts [50]. Thus, prevention and treatment efforts are particularly needed for this at-risk population. In this context, Ruotsalainen et al. [21] performed a systematic review focused on overweight/obese children to synthesise the effects of physical activity interventions on perceived appearance. While the review suggested that physical activity interventions can improve perceived appearance in overweight/obese adolescents, only two studies were identified. In this line, Daley et al. [43] found a positive effect of physical activity on self-perception in obese and morbidly obese adolescents at the 14-week and 28-week follow-up, but not immediately after the intervention. In a multicomponent intervention conducted in adolescent females (behavioural change and education), DeBar et al. [51] showed that those in the intervention group reported greater body satisfaction post-treatment compared with the control group.

Therefore, more studies both in boys and in girls are needed to corroborate the early evidence, suggesting that physical activity might have a positive effect on perceived appearance in young people. Special attention is required in the adolescence period and also in special populations, such as overweight and obese individuals.

3.3.3 Physical Activity and Self-Esteem

Self-esteem is the evaluative and affective dimension of self-concept [52] and is considered equivalent to self-regard, self-estimation and self-worth [53]. In other words, self-esteem is the degree to which an individual values himself or herself. Although it is widely believed that physical activity is associated with the development of self-esteem in young people, the findings are inconsistent [11].

Of note, Eime et al. [19] highlighted that, in addition to physical activity, sport participation may positively affect self-esteem [19]. In a longitudinal study with a sample of 500 adolescents, team sport achievements in early adolescence were found to be positively associated with self-esteem 3 years later in middle

adolescence [54]. On the other hand, many studies have observed an unclear association [44], or effect [13], of physical activity on self-esteem. For instance, Liu et al. [13] performed a meta-analysis and concluded that exercise did not improve self-esteem in young people. The same finding emerged when only objective measurements of physical activity were considered in observational studies [44]. This inconsistency might be explained, in part, by the definitional and conceptual ambiguity found between studies [11]. Therefore, future studies should define consistently self-esteem term in order to establish robust conclusions. We suggest the aforementioned definition to refer to self-esteem.

It is noteworthy that, even when significant associations were found, the effect of this association differs according to youths' characteristics. For instance, the positive influence that participating in sport club activities had on the development of self-esteem may differ by sex and age [55]. Furthermore, consistent with the *Exercise and Self-esteem Model* proposed by Sonstroem et al. [52] and Lubans et al. [22] improvements in self-esteem should be expected in the presence of positive changes in self-perceptions or global self-concept. It is important to note that changes in physical self-perceptions will need to be relatively large to promote improvements in global self-esteem.

To conclude, it seems that there is an unclear relationship between physical activity and global self-esteem in youths [13, 19, 22, 44]. A potential reason behind this finding is a paucity of high-quality studies and the conceptual ambiguity, among other reasons. Furthermore, the expectation of obtaining significant and positive effects of physical activity or sport participation on self-esteem seems to be unrealistic, at least, as far as improvements on physical self-concept are not reached (see Sect. 3.6).

3.3.4 Psychological Well-Being Outcomes with Minimal Evidence in Relation Physical Activity: Happiness, Positive Affect and Life Satisfaction

In addition to the above-discussed indicators, the literature has focused less on other important psychological well-being indicators: happiness, positive affect and life satisfaction. Subjective well-being refers to perceptions on whether one's own life is good, meaningful and worthwhile [56]. Although sometimes used interchangeably with happiness, subjective well-being includes evaluations that are both affective (i.e. positive affect) and cognitive (i.e. life satisfaction) in nature [57].

Previous research has shown that increasing physical activity is associated with higher levels of happiness [58]. Specifically, increasing the volume of physical activity was strongly associated with higher levels of happiness, while increasing the intensity had a small effect [58]. Identifying mechanisms through which physical activity promotes happiness are of interest (see Sect. 3.6). As suggested by Lubans et al. [22], a potential path is via changes in one or more brain monoamines

(i.e. dopamine, adrenaline and serotonin), which requires corroboration in studies involving young people [59].

Moreover, higher levels of extracurricular sport participation were related to higher life satisfaction among adolescents [60]. Similarly, playing team sports has been associated with greater life satisfaction among high school adolescents [61]. Lastly, only one RCT has tested the effects of physical activity on positive affect in obese adolescents and no association was found [43].

Overall, few studies have examined the associations between physical activity and happiness, positive affect and life satisfaction. Future studies are needed to address this gap of knowledge.

3.4 Yoga and Mental Health in Young People

According to the *ACSM's top 10 Worldwide Fitness Trends for 2018*, Yoga was ranked number 7, which first appeared in the top 10 in this survey in 2008 [62]. Yoga is a holistic system of multiple mind–body practices that include physical postures and exercises, breathing techniques, deep relaxation practices, cultivation of awareness/mindfulness and meditation [18]. In addition, yoga is a very different form of exercise since it requires lower energy expenditure and higher emphasis on breath regulation, mindfulness during practice and maintenance of postures. Thus, in this chapter, findings related to yoga and mental health are shown in an independent section.

The positive effect of yoga on mental health in adult populations is well established [63, 64]. However, less is known about its effectiveness in youths. Ferreira-Vorkapic et al. [18] conducted a systematic review on benefits from teaching yoga at schools. They found nine intervention studies focused on the effect of yoga on the mental health of youths. Results showed no significant changes between groups in self-reported positive affect, global self-worth or internalising problems. However, they found that negative affect increased for those children participating in yoga when compared to a regular physical education programme. They suggested several possible explanations for these results [18]. First, the practice of yoga requires effort and discipline. Therefore, the child's first contact with yoga is often demanding, and the child may experience higher levels of stress over the short term. Second, the 'dose' and type of yoga may not have been appealing to the participants. Third, one of the outcomes of yoga practice may be greater self-awareness and mindfulness, and these variables were not assessed in the included studies in that review. Lastly, the sample size of included studies was small.

In conclusion, future yoga programmes in young people should address the adaptation process, the attentional control and the adequacy of yoga practice for young people. These findings must be interpreted with caution because of the reduced number of RCTs in school settings and the conflicting findings.

3.5 Possible Negative Effects of Physical Activity Interventions on Young People's Mental Health

In general, physical activity might have beneficial effects on the mental health of young people. However, physical activity can also have negative effects on the mental health of young people in certain contexts and circumstances. For instance, poorly designed physical education lessons may thwart student's needs satisfaction and lead to decreases in perceived competence and global self-esteem [65]. Moreover, some studies have suggested that physical activity interventions can have a negative effect on social inclusion [66, 67], since social inequalities between players can actually be emphasised through the competitive component of sports [68].

It is important highlight that when young people do not experience increased physical competence or perceived appearance (e.g. by not gaining strength, not experiencing weight loss or losing games all the time), physical activity may actually have a negative influence on global self-concept [22]. This may be due to the fact that individuals may have unrealistic expectations regarding the effects of exercise training on body shape, which may lead to reduced physical self-concept.

3.6 Possible Mechanisms for the Effect of Physical Activity on Mental Health in Young People

Clarifying how and under which conditions mental health changes occur might facilitate the successful development of physical interventions [22]. In this context, Lubans et al. [22] proposed a conceptual model to explain the effect of physical activity on young people's mental health (Fig. 3.3). They suggested three groups of potential mechanisms (neurobiological, psychosocial and behavioural).

First, the neurobiological mechanism posits that physical activity may have a positive effect on the structure and function of the brain. For instance, previous studies have used neuroimaging techniques to identify structural and functional mechanisms that may explain the relationship between physical activity and mental health in young people [69]. It is important to note that these neuroimaging techniques do not provide a direct measure of mechanism change; instead, they represent the outcome of some other mechanistic changes in the brain. In this regard, it is well known that decreased levels of brain-derived neurotrophic factor (BDNF), a 14-kDa neurotrophin involved in the growth and healthy maintenance of neurons, are associated with increased levels of anxiety and depression [70, 71]. Exercise is known to increase BDNF levels in the central nervous system and, consequently, may improve anxiety and depressive symptoms [72]. Another possible explanation is that exercise stimulates the growth of new capillaries, which are critical for the transport of nutrients to neurons [73], which may influence mental health. Lastly, the release of

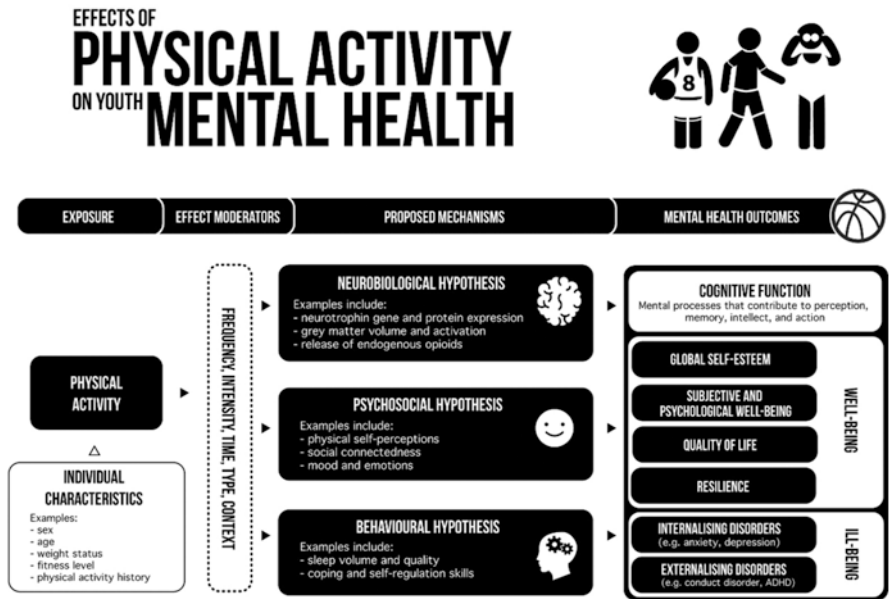


Fig. 3.3 Conceptual model for the effects of physical activity on mental health outcomes in children and adolescents. *ADHD* attention-deficit/hyperactivity disorder. Lubans et al. [22]

endogenous opioids and their interactions with other neurotransmitter systems might also provide a possible neurobiological explanation for the effects of physical activity on mental health [74]. For instance, non-pharmacological methods for raising brain dopamine, noradrenaline and serotonin, such as exercise, may prevent the onset of mental disorders [75, 76]. However, more studies are needed to test if the short-term pleasure that individuals experience during physical activity can enhance mental health in young people over time.

Second, as noted by Lubans et al. [22], the most commonly evaluated psychosocial mechanisms are physical self-concept sub-domains. They suggested that there is emerging evidence for a causal link between physical self-perceptions, improved by physical activity interventions, and indicators of psychological well-being (e.g. global self-concept, self-esteem). Social support and autonomy are other plausible psychosocial mechanisms that may mediate the effect of physical activity on mental health in young people. For instance, Lubans et al. [77] found that autonomy mediated the effect of the physical activity on psychological well-being in adolescent boys. However, more studies are needed to corroborate these findings.

Finally, behavioural mechanisms may also explain the effect of physical activity on mental health outcomes. Of note, participation in physical activity may improve sleep duration, sleep efficiency, sleep onset latency and reduce sleepiness [22]. Lubans et al. [22] did not identify relevant studies investigating behavioural mechanism variables in their systematic review, highlighting a clear gap in the literature. However, they suggested that additional behaviours, such as drug

taking (e.g. smoking and alcohol), diet and recreational screen-time, may also mediate the effect of physical activity interventions on mental health outcomes in youths.

Collectively, neurobiological, psychosocial and behavioural mechanisms might be responsible for the effects of physical activity on mental health in young people. However, there are not enough studies to draw firm conclusions about any of these potential mechanisms. Indeed, only physical self-perceptions have been tested as a potential psychosocial mechanism of the effect of physical activity in self-esteem. Thereby, future mediation models of the relationship of physical activity with mental health are warranted.

3.7 Sedentary Behaviour and Psychological Ill-Being in Young People

Summary

Evidence with regard to the sedentary behaviour and psychological ill-being outcomes (i.e. non-specific psychological ill-being, depression, anxiety, stress and negative affect) is shown in Fig. 3.4. Emerging evidence suggests that higher levels of sedentary behaviour are related to higher levels of psychological ill-being in children and adolescents (see Sects. 3.7.1 and 3.7.2). To date, the majority of studies have focused on associations between sedentary behaviour and depression (see Sect. 3.7.2). Less is known regarding associations between sedentary behaviour and anxiety, stress and negative affect (see Sect. 3.7.3).

Sedentary behaviour is defined as any waking behaviour characterised by an energy expenditure ≤ 1.5 metabolic equivalents (METs), while in a sitting, reclining

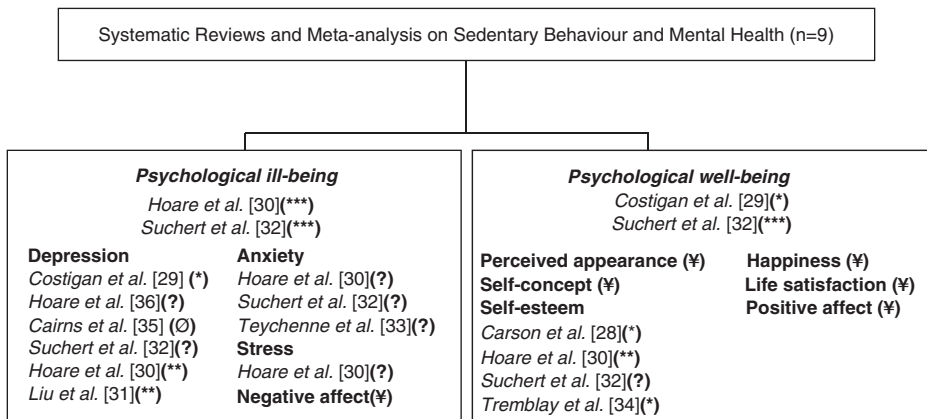


Fig. 3.4 Relationships summary between sedentary behaviour and mental health outcome. (*) = low evidence, (**) = moderate evidence, (***) = strong evidence, (?) = unclear evidence, (Ø) = no significant association/effect, (¥) = reviews did not included this outcome into the search terms.

or lying posture (Fig. 3.5). Sedentary behaviour includes screen-based sedentary behaviour (i.e. recreational screen time or non-recreational screen time) and non-screen-based sedentary behaviour. For the purpose of this chapter, types of sedentary behaviours examined were mainly watching television, computer/Internet use and video gaming and were, henceforth, referred to as ‘sedentary behaviours’. Studies that examined diagnosed sedentary behaviour disorders (e.g. Internet or gaming addiction) to the point that they disregard other life responsibilities were not explored, due to the focus of this chapter on habitual sedentary behaviours in young people and the involvement of these conditions in the mental health outcomes.



Fig. 3.5 Illustration of the final conceptual model of movement-based terminology arranged around a 24-h period. The figure organises the movements that take place throughout the day into two components: The inner ring represents the main behaviour categories using energy expenditure. The outer ring provides general categories using posture. The proportion of space occupied by each behaviour in this figure is not prescriptive of the time that should be spent in these behaviours each day. Tremblay [118]

3.7.1 Sedentary Behaviour and Non-specific Psychological Ill-Being

The term psychological ill-being includes both internalising (e.g. depression, anxiety, negative affect) and externalising disorders (e.g. aggression and ADHD). The Child Behavior Checklist and the Strengths and Difficulties Questionnaire are two of the most commonly used measures of internalising problems. Findings of this chapter indicated strong evidence for a positive relationship between sedentary behaviour and non-specific psychological ill-being in young people [30, 32].

Two studies demonstrated that exceeding 2 h/day average screen time was significantly associated with higher odds of psychological ill-being compared to 2 h or less [78, 79]. Of note, one of these studies [78] found that this relationship to be independent of physical activity levels and stronger in boys. Among Australian adolescents, after adjusting for sex, age, socio-economic status and body mass index, those who reported a high level of video game use were more likely to report high/very high levels of psychological ill-being compared to those who did not play games [80]. Suchert et al. [32] found seven studies examining the association between sedentary behaviour and overall psychological ill-being in children and adolescents. One study employed a longitudinal design, showing that screen time predicted emotional problems 2 years later [81]. While one cross-sectional study found no relationship between the time children spent watching TV and internalising problems [82], the other five cross-sectional studies revealed a positive association.

In summary, there is strong evidence for a positive association between sedentary behaviour and psychological ill-being in young people when psychological ill-being is assessed as a unique dimension, which include multiple aspects of ill-being (e.g. depression, anxiety, stress, negative affect). However, researchers are encouraged to use standardised, well-validated psychological ill-being measures to confirm these findings. Lastly, evidence is based on observational studies and mainly on cross-sectional studies. Therefore, RCTs are required to corroborate these findings.

3.7.2 Sedentary Behaviour and Depression

A large number of studies have examined the relationship between sedentary behaviour and depression in young people. For instance, Costigan et al. [29] found a positive association between sedentary behaviour and depressive symptoms among adolescent girls in their systematic review of the literature. However, as these studies employed observational designs, causation cannot be established. On the other hand, Suchert et al. [32] found that the relationship between using Internet or playing video games and depressive symptoms followed a curvilinear U-shaped trend (i.e. students reporting a moderate amount of time engaging in these sedentary activities reported the lowest scores of depressive symptoms) [83–85]. Moreover, Hoare et al. [30] concluded that there was evidence to suggest that lower levels of screen time for leisure were associated with lower levels of depressed mood, with adverse findings only appearing at more than 2–3 h/day of average of screen time.

In line with these findings, Liu et al. [31] conducted a meta-analysis of observational studies to pool the risk of depression with sedentary time in children and adolescents and quantified a dose–response relationship. Overall, higher levels of sedentary behaviour in children and adolescents were significantly associated with a higher risk of depression. Screen type, age and population acted as significant moderators. In addition, they found that only computer use was related to depression risk. Potentially, this effect could be due to the relative openness of the computer content, especially the Internet, compared to television and video games, if youth are being exposed more readily to negative information on their computers than they would otherwise encounter. Moreover, they observed a significant association between sedentary time and depression risk in teenagers <14 years, but not in those over 14 years. Compared with the reference group, teenagers <14 years with more sedentary time per day had a 25% increased risk of depression.

The result is consistent with a previous research [86], which found a significant interaction effect of age group on the association between sedentary time and depression, suggesting that higher sedentary time was associated with higher depression risk, especially for younger children. A possible explanation for this might be that younger children are typically more active. Therefore, replacing time spent participating in physical activity with sedentary pursuits may affect younger children more substantially. Besides, younger children have greater vulnerability to negative information from screen use, which also reduces their opportunities for self-development and interpersonal communication [86, 87] and, thus, may be more susceptible to depression.

Liu et al. [31] also found that compared with the reference group who had no sedentary behaviour, there was a nonlinear dose–response association of screen time-based sedentary behaviour (i.e. watching television, computer/Internet use and video gaming) with a decreasing risk of depression at sedentary time <2 h/day, with the lowest risk being observed for 1 h/day (Fig. 3.6). This finding is supported by the *Digital Goldilocks Hypothesis*, which suggested that screen time at moderate levels is not harmful and may be advantageous in a connected world, whereas ‘overuse’ may displace alternate activities, for example, interfering with school or with extracurricular or other social activities [88]. Of note, Przybylsk et al. [88] found that the relationships between screen time and mental health were nonlinear and that moderate engagement in screen time was not harmful. Such relation depended, in part, on whether the activities occurred on weekdays or weekends. They suggested that young people could engage in digital activities between 22 min and 2 h 13 min longer on weekend days than on weekdays before they found evidence of negative effects. These findings were replicated by Ferguson et al. [89], who additionally suggested that depression was highly elevated among youth who consumed over 6 h of media a day.

A key aspect that was not addressed in this meta-analysis was whether the content of the screen activity, for example, watching violence on screen time (e.g. violence vs. non-violence), may be related to depressive symptoms in young people. This issue continues to be hotly contested in the scientific community. Ferguson et al. [27] found in their meta-analysis that playing violent video games was associated with increased aggression, decreased prosocial behaviour and reduced

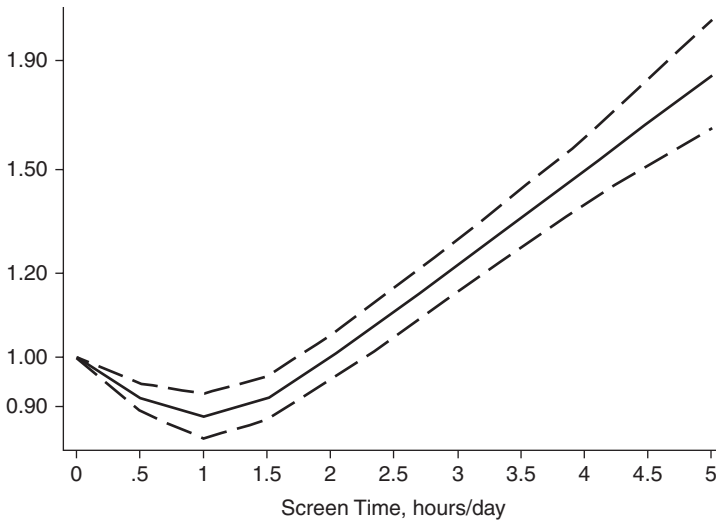


Fig. 3.6 The dose–response relationship for the association between screen time in children and adolescents and risk of depression (solid line) as estimated by a generalised least squares trend estimation. Screen time was modelled with a restricted cubic spline in a two-stage random-effects dose–response model. The ORs are plotted on the log scale. Dashed lines represent the 95% confidence intervals for the spline model. Zero hours/day of screen time served as the referent category. Liu et al. [31]

academic performance but not with depression. However, they suggested that research field may improve in theoretical and empirical rigor. Therefore, future studies might consider the content of screen time to provide more information in this regard.

To sum up, limiting sedentary time to 2 h/day is associated with a lower risk of depression, and the lowest risk is detected at sedentary time of 1 h/day. Therefore, guidelines should recommend not to exceed screen time in more than 2 h/day for mental health benefits as well. It is important to consider that young people could engage in screen time longer on weekend days than on weekdays. In addition, how adolescents watch, what they watch and with whom may have important implications [90].

3.7.3 Psychological Ill-Being Outcomes with Minimal Evidence in Relation Sedentary Behaviour: Anxiety, Stress and Negative Affect

Evidence demonstrates that sedentary behaviour is inversely associated with symptoms of depression and non-specific psychological ill-being. There is, however, much less evidence for the association of sedentary behaviour with anxiety, stress and negative affect. For instance, Griffiths et al. [91] found that sedentary behaviour was inversely associated with the risk of anxiety in girls (i.e. those who spent less

than 2 h in screen-based entertainment were more likely to suffer symptoms related to anxiety). Similarly, another study involving Chinese adolescents found that sedentary time was a risk factor for anxiety [92]. However, three systematic reviews have investigated the associations between sedentary behaviour and anxiety in youth and all of them suggested that limited evidence is available to draw conclusions [30, 32, 33]. Likewise, a recent review concluded that there was not enough evidence to determine the strength of association between sedentary behaviour and stress in young people [30]. However, Fang et al. [93] found that total amount of time spent using screen time per day was positively associated with perceived stress among young people. Lastly, no systematic review or original research was found on the association between sedentary behaviour and negative affect in youth.

Therefore, original research, cross-sectional, longitudinal and experimental studies are needed to test the association between sedentary behaviour, anxiety, stress and negative affect in young people.

3.8 Sedentary Behaviour and Psychological Well-Being in Young People

Summary

The relation between sedentary behaviour and psychological well-being outcomes (i.e. perceived appearance, self-concept, self-esteem, positive affect, life satisfaction and happiness) has been widely investigated, although usually much less than the relationship with physical activity and well-being. Emerging evidence was found on sedentary behaviour and overall psychological well-being [29, 32] and self-esteem [30, 32, 34] (see Sects. 3.8.1 and 3.8.2, respectively). Regarding to self-perception, self-concept, happiness, life satisfaction and positive affect outcomes, the evidence is unclear since no previous reviews included these outcomes in the search terms (see Sect. 3.8.3). Evidence with regard to the sedentary behaviour and psychological well-being outcomes is shown in Fig. 3.4.

3.8.1 Sedentary Behaviour and Non-specific Psychological Well-Being

For this brief section of the chapter, we review systematic reviews addressing links between sedentary behaviour and non-specific psychological well-being in young people. For the purpose of this chapter, we will use the non-specific psychological well-being term to refer to an overall/combined measurement of psychological well-being outcomes (e.g. global self-esteem or optimism).

In their systematic review of the literature, Costigan et al. [29] found an inverse association between sedentary behaviour and psychological well-being among adolescents [94]. In addition, Suchert et al. [32] conducted a systematic review on the association between sedentary behaviour and indicators of mental health in school-aged children and adolescents. They conceptualised psychological well-being and

quality of life within the same construct and combined findings of both into one common outcome. They concluded that there is strong evidence suggesting that higher levels of screen time are associated with poor psychological well-being and perceived quality of life. However, due to the inconsistency of definitions used, more studies focused on psychological well-being are needed to confirm these findings. In addition, it is recommended that researchers use standardised, well-validated psychological well-being measures in future studies.

3.8.2 Sedentary Behaviour and Self-Esteem

Self-esteem was the most studied psychological well-being outcome. First, Tremblay et al. [34] conducted a systematic review of sedentary behaviours and health indicators in school-aged youth. They suggested that decreased levels of sedentary behaviour (combined with physical activity) lead to improved self-esteem [95–97]. However, it is not possible to establish a direct causal effect between sedentary behaviour and self-esteem because the majority of studies were cross-sectional. Of note, Tremblay et al. [34] combined self-esteem, self-worth and self-concept into one common outcome called self-esteem. Therefore, a standardised definition of the self-esteem term is needed to confirm these findings. In addition, Russ et al. [98] found that each additional hour of screen time increases the risk of poor self-esteem. In accordance with the previous studies, Hoare et al. [30] concluded that there is a moderate evidence for relationship negative association between sedentary behaviour and self-esteem. In contrast to these findings, Suchert et al. [99] concluded that the association between sedentary behaviours and self-esteem was indeterminate. However, they identified two studies indicating an inverted U-shaped association, that is, children and adolescents reporting a moderate use of video games or TV showed the highest score of self-esteem [84, 100]. This is in line with the meta-analysis performed by Liu et al. [31] focused on the dose–response association of screen time and depression in youths.

Collectively, although self-esteem was widely studied, more high-quality studies on the effects of sedentary behaviours on self-esteem are needed to make strong conclusions. In addition, there is a need to define consistently self-esteem in order to establish robust conclusions. We suggest the aforementioned definition to refer to self-esteem (see Sect. 3.3.3).

3.8.3 Psychological Well-Being Outcomes with Minimal Evidence in Relation Sedentary Behaviour: Self-Concept, Perceived Appearance, Happiness, Life Satisfaction and Positive Affect

No previous reviews have examined the associations between sedentary behaviour and self-concept, perceived appearance, happiness, life satisfaction and positive affect outcomes in young people. Therefore, future literature might aim to

synthesise findings of existing cross-sectional, longitudinal and experimental studies. However, some evidence regarding to these outcomes has been found in a small number of original studies. For instance, Schneider et al. [101] found that the amount of time spent watching television correlated with higher body dissatisfaction in female adolescents. Babic et al. [90] found that changes in total recreational screen time and tablet/mobile phone use were negatively associated with physical self-concept in adolescents over a 6-month study period. These relationships may partly be explained by the emerging influence of social media technology commonly used by young people on tablets/mobile phone (e.g. Facebook, Instagram and Snapchat), which may encourage adolescents to compare themselves with their peers [90], and consequently increase their body dissatisfaction when discrepancies are found between perceived and ideal body shape.

Booker et al [102] found that young people with heavy screen-based media use were less happy than moderate users and more likely to have socioemotional difficulties. Interestingly, Padilla-Moledo et al. [103] found that viewing television for more than 2 h was correlated with lower life satisfaction in children but not in adolescents. Of note, we did not find any study testing the association of sedentary behaviour with positive affect in youth. Evidence suggested that positive affect is the hallmark of well-being and may also be the cause of many of the desirable characteristics, resources and successes correlated with happiness [104]. Therefore, more studies on sedentary behaviour and positive affect are needed.

3.9 Possible Positive Effects of Sedentary Behaviour on Mental Health in Young People

Time spent engaged in sedentary behaviours may have some benefits for young people's mental health. First, socially interactive screen-based recreation (e.g. multiplayer electronic games or social networking games) may produce social health gains for adolescents [105]. Second, engaging in small amounts of screen time (1 h/day) is unlikely to have any negative effects [31], but it may be potentially beneficial for the primary prevention of depression (Fig. 3.6). These potential benefits could be related to screen behaviours enhancing children's ability to read and visualise images and, consequently, improving academic performance. In addition, youth may psychologically benefit from processing humorous content in television, Internet and video games [106].

3.10 Possible Mechanisms for the Effect of Sedentary Behaviour on Mental Health in young people

While the evidence examining physical activity and mental health mechanisms is emerging [22], there is an important gap regarding the underlying mechanisms responsible for the possible effects of sedentary behaviour on mental health in young people.

With regard to a potential psychosocial mechanism, more time spent watching TV or using the Internet may lead to social withdrawal, to social isolation and hence to psychological ill-being problems and less psychological well-being [107]. For instance, Hoare et al. proposed that sedentary behaviour may elicit feelings of loneliness, given they often take place alone, and this solitude diminish mental health [36].

Alternatively, the behavioural mechanism hypothesis proposes that changes in mental health outcomes resulting from sedentary behaviour are mediated by changes in relevant and associated behaviours. Evidence indicates that specific sedentary activities, such as television and video viewing, are associated with poor dietary behaviours (e.g. unhealthy snacking/overconsumption of food and high-energy drinks). Moreover, Primack et al. [108] suggested that excessive media exposure often occurs at night and can displace sleep, which is valuable for normal cognitive and emotional development. In addition, they proposed that cultural messages transmitted through media may affect other behaviours related to mental health, such as eating disorders and aggressive behaviour [108]. Lastly, the displacement hypothesis suggests that time spent on screen-based activities may replace time participating in more productive and/or active activities, especially activities involving physical activity [109] and interpersonal communication [107], and thus may affect the mental health of young people.

Therefore, more studies focused on mechanism explaining the relationship between sedentary behaviour and mental health are needed to confirm these hypotheses. Specially, studies may be focused on neurobiological mechanism since they are completely unknown.

3.11 Recommendations to Improve Mental Health in Young People

Overall, we recommend the use of evidence-based physical activity strategies to maximise the positive effect of physical activity on mental health outcomes. In order to guide the planning of organised physical activity sessions in school, and after-school programmes, we specifically advise the use of *the Supportive, Active, Autonomous, Fair, Enjoyable (SAAFE) principles and practical strategies* designed by Lubans et al. [110] (Fig. 3.7). The SAAFE principles are based on the self-determination theory [111, 112], achievement goal theory [113], competence motivation theory [114] and Epstein's TARGET framework [Task (design of activities), Authority (distribution of decision-making and student autonomy), Recognition (use of incentives, rewards and feedback), Grouping (formation of students into groups), Evaluation (methods used to assess performance) and Time (appropriateness of workload and lesson pace)] [115]. In addition, given the current state-of-the-art, educational and health institutions may consider the general physical activity guidelines for children and adolescents when designing



Fig. 3.7 Overview of SAAFE teaching principles and strategies for physical activity programmes intending to improve mental health in children and adolescents. Lubans et al. [110]

physical activity interventions to preserve mental health in young people (e.g. *The 2008 Physical Activity Guidelines for Americans* [116]). In this context, it is highly advisable the use of the recently published *2018 Physical Activity Guidelines Advisory Committee Scientific Report* [117], which includes a special section for the effects of physical activity on brain health. Although the later guidelines are inspiring, they are not focused in young people in this specific section. Thus, further research is warranted in order to provide robust evidence for physical activity recommendations specifically designed for promoting mental health in young people.

With regard to sedentary behaviour, we support the use of the *American Psychological Association* [25] and the *American Pediatric Society* [26] recommendations. Of note, both instructions advise the establishment of consistent limits on the time spent using media and the types of media, but they did not specify how much time of screens is recommended to preserve mental health. We suggest not to exceed screen time in more than 2 h/day (Fig. 3.6). In addition, it is important to consider that young people could engage in screen time longer on weekend days than on weekdays. However, further research is needed to support these recommendations.

3.12 Literature Gaps and Future Research

The output of this chapter provides evidence to reconsider some important concerns in the physical activity, sedentary behaviour and mental health field. In this section, we offer to researchers in this field some practical suggestions for improving in theoretical and empirical rigor.

3.12.1 General Concerns/Gaps

1. *The ‘hypodermic needle’ theory proposed by Ferguson et al. [27]*: Researchers sometimes believe that physical activity or sedentary behaviour is ‘injected’ into passive individuals who automatically experience an effect on mental health. However, more effort is required to understand this relationship from other perspectives. For instance, understanding *when* young people practise physical activity or play videogames (e.g. weekdays vs. weekends), *where* (e.g. at school vs. out of school), *what* they do (e.g. moderate-to-vigorous physical activity vs. light physical activity) or watch (e.g. violence vs. non-violence), *how much* (e.g. more than 2 h vs. less than 2 h of screen time or at least 60 min vs. less than 60 min of moderate-to-vigorous physical activity every day) and *with whom* (e.g. team sports vs. individual sports or gaming alone vs. gaming with friends) might be useful to better understand the effect of physical activity or sedentary behaviour on the mental health of young people.
2. *Selective reporting bias and interpretation*: Researchers sometimes only cite and report other studies that support their personal hypotheses, and consequently, a selective interpretation is performed. We encourage researchers to publish null results and to consider all available literature in contrast or in line to their current findings.
3. *Standardised measures and rigorous methods*: Future studies in this field might provide well-validated and standardised measures of physical activity, sedentary behaviour and mental health to avoid inconsistent findings between studies.
4. *Standardised mental health terminology*: We found that several inconsistencies between studies are due to a problem with the terminology used. Throughout this chapter, we have proposed how to define and to understand these terms. However, a consensus of experts in this field is needed to provide a standardised mental health terminology.

3.12.2 Directions for Future Research on Physical Activity and Mental Health in Young People

1. Moderators such as age, sex, social risk factors and mental health at baseline should be considered for researchers testing the effect of physical activity on mental health in young people.
2. Specific physical activity interventions focus on improving mental health outcomes, rather than generic ‘one-size-fits-all’ approaches, are needed. In addition, interventions might attend to young people’s physical self-concept (i.e. perceived competence, perceived fitness and perceived appearance). The SAAFE principles and practical strategies might be useful for this purpose.
3. More studies on physical activity, psychological ill-being (anxiety, stress, negative affect) and psychological well-being outcomes (happiness, satisfaction with life and positive affect) are needed. Even observational studies may be worthy due to the lack of research.

4. Frequency, duration, intensity, type of physical activity practise and setting (e.g. at school or out-of-school) should be considered.
5. Mediation models are needed to identify the mechanisms (i.e. neurobiological, psychological and behavioural) responsible for any changes in mental health resulting from participation in physical activity.

3.12.3 Future Directions on Sedentary Behaviour and Mental Health in Young People

1. Answering the questions how young people watch, what they watch and with whom is needed to understand the relationship between sedentary behaviour might be screen time and mental health in young people.
2. There is limited evidence to conclude whether, or to what degree, associations between sedentary behaviour and mental health are explained by the content (e.g. violence, no violence) or the type (e.g. watching television, computer/Internet use and video gaming) of sedentary behaviour versus sedentariness itself.
3. More studies focused on the relationship between sedentary behaviour, psychological ill-being (anxiety, stress, negative affect) and psychological well-being outcomes (self-concept, perceived appearance, happiness, life satisfaction. and positive affect) based on minimal evidence are needed. Even observational studies may be worthy due to the lack of research.
4. Experimental studies on sedentary behaviour and mental health are required to draw conclusions with regard to cause and effect.
5. Mechanism explaining the relationship between sedentary behaviour and mental health is needed. Specially, studies may be focused on neurobiological mechanism since they are completely unknown.

Acknowledgements This work study was supported by the Spanish Ministry of Economy and Competitiveness (DEP2013-47540, DEP2016-79512-R, and DEP2017-91544-EXP), the European Regional Development Fund (ERDF)", the European Commission (No 667302), and the Alicia Koplowitz Foundation. This study was partially funded by the University of Granada, Research and Knowledge Transfer Fund (PPIT) 2016, the Excellence Actions Programme: Units of Excellence; Scientific Unit of Excellence on Exercise and Health (UCEES), the Andalusian Regional Government, the Regional Ministry of Economy, Knowledge, Entreprises and University, and the European Regional Development Fund (ERDF), ref. SOMM17/6107/UGR. CC-S and FE-L might be before CC-S since he is the second author of this work are supported by a grant from the Spanish Ministry of Economy and Competitiveness (BES-2014-067612 and BES-2014-068829, respectively). The affiliation of DR-L which is the National Health and Medical Research Council Senior Research Fellowship IE-C is supported by a grant from the Alicia Koplowitz Foundation and by the Spanish Ministry of Economy and Competitiveness (IJCI-2017-33642). In addition, this study was further supported by the SAMID III network, RETICS, funded by the PN I+D+I 2017-2021 (Spain), ISCHII-Sub-Directorate General for Research Assessment and Promotion and the European Regional Development Fund (ERDF) (Ref. RD16/0022). This work is part of a Ph.D. thesis conducted in the Biomedicine Doctoral Studies of the University of Granada, Spain.

Appendix

Table 3.1 Search strategy in databases review of review

Database	Search strategy	Limits
PubMed	((“Child”[Mesh]) OR (“Child, Preschool”[Mesh]) OR (“Adolescent”[Mesh]) OR (“Puberty”[Mesh]) OR (“boys”) OR (“girls”) OR (“childhood”) OR (“school-age”)) AND ((((((((((“Mental Health”[Mesh]) OR “Self Concept”[Mesh]) OR “Body Image”[Mesh]) OR “Self Efficacy”[Mesh]) OR “Happiness”[Mesh]) OR “Affect”[Mesh]) OR “Optimism”[Mesh]) OR “Anxiety”[Mesh]) OR “Depression”[Mesh]) OR “Pessimism”[Mesh]) OR “Stress, Psychological”[Mesh]) AND ((((((((((“Exercise”[Mesh]) OR “Sports”[Mesh]) OR “Motor Activity”[Mesh]) OR “Physical Education and Training”[Mesh]) OR “Moderate physical activity”) OR “Vigorous physical activity”) OR “Moderate-to-vigorous physical activity”) OR “MVPA”) OR “Sedentary Lifestyle”[Mesh]) OR “Sedentary time”) OR “Sedentary behavior”) OR “Sedentary behaviour”) OR “Inactivity”)	Publication date from 2011/01/01 to 2018/07/31 Filtered by: systematic reviews, reviews and meta-analyses Ages: children and adolescents: 2–18 years
Web of Science (WOS)	(Child* OR Preschool OR “Preschool child” OR “Preschool children” OR Preschooler* OR Adolescent* OR Teen* OR youth* OR Pubert* OR boy* OR girl* OR childhood OR school-age) AND (“Mental Health” OR “Mental Hygiene” OR “Self Concept*” OR “self-perception*” OR “Self-esteem*” OR “Self esteem*” OR “Body Image*” OR “Body representation*” OR “Body Schema” OR “Self Efficacy” OR “Self-efficacy” OR “Happiness*” OR “Positive Affect*” “Negative affect*” OR “Mood*” OR “Optimism” OR “Anxiet*” OR “Hypervigilance” OR “Nervousness” OR “Depression*” OR “Depressive symptom*” OR “Emotional depression*” OR “Pessimism” OR “Psychological stress*” OR “Life stress*” OR “Psychologic stress”) AND (Exercis* OR “physical exercis*” OR “Aerobic exercis*” OR Sport* OR athletic* OR “Motor Activity” OR “Motor activit*” OR “Physical activit*” OR “Locomotor activit*” OR “Physical Education and Training” OR “Physical education” OR “Moderate physical activity” OR “Vigorous physical activity” OR “Moderate-to-vigorous physical activity” OR mvpa OR “Sedentary Lifestyle*” OR “Sedentary time” OR Sedentary OR “Sedentary behavio\$r*” OR Inactivity)	Publication date from 2011 to 2018 Filtered by: reviews (this filter includes meta-analyses and systematic reviews) Ages: children and adolescents: 2–18 years

Table 3.2 Summary of systematic reviews and/or meta-analyses investigating the relationship between physical activity and/or sedentary behaviour and mental health outcomes ($n = 21$)

Quality	Authors, year (ref)		Type; k ; Age range		Predictors (physical activity and sedentary behaviour)	Mental health	Main findings
	Years covered; sample size	Research design (n included studies)	Research design (n included studies)	Age range			
Moderate	Tremblay et al., 2011 [34] 1958–2009; 328–4776	Systematic review; $k = 14$; 5–17 years RCTs (1), non-RCTs (2), prospective longitudinal (0), cross-sectional (11)	Sedentary behaviour	Self-concept, self-esteem, self-efficacy	Downs and Black score of 21.0 (standard deviation: ± 2.4) indicating moderate quality of reporting. 1 RCT (girls who decreased sedentary behaviour showed a trend towards improved self-esteem), 2 intervention (decreases in sedentary behaviour lead to improved self-worth and self-esteem), 11 cross-sectional (those with higher reported sedentary behaviour had poorer scores on self-worth)		
Moderate	Brown et al., 2013 [16] Up to 2011; 19–207	Meta-analysis; $k = 9$; 5–19 years RCTs (5), non-RCTs (4)	Aerobic exercise; sport participation; physical education lessons; yoga	Depression	There was a small significant overall effect for PA on depression (Hedges' $g = -0.26$, $SE = 0.09$, 95% CI = -0.43 , -0.08 , $p = 0.004$). More outcome-focused, high-quality trials are required to effectively inform the implementation of programmes to reduce depressive symptoms in children and adolescents		
Low	Costigan et al., 2013 [29] Up to 2011; 72–31022	Systematic review; $k = 4$; 12–18 years Intervention (0), prospective longitudinal (1), cross-sectional (4)	Screen-based sedentary behaviour	Depression, emotional symptoms, self-concept self-esteem	A positive association was observed between screen time and depression. Negative associations were identified between screen time and psychological well-being		

(continued)

Table 3.2 (continued)

Quality	Authors, year (ref) Years covered; sample size	Type; <i>k</i> ; Age range	Predictors (physical activity and sedentary behaviour)	Mental health	Main findings
		Research design (<i>n</i> included studies)			
Moderate	Eime et al., 2013 [19] 1990–2012; 18–51168	Systematic review; <i>k</i> = 25; <18 years Prospective longitudinal (8), cross-sectional (17)	Extracurricular activities, sport participation	Well-being, depression, social anxiety, shyness, self-esteem	The most common positive outcomes were higher self-esteem, fewer depressive symptoms and higher confidence amongst sport participants than non-sport participants. There are reports that participation in team sports rather than individual activities is associated with better mental health.
Moderate	Babic et al., 2014 [12] Up to 2013; 3909–2932	Meta-analysis; <i>k</i> = 64; 5–20 years Intervention (5), prospective longitudinal (12), cross-sectional (47)	Physical activity	Physical self-concept, perceived appearance	Physical Self-Concept: A weak to moderate effect size of $r = 0.25$ (95 % CI 0.16–0.34, $p = 0.001$). Perceived Appearance: weak association $r = 0.14$ (95 % CI 0.09–0.18, $p = 0.001$)
Low	Burnsall, 2014 [17] 2008–2013; data no shown	Systematic review; <i>k</i> = 10; 11–17 years RCTs (1), non-RCTs (1), prospective longitudinal (8)	Physical activity	Depression	Only one RCT explores the interaction between physical activity and depressive symptom in the adolescent age group. However, the body of evidence generated from this review indicates a strong inverse correlation between the two variables
Moderate	Cairns et al., 2014 [35] Up to 2013; 68–13500	Meta-analysis; <i>k</i> = 36; 12–18 years Prospective longitudinal (36)	Extracurricular activities, Physical activity, sport participation, sedentary behaviour	Depression	Significant association between extracurricular activities and depression, with a small, non-significant mean effect size. PA and depression, no clear evidence with a small but non-significant mean effect size and high heterogeneity. Sport and depression, a small but non-significant mean effect size with moderate heterogeneity

	Hoare et al., 2014 [36] 2002–2013; 160–4594	Systematic review; $k = 13$; 10–19 years Prospective longitudinal (6), cross-sectional (6)	Physical activity, sedentary behaviour	Depression	PA, sports participation and extracurricular activities were inversely associated with depression. Longer hours of screen use were related to higher depression in 14-year-olds. Depressed mood was found to be associated with exceeding recommendations for screen-based sedentary behaviour. Longitudinal studies found that PA predicted depressive outcomes concurrently and 1, 2 and 6 years later
Low	Ferreira-Vorkapic et al., 2015 [18] 1980–2014; 30–472	Meta-analysis; $k = 6$; 5–15 years Intervention in school (6)	Yoga-based intervention	General mood state, anxiety, self-esteem	Of the six studies, three studies supported the benefits of yoga on the mental health during youth. Higher effect sizes were found for mood state indicators, anxiety and self-esteem demonstrating that the yoga group showed significant better scores in the post intervention condition
Moderate	Liu et al., 2015 [13] Up to 2014; 17–464	Meta-analysis/ $k = 38$; 3–20 years RCTs (25), non-RCTs (13)	Physical activity	Self-esteem scale, self-perception, self-concept scale	PA alone is an effective method to improve self-esteem and self-concept, although the effect sizes were small in magnitude. The lack of publication bias and very low heterogeneity suggest that the results were relatively robust
Low	Ruotsalainen et al., 2015 [21] 1950–2013; 14–208	Systematic review; $k = 2$; 12–18 years RCTs (2)	Physical activity	Body image, life satisfaction, depression, self-esteem	Intervention has an effect on body satisfaction or physical self-perception and attitudes about appearance but not depression, self-perception or self-esteem. Life satisfaction was not measured or reported in any RCTs study

(continued)

Table 3.2 (continued)

Quality	Authors, year (ref) Years covered; sample size	Type; <i>k</i> ; Age range	Predictors (physical activity and sedentary behaviour)	Mental health	Main findings
		Research design (<i>n</i> included studies)			
Low	Suchert et al., 2015 [32]	Systematic review; <i>k</i> = 91; 5–18 years	Sedentary behaviour	Depression, anxiety, self-esteem, well-being	An indeterminate association of SB with depressive symptoms and anxiety was found. Based on data synthesis, an indeterminate association between SB and self-esteem was indicated. Four of the high-quality studies reported higher levels of SB, at least screen time, being related to less self-esteem. Data synthesis suggests a strong negative association between SB and well-being
	Data not shown; 30–136	RCTs (1), prospective longitudinal (16), cross-sectional (73)			
Low	Teychenne et al., 2015 [33]	Systematic review; <i>k</i> = 2; 5–16 years	Sedentary behaviour	Anxiety	High school students who spent more than 2 hours a day engaged in screen-based behaviours were 36% more likely to experience anxiety symptoms than those who engaged in less than 2 hours a day. In contrast, one cross-sectional study showed an inverse association between screen time and anxiety risk amongst 5-year-old girls (results were not significant for boys).
	1990–2014; 5003–13470	Prospective longitudinal (1), and Cross-sectional (1)			
Moderate	Carson et al., 2016 [28]	Systematic review; <i>k</i> = 10; 11–17 years	Sedentary behaviour	Self-esteem	Higher duration of screen time and computer use was significantly associated with lower self-esteem. Significant associations were not observed between screen time and physical self-concept. Overall, screen time was most consistently associated with lower self-esteem
	2010–2014; 96–422378	Cross-sectional (10)			

Moderate	Poitra et al., 2016 [44]	Systematic review; $k = 11$; 5–17 years	Physical activity	Psychological distress, self-esteem	No association was found between baseline MVPA and depressed mood in the follow-up. VPA: null associations. MVPA: associations were favourable, null or mixed. LPA: null associations. Self-esteem: MVPA: null associations
	1980-2015; 589 – 10641	RCTs (3), prospective longitudinal (1), cross-sectional (7)			
Low	Spruit et al., 2016 [20]	Meta-analysis; $k = 57$; 10–21 years	Physical activity	Internalizing problems and self-concept	Physical activity interventions significantly reduced internalizing problems in adolescents ($d = 0.316$). Physical activity interventions increased self-concept, indicated by a significant small-to-medium effect size ($d = 0.297$)
	Up to 2015; 6790	RCTs, Non-RCTs (Data no shown)			
Moderate	Carter et al., 2016 [15]	Meta-analysis; $k = 11$; 13–17 years	Physical exercise	Depression	Exercise showed a statistically significant moderate overall effect on depressive symptom reduction. Amongst trials with higher methodological scoring, a non-significant moderate effect was recorded
	1982-2015; 19-779	RCTs (11)			
Moderate	Liu et al., 2016 [31]	Meta-analysis; $k = 24$; 5–18 years	Screen time-based sedentary behaviour	Depression	Higher screen was significantly associated with a higher risk of depression. Screen type, age, population and reference category are significant moderators. Compared with the reference group who had no screen time, there was a non-linear dose–response association of ST with a decreasing risk of depression at $ST < 2$ h/day
	Up to 2015; 160-75066	Prospective longitudinal (4), cross-sectional (20)			
Moderate	Lubans., 2016 [22]	Systematic review; $k = 19$; 5–18 years	Physical activity	Psychological well-being, internalizing problems	The strongest evidence was found for improvements in physical self-perceptions, which accompanied enhanced self-esteem in the majority of studies. Few studies examined neurobiological and behavioural mechanisms, and it was unable to draw conclusions regarding their role in enhancing mental health
	Up to 2015; 18-1273	Intervention studies (19)			

(continued)

Table 3.2 (continued)

Quality	Authors, year (ref) Years covered; sample size	Type; <i>k</i> ; Age range	Predictors (physical activity and sedentary behaviour)	Mental health	Main findings
		Research design (<i>n</i> included studies)			
Moderate	Korczak., 2016 [14] 2005-2015; 89894	Meta-analysis; <i>k</i> = 40; <18 years	Physical activity	Depression	Moderator analyses revealed stronger effect sizes in studies with cross-sectional vs. longitudinal designs (<i>k</i> = 36, <i>r</i> = -0.17 vs. <i>k</i> = 14, <i>r</i> = -0.07); using depression self-report vs. interview (<i>k</i> = 46, <i>r</i> = -0.15 vs. <i>k</i> = 4, <i>r</i> = -0.05); using validated vs. non-validated PA measures (<i>k</i> = 29, <i>r</i> = -0.18 vs. <i>k</i> = 21, <i>r</i> = -0.08) and using measures of frequency and intensity of PA vs. intensity alone (<i>k</i> = 27, <i>r</i> = -0.17 vs <i>k</i> = 7, <i>r</i> = -0.05)
		Prospective longitudinal studies (14), cross-sectional (36)			
Moderate	Hoare et al., 2016 [30] Up to 2016; 126-136589	Systematic review; <i>k</i> = 32; 10-19 years	Sedentary behaviour	Depression, anxiety symptoms, self-esteem, stress, psychological distress	Strong consistent evidence was found for the relationship between both depressive symptomatology and psychological distress, and time spent using screens for leisure. Moderate evidence supported the relationship between low self-esteem and screen use. Poorer mental health status was found among adolescents using screen time more than 2-3 h per day
		Intervention study (1), prospective longitudinal (7), cross-sectional (24)			

Table 3.3 Risk of bias systematic review and meta-analyses studies

	1	2	3.1	3.2	3.3	3.4	3	4	5	6	7	8	9	10	11.1	11.2	11
Tremblay et al. [12]	▼	▲	▲	▲	▲	▲	▲	▼	▼	▲	▲	▲	▼	▼	▲	▼	▼
Brown et al. [5]	▼	▲	▲	▲	▼	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Costigan et al. [16]	▼	▼	▲	▲	▲	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Eime et al. [13]	▼	▲	▲	▲	▲	▼	▲	▼	▼	▲	▲	▲	▼	▼	▲	▼	▼
Babic et al. [4]	▼	▲	▲	▲	▼	▲	▲	▼	▼	▼	▲	▲	▲	▲	▲	▼	▼
Burnsall [17]	▼	▼	▲	▼	▼	▼	▲	▼	▼	▼	▼	▲	▼	▼	▼	▼	▼
Cairns et al. [3]	▼	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▲	▲	▲	▲	▼	▼
Hoare et al. [18]	▼	▼	▲	▲	▼	▼	▲	▼	▲	▲	▼	▼	▼	▼	▲	▼	▼
Ferreira-Vorkapic et al. [19]	▼	▲	▲	▲	▼	▼	▲	▼	▼	▲	▼	▼	▲	▼	▲	▼	▼
Liu et al. [8]	▼	▼	▲	▲	▼	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Ruotsalainen et al. [20]	▼	▲	▲	▲	▼	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Suchert et al. [21]	▼	▲	▲	▲	▼	▼	▲	▼	▼	▲	▲	▼	▼	▼	▲	▼	▼
Teychenne et al. [22]	▼	▼	▲	▲	▼	▲	▲	▼	▼	▲	▲	▲	▼	▼	▲	▼	▼
Carson et al. [14]	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▼	▼	▼	▼	▲	▼	▼
Poitras et al. [15]	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼	▲	▲	▼	▼	▲	▼	▼
Spruit et al. [9]	▼	▼	▲	▲	▼	▲	▲	▼	▼	▲	▼	▼	▲	▲	▼	▼	▼
Carter et al. [6]	▼	▲	▲	▲	▲	▲	▲	▲	▼	▲	▲	▲	▲	▲	▲	▼	▼
Liu et al. [10]	▼	▲	▲	▲	▲	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Korczak et al. [7]	▼	▲	▲	▲	▼	▲	▲	▲	▲	▲	▲	▲	▲	▲	▲	▼	▼
Lubans et al. [23]	▼	▲	▲	▲	▲	▲	▲	▼	▼	▲	▲	▲	▲	▲	▲	▼	▼
Hoare et al. [11]	▼	▲	▲	▲	▼	▼	▲	▼	▼	▲	▲	▲	▼	▼	▲	▼	▼

1—The research question and inclusion criteria should be established before the conduct of the review. 2—Was there duplicate study selection and data extraction? 3.1—At least two electronic sources should be searched. 3.2—Key words and/or MESH terms must be stated and where feasible the search strategy should be provided. 3.3—All searches should be supplemented by consulting current contents, reviews, textbooks, specialized registers or experts in the particular field of study. 3.4—It was reviewed the references in the studies found. 3—If at least 2 sources + one supplementary strategy used, select “yes”. 4—Was the status of publication used as an inclusion criterion? 5—Was a list of studies provided? 6—In an aggregated form such as a table, data from the original studies should be provided on the participants, interventions and outcomes. 7—Was the scientific quality of the included studies assessed and documented? 8—Was the scientific quality of the included studies used appropriately in formulating conclusions? 9—Were the methods used to combine the findings of studies appropriate? 10—Was the likelihood of publication bias assessed? 11.1—Source of funding or support for the systematic review. 11.2—Source of funding or support for each of the included studies. 11—Was the conflict of interest included? Potential sources of support should be clearly acknowledged in both the systematic review AND the included studies. ▼High risk of bias. ▲Low risk of bias

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Habits and Quality of Diet

4

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Abbreviations

BMI	Body mass index
CI	Confidence intervals
CVD	Cardiovascular diseases
DP	Dietary patterns
FMI	Fat mass index
HDL	High-density lipoprotein
LDL	Low-density lipoprotein
NCDs	Non-communicable diseases
OR, POR	Odds ratio, pooled odds ratio
PA	Physical activity
UK	United Kingdom

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4.1 Introduction

Adolescence is a period characterized by rapid growth and development, and thus nutritional status might be compromised due to the large amounts of energy and nutrients needed in order to fulfil physiological requirements. The peak of growth occurs in girls between 11 and 15 years and slightly later (from 13 to 16 years) in boys. In adolescents, food intake varies enormously from day to day; therefore, deficient or excessive intakes on 1 day may be compensated in the next [1]. This period of life goes often along with unhealthy nutrition behaviours [2], and several nutrients may increase their risk of deficiency [1]. During adolescence, dietary habits are strongly influenced by the environment, and sociocultural, emotional and behavioural factors. Independence is also acquired in terms of having access to foods that are not available at home, partly determining their nutritional vulnerability [3].

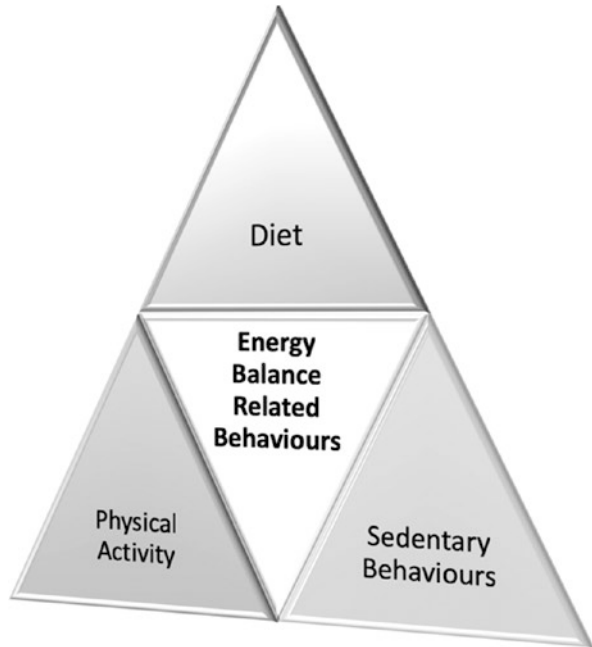
Together with poor dietary habits, physical activity and sedentary behaviours are frequently in a synergy between them in adolescence [4]. Indeed, it is not strange that many epidemiological studies cluster these three aspects to try to better understand these synergies and to be able to better predict an individual's overall healthy lifestyle.

Dietary assessment methodology in adolescence is still considered a big challenge in nutritional epidemiology associated with the complexity of capturing dietary intake and the determination of self- or proxy-reported intake remains an important element of health research [5]. Every available method has its own advantages and disadvantages and appropriate applications of these dietary assessment methods are widely discussed while still a gold standard for nutritional epidemiology is difficult to determine and even more in these stages of life. Correlations between nutritional biomarkers and nutrients, food consumption or dietary patterns are still moderate [6, 7], or from moderate to high when combining several dietary assessment methods [8]. Development of more accurate methodologies to assess dietary practices will also be crucial in order to evaluate the effect and the adherence to nutritional interventions using a practical, appropriate and low participant burden dietary assessment method [9].

4.2 Energy Balance Related Behaviours During Adolescent's Growth

Adolescence is a period characterized by multiple changes in terms of body composition which are related to energy balance related behaviours, such as diet or physical activity. Figure 4.1 shows the most important determinants of energy balance related behaviours. Diet and physical activity together with sedentary behaviours have been identified as the most prevalent determinants of health [10]. Their importance was also based on their tracking from childhood to adulthood [11]. One of the most important characteristics of these behaviours is that all of them may be influenced by peers or by the environment, playing an important role in the

Fig. 4.1 Main determinants of energy balance related behaviours in children



framework of nutrition-related chronic disease prevention. This is essential because the link between several illnesses that appear during adulthood had the origin during early ages [12]. For instance, it has been observed that those children and adolescents who present obesity at young ages were more likely to have obesity during adulthood, which might imply the development of several comorbidities as insulin resistance, dyslipidaemia or hypertension. Diet and physical activity levels act as moderators of body composition, and of some of these cardiometabolic features.

4.2.1 Nutrition as a Key Factor in a Healthy Development of the Youth

A healthy diet, rich in vegetables, fruits, legumes and whole grain cereals, has been linked with a better health status, both in youth [13, 14] and during adulthood [15–18]. Diet could be considered one of the most flexible risk factors that were related with the majority of the most prevalent non-communicable chronic diseases in adults. In fact, how children act from early ages has been related to future health problems. Especially, habits acquired at home will be established, increasing the probability to maintain them from adolescence to adulthood.

From a nutritional point of view, there are a lot of diseases related to nutrient intake, from the most common such as the excess of weight, until cardiovascular

diseases, metabolic syndrome, bone or mental health. Across the following paragraphs, each disease will be discussed with the current knowledge regarding food and beverage consumption.

One of the most prevalent diseases during the adulthood period are the cardiovascular diseases. In fact, several studies have analysed the relation between several specific food groups and their effect on several population age-groups. A reduction in cardiovascular risk factors during adolescence would lead to a reduction in the number of individuals affected by cardiovascular diseases later in life [19]. For instance, in a UK national programme it has been estimated that by reducing the cardiovascular risk by 1% would prevent around 25,000 cardiovascular disease cases and saving €40 million per year [20]. The reduction of cardiovascular risk factors could be done using different strategies from a nutritional point of view. For instance in children, high consumption of whole grain cereals was inversely associated with fat mass index (FMI), systolic blood pressure, low-density lipoprotein (LDL) cholesterol and circulating insulin [21]. Also, the intake of dietary fibre has beneficial effects on decreasing risk factors for developing several chronic diseases [22]. In this line, a systematic review developed in adults concludes that all the included studies reporting the effect of whole grain diets on cardiovascular disease risk factors (blood lipids and blood pressure) had an unclear or high risk of bias [15]. Moreover, the fat consumption has been linked with cardiovascular profile, and the evidence has shown that those dietary interventions developed in healthy young population groups aged between 2 and 19 years of age or those at risk of cardiovascular events, aiming to reduce saturated fatty acids intakes, resulting in a significant reduction in total and LDL cholesterol, as well as diastolic blood pressure without adverse effects on growth and development [23].

Also fruit and vegetable consumption had an important effect on the preventive cardiovascular events. Specific nutrient intakes as flavonoids from fruits and vegetables, during adolescence, were independently associated with lower serum low-density lipoprotein cholesterol among females [24]. Focusing on vegetal consumption, null results were found regarding legume consumption and stroke risk; however, in adults the highest consumers of legumes were associated with a decreased risk of 10% in both cardiovascular and coronary heart diseases (relative risk = 0.90; 95% CI 0.84–0.97) [16]. It is important to develop effective interventions that focus on legume consumption in order to clarify its effects of cardiovascular risks.

The other interesting food group related to cardiovascular events comes from animal sources such as dairy products or fish. Neutral associations have been observed between the dairy products and cardiovascular diseases and all-cause mortality in a recent meta-analysis that included 29 prospective cohort studies [25]. An additional systematic review with meta-analysis developed in adults showed that there is evidence indicating that the consumption of fish oil has improved some cardiovascular biomarkers such as triglycerides and high-density lipoprotein (HDL) cholesterol [26]. In this line, no information has been published on young population groups, however it is possible that similar findings could be obtained.

Osteoporosis is another important chronic disease. In this sense, a vegetarian-style dietary pattern during adolescence, rich in dark green vegetables, eggs, non-refined grains, 100% fruit juice, legumes/nuts/seeds, added fats, fruits and low-fat milk consumption during adolescence is positively associated with bone health in young adults in a longitudinal study [27].

The knowledge on the role of diet in mental health is increasing in the last years, and nutritional psychiatry is an emerging field in the framework of prevention. Both cross-sectional and longitudinal studies have shown that a highly processed diet has been related to higher risk of developing psychiatric symptoms, such as depression and anxiety, especially in adults. A cross-sectional analysis developed on pregnant adolescents showed that lower intake of B vitamins was associated with higher mental health and behaviour problems [28]. On the other side, a Mediterranean-style diet protects a person from developing a mental disorder [29]. Traditionally, cognitive deficits are found in later life, however in recent years, cognitive deficits exist in young healthy, normal weight individuals with poor glucoregulation, exemplifying the need for early preventative nutrition measurements [30]. One of the future prospects of the nutrition research areas could be related to the increase of the nutraceuticals, which are prescribed. However, the quality of good and well-controlled clinical trials examining these interventions should be developed. Moreover, the eruption of research targeting the effect of nutritional psychiatry on the modulation of the gut microbiota, through probiotic and prebiotic foods and supplements, constitute promising novel therapies for various neuropsychiatric conditions [30]. The recent association between the brain and the gut microbiota has been shown to have an influence on neurotransmission, which also has an influence on multiple systemic pathologies and obesity [31].

4.2.2 Physical Activity and Sedentary Behaviours, a Tandem in the Energy Expenditure

Both, physical activity and sedentary behaviours, are the main contributors to energy expenditure. Their relationship with health has been extensively observed in cross-sectional, longitudinal, intervention studies, and also in systematic reviews and meta-analysis. Physical activity was related to better health-related quality of life in children and adolescents, although the magnitude of these effects did not represent a minimal clinically important difference in most of the included studies from a meta-analysis study [32]. In any case, there is a clear relationship between physical activity and health status, indicating that increasing physical activity and fitness will result in additional improvements in health status [33]. Analysing the effect of physical activity and several illnesses has confirmed their role in decreasing insulin resistance and metabolic syndrome in children and adolescents [34], however the unstandardized methodologies used make difficult to obtain conclusions to develop successful strategies in physical activity interventions. Also, physical activity has potentially beneficial effects on mental health in young population

groups, however the evidence is limited because research designs are often weak and effects are small or moderate [35].

On the other hand, physical fitness also plays a role in improving the metabolic syndrome (i.e., decreasing insulin resistance) in young population groups [34]. In a recent meta-analysis that studied the cardiorespiratory fitness cut-offs to avoid cardiovascular risk in young people [36], the results showed that those boys and girls with low fitness level were 5.7 and 3.6 times, respectively, more likely to have cardiovascular disease risk (95% CI 4.8–6.7; 95% CI 3.0–4.3) than those with the highest fitness level.

Taking into consideration the effect of sedentary behaviours on the adolescent's health, it is remarkable to observe the increased proportion of young people who exceeded the current recommendations [37] that were established by the American Academic of Pediatrics, in less than 2 h/day of screen time [38]. In youth, limited evidence exists, but in adolescents, exceeding the 2 h/day limit with the weekend screen was significantly associated with metabolic syndrome (OR = 2.05 [1.13–3.73]; $p = 0.02$) [39]. Also, results from a meta-analysis found that sedentary behaviours are associated with an increased risk of insomnia (pooled odds ratio [POR] = 1.176, 95% confidence interval [CI] = 1.014–1.364) and sleep disturbances (POR = 1.381, 95% CI = 1.282–1.488) [40]. Besides, an additional review showed small but consistent associations between screen time in youth and poorer mental health [35].

Additionally, literature suggests a clear relationship between sedentary behaviours and health in adults. For instance, a recent dose-response meta-analysis showed that independently of physical activity, total sitting and television (TV) viewing time were associated with greater risk for several major chronic disease outcomes [41]. Specifically, for all-cause and cardiovascular mortality, a threshold of 6–8 h/day of total sitting and 3–4 h/day of TV viewing was identified, above which the risk was increased [41]. For this reason, it could be necessary to develop further studies on young population groups in order to link the different types of screen time behaviours.

4.3 From Nutrition to Feeding

Micronutrients are important elements, even if they are needed in small amounts for everyone's consumption. They are involved in many physiological and metabolic pathways, such as the maintenance of immune system or the utilization of macronutrients to produce energy for growth, development and movement [42]. This means that they have a big deal for adolescents' optimal growth and development.

The list of *essential micronutrients* (because our bodies cannot construct them from other ingredients as it happens in other cases) includes *13 vitamins and around 16 minerals* [43], although our diet includes other compounds such as phytochemicals, commonly found in plant-based foods [44], among others.

Vitamins are organic compounds required for the maintenance of optimal health and metabolic integrity [45]. During adolescence, the requirements for some

vitamins increase. This is the case for thiamine (B1), riboflavin (B2) and niacin (B3) because of their influence on the carbohydrate metabolism; vitamins B6, folate (B9) and B12 due to their participation in the synthesis of DNA; also, higher amounts of vitamin D for bone growth are needed; and finally, the input of vitamins A, C and E must be assured due to their role in the functioning and structure of new cells [46].

Minerals are inorganic elements with a physiological function in the body [45]. The main minerals that require attention during adolescence include calcium, responsible together with vitamin D for bone growth (especially important for girls with higher osteoporosis risk from postmenopausal period); iron, necessary for the increase in blood and muscle volume (again, especially important for girls because of their blood losses in menstruation); and zinc, which is part of enzymes involved in genetic expression [46].

Up to adolescence, the energy requirement of both sexes is equal. However, from this period on, energy differences between males and females start due to the onset of puberty and differences in physical activity practices. The establishment of energy requirements at this stage may be calculated based on the body weight (and particularly, body lean mass), physical activity and growth velocity. The distribution of energy throughout the day (20–25% for breakfast, 30–35% for lunch, 15–20% for mid-afternoon snack and 25% for dinner) and among macronutrients in percentage (50–60% carbohydrates, 30–35% lipids and 15–20% proteins) is equal for adolescents as for adults, while it may be slightly higher for proteins in the case of adolescents due to growth requirements. However, both for adults and adolescents, the usual daily protein intake is higher than recommended [46].

These data about micro- and macronutrients are of importance, as it is the basis to interpret nutrition knowledge. What people eat is food and these guidelines must be translated into simple and concrete messages to achieve them. The best way for people to understand this is in terms of foods and food patterns. The best strategy to meet the mentioned nutrients' recommendation is to promote a high variability, seasonality and sustainability in terms of foods. Generally, adolescents' diet should ensure an adequate quantity of cereals (preferably in their wholemeal version to meet the fibre recommendations), vegetables and fruits (around five daily portions between both), dairy products (2–4 daily portions), foods providing proteins including meat, fish, eggs, legumes and nuts (2–3 daily portions) [46], and water as the main hydration contributor (≈2000 mL/day) [47]. Besides, special attention should be placed to control the consumption of fats and sugars. For this reason, lean meat should be preferable among others, as well as unsaturated vegetable oils among other fats, sugar-rich products should be limited and adding sugar to foods must be avoided [46]. Processed foods may contain 'hidden' amounts of sugars and fats, so they must be consumed during limited times and in little portions, while controlling the food labelling must be recommended in any case.

Diet is a complex behaviour. Foods are not consumed isolated and there is no chance to derive any direct association between specific food groups' consumption

and a health issue. For this reason, it is necessary to extend the traditional reductionist nutrition approach to more advanced and widespread focus [48]. This can be encompassed by *dietary patterns*. Unhealthy *food or dietary patterns*, defined such as the quantities, proportions, variety or combination of different foods and drinks in diets, and the frequency with which they are habitually consumed [49], are, together with eating behaviour disorders (anorexia, bulimia nervosa) and inadequate nutrient intake among high performance adolescents' athletes concretely, the three main disorders resulting in a nutritional imbalance in youth [46]. These dietary patterns in youth might be characterized typically by skipping meals (mainly breakfast), eating in fast-food restaurants or meal to go, snacking (sweets, sugar-sweetened beverages, processed foods, salty snacks...) or following restrictive diets to lose weight.

Taking into account all the cited factors (increase in nutrient requirements for growth and development, high consumption of energy-dense and low-nutrient intake foods, and the tracing of potentially restrictive diets to lose weight which might compromise nutrient supply adequacy), the concern about the possibility of double burden of disease suffering in adolescence described by the coexistence of undernutrition along with overweight/obesity or diet-related non-communicable diseases [50] is of consideration even in developed countries where the ratio between obesity/undernutrition is higher than in low- or medium-income countries, as was recently reported by a systematic review on this issue [51]. In parallel, in such report [51], it was also found that in developing countries the obesity/undernutrition ratio is also increasing due to rapid lifestyle changes regarding food consumption, physical activity, rapid urbanization, economic development and health policies in those countries, resulting in the coexistence of undernutrition and overnutrition not only because of their typically limited access to a variety of foods due to economic constraints but also because of a westernized-dietary and unhealthy patterns' acquisition.

4.4 Measurements of the Diet

The analysis of the diet should be an additional prevention tool that gives the opportunity to improve the adolescents' well-being. Sometimes, nutrition and diet were not given due attention by parents and adolescents during this period because of the perception of their healthy status, and especially adolescents did not worry about their health both in the present and in the future. However, the effects of an unhealthy diet together with another unhealthy behaviour could be behind the current increase in non-communicable disease at young ages.

The evaluation of the diet is based on several methodologies that try to capture the most accurate intake of foods and beverages in all periods of life. Specially, during adolescence, they were able to report their usual intakes, and the most common used methods were the 24 h dietary recalls or food and beverage frequency questionnaires. The use of this qualitative or quantitative information gives the opportunity to analyse the diet composition taking into consideration the independent association of foods and beverages or taken in combination, with other behaviours or diseases.

One of the important determinants of food and beverage consumption is the socioeconomic status. The relationship between them has been extensively analysed. In European adults, healthy foods as fruits, vegetables and whole grain were positively associated with higher education, occupation and fewer economic difficulties [52]. For instance, taking into consideration the family income or the educational level with dietary patterns (DP), children and adolescents living in high developed countries with high parental education tend to have a healthier diet [53]. However, unclear associations were found in middle developed countries, showing an unhealthy diet among the high-income and educated populations. Also, it is important to mention that social vulnerabilities should be noted. For instance, children whose parents lacked a social network or being migrants were more likely to be in the processed foods' cluster, in a longitudinal study developed at the European level [54], which included higher consumption frequency of snacks and fast foods compared with the whole study. Moreover, those children whose parents were homemakers were less likely to be in the processed cluster at baseline [54].

The link between nutrition as a tool in the prevention of a lot of diseases has been analysed. For instance, a diet rich in milk and yogurt was associated with lower body fat, lower risk of cardiovascular disease and higher cardiorespiratory fitness [55]. An inverse association of fruits' and vegetables' consumption with systolic blood pressure, abdominal obesity, triglycerides, high-density lipoprotein cholesterol and metabolic syndrome was observed in one third of the studies included in a systematic review [56]. Also, dietary interventions are effective strategies to act from one of the most preventable chronic diseases, such as obesity, and lead to weight loss when the intervention adherence is high [57]. In this sense, the use of diets with a reduction in carbohydrates may optimize improvements in other type 2 diabetes risk factors, including insulin resistance and hyperglycaemia [57].

On the other hand, the quality of diet may also be used as a predictor, for instance, of mental health. A good quality diet was related to better mental health in children and adolescents [58], and healthy dietary patterns or consumption of a high-quality diet was associated with lower levels of depression or better mental health. Instead, there was a relationship between unhealthy diet and consumption of low-quality diet and depression or poor mental health [59]. In this sense, five key dietary recommendations for the prevention of depression have been established from the published evidence [60], which comprised to: (1) follow 'traditional' dietary patterns, such as the Mediterranean, Norwegian or Japanese diet; (2) increase the consumption of fruits, vegetables, legumes, wholegrain cereals, nuts and seeds; (3) include a high consumption of foods rich in omega-3 polyunsaturated fatty acids; (4) replace unhealthy foods with wholesome nutritious foods; (5) limit the intake of processed foods, 'fast' foods, commercial bakery goods and sweets.

The relationship between diet and any other energy balance related behaviours may be of help to understand the influence between them. For instance, a positive association of the Mediterranean dietary pattern adherence with high levels of physical activity (PA) or even more frequently, with less time spent in sedentary behaviours [61]. Also, the foods and beverages consumed could be influenced by the sedentary behaviours. Higher television viewing and computer or internet use

during the adolescence were associated with higher odds of consumption of sweetened beverages and lower odds of fruits' consumption [62]. Taking into consideration the overall diet, unhealthy dietary patterns characterized by high consumption of snacks and sugar-sweetened beverages were also associated with higher computer use and internet use for recreational reasons [63]. In the same study, lower adherence to the healthy dietary patterns, namely 'plant based', 'breakfast' or 'health conscious', was found in those adolescents who spent more than 4 h/day watching television [63].

4.5 Successful Nutritional Interventions

In this section of the chapter, the most successful interventions on micronutrient deficiencies and overweight/obesity during adolescence are going to be presented based on two very recent systematic literature reviews on the topic [64, 65].

4.5.1 Nutritional Interventions to Prevent Micronutrient Deficiencies

Mostly, these interventions are mainly done in low-to-moderate income countries where these deficiencies are more frequent [65]. In total, there was a pull of participants of 6350 adolescents belonging to the intervention group, against 5511 subjects including in the control group. In those studies, iron, folic acid, vitamin A, vitamin D, vitamin C, calcium and zinc were the prevalent micronutrients in which the interventions were focused. The interventions were mostly implemented in schools apart from some community-based studies which in comparison demonstrated to be underpowered. Most of the studies consisted in trying to modify lifestyles through diet, exercise and behavioural changes together with micronutrient supplementation. Finally, there was a large heterogeneity among the studies and the improvement was mainly associated with iron/folic acid in reducing anaemia. In these intervention studies, the male sample was underrepresented, so the results must be considered with caution. The context of medium-low to low socioeconomic status of the included countries must also be taken into account in terms of reproducibility in medium-high to high-income countries.

As a consequence of the very specific population groups in which they are implemented, the high amount of possible micronutrients in which the intervention might be focused, and the difference in relation if the intervention plays as a prevention or as a treatment, it is hard to derive a successful nutritional intervention in a preventive sense. However, there is no doubt that in the coming future this will be also a trending health topic among high-income countries, because, as it is already mentioned above in this chapter, the combination of micronutrient deficiencies and obesity condition will turn into reality.

4.5.2 Nutritional Interventions to Prevent Obesity

The impact of the 10 included interventions [64] was discrete, even though there was also a large heterogeneity among them. The overall conclusion in the systematic review was that physical activity or dietary control alone did not have any significant impact on BMI reduction while school-based delivery strategies were found to be more effective than interventions in non-educational settings. Contrary to what systematic reviews found for micronutrients' deficiencies' prevention, these interventions were done in high-income countries. This is of high relevance due to the increase in overweight and obesity rates also in low-income countries, meaning this is an important gap to fulfil with future and necessary research.

Among the retrieved interventions, the one published by Neumark Sztainer [66] is supposed to be the most effective when comparing experimental with control groups. It was focused only on adolescents girls and it was mainly based on an alternative physical education programme. The programme included socio-environmental (e.g., supportive atmosphere and different opportunities for physical activity), personal (e.g., self-perceptions, self-efficacy and attitudes regarding physical activity) and behavioural (e.g., goal-setting, skills) factors and their interactions and they were based on the Social Cognitive Theory [67]. Physical activity was offered four times a week, and nutrition and social support sessions were offered every other week on alternating weeks throughout a 16-week semester, and an attractive student manual to guide them with each of the components was provided.

Besides, the use of the internet and technological resources is growing, particularly among adolescents and for this reason an emerging field is being the health promotion programmes by using information and communication technologies (ICTs), such as e-mails, websites, computer programs, smartphones, text messages or games [68]. As they are methods 'adolescent-friendly' to be used even for disadvantaged adolescents or for those turned off by traditional health education methods, the effectiveness of these new technologies has been recently reviewed [64]. Among the 11 studies retrieved in that systematic review, only three [69–71] were categorized as a high-quality study, all three European and school based. From those, only one of the studies [71] reported a significant effect on the intervention group itself. Based on the theory of Planned Behavior, a web-based computer program tailored the intervention during 10 weeks (8 lessons, 15 min each). The almost 1000 adolescents were followed up at 4 months and 2 years after the intervention. Higher vegetables' intake and lower snack and sugar-sweetened beverage consumption were finally reported in the intervention group, while higher intake of fruits was found only in adolescents with a pre-low intake in the intervention group.

From a summary of the adolescence situation, it is clear that there is an important window for improvement in the effectiveness of nutritional interventions with adolescents, an important gap of knowledge on what is their nutritional situation worldwide, and finally, an important challenge for the specific characteristics of this population group, sometimes difficult to deal with.

4.6 Conclusion

Adolescence is a vulnerable period in terms of nutritional regulation. Not only because of the importance of assuring the required nutrients for growth and development but also because it is a period characterized by the abandonment of lifestyle behaviours influenced by the parents maybe healthier. This is translated into behaviours implying energy-rich and nutrient-low food consumption, skipping meals, lot of time devoted to screen use, and decreasing physical activity or sleep time, among others. Besides, adolescence is a period also critical in relation to social features and influences and with this picture, it is not strange that eating disorders may appear in one or in another sense. From a preventable point of view, accuracy in the determination of dietary patterns as a marker of nutrient intake is quite relevant in order to characterize adolescents being able to detect those at higher risk of inadequate nutritional status. Nutritional interventions in adolescence were frequently performed in developing countries because of their higher risk in terms of mainly micronutrient deficiency. However, there is a current trend both in developed and developing countries of overlapping between overweight/obesity condition and micronutrient deficiency due to the consumption of low-nutrient and high-energy dense foods that have already been mentioned. Then, there is a large work to do in the field of effective nutritional interventions for adolescents applying attractive and new methods.

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Biochemical Markers in Primordial Prevention: Premises and Promises

5

Eugène Jansen and Laila Meija

5.1 Introduction

This chapter will focus on the possible biomarkers that are important for monitoring of the health of adolescents. The following areas will be covered: nutrition and diet including almost all nutritional components, general health status including obesity, biomarkers of lifestyle such as the use of alcohol and smoking.

Furthermore, measurements of (groups of) biomarkers will be elaborated and explained in detail with the required references and a proposal will be given on the sets of biomarkers for monitoring the health of adolescents.

Adolescence begins with the onset of physiologically normal puberty and ends when an adult status has been reached. This period of development corresponds approximately to the period between the ages of 10 and 19 years, which is consistent with the World Health Organization's (WHO's) definition of adolescence. Adolescent period is characterized by dramatic changes resulting in hormonal changes in sexual organs, physical growth and development, brain changes, and social and emotional and psychosocial changes in lifestyle such as smoking, drug use, and changes in nutrition which can be both obesity and malnutrition. These changes are associated with variations in a number of biochemical parameters such as hormonal changes in steroid metabolism, markers of bone turnover, fat metabolism, induction of oxidative stress, nutritional biomarkers, and biomarkers of changes in lifestyle.

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5.2 Biomarker Theory

It is not the goal of this chapter to go into much detail about the theory of biomarkers, but it must be clear to the reader that biomarkers can be divided into several classes. There are biomarkers of exposure, biomarkers of effect, biomarkers of disease, and biomarkers of susceptibility.

Biomarkers of exposure are generally parent compounds or primary metabolites of environmental or nutritional compounds that have a kind of linear relationship with the external compound of interest. These compounds can be detected in blood samples or in urine, where urine can act as a kind of integrating organ which does not necessarily reflect the exposure.

Biomarkers of effect are compounds that are parent compounds or primary metabolites or other kind of compounds that are in between exposure and effect. This means that in general the higher the concentration of the biomarker, the closer a possible adverse effect will be present.

Biomarkers of disease are biomarkers that indicate a(n) (irreversible) disease state. They can be similar as biomarkers of effect, but they cross a certain threshold which is generally accepted as a disease state.

Biomarkers of susceptibility are biomarkers that affect and indicate a person's individual state for a higher risk for disease and are generally of genetic origin.

Biomarkers can have different kind of ranges. Some biomarkers only have a limited range, others can vary in decades. This usually depends on other processes in the body. For instance, cholesterol will vary between 2 and 10 mMol/L, whereas cotinine can vary between 1 and 1000 µg/L serum. Moreover, the relation between biomarkers and exposure or effect does not have to be linear but can also have a sigmoid relationship.

The materials in which biomarkers can be measured are mainly blood products, such as serum, plasma, or sometimes red or white blood cells, but can also be saliva or urine. In practice, serum is to be preferred because methods for the measurement of biomarkers are usually very well developed in clinical settings.

An ideal biomarker must fulfill the following criteria. The concentration or activity of the biomarker will be significantly increased (or sometimes decreased) in specific disease conditions; the biomarker must be easily quantifiable in the available biological fluid, preferably in clinical samples; there must be a good correlation with the intended outcome or progression of disease condition; and the measurement of the biomarker must be reliable, easy to perform, and cost effective.

Most of the biomarkers proposed in this chapter fulfill these criteria, since most of them are well-established clinical chemical parameters that can be measured on clinical analyzers with well-developed quality samples included. Some of the biomarkers, however, will need a more specialized laboratory for high-performance liquid chromatography (HPLC), liquid chromatography coupled with mass spectrometry (LCMS), or gas chromatography (GC) measurements. But, for all these methods detailed, well-established protocols are available in several published papers which are included in the reference list.

The serum or plasma samples must often be stored in freezers until the biomarker measurements are carried out. Therefore, it must be checked whether the stability of the samples in combination with the assays to determine the biomarkers gives reliable results and does not suffer from deterioration because of the storage or freezing conditions. For most biomarker assays, storage at $-70/-80^{\circ}\text{C}$ is to be preferred. For more detailed information on the stability studies of the most used biomarkers, a number of studies have been reported [1–5].

In this chapter, a number of new technological developments for a future personalized assessment, for example, microRNAs, epigenetics, metabolomics, or proteomics, will not be considered. All these techniques require rather sophisticated equipment and experienced laboratories. Especially, metabolomics and proteomics are promising techniques for general health and disease detection. They usually use LCMS, high-resolution nuclear magnetic resonance, or two-dimensional (2D) electrophoresis techniques. The epigenome integrates the information encoded in the genome with all the molecular and chemical changes by alterations in DNA methylation. MicroRNAs can broaden our understanding of the diverse molecular pathways mediating posttranscriptional control over gene expression. These small noncoding RNAs can be detected in serum samples, and fluctuate throughout life.

5.3 Biomarkers of General Health Status

The biomarkers of general health status comprise a number of physiological and clinical chemical parameters that are often determined in disease states. A selection of these biomarkers can be used to monitor the health status also when there is no reason for an expected illness or severe deviation out of range. In addition, other biomarkers can be monitored that can reflect not a particular disease or organ failure, but show a more general state of physiology. Examples of these biomarkers are high-sensitive C-reactive protein (HS-CRP) as a general biomarker low-level inflammation and biomarkers of oxidative stress. Recently, a set of three biomarkers that are related to oxidative stress processes have been developed [6], being reactive oxygen metabolites (ROM) as a biomarker of oxidative stress that measures low molecular weight (MW) oxygen species as product of lipid peroxidation. A second biomarker is the total thiol assay that determines the free sulfhydryl (SH) groups in proteins (SHP) and the third biomarker is the total biological antioxidant potency (BAP), which determines the total amount of antioxidants present in serum or plasma. In a study with 55 adolescents in Italy [7], ROM levels were significantly higher in obese children. The total biological antioxidant capacity (BAP) was lower compared to controls. A direct correlation was found between d-ROM levels and body mass index (BMI), while an inverse correlation was found between the BAP and BMI. It was concluded that fat accumulation has played a key role in the pathogenesis of systemic oxidative stress already during pediatric age. In a study with 595 healthy Japanese junior high school students [8], only in female students ROM showed increased levels with increasing BMI and percentage body fat (% body fat).

In male students, this correlation was absent or very low. In this study, BAP did not show any relation with BMI and percentage body fat.

Low-level inflammation must be kept as low as possible, in view of the nutritional habits and unhealthy lifestyle of adolescents. This is assessed by Almeida-de-Souza et al. [9] who propose the measurement of the inflammatory biomarkers such as CRP, interleukin-6 (IL-6), complement-3 (C3), and complement-4 (C4) in adolescents.

In Table 5.1, an overview is shown of a number of these biomarkers that can be applied to adolescents. All these biomarkers can be measured with existing clinical autoanalyzers in hospitals.

In other chapters on healthy or critical nutrition and brain development in combination with easy measurements of these biomarkers, a selection will be presented as to what is the best choice to monitor the health of adolescents

Table 5.1 Summary of important body tissues and related biomarkers

Organ/tissue/status	Biomarker
Liver	ALT, AST, GGT, LDH
Kidney	CREAT, Cyst C
Pancreas	Amylase, lipase
Heart	CK
Lipid status	CHOL, LDL-CHOL, HDL-CHOL, TG, FFA
Diabetes	GLUC, HbA1c, insulin
Immune status	IgG, IgM, IgA
Inflammation	HS-CRP, IL-6, TNF- α , C3/4
Antioxidant status	BAP
Oxidative stress	ROM
Redox status	SHp, TTL
Bone metabolism	25OHVitamin D

ALT alanine aminotransferase, *AST* aspartate aminotransferase, *GGT* γ -glutamyltransferase, *LDH* lactate dehydrogenase, *CREAT* creatinine, *Cyst C* cysteine C, *CK* creatine kinase, *CHOL* total cholesterol, *LDL* low-density lipoprotein, *HDL* high-density lipoprotein, *TG* triglycerides, *FFA* free fatty acids, *GLUC* glucose, *HbA1c* glycosylated hemoglobin, *IgG* immunoglobulin G, *IgM* immunoglobulin M, *IgA* immunoglobulin A, *HS-CRP* high-sensitive C-reactive protein, *IL-6* interleukin-6, *TNF- α* tumor necrosis factor alpha, *C3/4* complement 3/4, *BAP* biological antioxidant potency, *ROM* reactive oxygen metabolites, *SHp* SH-groups in proteins, *TTL* total thiol levels, *25OHVitamin D* 25-hydroxy vitamin D

5.4 Biomarkers of Nutrition

Important classes of nutrition that can affect people's health are the following: macronutrients such as carbohydrates (CHs), fat (meat and fish), vegetables and fruits (including antioxidants), and micronutrients such as minerals, trace elements, vitamins, and other biologically active substances. Especially for adolescents the following categories, described below, are possibly critically and most important for healthy nutrition. Other possible problems for adolescents are insufficient nutrient intake resulting in general deficiencies, eating disorders, and popular special diets, such as a vegetarian or vegan diet, which can result easily in specific deficiencies, such as vitamin B12, etc.

5.4.1 Biomarkers of Carbohydrates

The WHO has recently published a Guideline on sugar intake for adults and children [10, 11]. The recommendations of the WHO report are:

- WHO recommends a reduced intake of free sugars throughout the life course as a strong recommendation.
- In both adults and children, WHO recommends reducing the intake of free sugars to less than 10% of total energy intake as a strong recommendation and suggests a further reduction in the intake of free sugars to below 5% of total energy intake as a new conditional recommendation.

In contrast to the European Food Safety Authority (EFSA) policy that “there are insufficient data to set an upper limit for (added) sugar intake,” the recommendation of the WHO to lower the sugar intake with 50% is more health promoting and should be followed.

The intake of sugar is very high in adolescents. In a review paper, sugar consumption data are reported for children aged 10–19 years for 14 countries in Europe, North America, and Australasia based on the data available from national dietary surveys [12]. Total sugar intakes expressed as a percentage of total energy (%TE) ranged from 15.4% of total intake for 10–18-year-old boys in Italy to 29.6% for 15–17-year-old girls in Germany. Despite some differences in classification, the data included in this review suggest that, intakes of added sugars in children and adolescents are higher than those of other age populations.

Also in a large study ($n = 16,808$) in the USA using the National Health and Nutrition Examination Survey (NHANES) data from 2009 to 2012 [13], it is clearly shown that adolescents are the main target group of high sugar intake in the general population. These sugars are associated with excess energy intake and poorer diet quality. The foods/beverages that contribute to added sugars include sweetened beverages, sweet bakery, candy, and other dessert products. A remarkable observation is that even those in the lowest decile of added sugars exceed the 10% guidelines of the WHO.

In a study from Australia in which 3671 adolescents participated [14], it was concluded that sugar-sweetened beverages were most prevalent among adolescents. There was an association with health impact, especially with oral health status. In a Dutch study based on food consumption data in 2010 ($n = 1409$), adolescents consume the largest amounts of sugar and confectionary [15].

From these studies, it is clear that sugar consumption is possibly one of the most adverse health threats in adolescents in relation to nutrition.

Sucrose, being a glucose-fructose dimer and glucose alone, acts as a direct energy source, but also causes a boost in high levels of sugar after the consumption of each meal or especially after drinking soda liquids. Insulin will facilitate to decrease the blood levels of glucose, but still chronic high levels will cause damage to tissues and blood vessels.

The metabolic pathway of fructose (also a part of sucrose) is very different from that of glucose. Fructose is poorly absorbed from the gastrointestinal tract and it is cleared to a large extent by the liver. As a result, the circulating concentration of fructose is about 0.01 mMol/L in peripheral blood, compared with an average concentration of about 4–6 mMol/L for glucose in nondiabetic persons [4]. In the liver, fructose is converted into free fatty acids and triglycerides that are stored in the abdominal fat tissue. The metabolic effects of fructose consumption are more adverse than that of glucose. Most of the adverse effects are related to the metabolic syndrome as is shown in Fig. 5.1 and have been indicated in bold.

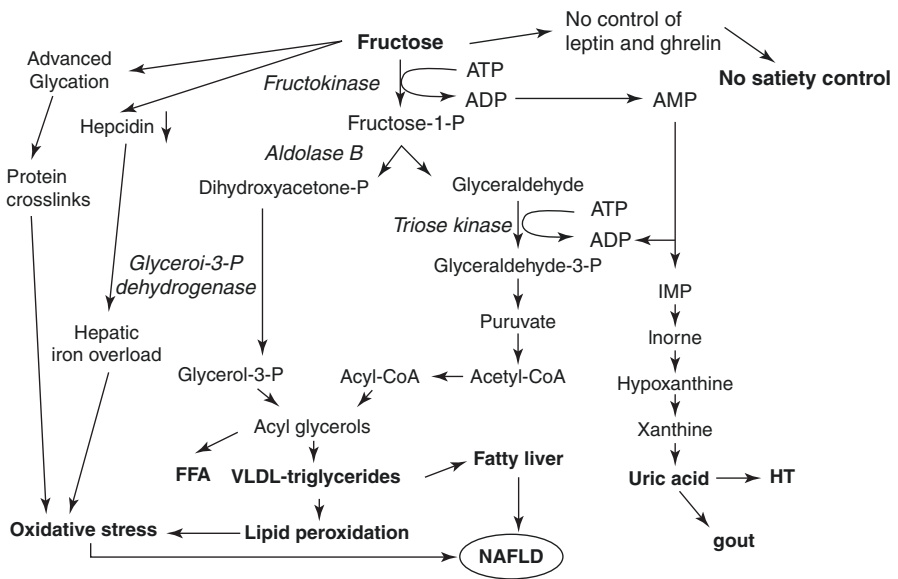


Fig. 5.1 Metabolism of fructose including adverse effects. FFA free fatty acids, VLDL very low density lipoproteins, HT hypertension, NAFLD nonalcoholic fatty liver disease

Many studies have been reported on possible adverse effects of fructose and/or sucrose. Recent meta-analyses, which were not supported financially by industry, summarize these studies in an objective way in [16–18]. These studies reported positive associations between fructose intake and several endpoints as indicated in Fig. 5.1.

Whether the present intake of fructose is a threat to public health will depend on the amount of fructose that people consume. In this respect, the adolescents are the main target group with the highest consumption of sugar and consequently also of fructose.

The fructose levels in blood are very low and therefore serum or plasma fructose is not a suitable biomarker. Monitoring of high intakes of glucose can be measured by (sober) glucose levels (short-time biomarker) in the blood or glucose bound to albumin as glycated albumin, the so-called glycosylated hemoglobin (Hb1Ac) as long-term biomarker reflecting the glucose blood level during the last 4 weeks.

5.4.2 Biomarkers of Fats and Lipids

The fatty acids can be divided into a number of subclasses, such as saturated FA (SFA), monounsaturated FA (MUFA), and polyunsaturated FA (PUFA), where the PUFA can be divided into *n*-3 and *n*-6 PUFA. Furthermore, the trans-FA are a special class of FA that are mainly by-products of fat hardening. In most countries, these FA are banned and do not contribute to the total FA to a large extent.

In general, the MUFA and PUFA are considered as more healthy FA, whereas SFA and the trans-FA have a more unhealthy reputation. The ratio of *n*-6/*n*-3 FA should be about 3, but in industrial countries, this ratio has increased substantially during the last century up to 20. Therefore, the consumption of the so-called fish *n*-3 PUFA (eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA)) is encouraged and also the shorter chain *n*-3 FA such as α -linolenic acid instead of its counterpart the *n*-6 FA linoleic acid.

The monitoring of the intake of the kind of fatty acids (FA) can be done by the analysis of the fatty acid patterns in the blood. In the blood, several subfractions can be used for this analysis, such as fatty acids bound to phospholipids, cholesterol esters, triglycerides, or free fatty acids in serum or plasma or phospholipids in erythrocytes. For the assessment of long-term dietary intake, the phospholipids or cholesterol esters must be used, although some effect of transient fatty acid consumption cannot be excluded.

5.4.3 Biomarkers of Vegetables and Fruits

The biomarker approach of the assessment of the intake of vegetables and fruits can be done by a determination of several key compounds in serum or plasma. These

compounds are some vitamins, such as the water-soluble vitamins as folate, vitamins B6 and B12, vitamin C, and the lipid-soluble vitamins such as vitamins A, E, D, and K. Besides the vitamins, the water-soluble antioxidants such as flavonoids and phenolic acids and the lipid-soluble carotenoids can be determined. Carotenoids are pigments that produce the bright yellow, red, and orange colors in plants, vegetables, and fruits [19]. Carotenoids act as a kind of antioxidant for humans. There are more than 600 different types of carotenoids. Some can be converted into vitamin A when released into the body. A few of the most common carotenoids include the following: α -carotene, β -carotene, β -cryptoxanthin, lutein, zeaxanthin, astaxanthin, and lycopene. Carotenoids must be consumed through the diet [20].

The most used method is the determination of the carotenoids in a multimethod using HPLC. In this method also, vitamins A and E can be included, although these vitamins can also originate from lipid-like foods. Vitamin C can also be a good biomarker of fruit and vegetable intake but since this vitamin is highly water-soluble, the daily variation can be large.

5.4.4 Biomarkers of Trace Metals and Micronutrients

Iron

The iron status in adolescents was evaluated in a European study Healthy Lifestyle in Europe by Nutrition in Adolescence (HELENA) with 3000 adolescents in 10 European cities [21]. It was found that the percentage of iron depletion was 17.6%, being significantly higher in girls (21.0%) compared to boys (13.8%). But the overall percentage of iron deficiency and iron deficiency anemia was only 4.7 and 1.3%, respectively, with no significant differences between boys and girls. It was concluded that attention should be given to the iron status of girls by ensuring that their dietary intake of iron is adequate. It must be noted that the iron status can be improved not only by increasing the iron intake but also to increase the iron uptake of consumed iron by increasing or decreasing the consumption of certain co-nutrients such as a higher consumption of products high in vitamin C (such as citrus fruits) or a lower consumption of calcium (milk products), tannins (tea, coffee), etc. With this approach, the use of iron-containing medicines can be avoided. It should be noted that high intake of iron in the form of iron-containing pills can increase oxidative stress processes and should therefore be avoided.

Biomarkers of the iron status are total serum iron and transferrin. The ratio of Fe/transferrin is a measure of the iron load in serum. Another biomarker is serum ferritin, which reflects the storage of iron in the tissues, mainly in the liver. A combination of these biomarkers will be sufficient for the assessment of the iron status in most individuals.

Other Trace Metals

Other deficiencies of trace metals and micronutrients, such as zinc, copper, and selenium, were not systematically reported among adolescents. Possible deficiencies do not differ from other age groups in the population.

Table 5.2 Summary of biomarkers of nutrition, including methods of analysis with the corresponding references

Biomarker	Method of analysis	References
Vitamin A	HPLC-UV	[22]
Vitamin B6	Enzymatic, HPLC-UV	[23]
Vitamin B12	Immunoanalyzer	[23, 24]
Folate	Immunoanalyzer	[23, 24]
Vitamin C	HPLC-UV, autoanalyzer	[25, 26]
25OHVitamin D	LCMS, autoanalyzer	[27]
Vitamin E	HPLC-FLUOR	[22]
Vitamin K2	HPLC-PD	[28]
Carotenoids ^a	HPLC-VIS	[22, 25]
Individual fatty acids	GC-FID	[29, 30]

^a α - and β -carotene, lycopene, canthaxanthin, zeaxanthin, astaxanthin, lutein

5.4.5 Measurements of Biomarkers of Nutrition

In Table 5.2, a number of the most important biomarkers for nutritional compounds have been listed including the method of analysis and references.

5.5 Biomarkers of Obesity

The consequences of obesity during childhood or adolescence can have harmful consequences at the time of obesity and can also have health risks at later life as described in a document of Centers of Disease Control and Prevention (CDC) (<https://www.cdc.gov/obesity/childhood/causes.html>).

Obesity during adolescence can have adverse effects, such as:

- High blood pressure and high cholesterol, which are risk factors for cardiovascular disease [31].
- Increased risk of impaired glucose tolerance, insulin resistance, and type 2 diabetes [32].
- Breathing problems, such as asthma and sleep apnea [33].
- Joint problems and musculoskeletal discomfort [34].
- Fatty liver disease, gallstones, and gastroesophageal reflux [35].

In addition, childhood obesity is also related to psychosocial problems, such as:

- Anxiety and depression [36].
- Low self-esteem and lower self-reported quality of life [37].
- Bullying and stigma [38].

Furthermore, adolescents who have obesity are more likely to become adults with obesity [39]. Adult obesity is associated with increased risk of a number of

serious health conditions including heart disease, type 2 diabetes, and cancer [12, 40]. Moreover, if children have obesity, their obesity and disease risk factors in adulthood are likely to be more severe [41].

The prevalence of obesity is still increasing in most countries. As an example, the prevalence of obesity in adolescents aged 12–19 years in the USA increased in 1988–1994 from 10.5% obese to 20.6% obese in 2013–2014 [42]. Severe obesity also increased in adolescents aged 12–19 years from 2.6% in 1988–1994 to 9.1% in 2013–2014. But this increase in the prevalence of obesity seems to level off because no significant trends were observed between 2005–2006 and 2013–2014 [42].

Biomarkers as indicators of obesity can be identified according to different criteria, including anthropometric and molecular indexes, such as body mass index, waist circumference, and % body fat, as well as physiological and behavioral aspects. They also include epigenetic biomarkers, cellular mediators of inflammation, such as several interleukins, cytokines, and factors related to microbiome-host interactions. Although, these molecular biomarkers can also reflect other biological processes, they possess valuable diagnostic and prognostic power for the obesity as thanostic biomarkers [43].

Other studies indicate a relation of obesity and oxidative stress in adolescents. In a previous chapter on General Health Biomarkers, such studies were indicated. In another study of adolescents with 42 boys, it was found that besides several biomarkers of metabolic syndrome (total cholesterol, triglycerides, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and blood glucose), also oxidative stress biomarkers have a positive correlation with obesity, in contrast to the total antioxidant status and thiol status [44].

5.6 Biomarkers of Addiction

In this category, we find lifestyle habits, such as smoking, the use of alcohol and drugs.

5.6.1 Smoking

The best biomarker for the assessment of smoking is cotinine, a metabolite of nicotine. Nicotine itself can also be used but will be converted to cotinine very rapidly, so for the assessment of long-term smoking cotinine is the biomarker of choice. Cotinine can be detected in both serum/plasma and urine. Methods that can be used are immunochemical methods and HPLC or LCMS.

5.6.2 Alcohol

For many years, a group of biomarkers can indicate a person's intake of alcohol. Several of these reflect the activity of certain liver enzymes: serum

γ -glutamyltransferase (GGT), aspartate aminotransferase (AST), and alanine aminotransferase (ALT). Carbohydrate-deficient transferrin (CDT) is a protein biomarker that was recognized some years ago and is more specific. The measurement of CDT, however, is done not very routinely. Ethyl-glucuronide (EtG) is also frequently used, is relatively inexpensive, but can detect alcohol intake only up to 2 days [45]. Although most of these biomarkers are not completely specific for alcohol intake, GGT and EtG reflect the best history of alcohol abuse [46].

5.6.3 Drugs

The use of drugs can be monitored by specific immunochemical tests in urine, sometimes a sample of venous blood or a sample of hair, saliva, or sweat. These commercially available tests can be performed routinely by using autoanalyzers which are present in almost all hospitals and health screening centers.

5.7 Biomarkers of Brain Development for Adolescents

Brain development is still going on in adolescent period. Therefore, lifestyle conditions and nutrition must pay or get special attention to facilitate this development. So, alcohol and psycho drugs are among lifestyle habits that should be avoided in abuse situations. Healthy development of brain can be derailed by exposure to stress, especially during important developmental periods such as childhood and adolescence and could be detected by epigenetic methods. Also, the role that microRNAs (miRNAs) have in embryonic neurodevelopment provides evidence that adolescent brain remodeling can be detected by a change in miRNA. But also in nutrition areas, there are also a number of vitamins, minerals, and fatty acids that need attention. In a paper of Suchdev et al. [47], a number of food components are described that are critical during a sensitive period of neurodevelopment, especially at child age, but can also be applied to adolescence. The components are proteins in general, LC-PUFA, iron, zinc, copper, iodine, folate, vitamins B12, C, D, and E.

The LC-PUFA can be divided into several classes as described before in this chapter. The most important classes for brain development are the *n*-3 and *n*-6 FAs. They are essential fatty acids which mean that humans are unable to synthesize these compounds, and therefore they must be provided through the diet [48]. EFAs are called essential because EFAs are thought to play a role in the prevention and treatment of all kinds of diseases, such as coronary artery disease, diabetes, and inflammatory diseases [49–51].

In early life, the human population lived on a diet with a ratio of *n*-6 to *n*-3 of approximately 2:1, whereas presently in Western diets this ratio is about 10:1 and can be even as high as 25:1. For overall health and disease prevention, the ratio of *n*-6 to *n*-3 needs to be reduced either by decreasing intake of *n*-6 or by

increasing intake of *n*-3 fatty acids [52]. There are two different ways to increase the intake of *n*-3 FAs. First is a direct way to consume fatty fish at least once/week which will increase the intake of DHA and EPA. A second way, which also lowers the intake and synthesis of *n*-6 FAs, is the consumption of the somewhat shorter chain *n*-3 FAs, such as linolenic acid present mainly in seeds of several plants such as linseeds. A second beneficial effect is a lower synthesis of linoleic acid from the *n*-6 class, because both acids use the same enzymes in their synthesis routes. The *n*-6 FAs of these kinds usually give rise to the formation to low-grade inflammatory processes, whereas the *n*-3 FAs give rise to anti-inflammation.

5.8 Conclusions

To monitor the health of adolescents, a selected set of biomarkers can be used not only to assess a general health status, but also to have specific focus on adolescents. These proposed biomarkers mainly cover the areas of nutrition and lifestyle. They can be used not only for large epidemiological studies on adolescents, but also for individual monitoring. These biomarkers, which are mentioned below, can be measured by rather simple and well-described methods.

In summary, the following biomarkers can be used for assessing the health status of adolescents. Several methodological aspects of recently proposed biomarkers, as those related to oxidative stress, as well as their effective additive value need to be evaluated in further studies before application to laboratory routine.

Biomarkers for general health and metabolic diseases include:

- ROM for oxidative stress status
- total thiols for redox status
- HbA1c for glucose status
- cholesterol, triglycerides for lipid status
- serum iron, transferrin, and ferritin for iron status

Nutritional biomarkers:

- β -carotene and vitamin C for fruit and vegetable intake
- individual fatty acids for healthy fat consumption

Lifestyle biomarkers:

- cotinine for assessing smoking behavior
- γ -glutamyltransferase for alcohol abuse
- specific drug tests for drug abuse

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Adolescents' Mental Health and Well-Being

Abstract

Adolescents' health and well-being promotion is a key component in the fields of public health, school health programs, and preventive medicine. Typically, health and well-being in adolescents are described and assessed by measuring rates of diseases or negative health indicators, in particular during adolescence where tools to evaluate positive health are lacking.

Adolescence is a period of pronounced physical, emotional, and social transformation that coincide with a period of marked brain development and refinement in synaptic connectivity and functional integration. However, brain function during adolescence is deeply modulated, from epigenetic point of view, by prenatal and early postnatal life producing long-lasting effects on physiology and behaviour (Chap. 6). Also, the concomitant development of brain regions influenced by changes in social environment leads to an increased emotional reactivity and vulnerability to internalizing and externalizing psychopathologies associated with poor emotion regulation (Chap. 7). This dynamic change in emotional modulation is probably due to subjective sleep complaints which affects about 90% of adolescents, as reported by parents, including bedtime resistance, problems initiating/maintaining sleep, and feeling rested upon waking (Chap. 8). This opens to opportunities for interventions with high impact and enduring effects on health and development. However, adolescent health care is challenging compared to that of children and adults, caused by their rapidly evolving physical, intellectual, and emotional development, suggesting the need for a transversal approach to social settings and determinants of health.

In particular, prevention in adolescence is possible when actions are directed at individual, families, and at school, creating an environment health-promoting. Actually, schools adopting this approach have demonstrated changes in culture and organizational practice to become more conducive to health improvement. According to this perspective, a dialogue-based approach, using, for example, open dialogue or relational mindfulness, constructing a new educational alliance founded on responsibility, commitment, and understanding can represent an effective counterbalance capable of reducing behavioural risk factors (Chap. 9).

Therefore, to foster well-being among adolescents is the need to bridge the gap in service provision from both the health and education perspectives, making health more school-based and student-centred.



Prenatal and Early Postnatal Influences on Neurodevelopment: The Role of Epigenetics

6

Veronica Mariotti, Sara Palumbo, and Silvia Pellegrini

6.1 Brain Development

The human brain is the most complex biological system. It is composed of about 86 billion neurons and as many glial cells [1]. Each neuron forms connections with more than 1000 other neurons, making about 60 trillion neuronal connections in the mature brain [2]. Given its complexity, the brain develops through a sophisticated process that goes from prenatal life to adolescence and, in some extent, also beyond.

The first step of brain development is neurulation, followed by a series of other sequential cellular events, some of which are temporally overlapping: neurogenesis, neuronal migration, neuronal maturation, apoptosis, synaptogenesis, pruning, and myelination [2, 3]. Neurulation leads to the formation of the neural tube, which represents the primitive nervous system. The brain will then develop from the rostral region of the neural tube, while the spinal cord will derive from the caudal region [2, 4]. After neural tube closure, the neural progenitors start to proliferate by symmetric division to increase their number, in order to produce the billion neurons and glial cells that make up the mature brain [2]. Around the fifth gestational week, neural progenitors begin to asymmetrically divide starting neurogenesis [5]. Asymmetric division produces two different daughter cells: one that remains in the proliferative zone and undergoes further rounds of cell division, and the other that

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migrates out of the proliferative zone to become a postmitotic cell that will differentiate into a neuron or a glial cell [2, 6]. Once reached their final location, postmitotic cells becoming neurons (neuroblasts) begin their maturation by developing axons and dendrites that allow them to establish appropriate connections with other neurons [3]. During the axon extension toward target cells, some neurons die by apoptosis [7]. According to the “*neurotrophic factor hypothesis*” [4], the developing neurons compete each other for a limited amount of neurotrophin factors released by the target cells [8]. Only neurons able to store an adequate amount of neurotrophins will survive, while the others will undergo apoptosis [3]. In this way, about 50% of neurons are eliminated before birth [7]. The survived neurons continue their maturation process by developing synapses [4]. The formation of synapses, known as synaptogenesis, goes from the end of gestation through the postnatal period until the onset of puberty, with its maximum peak during the first two years of life [9]. Synaptogenesis in these two years has been defined “*furious/exuberant*”, as about 40,000 synapses per second are created [10]. Afterward, a gradual reduction of the unused synapses occurs until early adulthood [11]. The elimination of synapses, known as synaptic pruning, is largely driven by the experience and is thought to be related to learning [12]. According to the “*use it or lose it*” rule, the more active synapses are strengthened, while the unused ones are cut off [11]. Both synaptogenesis and pruning start earlier in primary sensorimotor areas and later in regions associated with higher cognitive functions, including prefrontal cortex [13, 14]. In visual and auditory cortex, for example, pruning is completed by years 4 or 6 [11], while in prefrontal cortex, it lasts beyond adolescence until the third decade of life [15].

The final stage of brain development is myelination. During this process, axons are covered with a sheet of myelin by oligodendrocytes to potentiate the transmission of electrical impulses along the axons, thus allowing neurons to communicate more efficiently to each other [6]. Like synaptogenesis and pruning, myelination starts earlier in sensorimotor areas and later in associative areas. Prefrontal and lateral temporal areas are the last ones to mature, and their myelination is completed by age 30 [11–13, 16].

In summary, brain starts to develop a few weeks after conception and reaches its full maturation about 20–30 years later [17]. Changes that take place over this timeframe are of primary importance, as they constitute the “*hardware*” of the adult brain. As Dehaene-Lambertz said, “*The remarkable and complex cognitive functions observed in humans do not suddenly emerge in adulthood but are shaped by two decades of development*” [18].

Studies on monozygotic twins have shown that personality traits and psychiatric diseases are not 100% heritable. Heritability is 70% for depression, 75% for schizophrenia, 81% for hyperactivity disorder, and 42% for personality disorders [7]. This indicates that both genetic and environmental factors contribute to the etiology of complex human behaviors.

The brain, indeed, responds to external stimuli by changing its own trajectories throughout the whole life [19–22]. Nevertheless, brain sensitivity to the

environment reaches its highest peak during prenatal and early postnatal life, when the brain undergoes most of its development and is extremely vulnerable to both organizing and disorganizing experiences [23]. The quality of prenatal and early postnatal environment may then influence the trajectory of neuronal development and contribute to shape the developing brain [9, 23].

6.2 Prenatal Stress: Neuroanatomical and Behavioral Outcomes

As previously described, prenatal life is characterized by a rapid growth of the nervous system consisting of fast proliferation and differentiation of brain cells. The quality of the environment experienced by the fetus is extremely critical for the correct development of the central nervous system. A stressful environment, in fact, alters the neuropsychological development, thus producing long-term consequences on child mental health [24]. Barker, an English epidemiologist, first hypothesized that the origin of complex diseases dates back to the fetal life [25]. According to the Barker's hypothesis, adverse prenatal stimuli that do not cause the death of the fetus (e.g., maternal obesity, maternal infection, hypo/hyper maternal nutrition, maternal smoking, and maternal psychological traumas) induce tissue remodeling in the fetus to ensure its survival. However, the price to pay to overcome difficulties during the fetal life is an increased risk of developing diseases in adulthood (e.g., cardiovascular problems, diabetes, osteoporosis, obesity) [25].

According to the Barker's hypothesis, psychiatric disorders might have fetal origin as well [26]. Findings from retrospective studies, for example, showed that children, whose mothers had experienced natural disasters (e.g., floods, earthquakes, storms, war, terrorist attacks) during pregnancy, had higher risk of developing schizophrenia, autism, language and attention disorders, anxiety, and depression [27]. More recent findings from prospective studies showed that infants, whose mothers had suffered from anxiety/depression or stressful life events (e.g., illness or death of close relatives, chronic interpersonal conflicts at home or at work) during pregnancy, were more irritable and had higher incidence of eating and sleep disorders, as compared to newborns from mothers with a serene pregnancy [27]. Moreover, these infants were at higher risk of developing aggressive behaviors, conduct disorders, anxiety, and depression during adolescence [27–29]. Proving the causative link between prenatal stress and long-term behavioral outcomes in humans, however, is difficult, due to the multiple environmental variables, including the quality of postnatal life. Strong support to the casual relation between prenatal stress and long-term behavioral outcomes, instead, comes from research in rodents. Studies in rodents, in fact, have shown that prenatal stress (e.g., intermittent electric shocks or restraint in cylinders under a strong light for periods ranging from 45 min to 6 h three times a day) [30] affects the development of brain regions that modulate emotional and cognitive behaviors, including hippocampus and prefrontal cortex. Offspring of mothers exposed to stress during

pregnancy showed an atypical dendritic complexity and dendritic spine density in CA1, CA3, and dentate gyrus hippocampal regions [31–33]. Similar alterations have been also found in dorsal anterior cingulate and orbitofrontal cortex [34], as well as an altered neurogenesis has been reported in hippocampus [35, 36]. Finally, prenatally stressed animals showed deficits in spatial learning and memory and in social interactions, as well as enhanced vulnerability to drug abuse, anxiety, and depressive-like behaviors [30, 37].

Interestingly, many of the studies in humans and animals reported a gender effect on behavioral outcomes, induced by prenatal stress [38]. Some studies reported emotional changes mostly in male offspring [39–41]. Other studies reported an increased anxiety-like behavior predominantly in prenatally stressed females [42, 43]. These conflicting results are probably due to many other confounding factors in addition to gender, including the intensity, duration, type, and timing of stress [26]. For example, the first gestational trimester has been suggested to represent the period with the greatest vulnerability to stressors, with respect to schizophrenia and ADHD [26, 44, 45].

6.3 Early Postnatal Stress: Neuroanatomical and Behavioral Outcomes

After birth, neural circuits undergo a process of reorganization that includes synapsis formation and pruning and axon myelination [3]. Experiences in this period of life may have an impact on developing neural circuits, leading to permanent changes in brain morphology and functioning [46]. In the early postnatal period, the quality of maternal care plays a critical role in human brain development. Suboptimal maternal care represents a source of stress for the baby that may modify the brain development, thus inducing emotional and cognitive deficits in adulthood [47]. In humans, the long-term effects of altered mother–infant interactions have been observed in children raised in orphanages. Institutionalized children, as compared to non-institutionalized children, have more difficulties in emotion regulation [48], more deficits in memory and executive functions [49], and a number of morphological and functional brain alterations, including greater amygdala volume [48, 50], widespread reduction of cortical thickness across prefrontal, parietal, and temporal areas [51], and decreased white matter connectivity in the uncinate fasciculus [52, 53]. These findings, however, are not consistent across all studies, probably due to differences regarding the age of institutionalization, the permanence in orphanage, and the specific characteristics of the orphanage. Information about the prenatal environment experienced by these children, in fact, is often lacking [54].

The quality of maternal care is a critical factor for the development of proper behavioral responses, also in rodents. In this regard, interesting results come from studies that exploited the inter-individual differences in maternal care, observed in these animals during the first weeks of their offspring life [47]. High-licking

grooming (H-LG) mothers spend a lot of time in licking and grooming their pups, while low-licking grooming (L-LG) mothers exhibit poor licking/grooming behavior toward their pups [55]. Maternal care can be also artificially altered by limiting nesting and bedding material (LBN), typically from postnatal days 2–9, thus causing stress in the mother that consequently exhibits fragmented cares [56]. Another paradigm of early postnatal stress is represented by the maternal separation, when pups are separated from their mothers for a whole day (maternal deprivation) or for a few hours a day (repeated maternal separation) during their first weeks of life [57]. These experimental paradigms provided convincing evidence of a direct link between maternal care and important alterations in the offspring hippocampal and frontal cortex development. For example, offspring of L-LG mothers showed decreased neuronal survival, diminished synaptogenesis and dendritic arborization, and a reduced number of dendritic spines in the hippocampus, as compared to H-LG mothers' offspring [58–61]. Decreased total dendritic length and dendritic spine density were also observed in prefrontal cortex, hippocampus, and nucleus accumbens of pups separated from their mothers [62–64]. Finally, an atypical dendritic development of prefrontal cortex neurons was also observed in offspring reared in LBN cages [65]. All these neuroanatomical changes also impact both cognitive and emotional responses. Offspring of L-LG mothers, in fact, displayed decreased performance on spatial learning and memory tests [58]. Pups reared in LBN cages or separated from their mothers showed anxiety-like behaviors in open field or elevated plus maze tests, and depressive-like behaviors in forced swim or sucrose preference tests [56, 57]. Male offspring separated from their mothers showed an atypical territorial response at the resident intruder test that seems to be species-specific, as rats and mice respond differently. Rats showed higher levels of aggression toward the male intruder [66], while mice were less aggressive, showing a greater latency to attack [67].

Research in animals has certainly contributed to the knowledge of maternal care effects on brain development; however, translating these results from animals to humans requires attention, because brain development in rodents has a different time course as compared to humans. The last trimester of human gestation, in fact, has been estimated to correspond to postnatal days 1–10 in rodents [68].

6.4 Epigenetic Modifications

The environment modifies the trajectory of neuronal development by introducing epigenetic changes. The phenotypic differences that characterize monozygotic twins and emerge as they become older, along with the diversification of their lifestyles and living environments, depend on their different epigenomes, that is different epigenetic changes in identical genomes [69].

Epigenetic modifications are functional changes in the DNA that alter the expression of genes without modifying their nucleotide sequence [70]. The principal

epigenetic modifications are represented by DNA methylation of cytosines within CpG islands, post-translational histone modifications (e.g., acetylation, deacetylation, methylation, phosphorylation, and ubiquitination), and post-transcriptional regulation by microRNAs (miRNAs) [71, 72].

DNA methylation consists of the addition of methyl ($-CH_3$) groups to cytosines, preferably cytosine–guanine dinucleotides (i.e., CpG site) grouped in specific loci of the genome, the CpG islands, located into promoters, exons, and, to a lower extent, introns [73, 74]. Methylation of promoter-associated CpG islands reduces the accessibility of DNA to transcription factors and thus reduces gene expression [70]. DNA methylation in sites different from CpG islands has been reported to have an opposite effect on gene expression [75]. DNA methylation is catalyzed by a family of DNA methyltransferases (DNMT-1, -3a, and -3b). DNMT1 is responsible for methylation maintenance, as it methylates the newly replicated strand of DNA by copying the methylation pattern from the parent strand. Its role preserves the correct DNA methylation pattern during mitosis in daughter cells [76]. DNMT-3a and -3b perform de novo methylation of unmethylated CpGs and produce novel DNA methylation marks. De novo methylation mainly occurs in early embryonic cells and, not surprisingly, both these enzymes are highly expressed in these cells [77].

Post-translational histone modifications are covalent modifications of the amino-terminal tails of histones, which are proteins responsible for DNA condensation in the nucleus. DNA wraps twice (146 base pairs) around an octamer of histones to form the nucleosome [78]. Several distinct histone modifications may alter the interactions among histones and between DNA and histones [79]. Histone acetylation, for example, is associated with an increased transcriptional activity. It is catalyzed by the histone acetyltransferase (HAT) enzymes that cause chromatin decondensation by transferring acetyl groups from the acetyl-Coenzyme A to lysine residues within the amino-terminal tails of nucleosomal histones. The addition of acetyl groups neutralizes the positive charge of lysine, thus weakening the interaction between histones and DNA and making DNA more accessible to the transcriptional machinery [80].

miRNAs are transcripts not translated into proteins, which bind to complementary sequences in the 3'-untranslated regions of target mRNAs, thus blocking gene expression either temporarily, through the mRNA translational repression, or permanently, through the mRNA cleavage [81].

Epigenetic changes usually remain stable throughout the whole life of an individual, as they are inherited during mitosis by the daughter cells [82]. When the epigenetic marks interest the germ cells, they are also transmitted across generations [71, 83]. Trans-generational epigenetic inheritance results from the resilience of certain gene loci to epigenetic reprogramming (i.e., erasure of DNA methylation marks and histone modifications) occurring during gametogenesis and embryogenesis [84–86].

Since the epigenetic modifications affect the gene expression without altering the nucleotide sequence, different environmental stimuli result in a broad range of behavioral phenotypes from the same genotype.

6.5 Epigenetic Mechanisms of Early Stress

6.5.1 Prenatal Epigenetic Regulation of Genes Relating to Hypothalamus–Pituitary–Adrenal (HPA) Axis

The HPA axis is a complex system involved in maintaining normal circadian rhythm and represents a key system in stress response [87]. In presence of stress, the hypothalamus releases the corticotropin-releasing hormone (CRH) and arginine vasopressin (AVP) that stimulate the release of the adrenocorticotrophic hormone (ACTH, or corticotrophin) from the pituitary gland, which in turn induces the release of glucocorticoids (cortisol in humans and corticosterone in rodents) from the adrenal gland. Elevated levels of plasma glucocorticoids represent a prompt adaptive response to stressors. Normally, glucocorticoids regulate their own secretion by a negative feedback mechanism. As stress decreases, cortisol/corticosterone interacts with the glucocorticoid receptors in the hippocampus, hypothalamus, and pituitary gland to inhibit further production of CRH and ACTH and to restore the homeostatic condition of HPA axis [37]. Glucocorticoids are important for normal brain development, as they affect cell survival, as well as axon and dendrite remodeling [37]; altered levels of these hormones impair the development and functioning of the brain [88]. Findings from animal studies showed that the HPA axis plays a central role in mediating the long-term effects of prenatal stress [89]. Prenatal stress exposure, indeed, has been associated with HPA axis hyperactivity and long-term behavioral outcomes, including depression and anxiety-like behaviors in rodent offspring [90]. The transfer of cortisol/corticosterone from mother to fetus has been indicated as one of the main mechanisms through which maternal stress reaches the fetus, thus altering the developing fetal HPA axis [28]. The fetus, which is normally exposed to maternal cortisol/corticosterone that crosses the placental barrier, is able to convert cortisol/ corticosterone into its inactive form, the cortisone/11-dehydrocorticosterone, by the activity of the placental enzyme 11-beta-hydroxysteroid dehydrogenase (11-Beta-HSD2) [91]. However, studies in animals showed that prolonged exposures to stressors may increase maternal glucocorticoids up to the level required to inactivate the 11-Beta-HSD2 enzyme [24]. The loss of enzyme function translates into an increased fetal exposure to maternal glucocorticoids that excessively stimulate the activity of the developing fetal HPA axis [28]. The downregulation of the 11-Beta-HSD2 enzyme might be due to the hypermethylation of the *11-Beta-HSD2* gene, as, in rats, chronic restraint stress during gestational days 14–20 has been associated with the increased methylation and decreased mRNA expression of the placental *11-Beta-HSD2* gene [92]. Similarly, in humans, prenatal stress positively correlated with the placental *11-Beta-HSD2* hypermethylation [93], and negatively correlated with the placental 11-Beta-HSD2 expression [94]. Interestingly, the *11-Beta-HSD2* methylation inversely correlated with the quality of movements in newborns [95] and the fetal coupling, which is an index of fetal central nervous system (CNS) development [93].

Epigenetic changes following the exposure to prenatal stress have been also observed in *CRH* and *NR3C1* (Nuclear Receptor Subfamily 3 Group C member 1)

genes. Specifically, male mice exposed to early prenatal stress showed an increased methylation and decreased hippocampal expression of *NR3C1* gene [41]. *NR3C1* gene encodes the glucocorticoid receptor by which glucocorticoids regulate their secretion through a negative feedback mechanism. The *NR3C1* downregulation by hypermethylation might therefore affect this mechanism, thus inhibiting the ability of glucocorticoids to restore the homeostatic condition of HPA axis. Male mice exposed to early prenatal stress also showed hypomethylation of *CRH* gene both in hippocampus and in amygdala, and increased expression of *CRH* gene in the amygdala [41]. As these animals showed a hyperactivity of HPA axis and a depression-like phenotype, the epigenetic changes in *CRH* and *NR3C1* genes have been hypothesized as mechanisms by which prenatal stress affects the functioning of the developing HPA axis with long-lasting effects on behavior [41].

In humans, the link between maternal stress and maternal cortisol levels during pregnancy is less clear, as well as the link between maternal cortisol levels during pregnancy and long-term effects on child behavior [28]. However, an increased methylation of *NR3C1* has been observed in the placenta and cord blood of newborns, whose mothers had experienced depression or anxiety symptoms during pregnancy [96–98]. Cord blood *NR3C1* hypermethylation has been in turn associated with augmented salivary cortisol in response to stress at 3 months of age [96], and placental *NR3C1* hypermethylation has been associated with high hypotonia, lethargy, and poor self-regulation in newborns [98]. Increased blood *NR3C1* methylation was also found in children and adolescents, whose mothers had experienced genocide or intimate partner violence during pregnancy [99, 100].

6.5.2 Early Postnatal Epigenetic Regulation of Genes Related to HPA Axis

At the end of gestation, in rodents, the glucocorticoid levels decrease and remain low for the first 2 weeks after birth [37]. This time window is called “stress hyporesponsive period”, as during this period, the majority of stressors evoke a subthreshold response of the HPA axis. The maintenance of low glucocorticoid levels probably represents an evolutionary strategy aimed at protecting the developing SNC from deleterious effects produced by high glucocorticoid concentrations [37]. In humans, a period of HPA axis hyporesponsivity has been also observed, lasting throughout childhood [101].

An early-life chronic exposure to stress, due, for example, to low-quality parental care, may prematurely interrupt the HPA hyporesponsivity, thus profoundly affecting both cognitive and physiological functions [102].

Offspring of L-LG mothers exhibit increased stress-responsiveness, decreased hippocampal expression of *NR3C1*, and increased hypothalamic expression of *CRH* [103]. In 2004, an outstanding study demonstrated for the first time that maternal care affects the methylation status of *NR3C1* gene. In the *NR3C1* exon-1, in fact, is located the binding site for the nerve-growth-factor-inducible-protein-A (NGFI-A) transcription factor; this site has been found hypermethylated in the offspring of

L-LG mothers [104, 105]. A longitudinal analysis of *NR3C1* methylation showed that different levels of methylation between pups of L-LG and H-LG mothers can be appreciated during the first postnatal week—when the differences in parental care are more distinguishable—and persist until adulthood [104, 105]. A few hours before birth, in fact, the exon-1 of *NR3C1* is completely unmethylated, while, at postnatal day 1, the binding site of NGFI-A is highly methylated in offspring of both H-LG and L-LG mothers. The differential *NR3C1* methylation, then, becomes evident on postpartum days 1–6, when the behavioral dissimilarities between H-LG and L-LG mothers show up. These results demonstrate that the *NR3C1* demethylation is driven by maternal care [104, 105]. The parental behavior of H-LG mothers has been suggested to increase the transcription of NGFI-A that interacts with the highly methylated site in exon-1 of *NR3C1* gene, thus triggering its demethylation that results in increased levels of NR3C1 expression [104, 105]. *NR3C1* demethylation might be mediated by the recruitment of a CREB-binding protein (CBP) by NGFI-A. CBP increases the histone acetylation and consequently the DNA demethylase accessibility to DNA that induces a stable *NR3C1* promoter activation [105].

Interestingly, hypermethylation of *NR3C1* gene, as well as decreased levels of glucocorticoid receptor mRNA, has also been observed in the human hippocampus of suicides, victims of childhood abuse, while they were not found either in controls or in suicides without a history of abuse. These findings suggest that childhood abuse might epigenetically modify the HPA axis activity, with possible implications on the risk of psychopathology in adulthood [106].

6.5.3 Early Postnatal Epigenetic Regulation of Estrogen Receptor Alpha ($ER\alpha$) Gene

A matrilineal transmission of maternal behavior has been proposed. Female offspring of H-LG and L-LG dams exhibit, toward their pups, the licking/grooming behavioral model of their mothers [107, 108]. Both L-LG females and their offspring have reduced levels of oxytocin receptor (OXTR) in the medial pre-optic area (MPOA) that is essential for the activation of maternal care [109, 110]. Consistently, the central infusion of an OXTR antagonist results in a reduction of liking/grooming behavior in H-LG mothers [109]. *OXTR* gene expression is induced by the estrogen- $ER\alpha$ complex, and, in the absence of $ER\alpha$, the ability of estrogens to increase the *OXTR* transcription is reduced [111]. Reduced $ER\alpha$ expression has been found in the MPOA of both L-LG dams and their offspring [112]. Interestingly, offspring of L-LG mothers, adopted at birth by H-LG mothers, showed increased expression of $ER\alpha$ in MPOA. Vice versa, offspring of H-LG mothers, adopted at birth by L-LG mothers, showed reduced expression of $ER\alpha$ in MPOA [113]. Thus, the expression change of the *ER\alpha* gene might be mediated by the maternal care received immediately after birth. Methylation analysis of the *ER\alpha* promoter in MPOA showed higher methylation of the *ER\alpha* gene in the L-LG offspring, as compared to the H-LG offspring [113]. This different methylation concerns various sites in the gene promoter, including the binding site of the transcription factor Stat5 that upregulates *ER\alpha*

[113]. Thus, L-LG behavior, by methylating the binding site of Stat5 on *ERα*, might downregulate the *ERα* expression. These results prove that the epigenetic regulation of *ERα* expression might represent the way by which parental behavior is transmitted from mothers to offspring [55].

Studies in rodents showed that also the post-weaning social environment plays an important role in mediating the transmission of maternal behavior from mothers to offspring. Growing in impoverished environments, indeed, caused in the offspring of H-LG dams a reduction of their licking/grooming behavior (offspring of H-LG dams became L-LG mothers) and a decrease of oxytocin receptor binding in MPOA. Vice versa, growing in enriched environments caused in the offspring of L-LG mothers an increase of licking/grooming behavior (offspring of L-LG dams became H-LG mothers) and an increase of oxytocin receptor binding in MPOA [114].

These results provide evidence of an environment-by-environment interaction, by which the effects of previous experiences (e.g., the epigenetic effect of maternal care during the first week of life) might be further modified by the environment in later stages of development [55].

6.5.4 Early Epigenetic Regulation of Brain-Derived Neurotrophic Factor (BDNF) and Solute Carrier Family 6 Member 4 (SLC6A4) Genes

Other genes that appear epigenetically regulated by early adversities are *BDNF* and *SLC6A4*. The *BDNF* gene encodes a neurotrophin crucial for neuronal growth, maturation, survival, and plasticity [115–117].

Many preclinical studies showed that early-life experiences affect *BDNF* gene expression, thus producing long-lasting changes in behavior [118–124]. Increased *BDNF* methylation has been observed in the amygdala and hippocampus of adult male rats exposed to different prenatal stress (e.g., restraint, swim, lights on overnight) [125], and in the hippocampus and blood of adult male mice as a consequence of prenatal exposure to the environmental toxicant bisphenol A [126]. Moreover, increased *BDNF* methylation and decreased BDNF expression have been observed in the prefrontal cortex of adult male rats exposed to abusive caregivers during the first postnatal week [127]. However, the scientific literature concerning animal studies has shown that the epigenetic regulation of *BDNF* gene by early-life stress exposure is difficult to study, as the obtained results depend on several factors, including the tissue source, the tested loci, the age at testing, and the animal gender [128–130].

Findings from human studies reported a decreased methylation of *BDNF* gene in infants born from mothers depressed during pregnancy [131]. In women with bulimia nervosa or borderline personality disorder, instead, an association between early postnatal stress and hypermethylation of *BDNF* gene was found. Specifically, in women with bulimia nervosa who have been physically abused during childhood, methylation at specific sites on the *BDNF* gene was higher than in women with

bulimia nervosa without any physical abuse [132]. Moreover, in patients with borderline personality disorder, who experienced childhood maltreatment, a positive correlation has been observed between methylation status of *BDNF* gene and the number of childhood traumas [133].

Another gene epigenetically regulated by early stress is *SLC6A4*. This gene encodes the serotonin transporter that regulates the serotonergic signaling through the re-uptake of serotonin from the synaptic cleft into presynaptic neurons. In vitro studies showed that methylation of *SLC6A4* gene inhibits its expression [134, 135].

In humans, a prenatal exposure to maternal depressed mood during the second trimester of pregnancy has been associated with reduced methylation of both mother and infant *SLC6A4* gene [136]. A correlation between *SLC6A4* methylation and childhood traumas has been also found. *SLC6A4* hypermethylation, for example, was associated with childhood sex abuse in women [137], with childhood adversities in depressed patients [138], and with childhood bullying victimization in monozygotic twins [139].

6.6 Future Directions: The Implication of Telomeres and Gut Microbiota in Modulating the Effects of Early Life Adversities

Telomeres are repeated sequences of DNA rich in guanine that cap chromosome ends, thus protecting them from degradation. At each cell division, they gradually shorten, until they become so short that the cell dies. Telomere length is a biomarker of aging and age-related diseases [140]. Some studies found an association between prenatal stress and shorter leucocyte telomeres in newborns [141, 142]. The mechanism by which maternal stress may influence the telomere length is unknown. However, the increase of glucocorticoid levels in response to stress may be the link between prenatal stress and shorter telomeres at birth. High levels of glucocorticoids during the prenatal period, indeed, have been associated with shorter telomeres in the offspring [143]. Glucocorticoids may have an impact on telomere length by affecting oxidative stress markers or by regulating the telomere-restorative enzyme, telomerase [142].

The human gut microbiota, a combination of different microorganisms (bacteria, viruses and protozoa) coexisting in the gut [88], affects brain functioning through the gut–brain axis [88]. This latter is a complex system of hormonal, neuronal, and immune pathways that allows a bidirectional communication between brain and intestine [102]. Given that the gut microbiota develops in the first 3 years of life, which represent a critical period for brain development, early-life perturbations of gut microbiota may affect brain maturation, thus producing long-lasting consequences on behavior [102]. The gut microbiota influences the development of the gut–brain axis and, therefore, the development of the brain through the synthesis and release of neurotransmitters, including serotonin and dopamine [144]. It also plays a key role in neuronal cell division, neuronal migration, and synapsis formation [7]. The gut microbiota also influences the development of the gut–brain axis

by the synthesis and release of the short-chain fatty acids, like butyrate that is an epigenetic modulator acting through histone deacetylases [144], and propionate that affects the synthesis and release of neurotransmitters during early neurodevelopment [145]. Recent findings suggest a critical role for the gut microbiota in regulating the maturation and function of microglia [146].

According to one of the most accredited theories, the fetus develops in a sterile environment and its first microbial exposure takes place during delivery, when the baby, by passing through vagina, ingests the population of microorganisms living there. However, recent studies questioned this theory, as maternal gut bacteria have been isolated from the umbilical cord blood, the placenta, and the meconium [88]. Actually, the mechanism by which maternal gut bacteria have access to the developing fetus has not been yet fully understood and the original theory about the fetus sterile until birth continues to be widely accepted by the scientific community [102]. According to this theory, the microflora begins to develop in the newborn as soon as it comes in contact with microbes in the genitourinary tract of the mother [88]. Interestingly, the microbial population of children born by natural childbirth is different from that of children born by caesarean section. The microbial population of caesarean children is similar to that of their mother's skin, while the microbial population of children naturally born is similar to the maternal vaginal one [147]. Studies in monkeys and humans showed that prenatal stress alters the infant intestinal microbiota promoting the colonization of pathogenic microorganisms at the expense of nonpathogens [148, 149]. A preclinical study, in 2015, found that stress during pregnancy induces a reduction in the number of vaginal nonpathogenic microorganisms (*Lactobacillus*). The same dysbiosis was found in the intestine of prenatally stressed offspring, thus demonstrating that the bacteria that colonize the offspring gut are directly influenced by the vertical transmission of the maternal vaginal microbiota [150]. The infant gut bacterial colonization after delivery overlaps with a critical period for brain development, and thus an altered maternal vaginal microbiota might represent a risk factor for depression and other brain disorders, including autism, schizophrenia, and Parkinson's disease [144]. To explore the impact of altered gut microbiota on brain development and function, germ-free (GF) animals completely free from any microorganism since birth and raised in a sterile environment were used [151]. GF rodents, as compared to specific-pathogen-free (SPF) controls, showed an increased permeability of their blood–brain barrier and a reduced expression of tight junction proteins that persist in adulthood [152]. Moreover, GF rodents showed a higher activation of the HPA axis, as suggested by an increased level of plasma corticosterone after the restraint stress or the open-field test [153, 154]. GF animals also showed a decreased hippocampal and cortical expression of *NR3C1* gene, and an increased hypothalamic expression of *CRH* gene [154]. Interestingly, the GF gut colonization by the microbiota of SPF animals, immediately after birth, normalizes the hyperactivity of the HPA axis, but only when it is introduced at an early stage of development. These results indicate that a critical window exists, in which the brain is more sensitive to gut signals central for the normal development of the HPA axis [153]. The authors of this study have also found lower levels of BDNF protein in the cortex and

hippocampus of GF mice [153]. A recent study on microbial regulation of miRNA expression identified different miRNA expression profiles in the prefrontal cortex and amygdala of GF mice, as compared to conventionally raised controls. Out of these differentially expressed miRNAs, miR-206-3p, which is implicated in the regulation of *BDNF* gene expression, has been identified [155]. The same authors also observed that the expression of most miRNAs remains altered following post-weaning exposure to microbes [155], further supporting the hypothesis about the existence of a critical window during which the microbiota is essential to regulate brain development [156].

GF mice show altered sociality and repetitive and stereotypic behaviors [157, 158]. These behaviors are also observed in individuals with Autism Spectrum Disorder (ASD). Since ASD patients have an altered composition of gut microbiota, a role for the gut microbiota in the onset of ASD has been hypothesized [151].

6.7 Conclusions

Both genetic and environmental factors are crucial for brain development. *Brains do not develop normally in the absence of critical genetic signaling and they do not develop normally in the absence of essential environmental inputs* [2]. Several pre-clinical and clinical studies have shown that the perinatal environment, mostly represented by the mother mental and physical health during pregnancy and by the mother parental style after childbirth, exerts a profound influence on children brain development, thus producing long-lasting effects. In particular, epigenetic changes have been reported to represent the molecular mechanisms by which the environment modulates the expression of genes, including *NR3C1*, *CRH*, and *11-Beta-HSD2* involved in the HPA axis activity, or *BDNF* and *SLC6A4* implicated in neurogenesis and serotonin neurotransmission, whose activity is crucial for normal brain development. Evidence for a role of telomere length and gut microbiota in mediating the long-term effects induced by stress during perinatal life have also been reported, but the underlying epigenetic mechanisms are not yet revealed. Given the extreme complexity of the human brain morphology and functioning, epigenetic changes probably affect the expression of many other genes, in addition to those already described, critical to shape the adult behavior in response to early-life adversities. As a matter of fact, adolescence represents a time window during which the consequences of early stress exposure can be counteracted as, during this period of life, a reorganization of the highest order associative areas occurs in order to complete the brain maturation.

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The Role of Environmental Enrichment on Neurodevelopment: Emotion Regulation in Adolescence as a Model Paradigm

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7.1 Introduction

Amidst the background of exciting developments in psychopharmacology and of discovery of the neurobiological basis of mental illness, George Engel, in 1977, proposed the biopsychosocial model as a means of securing a maintained place for the psychosocial components alongside biology [1]. Engel, wary of biomedical reductionism as well as the foibles of Cartesian dualism, championed contextualism and a broader purview for understanding mental health [2]. This model retains its relevance to this day, and perhaps finds renewed strengths as developments in neurobiology in tandem with their interactions with the human environment have proceeded.

In the near half a century since Engel's proposal, advances in neurobiology have been significant. What George H.W. Bush championed as the "decade of the brain" has become but the start of increasing research in and development of our understanding of the neural bases of human health behavior. The latest iteration of these explorations is manifest in the Research Domain Criteria initiative [3]. This

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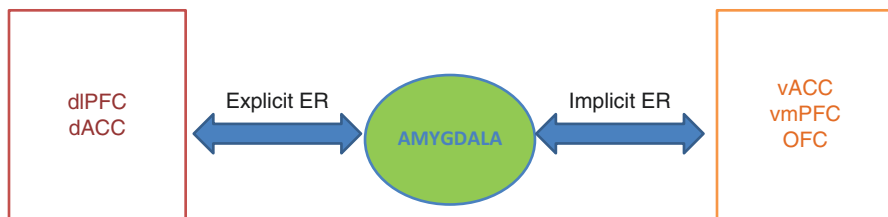


Fig. 7.1 Emotion regulation (ER) in adulthood. Note, well-developed Explicit ER in the adulthood

approach seeks to eschew the traditional clinical model of classification in favor of movement toward dimensional models of health and psychopathology. Privileging formulations upon observable phenomena with defined neural correlates, the approach may be taken at face value of sacrificing the role of the psychosocial model in favor of biology.

Yet, developments within this model have not only retained, but have fundamentally strengthened our understanding of the role of the environment upon our underlying neurobiology. A pristine example of this lies in our understanding of emotion regulation (ER), a key parameter of human health and well-being. Whereas ER is an intrinsic process with clear neural correlates, the environment is crucial for its development and employment in adolescence. Without a developed ER system, the adolescent is at the mercy of fluctuations in mood that can be not only a major impairment in his or her attainment of key developmental milestones, but can also be a significant risk factor for serious outcomes of consequence, including suicide and violence (Fig. 7.1).

In the sections that follow, we define emotion regulation and its variants while demonstrating the importance of the environment for understanding how emotion regulation develops, and how this development is crucial for adolescent health.

7.2 Emotions and Emotion Regulation as a Developmental Process

Emotions shape how we think, feel, and behave. Every day, we experience a variety of emotions that differ in type, intensity, duration, and complexity [4]. Although emotions are often helpful in promoting well-being by helping to navigate different experiences and challenges, sometimes, emotions can be harmful when they do not match a given situation which can result in distress or even psychiatric illness [5]. Learning to recognize when emotions are counterproductive to a particular circumstance and adjusting behaviors accordingly is critical in early development to help effectively control unpleasant feelings.

An inability to regulate overwhelming negative emotions or difficulties in effectively implementing adaptive strategies to cope with challenging emotions can impede the ability to address the emotion adequately, leading to depression or anxiety [6, 7]. Furthermore, ineffective coping strategies, such as substance use as conceptualized through the self-medication hypothesis, and emotional burden may lead to various psychiatric disorders [5].

ER refers to shaping which emotions one has, when one has them, and how one experiences or expresses these emotions [8]. ER evolves throughout the development and undergoes changes during the transition to adolescence [9]. In the adolescent years, emotions are often tumultuous and frequently fluctuate.

For example, it is not uncommon for teenagers to feel extreme anger toward parents for not allowing them to attend a party, overwhelming anxiety about upcoming performance at school, and profound sadness when experiencing social rejection in quick, seemingly overlapping, succession. These intense emotions are often associated with underlying developmental changes, such as hormonal, social, emotional, and cognitive changes. During the pubertal maturation period, heightened stress exposure and responsivity may result in an increase in emotional reactivity, making it difficult to appropriately regulate emotions [10]. Although some teens find healthy coping skills, such as playing an instrument or watching a favorite television show, some adopt ineffective emotion regulation patterns that are often maladaptive, such as binge eating or using drugs. Such dysfunctional patterns of emotion regulation characterize and play an important role in many psychopathologies [11], including depression in adolescents [12] and are especially important in teen years. Breaking the pattern of these maladaptive behaviors in early years may have a positive effect on future outcomes.

7.3 Implicit and Explicit Emotion Regulation

The number of publications about ER has dramatically increased in the last 20 years [13]. These publications have developed various subprocesses of the ER system. One helpful distinction exists in the differentiation of explicit ER from implicit ER. Emotion regulation can be conscious or unconscious, defined as explicit and implicit dimensions of ER, respectively [14]. While adult research has traditionally focused mainly on explicit emotion regulation [8], research in infants and children includes a more recent focus on implicit emotion regulation [15].

Explicit (effortful) ER involves conscious efforts to monitor, adjust, and control one's emotions [14] and in most cases, individuals are aware that they are implementing these strategies [16]. It refers to conscious effort, such as the effort in learning a new language or the effort in learning how to ride a bike, until it becomes more automatic, or implicit. Explicit ER processes are more

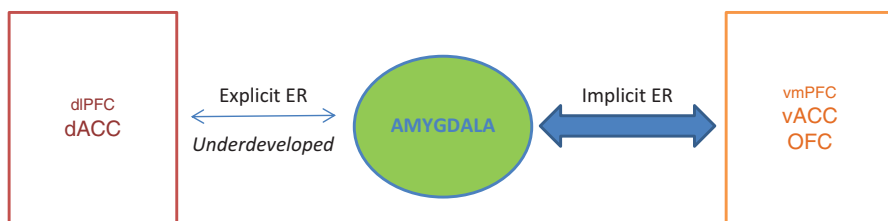


Fig. 7.2 Emotion regulation in early development. Note, less developed dorsolateral prefrontal cortex (dlPFC) structures to ventromedial prefrontal cortex (vmPFC) regions suggesting greater role of implicit emotion regulation in childhood and adolescence. *dACC* dorsal anterior cingulate cortex, *vACC* ventral anterior cingulate cortex, *OFC* orbitofrontal cortex

dorsolaterally mediated in the prefrontal cortex [17] and are dependent upon the dorsal anterior cingulate cortex (dACC) and dorsolateral prefrontal cortex (dlPFC) [18] (Fig. 7.2). Examples of explicit ER are cognitive reappraisal, emotional suppression, and effortful distraction [14]. Since the explicit ER process is effortful, and is carried out with considerable awareness, it is difficult to implement in children and teens. Beyond the intuitive difficulty of effortful emotion regulation, there are also neurodevelopmental arguments for the difficulty of explicit ER in children. The major brain regions implicated in explicit ER, notably dlPFC, are the last to mature [19, 20].

In contrast, *implicit ER* (automatic) occurs without intent or conscious and typically utilizes a person's immediate response tendencies [16, 21]. Unlike explicit ER, implicit ER is more ventromedially mediated and depends upon ventral prefrontal cortex (vPFC) including orbitofrontal cortex (OFC), ventromedial PFC (vmPFC), and ventral anterior cingulate cortex (vACC) [22].

Defense mechanisms are defined as different ways an individual responds to stressors. Psychoanalytic psychotherapy operates on effortlessly applied process which promotes more flexibility and adaptability in the use of defense mechanisms. Previously, it has been demonstrated that there is significant overlap between implicit ER and defense mechanisms [14]. In this observation, there is a clear interchange between the biobehavioral and the psychosocial as words and interventions in the format of defense interpretations and analysis permit an entry to interact upon a neutrally defined construct and promote change.

7.4 Psychotherapy Can Promote Explicit ER in Adults

Psychoanalytic psychotherapy is not the only means by which psychosocial interventions can interact on the ER system. An understanding of the way in which psychotherapy can impact this system demonstrates how the environment can affect biological processes.

Cognitive behavioral therapy (CBT) is widely used to treat a variety [23] of psychopathology, included, but not limited to, depression, posttraumatic stress disorder, obsessive-compulsive disorder, panic disorder, generalized anxiety disorder, social anxiety disorder, and specific phobia. It is often recommended to treat multiple disorders in adults and children. CBT is typically conceptualized as a short-term, skills-focused treatment aimed at altering maladaptive emotional responses by changing the patient's thoughts, behaviors, or both [24].

The theory behind CBT is that emotions, cognitions, and behaviors are dependent upon one another such that changing any one of these components has a direct effect on the others. CBT teaches ER cognitive reappraisal, which trains individuals to reinterpret or reappraise affective stimuli situation from a new perspective consequently changing their emotion and in turn leading to changes in the brain [25, 26]. Cognitive reappraisal tends to diminish negative emotions, such as sadness or disgust [27] and can improve the subjective state of individuals without any manifestation of physiological stress [27, 28].

For example, imagine a situation wherein you come to school and realize that you left your mathematics homework at home. At first, you may get angry or frustrated, and for instance, engage in blaming your mother for rushing you out the door; appraising the situation in anger leads to feeling frustrated throughout the day which negatively affects performance in mathematics class. Instead, imagine reappraising given situation by more positive thoughts, such as although I forgot my homework, I was able to eat breakfast, I was able to spend time with my dog in the morning or admitting that I usually do not forget homework, but life happens. Cognitive reappraisal is effective in reappraising the situation and thus has been extensively studied strategy for regulating emotions.

The core elements of reappraisal are essential not only to CBT, but *dialectical behavioral therapy (DBT)* as well [29]. DBT is a form of cognitive behavioral therapy (CBT) that was developed specifically for chronically suicide-prone patients with borderline personality disorder and includes behavior-changing techniques and methods for learning to accept feelings. DBT has shown significant improvement across a range of suicide risk factors in adolescent [30, 31] as well as adult population [29, 32]. There is direct evidence that DBT interventions, of which intervention to increase ER is one of the four key modules, directly impact ER system [33].

Both CBT and DBT are frequently used in adults to treat maladaptive emotions. However, since it depends on explicit or effortful emotion regulation, which requires conscious awareness and effort, it is challenging to use for children and teens as well as for some adults. Neuroimaging studies further suggest that children in particular struggle to produce the same pattern of brain activity typically associated with successful adult engagement in cognitive reappraisal [19], perhaps relating again to the neurodevelopmental argument that children may not yet have the requisite neural machinery. Indeed, even in adults, explicit ER cannot be used all the time because it requires conscious effort. However, if practiced enough, the explicit ER process may become implicit [16].

7.5 Development, Emotion Regulation, and the Environment

Developmental models of ER also demonstrate how the environment is a key factor in the development of these processes in the lifespan.

Emotional regulation starts in early development, and the ability to effectively regulate emotions is an essential aspect of children's successful development [34–36]. Poor emotion regulation during infancy and toddlerhood is linked to aggression, withdrawal [37], and impairment in cognitive and social development [38, 39] later in life.

In infancy, self-regulation includes the capacity to maintain positive states as well as the management of distress and negative states [40]. During the first months of life, although emotion regulation is largely managed by caregivers, infants also rely on reflexive behaviors, such as sucking, rooting, and head turning toward or away from a stimulus, in their attempts to regulate emotions and self-soothe [34, 41]. At 3–6 months, infants develop ability to voluntarily shift attention [42] and as a result are able to start engaging in more effective strategies, such as attention distraction [43] by focusing on neutral objects. During the toddler years, initiation of the organization of neural connectivity begins and children transition from relying on their caregivers to more independent strategies to regulate their emotions, including self-touching, self-stimulation, fidgeting, and attention-related behaviors [34, 44, 45]. Toddlerhood is an important developmental stage. At this age, children learn to communicate their emotions by learning which emotions to express, when to express them, and how to best express them in response to requests and needs, which greatly facilitates their emotional development [46].

In literature, it is well established that parents affect the development of emotion regulation in children [39, 47, 48]. Self-regulation during infancy develops in mutually regulated dyadic parent–infant systems [49] and is particularly influenced by specific maternal interaction patterns [34, 50–52]. Maternal mental health and behaviors, such as depression [44], may influence the development of emotional regulation. To achieve effective emotion regulation, it is crucial to explore environmental and social input.

Even in early development, infants as young as 10 months old monitor and refer to people in an ambiguous situation depending on their attention toward them [53]. In addition, infants rely on caregiver's affect to express and regulate their emotions, especially the negative ones, in such a way that allows their attachment needs to be met [54]. These repetitive patterns of interactions between the infant and a caregiver are thought to become internalized and then generalized to other contexts in which they may be less adaptive [55].

If the caregiver responds to infant's negative affect with comfort, calm, attentive and gentle approach, the infant will internalize those tools to adaptively and implicitly regulate negative emotion. If the caregiver responds to negative affect with avoidance or fear, the infant will be likely to develop maladaptive coping patterns or defense mechanisms.

Although most individuals show development in the direction of more adaptive and less maladaptive coping and defense strategies from adolescence until later in life [56], immature defenses and a reduced use of mature defenses have a negative impact on the development of personality later in life [57].

7.6 Developmentally, Teenagers Are Not with Fully Developed Emotion Regulation “Hardware”

The growing adolescent brain undergoes many changes, including gray matter reduction in certain parts of the brain [58–60], increase of white matter [61–63], increased myelination [63], and changes in the patterns of connectivity [64]. In animal studies, it has been shown that in adolescent brain there is a change in dopamine production [65], increase in GABA throughout adolescence [66] and changes in NMDA receptor occur [67].

Brain structural parts of ER are formed in utero and continue to evolve throughout the development. The brain tends to mature from the bottom to top, back to front, and inside out. Visual regions which are in the back of the brain are developed by age 5. Motor regions, which are responsible for planning, *control*, and execution of voluntary movements, mature by adolescence. However, the topmost frontal parts, the frontal lobe and upper area of the cortex which is responsible for decision making, are still immature in adolescents and do not fully mature until the age 24 [68].

Returning to psychotherapy, it is noteworthy that different psychotherapies rely on different parts of the brain. For example, cognitive reappraisal relies on late-maturing parts of the brain, thus relying on explicit ER. Studies have consistently shown that reappraisal involves increased activation of specific areas within the *prefrontal cortex* (PFC) and anterior cingulate cortex (ACC) [69, 70]. However, implicit emotion regulation relies on the brain areas that develop earlier, thus might be more appropriate to be used in children and teenagers. The studies have shown that ventrolateral prefrontal cortex (VLPFC) plays an essential role during implicit emotion regulation [71].

Therefore, children’s brains may not have all the “brain hardware” necessary to use cognitive reappraisal or other CBT methods. Using other therapeutic techniques that rely more on parts of the brain that develop earlier (lower and more central parts of the prefrontal cortex) and are essential in implicit emotions regulation may be more beneficial.

7.7 Implicit Emotion Regulation and Environmental Inputs of Childhood Upbringing Are More Important

It has been shown that both maternal psychological maltreatment and paternal physical maltreatment in childhood predict psychiatric *symptomatology* in adulthood [72]. In addition to psychological burden, adverse childhood experiences have been linked

to obesity in adolescents [73]. However, positive environmental influence, such as greater childhood nurturance, has been linked to adaptive defensive styles in early adulthood, leading to healthier midlife functioning at work and in relationships [74]. Individuals with a history of childhood maltreatment have a decreased ability to modulate and tolerate aversive emotional states [75] and have associated neurobiological changes that may underlie the increased risk of psychopathology [76]. There has been evidence that childhood adversity may predispose individuals to a lifetime of maladaptive coping strategies [77] and can undermine children's development of effective emotion regulation skills [78]. Childhood emotional neglect has been shown to be related to avoidance, while childhood emotional abuse has been related to rumination [79]. Children employ such coping mechanisms or defenses similar to implicit ER to protect themselves from unbearable and unpleasant feelings [17]. People express maladaptive emotion regulation or coping mechanisms to protect himself or herself from painful emotions [14] which develop throughout the childhood and are modulated throughout environmental influences, such as social interactions with friends, interactions with peers at school and family upbringing.

7.8 Role of Treatment: Sometimes a Parent-Child "Fit" Is Not "Good Enough"

Adolescence represents a critical phase of life in which biological, physical, psychological, and social development [80] occurs influenced by genetic and environmental factors. Social interactions are important in impacting human brain development, cognition, and well-being [81, 82], especially in early life [83]. The relationship between a parent and child is one of the most important relationships for both parents and children across their respective lifespans. This relationship is, of course, bidirectional [84]. Familial relationship has an influence on child health outcomes [85] and vice versa [86]. It has been shown that dyadic reciprocity of parent and child predicts child's development of emotion regulation and adjustment [87, 88].

Parent-child conflicts are inevitable and common [89]. Although some conflict may promote healthy development, some may lead to additional family stress [90]. It has been shown that conflicts between parent and child can exacerbate and contribute to psychopathology, such as inattention and hyperactivity disorder (ADHD), opposition defiant disorder (ODD), and conduct disorder (CD) [91]. Poor relationships with caregivers are associated with hyperactivity [92] in children, and children with ADHD are at significant risk for behavioral, social, familial, and academic difficulties relative to their normal counterparts [93]. In addition, the presence of ADHD in children is associated with disturbances in family and marital functioning [94]. Instead, mothers with depressive symptoms show poorer relationships with their children [95], which may lead to a disruptive behavior [96]. Also, fathers with depression are associated with increase in father-child conflict and child

internalizing and externalizing symptoms [97]. On the other hand, positive parent–adolescent relationship may serve as a *protective factor* by reducing risk of depression among the adolescents of depressed mothers [98].

Thus, disruptive parent–child interactions are bidirectional [99] and influence adolescent family satisfaction and self-satisfaction [100]. Consequently, coping with stressful family dynamics is crucial to maintaining good relationships [101]. Conflict-coping tactics may moderate the relationships between conflict frequency, adolescent family satisfaction, and adolescent self-satisfaction [100].

7.9 Professionals Through Psychosocial Interventions Play a Role

Ability to successfully cope with challenges while transitioning through different stages in life might be challenging. Adolescence is a critical developmental period. As multiple mental disorders manifest for the first time at this stage [102], early interventions are crucial. Learning coping strategies and emotional regulation early in life may be beneficial to both parents and child leading to a more positive dyad. When there is significant conflict between parent and child, professionals may play a critical role in helping to recognize frightening emotions, teaching effective coping skills, and providing appropriate therapeutic interventions. By providing developmentally appropriate interventions, professionals may strengthen the dyad between a parent and child. Behavioral intervention focusing on self-regulation can be effective in reducing externalizing problems, but internalizing problems require an intervention that is sensitive to the underlying behavioral inhibition [103].

It is important to choose suitable psychotherapy approaches when treating youth. Psychotherapy approaches that rely on brain structures that mature earlier in the development might be more effective in childhood.

For example, rather than choosing CBT, which focuses on late-maturing brain structures, psychoanalytic psychotherapy may be more appropriate, as it relies on earlier developed inferomedial structures of the brain. Since psychoanalytic psychotherapy consists of effortlessly applied processes and is based on implicit emotion regulation, it may be a more appropriate therapeutic intervention with the adolescent population. It focuses on defense mechanisms and is more flexible and adaptable. Choosing developmentally suitable interventions may help a teen to more effectively regulate his/her emotions and respond to adverse life stressors.

Regulation Focused Dynamic Psychotherapy (RFP-C), as proposed by Rice and Hoffman [14], which focuses on addressing the child's defenses against unpleasant emotions and attempts to help the child develop implicit emotion regulation systems, should be considered when choosing a treatment therapy for maladaptive behaviors in teens [14]. By learning alternative strategies when facing unpleasant feelings, children develop a broader range of adaptive defenses leading to a healthier development [104].

7.10 Creating Interventions for Teens: Adolescence as a Culturally Bound Phase

The concept of adolescence was first formed in America during the early twentieth century to describe a period in which individuals were at greatest risk of being afflicted by many of the nation's top health concerns: drug addiction, violence, sexually transmitted diseases, and suicides, to name a few [105]. Defined as a harrowing phase of life with a slew of unsavory experiences, adolescence came to be viewed as a "stage of storm and stress," by many thinkers in psychology [106]. Although psychiatric illnesses in the US increase dramatically during adolescence [107, 108], researchers now understand that the specific challenges that teenagers face during this period and the way in which they respond to such challenges vary tremendously, depending on their specific sociocultural context [109–113]. Margaret Mead [113] first demonstrated the heavy influence of culture on psychosexual development in studying the differences between adolescent girls in the U.S. compared to those living on the Samoan islands [113]. She explored the unique social and political norms within the villages and argued that Samoan teenagers were shielded from many of the stresses their American counterparts experienced because of their culture's unique social structure and norms which provided them with more autonomy and increased levels of support.

Mead's discovery helped to move psychology away from perceiving adolescence as a time of "storm and stress" and instead come to understand adolescence as a stage that is dependent upon the larger social context. Understanding the unique challenges a teen faces during this developmental period can only be accomplished by exploring their unique culture's understandings of race, ethnicity, gender, sexuality, religion, social relations, and so forth. Furthermore, assessing the extent to which individuals are perceived as autonomous beings within society is also important. Different age requirements for voting, driving, drinking alcohol, smoking, enlisting in the military, marriage, etc. are just a few examples of how the larger sociocultural context influences not only the types of challenges teens face, but the timing of these hurdles.

7.11 Teens Are Especially Suited for Psychotherapy

Although the developmental challenges teenagers face depend heavily on the larger sociocultural context, all adolescents face intense psychological and physical changes that make them especially suited for psychotherapy. Teenagers often withdraw from their caretakers in an effort to gain more independence and autonomy, which can make providing them with the support they need during this time all the more challenging. Psychotherapy not only offers teens with a space to work through their academic, social, and cultural challenges with a well-trained adult, but it also provides them with a judgment-free arena to test new coping skills, engage in new communication styles, explore emerging identities, and investigate the motivations behind their and other's behavior.

Teenagers are also well suited for psychotherapy because their emotions, thoughts, and behaviors are especially malleable. Teenagers experience heightened emotional arousal to external stimuli [114–122] which motivates them to adopt new defense mechanisms and habits to gain more control over their fluctuating internal states. During this period, teens are likely to try on new personalities, take on new mindsets, and mirror behaviors exhibited around them which makes prime for psychotherapy.

Psychotherapy can provide adolescents with conscious, effortful cognitive-behavioral strategies, including cognitive reappraisal [123, 124], suppression [125, 126], and effortful distraction [127], which have been shown to attenuate the limbic, hormonal, and sympathetic autonomic activity through midline prefrontal control in response to painful emotions [125]. The types of coping mechanisms teenagers adopt to help regulate their emotional states largely depend on the behaviors modeled around them. While many teens often blow-off steam by engaging in academic pursuits, extra-curricular activities like sports, and other hobbies, marathoning Netflix shows, or spending quality time with friends, some teens resort to using alcohol, recreational drugs, junk food, and physical and/or verbal aggression to cope with negative emotions.

Adolescents often use these maladaptive defenses to temporarily avoid having to deal with negative feelings. For example, eating junk food can provide individuals with a sense of pleasure and comfort that may hide a deeper sense of dissatisfaction or loneliness, and engaging in self-destructive activities like cutting or using recreational drugs may provide teenagers with a source of distraction from unpleasant thoughts. However, because maladaptive behaviors simply cover up undesirable feelings and do not help target the thoughts and behaviors behind them, they do not provide long-term relief and can easily turn into habits that are difficult to break. Psychotherapy can be tremendously helpful in this scenario by helping individuals to gain the capacity to better manage negative feelings and avoid counterproductive behaviors. This not only provides long-term psychological benefits, but has also been shown to improve physical health. Mental and behavioral disorders such as binge eating, smoking, alcohol use, drug use, and lack of exercise are responsible for more than half the disease burden in the U.S. [128] and they have been well established as being the leading cause of preventable morbidity and mortality [129–135]. By targeting these negative behaviors early on in development, before adolescents reach adulthood, psychotherapy can bring significant public health benefits.

7.12 Conclusion

The psychological and physical growth experienced by individuals in adolescence is unlike any other developmental period. The intense emotional experience during adolescence sets it apart from all other developmental stages and is thought to be the basis behind the rise in psychopathology [108], anxiety [136], and suicides [137] during this time. As individuals progress through adolescence, there is maturation of the cortical control regions such as the prefrontal cortex which results in improved

cognitive control [138]. This in theory can result in greater emotion regulation with time; however, the maturation of these regions is heavily influenced by one's environment. Stressors, support systems, and interpersonal relationships not only influence the development of these cortical control regions, but they can also affect the response of already developed subcortical regions responsible for emotions, like the limbic system. Research shows that individuals who experience significant trauma during adolescence often have decrease activity of the neuronal circuits involved in emotion regulation [139] making them especially vulnerable to developing symptoms of anxiety and depression.

Just as trauma can have adverse effects on neurodevelopment, psychotherapy that focuses reappraisal of emotions can conversely dampen emotional reactivity by increasing cortical–subcortical connections [140], again illustrating the complex interplay between neurodevelopment and environmental factors.

Emotion regulation is a marker of mental health in children and adolescence [15, 141, 142] and the ability to appropriately and flexibly apply emotion regulation is heavily dependent on neurodevelopment and the environment. While trauma and psychotherapy are extreme examples of environmental modifiers, other environmental challenges and support factors also play a significant role in the acquisition of emotion regulation techniques. As teenagers withdraw from parents to gain more independence, they inadvertently allow themselves to explore new self-soothing techniques to reduce stress. Instead of looking toward caregivers to regulate their internal state, teenagers start to look to their peers. This transition allows them to be exposed to a variety of coping skills, thought processes, opinions, and behaviors which give them an arsenal of tools to help them manage their fluctuating and intense emotions as they face new developmental challenges.

This gravitation away from their parents during this period of significant neurological development is thus crucial for teenagers to acquire the skills and tools they need to become independent, self-sufficient adults, capable of managing an array of internal states.

As teenagers face social, emotional, and cognitive challenges throughout adolescence, the use of implicit emotion regulation processes is critical. Teenagers are at greater risk of being exposed to traumatic experiences [143, 144] and developing mood and anxiety disorders [145, 146] and those who show decreased abilities to regulate internal affective states have been shown to have higher levels of psychopathology than their peers [139, 147–150]. Teens who can automatically employ reflexive emotional regulation tactics are thus able to better respond and adapt to their environments. Although the use implicit emotion regulation tactics occurs outside of one's awareness, and is thus effortless, it is possible for one to adopt explicit strategies, such cognitive reappraisal, that become implicit over time with frequent use [151, 152].

Thus, evidence suggests that the more that teenagers can take a step back and are able to analyze and reappraise their emotional responses to various situations, the more they may be able to control their responses in the future.

The intense and tumultuous emotional experience of adolescence makes it all the more important to increase teens' ability to adequately manage stress and their

emotional states. Psychotherapy with adolescence should focus on managing self-regulation of distress and emotional reactivity during this time of tenuous neurodevelopment, as emotion regulation skills remain critical during this time. There is evidence that clinically depressed teens have less effective skills for managing negative emotions than their non-affected peers [153], suggesting that therapy aimed at increasing emotion regulation may be particularly helpful for adolescents. Typical models of treating adult mood disorders, like CBT, DBT, mindfulness, and interpersonal psychotherapy, include components of emotion regulation; however, they fail to approach emotion regulation from a developmental perspective and thus may fall short of helping teens to gain the basic tools they need to regulate their internal states as they progress through various neurodevelopmental stages.

The integration of CBT with emotion-focused therapies, known as ECBT, is an especially promising intervention for children and adolescents with emotional disorders [154]. Recent studies on ECBT that specifically teaches cognitive restructuring, relaxation, and psychoeducation in anxiety provoking situation, were shown to help reduce self-harm behaviors in teens [155], and help children aged 7–12 identify and discuss their emotions, as well as understand ER [156]. Although both studies suggest that ECBT is a promising intervention for children and adolescents, ECBT requires a randomized clinical trial to further evaluate its effectiveness.

In addition to evaluating the effectiveness of ECBT and other therapies that approach emotion regulation from a developmental perspective, it is critical that we understand how we can make these treatment modalities more accessible to children and adolescents. Unlike adults for whom general medical practitioners are typically the first-line providers of mental health care, schools remain the primary providers of mental health services for children [157–160]. Over 75% of children receive mental health services in school [157], and although the use of behavioral and cognitive techniques to address the emotional, behavioral and social problems in school has been well documented in the literature [161–165], few studies have systematically reviewed evidence on the effectiveness of these school-based interventions on ER [166].

In summary, we can see through the ER construct that the environment plays a crucial role both in development and as a therapeutic modality for interaction with a key biologic process in adolescent health and well-being. Further studies on psychosocial interventions, both through caregiver mental health as a factor in ER promotion upon the child in early development, as well as on direct application in teenage populations, will continue to heighten appreciation for the environment upon the development of brain and behavior.

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Relationship Between Emotions, Sleep and Well-Being

8

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8.1 Psychophysiological Functions of Sleep

Sleep is a natural, universal phenomenon present in all living organisms, maintained across all steps of phylogenetic evolution and also observable in species without a centralized nervous system, like jellyfish [1]. Even if sleep is a state defined by the cessation of finalized behaviour and a strong disconnection from the sensory environment, it is not a passive phenomenon [2], but it is a highly active process as vital as respiration or digestion. Sleep is not a unitary phenomenon, but it is composed of a dynamic sequence of stages that show high degrees of inter- and intra-individual variability. In the last few decades, the long-standing question ‘why do we sleep?’ has received several answers. Since the development of the electroencephalogram (EEG) by Hens Berger in 1929, sleep has been continuously investigated in humans, leading to the definition of rapid eye movement (REM) sleep and non-REM (NREM) sleep, which in turn is divided in three stages, related to the increase of sleep depth (i.e. increase of awakening threshold): N1, N2 and N3. The alternation between sleep stages follows a sequence of cycles during the night, lasting nearly 90 min each (N1-N2-N3 REM; reviewed in [3]). It is now well established that sleep is fundamental for neuronal detoxification, tissue restoration, conservation of energy, enhancement of the immune system and, finally, increasing neuronal plasticity [4]. In order to develop a model of sleep function, the synaptic homeostasis hypothesis has been developed [5, 6]. According to this theory, experience-dependent learning during the day is related to the increase of cortical

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synaptic weight (i.e. wakefulness promotes activity-dependent strengthening of synaptic connections). Conversely, during the night, sleep reverses plasticity rules, thus promoting the activity-dependent weakening of connections, leading to homeostatic down selection of synapses actuated during the day. In this way, sleep basically resets synaptic weight in the central nervous system, allowing the brain to learn again during the following day [5, 6]. Together, these functions are related to slow waves (including sleep slow oscillations (SSO) and K-complexes, very slow, triphasic slow waves with a frequency between 0.5 and 1 Hz, mainly detectable at the frontal level; see [7, 8]), and sleep spindles. Slow waves are low frequency (0.5–4 Hz), high amplitude oscillations generated in the cortex that are critically dependent on the activity of subcortical structures, like the thalamus [9, 10], and the olfactory bulb [11]. Slow waves are abundant in the first part of the night (early sleep) and reduce exponentially during the night, but are increased after sleep deprivation, indicating an important role in homeostatic regenerative functions of sleep [3]. Sleep spindles are brief, fast oscillations, lasting 1–2 s, with a frequency of 11–16 Hz. They are generated through thalamocortical loops and are mainly related to declarative memory consolidation during sleep [12, 13]. Sleep is also fundamental for enhancing learning-related processes, sustained by local slow-wave power (i.e. slow-wave activity) and SSO. Basically, increased daytime, performance-related, synaptic activity in cortical regions (e.g. activity in visuomotor cortices related to the performance of a visuospatial learning task) will be reflected in increased slow-wave activity/SSO in the same regions during the following night [14].

Beyond memory consolidation, one of the main roles of sleep is emotion regulation, although the identity of the specific sleep stages, features and mechanisms involved in this process is currently a hot research topic. Several studies have identified REM sleep as fundamental [15, 16]. In fact, REM sleep is not only associated with the consolidation of conditioned fear memories [17], but also with the unbinding of ('hot') emotional aspects of a memory from the ('cold') memory itself [18], thus facilitating the extinction of conditioned fear. In other words, REM sleep, and particularly the total amount of EEG theta activity, can separate emotionally relevant components of a memory (its 'visceral charge') from emotionally irrelevant ones [19, 20], resulting in a dissipation of subjective emotional intensity and in the consolidation of the information itself, as a sort of 'overnight therapy' [21, 22]. The neurophysiological substrate of this process has been identified as the active inhibition of the amygdala through top-down prefrontal cortex (PFC) connections [23], causing a reduction of the activity of the amygdala, paralleled by an increase of the activity of the hippocampus (the 'sleep to forget and sleep to remember' model [21]).

Even if theoretical connections between homeostatic functions of sleep and emotion regulation have never been directly investigated, they take on particular importance when considering a critical developmental period like adolescence.

8.2 Adolescence, Emotions and Emotion Regulation

Adolescence is a critical developmental age that starts with sexual maturation (puberty) and ends with the achievement of the social roles of young adulthood, usually taking place between 12 and 17 years old. It has been defined as an age characterized by both strengths and vulnerabilities, and is a critical period of development of emotion regulation [24]. During this stormy period, the central nervous system undergoes a slow process of maturation, with several functional and anatomical modifications, most importantly, a massive neuronal pruning [25]. This slow maturing process is most evident within the prefrontal cortices, begins during childhood and continues until early adulthood, resulting in the development of high-order psychological functions [25, 26]. Accordingly, adolescence is characterized by heightened emotional experiences, which are probably caused by the different maturation trajectories of cortical (prefrontal) and subcortical (amygdala) brain structures, leading to a diminished ability to regulate emotions [27].

Emotions are highly salient and fundamental qualities of our conscious life, which can modulate attention to stimuli, interrupt cognitive or behavioural processes and trigger actions in the outer world [28, 29]. In order to adapt successfully to the environment, humans have the ability to regulate emotions, applying strategies that modulate, consciously and unconsciously, emotional experience and expression [30], in order to use emotions as resources in decision-making processes within complex social contexts [24, 31]. Emotion regulation begins as the individual acknowledges a new event or situation, and interprets it in the context of his goals [32, 33]. Subsequently, attempts to adaptively regulate the new emotion take place in an iterative way, modulated by environmental feedback, according to the following stages: (1) situation selection, (2) situation modification, (3) attentional deployment, (4) cognitive change (e.g. reappraisal) and (5) response modulation (e.g. behavioural suppression) [32]. At the neurophysiological level, successful emotion regulation in adults is mainly related to increased PFC activity and decreased amygdala activity [34–36], while emotion dysregulation is related to deficit of the top-down inhibition of the amygdala by the PFC [37, 38]. However, emotion regulation has been linked to an expanded prefrontal network, comprising the dorsolateral, dorsomedial, ventrolateral, and the posterior prefrontal cortices, the anterior cingulate cortex and the inferior parietal regions [39] (Fig. 8.1).

Emotion regulation increases with age, from childhood to adulthood [34, 40–42], with a critical period occurring during adolescence [43]. Alterations in this process can lead to the development of severe psychopathological conditions in adulthood. In fact, emotion disturbance and dysregulation are transdiagnostic processes observed in almost all forms of psychopathology, both internalizing and externalizing [44, 45]. As described next, sleep has a fundamental role in the successful development of these abilities.

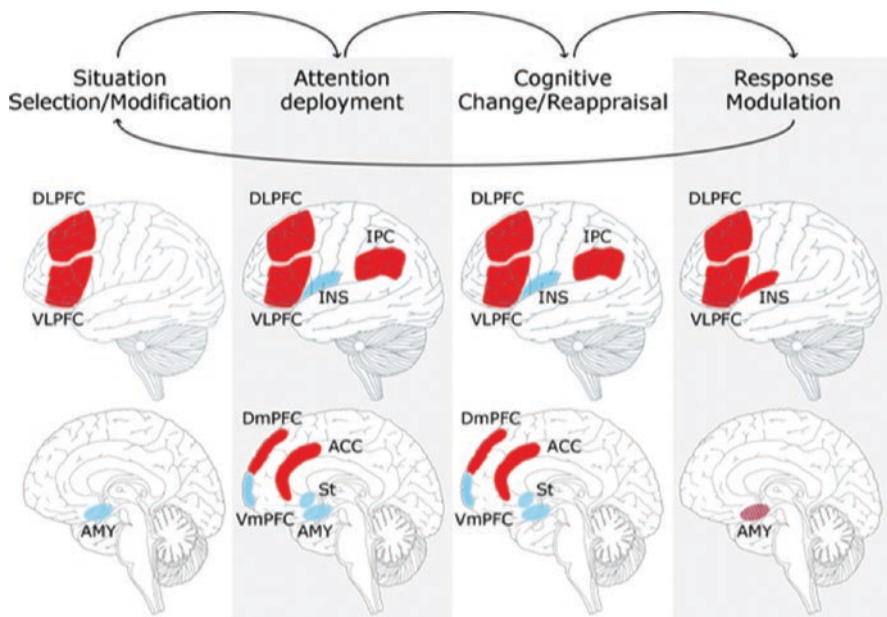


Fig. 8.1 Emotion generation and regulation in the adolescent brain. In blue, functional decrease of activity; in red, functional increase of activity. *DLPFC* dorsolateral prefrontal cortex, *VLPCF* ventrolateral prefrontal cortex, *INS* insula, *IPC* inferior parietal cortex, *DmPFC* dorsomedial prefrontal cortex, *VmPFC* ventromedial prefrontal cortex, *ACC* anterior cingulate cortex, *AMY* amygdala, *St* ventral striatum. Adapted from Ochsner et al. [39] and Gross [32]. (Authors thank Dr. Sergio Frumento for having adapted the figure)

8.3 Sleep and Sleep Deprivation in Adolescence

Across the life span, emotion regulation increases in tandem with continuous change in sleeping patterns, with a reduction in both NREM and REM sleep, and total sleep time. In particular, sleep in adolescence is marked by a progressive reduction of EEG signal amplitude and power (up to 40%) across all EEG frequency bands, which is related to age and puberty stage [46–49]. At the same time, adolescent sleep is related to the progressive increase of sleep spindles in peak frequency and EEG coherence in multiple frequencies, which have been related to the myelination of long-range connections in thalamocortical networks [47, 48, 50–52]. An MRI study has confirmed that this reduction in EEG power during sleep in adolescence is correlated with massive pruning of grey matter [53]. With EEG, Kurth et al. [54] found that progressive reduction of slow-wave activity has a posterior-to-anterior gradient, which follows precisely the local reductions of grey matter, as another study longitudinally assessed with MRI [55].

These data suggest an important link between slow waves and sleep spindles in brain maturation during adolescence, in particular in the PFC, which develops later than other brain cortices, and is crucial for emotion regulation. In the scientific

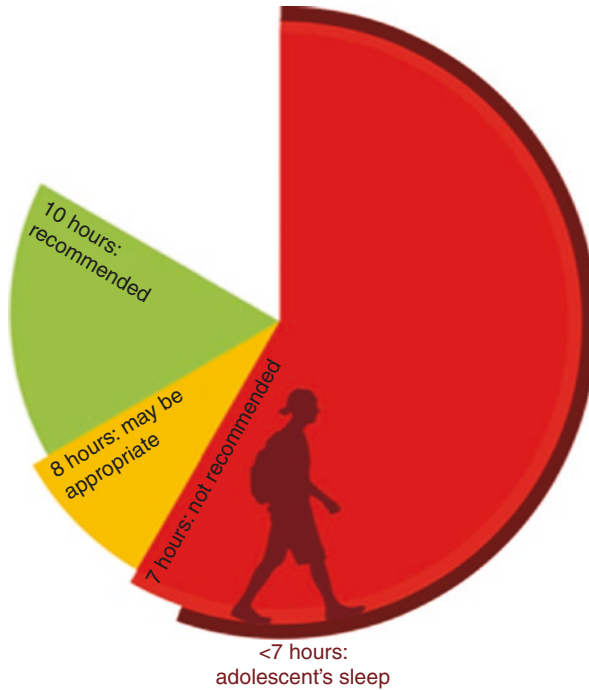


Fig. 8.2 Number of hours the adolescents should sleep per day and how much they actually sleep. Adapted from Hirshkowitz et al. [64]. (Authors thank Dr. Sergio Frumento for having adapted the figure)

literature, links between poor sleep and emotion dysregulation have been intensively investigated in adults (for reviews, see [18, 56–62]), but how poor sleep specifically impacts adults and adolescents is still unknown [63]. Unfortunately, even if the recommended sleep time for adolescents is 9 h per night, the National Sleep Foundation team has stated that adolescents do not get the adequate amount of sleep, sleeping only 6–7 h per night [64] (Fig. 8.2). The reasons for this are complex and biopsychosocial in nature [65]: (1) the physiology of the hormone melatonin in adolescence is completely different from childhood, with its releasing shifted later during the evening [66]; this, together with increased ability to resist sleep pressure, lead adolescents to be ‘owls’ (i.e. evening type), going to bed later in the night; (2) school start time is often set very early in the morning (7:30 to 8:30), forcing awakening much earlier than the recommended 9 h of sleep (i.e. the so-called ‘social jetlag’ [67]); and (3) the occurrence of familiar and social major risk factors, as aversive family environment, evening light exposure, computer use and tobacco and caffeine use, lead to significantly reduced sleep time [68]. Collectively, prolonged poor sleep conditions are important risk factors for psychopathology in adolescence and, conversely, psychopathology itself is highly related to co-morbid sleep problems (near 95% [69]). Moreover, poor sleep is related to several cognitive, behavioural and emotional alterations (for reviews, see [70–73]),

which lead to decreased well-being, defined as a reduction of subjective quality of life and life satisfaction, prevalent negative mood and emotions and absence of meaning in life [74].

A large number of cross-sectional studies showed that poor sleep is associated with deficits in emotion regulation, reduction of well-being and health-related quality of life [75–78] as well as increased anxiety [79], depression [80], aggression and hostility [81], academic failure [82, 83], legal and illegal drug use [84, 85] and accidents [82]. Longitudinally, poor sleep in adolescence can cause long-term reductions in well-being and life satisfaction, increased anxiety, depression, substance use and bad educational outcomes [86–93]. To sum up, all the above-mentioned psychological and behavioural outcomes are associated with prolonged conditions of bad sleep (i.e. chronic sleep deprivation or ‘sleep debt’ [94]), and are united by the lack of emotion regulation [24].

8.4 Sleep Deprivation and Emotion Dysregulation

Experimental psychophysiological studies of sleep deprivation have detected subjective and objective signs of emotion dysregulation, at the level of both the central and autonomic nervous system. In adults, one night of sleep deprivation increases amygdala activation up to 60%, in reaction to negative pictures (e.g. weapons, snakes, mutilations), indicating an inability to down-regulate negative emotions [95]. Amygdala hyperactivity has been detected also after a more ecological sleep deprivation protocol (five nights of 4-h sleep restriction), using subliminally presented frightened faces [96]. Decreased functional connectivity between the medial PFC and the amygdala, together with the hyperreactivity of the latter, has been related to less than 6 h of habitual sleep per night [97–99]. Moreover, sleep deprivation impairs recognition of emotional facial expressions [100, 101] and increases the distractibility caused by emotional images, paralleled by increased amygdala activation and reduced functional connectivity with the PFC [98]. Taken together, all these studies consider decreased inhibition of the amygdala exerted by the PFC as a marker of emotion dysregulation after sleep deprivation. Recently, in adults who underwent a fear consolidation experimental paradigm, Feng et al. [102] found that sleep deprivation interferes with top-down ventromedial PFC inhibition of the amygdala, increasing also bottom-up arousal signalling by the insular pathway [102]. Notably, insular cortex integrates interoceptive information on the state of the organism arising from subcortical areas, which are fundamental for adaptive emotional behaviour [103–105]. These data reflect an important and still under-investigated link between altered interoception, emotion dysregulation and sleep disorders (see [106]). In addition, suggesting an important involvement of the autonomic nervous system, Franzen and collaborators found, in sleep-deprived adults, that increased sleepiness positively correlated with involuntary pupillary responses to negative emotional pictures [107]. Sleep deprivation also affects heart rate variability (i.e. increased the low-frequency component and decreased the high-frequency component of heart rate variability), indicating an enhancement of

sympathetic activity [108, 109], which has been related to psychopathology and to reductions of flexibility to emotional challenges [110, 111].

Furthermore, sleep deprivation enhances mesolimbic reward system activity, which includes the midbrain ventral tegmental area, the striatum and the PFC (medial PFC and orbitofrontal cortex), and has been related to increased responsiveness to reward-stimuli, possibly leading to impulsivity, risk-taking behaviours and sensation seeking [60] (e.g. licit and illicit drug use; reviewed in [59]). Specifically, sleep deprivation amplifies subjectively reported and objectively detected activity (with functional MRI) throughout the human reward brain network in response to pleasure-evoking stimuli, associated with a reduction of the coupling between the mesolimbic system and the medial prefrontal and orbitofrontal cortices [112].

Unfortunately, unlike adults, sleep deprivation protocols in adolescence are less numerous, because of various methodological and ethical issues [72]. However, experiments on adolescents have found coherent results related to emotion dysregulation: for example, sleep restriction protocols in adolescents decrease emotion regulation, higher level executive functions and positive affect and increase negative affect (e.g. tension, anxiety, hostility, confusion and fatigue) [113–117].

A number of authors have suggested that sleep deprivation can alter emotion generation and emotion regulation via different pathways: (1) sleep deprivation may increase negative emotions by lowering the threshold to aversive stimuli that may be otherwise discarded [18], by decreasing motivation and ability to interpret goal-related events [58] and by increasing the encoding of negative memories, selectively biasing the encoding of positive and neutral ones [118]; (2) sleep deprivation may cause a state of central and peripheral emotional hypersensitivity that impairs the communication between brain and body, fundamental for the ‘embodied’ perception of emotions and leading to indiscriminate emotional generalization [59, 60]; (3) sleep deprivation may alter emotion regulation through behavioural tendencies and neurophysiological changes, including situation selection (by reducing energy and activity levels), attention (by increasing selective attention to negative stimuli), cognitive appraisal (by promoting overgeneralized conservative responses) and behavioural response (by increasing amplified and maladaptive emotional responses) [58, 61].

Psychophysiological data suggest that adolescence is a particularly vulnerable period for sleep deprivation as compared with adulthood. In this regard, using computerized acoustic analysis, a study found that sleep-deprived adolescents display fewer positive emotions as compared to adults [116]. Unfortunately, there is still a paucity of experimental and longitudinal sleep deprivation studies on adolescents, making it difficult to determine the degree to which psychophysiological consequences of sleep loss overlap (or not) in adolescents and adults [63, 72]. In addition to the well-assessed role of REM sleep in emotions, an under-investigated role, both for the correct maturation of adolescent brain and, consequently, emotion regulation and well-being, may be played by specific features of NREM sleep, like slow waves, SSO and sleep spindles [62]. Again, no study has directly investigated adolescent NREM sleep features in relation to emotion

regulation (but see [119] for sleep spindles in adults). This can be a promising line of research for the future: the study of sleep features in healthy sleep and sleep loss may provide a unique window onto adolescent cortical maturation, emotion regulation and well-being [62, 63].

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Adolescents in the 21st Century: Back to Dialogue from Marked Lives vs Dreamed Lives

Marco Braghero

9.1 Twenty-First-Century Adolescents

The kaleidoscope of adolescents shows very ambivalent and ambiguous images and representations: teens who love “hit and run,” instant gratification and then move on to something else, convinced that they can have everything and do anything, totally disconnected from the consequences of their actions; but also teens immersed in reflexive depth, consisting of experiences, who want to be present, to be the stars, often without knowing how. And between these two images, there appears to be a gap that can never be bridged, the impossibility to connect the principle of pleasure with the principle of reality. Furthermore, the digital revolution has convinced the youngest generations that everything must be easy and immediate.

For a long time, psychology has been using the word adolescent with two meanings: as that phase in time between puberty and adulthood, and as a recursive mode of the psyche whose features (uncertainty, anxiety for the future, irruption of drives, need for reassurances and, at the same time, freedom) can appear various times in one’s life experience. In both meanings, the leitmotif is represented by the concept of transformation that implies changes at various levels: sexual, cognitive, identity, morality, and sociality [1]. In the past decades, the second meaning has become more relevant, and uncertainty of change between fear and expectation is one of its fundamental traits. This model of adolescence, created by psychology and psychoanalysis starting from the early 1900s, now appears to be inappropriate for describing the time of passage from childhood to the adult age. The physiognomy of adolescents appears to have changed. In particular, deep social and cultural changes that have affected the past 70 years, the first and foremost, the digital revolution,

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have progressively reshaped the features of the successive generations. In our age, adolescence goes well beyond the age of 20; sometimes, it seems to never end. We need to wonder if the adolescence of psychology essays still exists or if we should redefine that age through the multiple changes it expresses.

Now, as in the past century, every day, during the same day, an adolescent can go from unwavering certainties to be everything and to be able to do anything, to suffer a true identity crisis, even panic in some cases, with respect to sudden existential doubts. These images, like in a kaleidoscope, mix and blur: shallow, perfect, and round in their uncertainties and others that suddenly enter causing confusion, more reflexive and profound images, yet unknown and unexpected. But today, adolescents have lost the models, institutions, and adults of reference.

As Bauman points out, sudden and irresolvable moral issues arise, and “the opposition between the possible and impossible has replaced the antinomy between what is allowed and what is prohibited” [2]. Sometimes with a poor awareness that there is a difference between just and unjust, sometimes they do not know how to deal with a moral problem. They are not immoral, rather morally illiterate and affection illiterate. Who has the responsibility for this illiteracy? Families and the school still represent the main resources that children have available, but, at the same time, institution and adults are also the main culprits for the nondevelopment of emotional intelligence, of ethical illiteracy, and of many failures, some of which tragic. The responsibility lies with those who told children that responsibilities are a problem, whereas they are the yardstick to measure one’s growth. Responsibilities and the ability to take one’s life into one’s own hands define an adult being and differentiate him from a teen. The iniquity of this millennium, according to Massimo Ammaniti, is not the new generations but the “Adultescents”, eternal 40-year-old adolescents. These adolescent-adults are the outcome of a consumer culture. Their age ranges between 30 and 45 years. Born in the age of the economic boom, they have followed life values and models increasingly far from the paradigm of responsibilities and of commitment. “An Adultescent” is tied to a way of living where the complexities of moral values and of the family have an abstract meaning. Children of “Adultescent” parents are suffering the most because they are obliged to look elsewhere for models to follow. There is no sense of responsibility toward others or the society hosting them. Their only objective is to appear better than they are. The aim to “appear” only causes dissatisfaction, family problems, loneliness, unrestrained consumerism, and a poor sense of responsibility. Professor Ammaniti maintains that there is a high level of fear of the future by new generations because of a direct responsibility of current Adultescents and of the Institutions which are unable to respond to the needs of the young generations [3].

For these and for many other reasons, the topic of a “new educational alliance” has become central for the well-being of adolescents even before school or training successes and so that the school functions well. The relation and strategic significance of the alliance have been proved by references to the constitution charter, by current regulations, in statements and European maps, and in the widespread and multiple international literature.

The 2012 National Indications maintained the need to build an educational alliance with parents, and pointed out that these relationships should not arise just in critical moments but remain constant, acknowledging mutual roles and supporting each other in their common educational goals. This principle is also enshrined in the Italian Constitution (art. 30) while mutually respecting the different roles and educational environments, and with the other social groups where everybody's personality emerges (Article 2). The Charter of rights and duties of parents in Europe prepared by the European Parents Association (EPA) states that parents must work together: in schools, with schools, and points out in art. 3 that they have the duty to commit themselves as partners in education in those schools their children attend, but also the right to access all the information within the educational institutions that deal with their children. The Charter also gives parents the right to exert influence in their children's schools' policies. In the Declaration of Zaragoza for education and training (2008), at clause 6, it is maintained that there must be a continuous and active partnership and a participation of families in the educational process of their children, and similarly, respect for and support to teachers. Finally, active participation of parents in the life of the school is a resource we cannot give up, but its practical implementation has many obscure elements. For example, the most recent data about parent participation in the election of the Joint Bodies are a good indicator: only 7%. For many years now, it has been stated the need to redefine and reestablish them, but, with the varied and multiple reforms one after another in the past two decades, there has never been the courage to face the issue. Pietropolli Charmet describes the change that has occurred in Italy as the transition from the regulatory to the affective family [4]. The first was characterized by formal and distant relations, by precise role definitions, and by a robust paternal authority aimed at passing on values, rules, and principles, that required obedience, submission, and conformism. This meant that children felt a strong desire for freedom, also characterized by a high level of conflict. All this has disappeared. The affective family, the modern one, is characterized by the central role of children and by an over-investment in them. Relations are characterized by a symmetry of roles and by complicity with a major reduction in intergenerational conflicts. The parent's objective is to supply love, support, safety, meeting all needs. Children in this family are hyper-protected, barely exposed to frustrations, and this makes them particularly fragile and vulnerable. It is absolutely necessary to avoid that children suffer damage, that they feel offended, and that the image that has been patiently built of them is questioned. They are fragile children because they are exposed to the disappointment resulting from the gap between expectations of acknowledgment and the real treatment by teachers, peers, and parents. They are fragile because they are pained by humiliation and by the risk of being too often ashamed of their body and of their, sometimes unsolvable, social invisibility.

The world of school is stiff, rigid, and this has caused a sharp divide between the school and adolescents. With its current model, the school is not able to "engage" adolescents.

Why do adolescents not see the school as an opportunity for self-fulfillment rather than, often, as a boring obstacle in their life? They certainly no longer assign

a historical or symbolic meaning to the school, nor an institutional meaning. Without these meanings, a teacher entering the class no longer represents anything but himself in the eyes of the child, and everyday, he must laboriously regain his authority. Also having an effect is the fact that parents, in the first place, when exercising their parental function, have emptied their role of symbolic meanings. If the family has left children to define the rules of the family, they will try to dictate the rules also at school. Without this symbolic meaning assigned to the school, an adolescent does not feel any guilt and is not afraid of any punishment by the school. Ethics has been superseded by appearance. During classes, an adolescent ignores what is happening, because he is working on the creation and maintenance of his image, adapting his body to it, with the only purpose of becoming popular at school, in his community; it is not the most skilled who will be rewarded, but the “coolest” who will pass all competitions. An adolescent lives in a state of lack of confidence in himself and in the future.

School is increasingly perceived as a sort of hypermarket that must satisfy “customers,” who will be ready to state their case because, after all, customers are always right.

A teacher can regenerate the relationship, can still attract and affect adolescents with passion more than with severity, with the richness and beauty of knowledge, through the emotions and the erotic in the learning–teaching process, already mentioned by Platone [5]. Not falling in love as an experience that emulates the symbiosis between mother and child, that feeds on filling an absence, but love which is an active, creative, and generative movement [6]. The methods used matter and make the difference; it is necessary to establish a learning environment that connects with adolescents. School must respect what the student already is, without any will to change him, to destroy the project that he has about himself. True school reform should be made around relationships. Adolescents seek and need adults at home and at school. Also, systematic bullying finds nourishment in loneliness, in the lack of authoritative adults of reference, in the inability to set up relationships outside the virtual world. Cyber-bullying is violent because it is very fast and extensive. School, in terms of educational alliance, is a location which is always there and active, that can have the bully perceive himself as a resource for his schoolmates, that can dismantle fears and set up significant networks and relationships. Teachers, without turning themselves into psychotherapists, can be coach-facilitators and mediators of reality.

Despite numerous research projects [7]¹ and all current regulations, we have not been able so far to build a new paradigm that can trigger a new alliance to anticipate, contain, and stop school truancy, which proves the failure of our educational system, especially in terms of relations.

Since 1995, 3.5 million students have left public schools out of more than 11 million students registered at higher schools (–30.6%). Boys and girls who have

¹Mai Stafford della Medical Research Council’s Lifelong Health and Ageing unit (University College di Londra), “l’iperprotettività dei genitori verso i figli, soprattutto durante il periodo dell’infanzia e della crescita, può causare loro dei danni psicologici permanenti da adulti”.

disappeared from the school radar, which, in this respect, reminds us of the notorious failings of the Italian water network that loses 35% of the water it carries: little more than a sieve [8].

The cost is huge: €55 billion. And the hemorrhaging continues: at least 130,000 adolescents who start higher schools will not get to the diploma. They will end up in the statistics according to which, two Italians out of five have no more than a junior high school diploma and of one young adult out of four who does not study or work.

And high school education? Among those who have a diploma and enter university, one out of two will not make it. In total, out of 100 registered at high schools, only 18 graduate. But then a quarter of graduates work abroad ... And 38% of diploma or degree-holders who remain do not find a job in line with the level of their curriculums. A disaster.

Yet, education is cost-effective: unemployment among those with junior high school license is almost twice compared to those who achieved their diploma and almost four times as much as those with a degree; education affects health, reducing healthcare costs; it implies less criminality and lower costs for security.

Finally, preventing truancy would have much lower costs than those resulting from the need to manage its social consequences. Despite this, today, attention focuses more on the million migrants who have come in the past 20 years than on the three and a half million Italian adolescents who in the same period have abandoned school, making our country poorer in educational terms and not only. A big multiannual plan is necessary, a “Marshall plan” for education, a new educational alliance before a “Nuremberg” is organized for education, which would probably condemn all of us: parents, families, teachers, experts, politicians, and adults.

“School has only one problem. The children it loses.” This was written half a century ago by don Milani in “Letter to a teacher,” but even today that “problem” continues to weaken—as a major hemorrhage that we have been unable to stop for decades—the youngest tissues and arteries of Italian society [9].

Would you like to have tangible proof, not recent, but current and projected in the next few years? Well, of 590,000 adolescents who have started state high schools, full of hopes and projects, at least 130,000 will not get to their diploma. Puff, disappeared. They will throw in the towel. Desaparecidos of the next desk [8].

Children want to be there, they want to show us what they can do, though often they do it wrong. They need adults who help them grow, who take educational responsibility.

In other terms, the crisis of adolescence that appears to be deferred to a later date, now appears to be experienced mainly by parents and teachers, who suddenly come in touch with a child or a pupil who has often become ungovernable, or rather that they discover has always been ungovernable, an alien. But now, he is no longer a child and his reach is wider, his “superpowers” have matured and he is well out of the bounds of control. It is not by chance that there is a strong demand for severity and iron fist on the behavior of some (many) adolescents that no one believes to be able to face.

Unfortunately, however, this demand for intransigence more often deals with other children. Unfortunately, too often, every adult asks other adults, hardly ever themselves, to be respected, to be intransigent, severe, able to manage them. This triggers and feeds a vicious circle of “false delegation” which strengthens instead an inconsistent and unreliable image of an adult, who ends up fostering the impossibility to govern the situation. In recent years, an increasing demand has developed for specialist actions, especially of a medical, psychosocial, and police type. Adolescence and education is progressively becoming “clinical,” is treated as a disease, as a crime, and not as an educational emergency, which it is, as if adults—in their specific roles—had surrendered. The recipient of the educational action is becoming more and more the adult, the parent, the teacher, or the professional, rather than the adolescent for whom the action had been initially conceived and addressed.

The delicate relationship between parents and children, between family and school, highlights just how much increasingly complex social contexts find it difficult to listen to each other and to share taking care. This distance generates an empty space between social-educational players, in which young people live and their unease develops, increasingly often submersed and unknown. When the common objective is the regeneration of a human and educational path of the child-student, the reconstruction of trust bonds between family and school is strategic and functional. Generating a new educational alliance on the background of an idea of school based on dialogue and participation, conceived as a true educating community, imposes a pedagogy of hope.

A pedagogy that enables us to connect with the real experiences that children live today. A pedagogy that offers tools to face the revolutions of the twenty-first century: digital and biotechnological, that can offer valid training able to fight the “biopower,” as Foucault calls it, unable to critically think of diversity [10]. A pedagogy that enables the construction of horizons of meaning, to expand and increase humanity. A pedagogy that offers a valid alternative to the now too invasive pedagogy of skills that, as Benasayag says, often has only the objective of “selling” to students useful skills for the market, for a monodimensional macroeconomy.

We adults are still in time to offer children a pedagogy that is “an invitation to knowledge and to life.” This invitation is the fact that children can, little by little, discover at the same time the world and their inner world. That is to say that children can discover the elective affinities, the tropisms, and the desires that are its foundations and that give it a specific structure and then through their singularity, their way of being in the world, they can include the world in their lives and learn to try to change it. Education has always implied this integration between individualities and the world. The school should offer its students the possibility and the ability to take the multiple viewpoints to observe reality. Besides, current macroeconomic paradigms that push pedagogy for skills are likely not to drive the future of children who are now attending our schools [11]. Competences boiled down to mere function represent a very bad way of interpreting the conscious fullness to be able to appreciate the “moment now” [12] and as Francesco Piccolo would say, to be able to live “moments of negligible happiness” [13]. The pedagogy of hope, instead, develops competences of life and planetary citizenship and is aimed at fighting the drift of the construction of permanently living in the oblivion of ourselves, of humans without

interiority, without subjectivity, without elective affinities, a “man without qualities” as Robert Musil aptly described already in 1905 [14].

9.2 Co-constructing a New Educational Alliance in the Age of Change

In this chapter, we will focus our attention on how to build the educational alliance between school-student-families as an opportunity for well-being for each and everyone. This alliance is our hope for the future.

This chapter is the outcome of experiences and practices in recent years that have shown the importance of generating a new educational alliance between institutions, operators, and families. Building a new alliance with the direct participation of children can set the foundation for a progressive improvement of intergenerational relationships, and above all, can give us the opportunity to tackle together the huge challenges of the twenty-first century, the two revolutions under way: biotechnological and IT. Besides, we must be equipped to meet the increasingly urgent environmental needs of our planet. We are in a true educational emergency, searching new paradigms for the construction of “significant communities.” In the construction of this “new alliance” an element to take into account is the formidable generational leap under way. Actually, since 2018, for the first time, all children in schools will belong to the twenty-first century and therefore belong entirely to the digital culture. If we also want to include those students who have repeated school years, we would not go beyond 1996, therefore, all digital natives. This means that the analogue generations of mothers, fathers, and teachers are in a big educational, communication, and value impasse.

As Cattaneo and Torrero state well [15]:

... that the school today must first and foremost educate, and that it can teach only by educating is a revolutionary statement [...]. The idea that the school must first and foremost educate has the advantage of dealing with the root causes of the problem, but it has required a huge effort in terms of ideas and organization. What does it mean to educate the heart of a generation of children withered by the world of technique and consumption? [15]

Humans are experiencing revolutions at an unprecedented speed, no new narration has emerged so far to take the place of the “old stories” that no longer represent contemporary reality. The urgent educational emergency poses a question: how can we prepare ourselves, and especially our children, to face and live in a world turned upside down by completely new and overwhelming changes and constant uncertainties?

Those who are born now will be more than thirty in 2050, and if they are lucky, they will see the rise of the twenty-second century and be their citizens. What can we teach to these children to help them not just survive but live their time to the full? What professional skills will they need to find a job, understand and be aware of what happens around them and be able to orient themselves? None of us knows what 2050 will be like; we have no answers. What can we do then? Now that changes are so sudden that the time of discoveries is shorter, now that technology offers us the

possibility and the technical tools to change our bodies, our brain, and our mind we can no longer be sure of anything—not even what once appeared to be immutable forever. Until 50 years ago, most humans were fairly convinced that the main features of society would not change, and apart from natural events and wars, nothing would change with respect to the fundamental principles on which our educational systems are based and on how to educate children. Actually, while the world has changed, the school has undergone poor and insignificant changes. If we compare the various images of postmodernity (airplanes, telephones, cars, but also hospitals, various devices) nothing stays the same more than the pictures of the school, classrooms, desks, even blackboards, though sometimes they are LIM, often, too often, the old slate blackboards are still used. We do not know what people will do to make a living, we do not know how institutions or bureaucracies will work, we do not know what culture and custom will drive relationships, and we do not know its paradigms. It is very likely that people will live much longer than today, and the human body might become object of an unprecedented revolution thanks to bioengineering and brain–computer interfaces. Therefore, a large part of what we teach today to children might be totally obsolete and irrelevant by 2050. Many of our students experience and often show this feeling, though unaware. What is the meaning of their relationship with adults? What is the meaning of what they are requested to learn? What is the meaning of their being at school? What reasons do they have to take part in their educational process? What we know is that if humanity still wants to be the protagonist of its future, it must count even more on the interdependence of relations, on the possibility to generate and experience existential polyphonies [16].

When educational systems established themselves in modern times, this was huge progress not only for teaching, but also and especially for society. The impact of educational systems on the modern world was huge. But in the twenty-first century, we are overwhelmed by a flood of information and notions and also much bad information and what is called “fake news.” No government, no nation manages and can hope to stop, limit, censor, or curb the information flood which consists of contradictory documents and also vulgar and repeated lies. In such a scenario, the last thing the school must do is to give additional information to its pupils. Children need tools and critical thinking to interpret information, to distinguish what is significant from what is irrelevant, and above all to be able to find orientation and put all this information into a wide global vision. This is actually the mission that Western schools have been pursuing for a long time without being able to reach satisfactory results. Now the time is over! If our educational systems do not manage to offer to the next generations an overall vision of the cosmos, the future of life will be decided by chance, or rather by algorithms, by biotechnologies, new generations risk to be objects of biopower, dumb waiters of technology. That is why educational decisions we take today will affect the future as has never occurred in past centuries.

What are we supposed to teach? Many educationalists try to state the approach of future teaching with four “Cs”: critical ability, communication, collaboration, and creativity. Therefore, in practice, reducing specific disciplinary technical knowledge and developing useful abilities to life in general, what we can call interdisciplinary or key competences.

I believe that while I think those competences are fundamental, there are two additional competences on which our next educational politics and actions should focus: dialogue, with everything it includes and that we will see, and the ability to manage change, learning new things and keeping control in emergency situations. Disruption and uncertainty will be the feature of the future reality, whose only inescapable certainty will be continuous and sudden change.

Change, of which adolescents have always been in the forefront despite themselves, is nearly always stressful, and after a certain age, most people are no longer able to face new challenges and new situations. The future has already now in store continuous changes, continuous transformations, and developing emotional intelligence becomes necessary and fundamental. The most urgent problem that educational systems must face is relations. The “relationship” has always been an object of attention of philosophy, poetry, and literature and has now become the object of study also of neurosciences, of neurobiology, of quantum physics, but it does not yet find a place in school curricula; not as a subject, of course, but as a cornerstone on which to build educational and training processes.

Quantum physics teaches us that life, reality is relation. This theory does not describe how things “are”: it describes how things “happen” and “influence each other.” It does not describe where a particle is, but where a particle “lets itself be seen by others.”

The world of existing things is “boiled down” to the way of possible interactions. Reality is “boiled down” to interaction. Reality is “boiled down” to relation. There is no reality, in the world described by quantum mechanics, without relationship between the various systems.

Things cannot enter relationships; rather, relationships originate things. Nature events are always interactions. All the events of a system are necessary to another system [17].

Quantum physics has taught us not to think in terms of things that are in one state or another, rather in terms of processes. It is time that the school deals with the relationship, and the co-construction of the processes of the educational alliance has its foundations in a dialogue-based approach.

The process we implement, through a dialogue-based approach promotes-develops-accelerates-integrates-supports-takes care of the relationships between and with people, between and with the different parts of the system, opening to other systems. It is an inclusive, innovative, dynamic, and continuous process that needs the development and care of emotional intelligence. Among the various research projects on emotional intelligence, we mention the project carried out more than 30 years ago by Davidson.

The six domains of emotional intelligence suggested by Davidson, which are alone worth the construction of the curriculum are as follows: perspective, social intelligence, self-awareness, sensitivity to the context, attention and resilience [18]. It is precisely the last of these that faced with the continuous transformations and the turbulent change processes take on a vital meaning. Teaching children to live in the uncertainty and to keep their mental balance in front of a “non thinkable” future is decidedly more difficult than teaching them equations, the use of the radical

orist, or the causes of a world war. Unfortunately, you do not learn to be resilient by reading a book or by participating in workshops. This is difficult for teachers, a mission that appears to be impossible, since they are products themselves of a world that is disappearing and that anyway has lost its certainties. The educational paradigm is still the one that was the outcome of the industrial revolution: control—fear, assembly line type, a large building with the same identical rooms, inside these rooms, benches, chairs, teacher's desk, and blackboard. At the sound of the bell, you enter one of these rooms together with some 30 children who were born, more or less, in the same year. Every hour some adults enter the room, they follow each other and talk about different things, often with no connections with each other. This model has not been working for some time now, but apart, a few praiseworthy experiments which are not operational yet, an alternative has still not been found.

Following adults, in the past, was a relatively easy and safe decision, and the world was changing slowly. The twenty-first century will be different. Because of the sudden changes and transformations under way, children will never be able to be sure that what is told them is wisdom or ideological bias, or obsolete knowledge. What can young people rely on? Technology? Technology can be very helpful, but if it earns too much power in people's lives, the actual risk is that the same people become hostages that depend on its programs. A new educational alliance must offer children the necessary thinking and tools that will give them the opportunity to run faster than algorithms, if we want future generations to have a minimum of conscious control on their individual life and on the future of life.

Therefore, faced with these difficulties and the progressive disintegration of human communities, there emerges the need to deal with this uncertainty together, regenerating the human community.

This regeneration can start from small local communities, from families, from schools and institutions that deal with young people for various reasons. This process, with variable geography and geometry, begins by becoming aware of this emergency, with the ability to question oneself, to ask oneself open-ended questions on what can be done differently, something that has not been tried yet or on what is working elsewhere. Awareness implies attentive and generous and profound listening to oneself and to the other/others who always, whether they are aware of it or not, pose questions to us. The construction of this new alliance goes from building respect, with a specific attention to the climate of the group and of the context and of its "enriched environment." This is an inclusive process aimed at building trust and at building shared responsibilities. A dialogue-based approach that includes all this, as we can see, can be a powerful "counter-device" [19] capable of facing the educational emergency in which we find ourselves and capable of offering other viewpoints, other paradigms to the educating community where old devices, still under way, are no longer able to face the reality of the twenty-first century. This counter-device represents an opportunity to promote, favor, and generate a new educational alliance.

In order to implement this new educational alliance, significant networks must be set up locally, with the participation of all subjects who, for various reasons, work with and for adolescents. These networks can already be easily set up in Italy with current laws. There is no need to wait for another new Law, no "unprecedented

reform.” It is possible to proceed “local by local” with local governance tools that have already been used: area plans, local agreements, program agreements ... In addition, it is strategically important to give some sense and to develop the participation in every government document that the various institutions “must” prepare. For example, with respect to schools: the School Regulation, the 3-year plan of Training Offer (PTOF), the RAV (or self-assessment report) with objectives, actions and an improvement plan, the Co-liability agreement, the PDP or Customized Educational Plan (also called PEP), the PEI Individualized Educational Plan ... all these documents can only be “hateful” and useless fulfillments or be occasions and opportunities to co-construct the new alliances.

Network governance, in particular of local networks, does not come from above, nor below, that is bottom up, rather is in the ability to stay “in between,” that is, of those who are at the center to mediate, connect, innovate, train, communicate; in one word, network strength is in the “middle,” as Bruno Latour suggests [20]. We believe that the governance of today and of the next 10/20 years needs people who are able to stay in the middle, and who are able to stay there based on dialogue.

Let us think of the creation of new forms of educational alliances as an opportunity, as perspective for the development of many people who try to work in networks and in their governance.

A dialogue-based approach contributes to change paradigms of reference: from the paradigms of control and fear, it allows us to pass to the paradigms of responsibility, of commitment, and of understanding.

A new educational alliance has a polyarchic and polycentric nature, meaning that from time to time central action and focus shifts to various players: the schoolmaster, teaching staff, non-teaching staff, students, families, the various other systems involved, and the other local stakeholders. But, in this polyarchic and situational and transformational polycentrism, our look that must never be absent is that which sees students as the main players in all educational actions and policies. The main players, not because adults want it but because children find reasons and meaning in becoming the chief agents of their lives.

The school as a fundamental local institution, takes very many decisions every day, very often unconsciously and that affect the lives of adolescents and their families.

An educational alliance co-builds an autonomous school, co-managed by managers, teachers, students, parents, local stakeholders who are able to define the objects of the educational project and able to negotiate funds with national and/or local school authorities.

An educational alliance contributes to overcome the stiffness of the school, the first cause of truancy, also by means of higher customization of educational pathways. Customization able to enhance individual talents and develop group potential. School systems, like in Italy, that offer only “set menu packages,” explains Ichino, “are a legacy of a class-based society that does not want social mobility. They are also unfit for an increasingly uncertain world, that requires time to understand where to search for work and what is required in order to be adequately prepared” [21].

One of the features of customized curricula will be that of being constructed also by subjects chosen by the students after an initial exploring and orientation stage led

by teachers. Only subsequently are they obliged to decide, again with the support of teachers, in which subjects to continue with advanced studies and where only mandatory basic courses should be maintained.

The full awareness of this action is a first facilitating element for the co-construction of educational alliance. In this respect, as we shall see, mindfulness practices are very helpful [22]. Self-awareness, as Goleman says, is a starting point for the development of emotional and social intelligence [23]. Awareness helps us co-construct alliances able to second, develop, and “guide” autonomy, self-assessment, self-care by students and families; to develop a sense for collective cooperation, for working together, for peer-to-peer practices and experiences. An alliance able to anticipate problems, to take on concerns as a constitutive element of our educational action. Concerns understood as being able to constructively deal with what is going on. Capable of becoming a constructor of the future, of being able to imagine the future starting from the present, as it is with that which emerges and what is available. Capable of reading the various educational responsibilities. In serious and urgent crisis periods, which, however, represent only a minor percentage of the cases, relying almost entirely on the competence of professionals of education. In these cases, the central position of decision-making power will be in the hands of school managers, teachers, and other professionals. But in all other situations, the central position for decision-making and for actions will be shared and will feature the participation of all actors.

It is therefore necessary to overturn the usual pattern and reverse direction, and the work of a school that wants to generate a new educational alliance proceeds as follows:

- Preparing spaces and times for generous and profound listening.
- Putting at the center the potential of adolescents and their families and not the issues and/or the things that do not go well or that they are not able to do.
- Giving credit and substance to the subjectivity and experience of adolescents and their families.
- Involving family members, figures of reference, and the teaching community from the outset.
- Dealing in advance with possible issues at source.
- Preparing its own internal organization pursuant to current regulations, in terms of spaces, times, and opportunities to implement an encounter and the co-construction of the educational alliance.

An alliance aimed at the community is educational practice, regardless of who is making it, its methods, its theoretical background and professionalism, because it is a set of activities that generate learning, that is, education, therefore, the typical focus of attention of pedagogy.

The direct participation of all stakeholders is a methodological necessity, since no one is invincible in front of the complex problems of such a complex society.

The care must therefore not be the exclusive of specialists, but it must be shared by all, child included, bearing in mind that it is not the quantity of actions that one implements that generates a successful pathway, but their quality.

To facilitate everybody’s involvement, it is important that the “coach-facilitator” teacher is able to precisely clarify the reasons that lead to take such an action, expressing these concepts with words having a shared meaning.

Participation in a project and its sustainability are based also on the possibility to understand the language and on value sharing.

Today, there are multiple values that unfortunately conflict, therefore, it is more difficult to find principles that are shared a priori. Expressing, negotiating, and suspending any judgment is the road to take to try to find shared ways of working.

The school manager and teachers are the most expert when the issue is the cultural legacy that schools try to convey, but managers and teachers do not experience the same life of their pupils and do not share their future (Box 9.1).

An adolescent is therefore both familiar and foreign, a mystery to which a dialogue-based relationship can do justice, in the mutual learning of asymmetrical relationships that become symmetrical through dialogue [24].

Box 9.1 The Role of the SCHOOL in the Alliance Process

1	Facilitate dialogue, promote, facilitate, and guard relationships.
2	Strengthen emotional intelligence to work for the full development of the human being.
3	Foster the school success of all students acknowledging and enhancing all the diversities (social, economic, cultural, linguistic, religious, sexual, political...) in order to ensure and promote dignity and equality among all students.
4	Teach to put together the great objects of knowledge within a complex perspective: promote the typical knowledge of a new humanism, foster independence of practice and thought in students.
5	Teach to learn how to learn and the life skills of a citizen of the Earth and develop awareness with respect to the big issues.
6	Promote, participate, and share the definition of the shared responsibility covenant.
7	Make students acquire the necessary thought instruments to learn to select information.
8	Promote in students the ability to find and process methods and categories that orient their personal paths.
The role of the FAMILY in the alliance process	
1	Observe systematically.
2	Know how to separate listening and talking (dialogue narration).
3	Stimulate critical and metacognitive reflection on experience.
4	Suggest significant emotional/affective experiences.
5	Stimulate experimenting all expressive languages (language, body, image, drawing, music, exploration of reality).
6	Reassure and include in a system of expressed and shared rules.
7	Share and participate in writing the Shared Responsibility Covenant.
The role of the STUDENT in the alliance process	
1	Be willing to always keep the dialogue open.
2	Be an active part in the learning-teaching process.
3	Work together with peers for the success of the group.
4	Promote a critical reflection on well-being in class and outside.
5	Share and participate in writing the shared responsibility covenant.
6	Share and participate in writing class rules.
7	Be actively committed in the self-assessment process.

9.3 Dialogic Practice for a Generative Educational Alliance: An Overview

“Dialogicity, as Arnkil and Seikkula maintain, is not a method, nor a set of techniques, but is an attitude, a way of seeing that is based on recognizing and respecting the otherness of the other and addressing it” [25].

And also, as Ivana Markova says, dialogicity as “social and psychological human ability to let yourself be involved in thinking and communicating together” [26, 27].

Dialogue practices are a supporting and (accompanying) process to increase the deployment of the potential of the person, to achieve his fullness (full completion) through the expansion (revelation) of his awareness (conscience), of a greater responsibility, through the commitment of the action and the construction of significant relationships and by meeting with the environment.

Dialogue practices require “responsiveness” (the ability to give prompt, sensitive, conscious and knowledgeable responses), not just following preset guidelines.

By means of a dialogue-based approach, dialogue can be generated embracing and following the way of living and the language of all the members of the teaching community, be they teachers, students, families and/or social network organizations, completely, entirely, without exceptions or bias. This is not easy, while at the same time challenging and generative.

The paradox of dialogue lies in its simultaneous simplicity and complexity. It is as easy as life and it is also complex, just like life. But dialogue, as Bachtin maintains, is something from which we cannot escape, since dialogue is life itself:

... Open Dialogue is true human life. In its true nature, life is dialogic. Living means participating in dialogue: asking, giving feedback, answering, agreeing and much more... In the dialogue, people participate fully and through their entire lives: with their eyes, their lips, their hands, their souls, their spirits, with all their bodies and all their minds; they invest all of themselves in talk and this talk enters the dialogic factory of human life [28].

The challenge for dialogicity is to generate and foster the space to be heard, “heard and answered” (responsiveness) also and especially in worrying situations. The challenge of dialogicity is developing the awareness that if we want, we can feel good!

Dialogic practice has therefore two fundamental features: (1) a systems of integrated educational care based on the local community with the involvement of family members and social networks from the very first moment help is requested and (2) a “dialogic practice,” consisting of the quality of educational interviews in meetings (class councils, talks with family members, school–family communications, orientation interviews, coaching sessions ...).

Meetings, “educational care” meetings are the key context for dialogic practices, putting together professionals and the family and social network of the educational community in a partnership. Thus, Dialogic Practice is included and integrated in a wider educational community service that shares its spaces and resources.

There are seven basic principles of dialogic practices, which are the guidelines that the Finnish team originally proposed (Box 9.2) [29].

Box 9.2 The Seven Principles of the Dialogue-Based Approach

1	Immediate help.
2	Social network perspective.
3	Flexibility and mobility.
4	Responsibility.
5	Educational continuity.
6	Tolerance of uncertainty.
7	Dialogue (Polyphony).

These seven principles are the wide range of values on which the 12 fidelity elements of Dialogic Practice focus with greater accuracy (Box 9.3).

Box 9.3 The 12 Key Elements to Evaluate the Fidelity of Dialogic Practices

1	Two (or more) teachers (facilitators) in meetings with families.
2	Participation of family and network.
3	Using open-ended questions.
4	Responding to what students say.
5	Emphasizing the present moment.
6	Eliciting multiple viewpoints.
7	Use of a relational focus in the dialogue.
8	Responding to a problem discourse of behavior in a matter-of-fact style and attentive do meanings.
9	Emphasizing the students’ own words and stories, not symptoms.
10	Conversation among professionals (reflections) in meetings with students and families.
11	Being transparent.
12	Tolerating uncertainty.

To be in a transformative dialogue with people requires *quality in a systemic presence*, and an attention to the “living moment” [12] without a preconceived hypothesis or specific agenda. The art and skill of Dialogic Practice means that the professionals’ communications are not formulaic or specific jargon, for example, the “language of education.” Dialogue involves being able to listen and adapt to the particular context and language of every exchange. For this reason, it is not possible here to make specific recommendations for sessions and meetings in advance, or for the alleged specific stages of the educational process. Prescribing this form of detailed structure could end up working against dialogue. It is the unique interaction among the members of a specific group of participants engaging in an inevitably idiosyncratic educational conversation that provides the possibilities for positive change.

At the same time, there are systematic elements of Dialogic Practice. In this way, there is a paradox. While every dialogue is unique, there are distinct elements or conversational actions on the part of the professionals that generate and promote the flow of dialogue, and in turn, help mobilize the resources of the persons at the center of concern and the network. This is what we mean by “key elements.”

Dialogic Practice is based on a special kind of interaction, in which the basic feature is that each participant feels heard and responded to. With an emphasis on listening and responding, dialogue fosters the coexistence of multiple, separate, and equally valid “voices,” within the treatment meeting. This multiplicity of voices within the network is what Bakhtin calls “polyphony.” In the context of a tense and severe crisis, this process can be complex, requiring sensitivity in bringing forth the voices of those who are silent, less vocal, hesitant, bewildered, or difficult to understand. Within a “polyphonic conversation,” there is space for each voice, thus reducing the gap between the so-called “sick” and “well.” The collaborative exchange among all the different voices weaves new, more shared ways of understanding, to which everyone contributes significantly. This results in a common experience which Bakhtin describes as “without hierarchy” [28].

As stated above, by calling a conversation “dialogic,” we mean specifically that the conversation has the potential for a person to feel heard, which is the beginning of any change. Evaluating the dialogical quality of a conversation means, first and foremost, evaluating the responsiveness of professionals. One of the first steps is often for one of the team members to engage with the person at the center of the issue-crisis in a careful, detailed, back-and-forth interchange. The purpose is to listen, and as necessary, assist in finding words for the person’s distress, rage, anguish, and feelings, otherwise embodied in symptoms, and evolve toward a common language. As illustrated below, having input from the group helps to shed further light on the nature of the crisis, of the issue-situation. The dialogical professional invites each person in the meeting to share their perspective and the various related issues that come up during the conversation. Instead of looking at professionals’ skills in terms of the way they conduct a structured interviewing methodology, the principal criterion is the, often personal, way the professionals respond to the issues expressed by the person involved and by those of others present in the meeting.

9.4 Responding and Reflecting

Teachers, “coach facilitators,” are required to have two types of fundamental skills to perform Dialogic Practice: the skill of responding and the skill of reflecting [30]. The skill of responding is a three-part process that applies to the way all the fidelity elements are employed (Box 9.3). This process must be present to call an exchange dialogical. While defining the quality of the coach-facilitator’s action, one has to look at (1) what is initially said by the child and/or the family; (2) the answer of the coach/es facilitator/s to those statements and (3) the reaction to the response given. How does the response of the coach-facilitator further the experience of each participant in being heard, understood, and acknowledged? How do these three steps generate dialogically responsive interaction?

The other basic skill of Dialogic Practice—the skill of reflecting—is the ability to engage in an open, participatory, transparent, and jargon-free conversation with the group and other professionals in the meeting. The skill of reflecting builds in the skill of responding.

“Reflecting” is different from how this same term is used in other forms of meetings and/or methods. In Dialogic Practice, this term refers to the way professionals talk about their own ideas in front of the children and their relatives. We have learned that this can be confusing since many professionals interested in Dialogic Practice have also been trained in the technique of motivational interviewing and in other reflexive methods.

A dialogic meeting includes both monological and dialogical communication. The “monological” sequences in dialogue are necessary to make practical agreements, or to gain new information that can assist in a better and more complete understanding of the situation. By monological communication, we mean that there are sequences in which the professionals themselves introduce conversational topics. Such sequences can comprise collecting information, providing advice, action planning, or otherwise initiating new subjects for discussion that do not build on what participants previously had said [31]. In a dialogical educational meeting, up to a third of the conversation can be monological, to stay consistent with the approach and conduct an effective meeting. Monologue can refer to the rules of the game, the nature of communication, or be within the social network or be that between the experts and the network. That said, there is a difference between monological communication described above and what is meant by the term “monological discourse.” The latter refers to an institutional way of talking in which there is a privileged, top-down expert without a contributing listener. Instead of sustaining a dialogue among the various participants, all of whom are regarded as legitimate and equal, an entirely monological approach works against a more collaborative process that can lead to new ideas and creativity. In explaining this contrast further, it is helpful to refer to John Shotter’s translation of “dialogical” versus “monological” [32] discourse into the more accessible terms of “witness thinking” versus “aboutness thinking” [33]. In our experience, this former way of thinking and practice has tended to open up more possibilities in crises and to help “unfreeze” situations from becoming chronic.

In Box 9.3, there is a list of the fidelity elements of Dialogic Practice. These elements deserve an analysis that cannot be the object of this article. Each meeting, each session includes these elements. These 12-fidelity elements are not separate but often overlap and occur simultaneously in actual practice.

9.5 Dialogic Practices to Change Paradigm

The use of dialogic approach accompanies the PTOF of the School and fosters overall integration. Dialogic practices enable and facilitate an improvement in internal and external communication between teachers, school, and students/families, between class and class and inside the same classes and courses; and is oriented to a “creative and non-violent” management of conflicts, allowing to return to education.

Everyone has a unique place inside the fabric of one's relations and nobody else can take exactly the same position [32].

Therefore, any perspective is unique and different.

The other (the other as a unique person) is always more than one can ever grasp. It is this foreignness, difference of the otherness that makes dialogue necessary-possible [34].

A dialogic approach allows to explore new paradigms. It facilitates passing from the paradigm of control and fear to that of responsibility, commitment and understanding.

Dialogical meetings follow simple rules (Box 9.4) and give attention to some facilitating aspects (Box 9.5).

Box 9.4 A Few Simple Rules for Dialogic Meetings

1	Active and generous listening.
2	Do not interrupt and speak over the other.
3	Accept polyphony and the emergent.
4	Tolerate uncertainty.
5	Respect silence.
6	Respect symmetrical-asymmetry.
7	Talk in the first person.
8	Consistency between body-language-emotions-actions.
9	Be capable of responsiveness.
10	Suspend judgment.
11	Suspend interpretations and advice.
12	Learn to ask open-ended questions.
13	Offer feedback.
14	Reflect and summarize using the language of our counterparts.
15	Consider that the other is always the "expert" of his/her situation.
16	Revelation.
17	Be in what you feel and experience by "revealing yourself"

Box 9.5 Facilitating Aspects in Practice

1	Invite the many <i>voices of the network</i> .
2	Use a reflexive structure delaying comments and <i>separating talking from listening</i> .
3	Follow what participants prefer in terms of topics and language <i>echoing from time to time what is being said (summarize: incarnated word)</i> .
4	<i>Everyone should talk using the first person</i> (rather than representing a general view).
5	Prefer open-ended questions that invite to respond (rather than finite statements such as "this is what things are").
6	<i>Focus on the "here and now"</i> (rather than orienting the discussion toward a preset objective or dwelling on the past).
7	<i>Aim for concrete plans with subsequent steps to take together</i> (rather than common general explanations).

9.6 Being Dialogical = Well-Being (Box 9.6)

Dialogical practices introduce radical change: the possibility to meet colleagues, students, and families as human beings in their fullness, in a process which does not consist of strategic actions that aim at changing other people.

Box 9.6 Being “More Dialogical” Means Being More Present in the Here and Now. Below are a Few Simple Guidelines, Suggested by Arnkil and Seikkula, to Take into Account: Facilitating Practice

- | | |
|---|--|
| 1 | Give preference to topics that deal with the present moment, rather than relying on stories of the past. |
| 2 | While taking professional obligations into account, follow the stories of the users and focus on your openings. It is useful to respond repeating word by word what was said, then asking to tell something more about it. |
| 3 | Responsiveness: guarantee an answer to what is being said. Responses are concrete, global actions. There is nothing more terrible than remaining without an answer. |
| 4 | Note different voices, horizontal (oral) and vertical (inner). |
| 5 | Listen to the reactions of your body: difficult issues of human life cause emotional responses in the operator. |
| 6 | Take time to reflect with your colleagues in front of the users: this increases the transparency of the process and users can acquire a greater ability to act in it. |
| 7 | Make your statements dialogical: elicit responses, speak in first person. Dialogue is possible only between physically present people. |
| 8 | Proceed with calm, moments of silence are positive for dialogue: life is dialogical music. |

Why are dialogical practices effective (Box 9.7)?

Box 9.7 Why Are Dialogical Practices Effective?

- | | |
|----|--|
| 1 | It is an immediate response—using emotional and effective elements of the crisis and/or issue, an effective action against dropping out, favors the development of talent and potential, increases awareness in orientation processes, develops the overall well-being in the educational community. |
| 2 | The inclusion of the social network through polyphony of voices in horizontal and vertical terms. |
| 3 | Focus on dialogue in meetings: to take all voices into account and therefore work together. |
| 4 | Plans and builds shared actions during and after every meeting. |
| 5 | Develops individual and collective responsibility. |
| 6 | Makes relationships more responsive. |
| 7 | Promotes the transformation of culture and structure in the sense of dialogue. |
| 8 | Improves teaching and learning processes. |
| 9 | Assists in co-constructing, gives sense, substance, participation and sharing to the fundamental school documents: PTOF, School Regulation, RAV and Improvement Plan, Training Plan, Shared Responsibility Covenant, School–Family–Territory communication |
| 10 | Develops consistency between Languages—Emotions—Thoughts—Actions and improves learning organization processes. |

In addition, dialogical practices prove to be very effective for the development of key skills (Box 9.8).

Box 9.8 How Dialogical Practices Develop the 8 Key Skills

1	Listening (communicating and learning to learn).
2	The art of asking and receiving open-ended questions (communicating and learning to learn).
3	Problematize and reflect on educational processes (learning to learn and act autonomously and responsibly).
4	Anticipate and solve difficult situations and conflicts (solve problems and act autonomously and responsibly).
5	Implement and promote enriched, generative, innovative environments (plan, collaborate and participate, solve problems and act autonomously and responsibly).
6	Learn to work and cooperate together: build winning teams: from the class to the team (collaborate and participate, solve problems and act autonomously and responsibly).
7	Plan and orient the future (plan, define connections and relationships, acquire and interpret information, collaborate and participate).
8	Build educational alliances (define connections and relationships, acquire and interpret information, collaborate and participate, plan).

9.7 Dialogical Practices: Possible Steps and Tools (Box 9.9)

Are we trained to listen to each other? To express our emotions?

We cannot ask others what we are not able to do!

Box 9.9 Dialogical Instruments

1	Motivational interview (CM).
2	Open dialogue (OD).
3	Early open cooperation (EOC).
4	Reflexive dialogues (RD).
5	Dialogues from the future or remembering the future (FD).
6	Practicing intervision (peer supervision PS).
7	World Café.
8	Individual coaching (IC).
9	Relational mindfulness.

9.8 Early Open Cooperation (EOC)

9.8.1 It Teaches to “Use” Concerns: Generativity of Prevention

Generativity is therefore, first of all, the concern to create and lead a new generation. According to Erikson, generativity is the desire of an adult to go beyond the present; to leave a mark in the world, through the care and active concern for generations, creating

and leaving a legacy of new sources of meaning and value [35]. Generativity is the ability of a theory or an idea to change the status quo and help people reach unimaginable results. A dialogic approach is not limited to mapping the past world (“say what is”) because its generative power lies in anticipating and prefiguring the future, challenging the assumptions that have guided us so far and open new possibilities to live better. Husserl refers to generativity to embrace the world of life and widen the topic of intersubjectivity. The result is a dynamic coupling between oneself and the other to include the parameters of life, death, and interconnection of generations [36, 37].

Generativity lies in the world of life understood as the horizon in which our experiences take place because what emerges and shows does so according to an opening and an extension limited by this, by this land that includes ancestors and culture. Analyzing that world means investigating generativity as a process that takes place through the generations within which any individual genesis has always been located.

Generativity is the essence of training since it transforms, contributes to the realization of the subject, is not limited to the generation of new knowledge, but takes care of promoting humans, of giving them possibilities for life. It represents the emergence of something new with orientation to value.

Dialogical approach is therefore generative because it develops new scenarios orienting the action of the subject, making it capable not only of “letting new ideas emerge” but also to imagine and prefigure the future to build bridges and alliances with the other.

Generativity represents the fight against stagnation that in this moment affects subjects, institutions, and organizations. It moves against the idea of a reality that cannot be changed, because its life blood is otherness and difference.

The generativity of dialogue gives us a vision that is founded in co-emerging, coexisting, co-participating, cooperating. Alliances are established for which there are no longer solipsistic acts and every collective act creates trust, raises hope, mobilizes resources, and activates a shared movement in view of a common goal. Generativity lays the foundations of cooperation, of trust, of shared meaning. Generativity also changes strategies. The young person, through training, acquires the ability to see the opportunity that emerges among others in subjects, situations, contexts, to prolong outside of himself and his time, the life of his ideas, his values, and his actions. The generative capacity of dialogue promotes a positive attitude toward life, to be able to be in the uncertainty of crisis, to face external pressures without collapsing, to wait for a future that does not yet exist, and at the same time continues to generate value.

The educational alliance is generative and develops the abilities to appreciate and recognize what is possible; the creation of spaces for thinking, for desire; imagination as a discovery, that is, as a search for the limit beyond which there is often a hidden opportunity.

Despite the principles of open dialogue, in the EOC, one learns to express one’s concern before, as an anticipation.

Colleagues, students, families, and the social network are involved.

There are two facilitators. The person who presents the concern speaks first and expresses it in the first person. A shared action plan is concluded.

This is the most frequently used tool during class councils to face difficult and problem cases.

Three fundamental principles of the EOC (Box 9.10)

1. Deal with concerns early and in a dialogical way.
2. Discuss issues that affect adolescents and families only in their presence.
3. Join professional resources with the resources of the family, friends, and social networks.

Box 9.10 Try to Think If You Have Ever Found Yourself, as Professionals, in a Situation Like this

1	You know or guess that there are other professionals somehow connected to the situation on which you are working.
2	You anticipate that things will not go in the direction you wanted.
3	More resources for help would be useful and better collaboration between the various parties involved.
4	You perceive you are somehow unaware of what is going on.
5	You perceive that the actions of others can affect your objectives.
6	You would like to have more control over the general situation.

If you had a similar experience to Box 9.10, you have been in a “Grey Zone of Concern,” where nothing is very clear, apart from the fact of being concerned.

If you are concerned, you are in the best position to ask for help and therefore to be ready for a training process (Fig. 9.1).

It is never too early to:

1. Be open.
2. Encourage collaboration.
3. Enter a dialogue.

no anxiety	mild worry		Gray Zone		Serious Worry	
1) There is no worry	2) Sense of slight worry, sometimes I want things to change	3) Recurrent feeling of worry and desire for change decreased confidence in their possibilities; trust in their possibilities.	4) Growing worry, decrease of confidence in their possibilities	Clear worry, feeling that internal resources are almost over	Serious constant worry, the user is in danger, internal resources are exhausted	Very strong, deep and continuous worry the user is in immediate and serious danger, the internal resources are exhausted
	Trust your confidence in your possibilities	It is thought that additional resources are needed	The Desire that someone gives help and control	There is a need for someone to help and control	There is immediate need for external control and help for one's service	There is a need for an immediate change in the user's situation

Fig. 9.1 In what area are we compared to our concern? (Arnkil, Saarinen, Braghero)

9.8.2 Co-construction Proposal of an Educational Alliance: Our Current Experience²

A dialogic approach integrated in coaching and in the relational mindfulness principles (hereinafter DPCM³), considering, among other things, the positive and now multidecade Finnish experience, can provide an opportunity to schools, managers, teachers, students, and their families, interested in knowing and developing an innovative approach to tackle the new challenges and requests coming from contemporary complexity.

Since 2013, DPCM has proposed experimenting with dialogic practices in the protection of minors in eight Municipalities near Milan (Baranzate, Bollate, Cesate, Garbagnate Milanese, Novate Milanese, Paderno Dugnano, Senago, Solaro) joined in the Azienda Comuni Insieme. In the same year, and until now, eight schools of all levels in the provinces of Mantua and Brescia, led by the Istituto Comprensivo di Castel Goffredo, Mantua, have decided to experiment with dialogic approach, especially with respect to class management and the relationship with families. And in 2018, in partnership with magazine *Tuttoscuola*, four schools in Rome, Perugia, Florence e Noto, Syracuse, have joined our project on the educational alliance. In total, 12 schools have been involved.

The educational alliance must be regenerated also to lower the level of conflicts (and litigations) with families and staff, starting from a conscious, shared and participated rewriting of the main school documents: School Regulation, PTOF (3-year Educational Offer Plan), RAV (Self-Assessment Report), and relevant objectives, actions in the improvement plan. And the process includes the actual implementation of a true shared responsibility covenant.

DPCM aims at supporting the transformation of public services and complex organizations using dialogic approaches to improve the quality of relationships through the dialogic instruments listed in Box 9.7. Applying a dialogic approach means mobilizing the psychological resources of the persons directly involved and of the entire community and social network of reference, it means being able to generate dialogue.

“Dialogic” dialogue is a new way of holding debates and dealing with difficult situations. It can help get to the root of complex problems and enables persons with different opinions to think and work more effectively together. It enables us to shift our focus toward relationships, feelings, emotions, mainly dealing with developing emotional intelligence.

²DPCM Dialogic Practice Coaching Mindfulness.

³Dialogical Practice Coaching & Mindfulness is made up of a group of professionals who, under the guidance of Marco Braghero and Nicoletta Foresti, have been working for over 5 years for the dissemination, research and training of dialogical practices integrated with mindfulness and coaching in complex organizations.

Blended educational program “Dialogic educational alliances for inclusion” is addressed to school managers, staff, class coordinators, and to all teachers. It also involves parents and students, and will particularly focus on pupils with disabilities, with special educational needs, on foreign pupils, in orientation and reorientation processes, and in all cases of difficult and problem situations.

The model of reference is that of “dialogic approach” based on dialogue, open and anticipated cooperation, empathy, commitment, transparency and responsibility. A dialogic approach is typical of a service leadership and of nonviolent communication.

The co-construction of the “Shared Responsibility Covenant” (PdC) shows our vision of the future, defines the group-class and personal objectives, and is shared with the community. It becomes a compass for the entire class council.

Trying out this training path has been suggested to a limited number of schools (12), having in common the same design ideal, the possibility to set up a laboratory to work dynamically and in a lean way.

Each school decided how many classes and/or sections participated in the experiment (school managers oriented themselves in three classes, same section and three classes for the control group). The other classes were used as control groups. The following year, the first three classes, that experimented, would act as supervisors, and control classes would be directly involved while there would be three further control classes and so on. In 3 years, at the most, four schools will be operating with this new co-constructed alliance.

Schools were selected, following presentations, according to the expression of interest by teachers and in order to set up a significant sample by type of schools and geographical features.

Objectives:

- Improve and develop DS staff and class coordinator skills.
- Generate and co-construct a new school–family alliance.
- Help school managers and their staff, class coordinators, all class councils, students, and their families co-construct a concrete Shared. Responsibility Covenant which is shared and participated.

Target

DS, DSGA, staff positions (DS assistants under c. 83 L. 107/15), class coordinator teachers, families, and students involved

The fundamental feature is that all these figures will be involved TOGETHER in the training path.

In particular, training will be oriented as follows:

- For the DS, on how to organize a team that works in an integrated way, on how to guarantee the shared responsibility covenant with a dialogic approach.
- For staff and class coordinators on across-the-board skills, service leadership, dialogic practices and specific skills (“non violent” communication, team building, managing meetings and encounters ...)

- For students, develop dialogic skills, on their life skills, the ability to take responsibilities, to cooperate, to respect undertakings, to work in a group, to learn the meaning of participation, recover trust in adults and institutions.
- For families, develop dialogic skills, improve their participation in their children's school life, co-construct a new alliance and participation with the school, and improve their parental skills.
- Each participating school has undertaken to implement organizational changes of spaces, times, and modes according to the outcomes of the dialogues and preparatory webinars. It has also undertaken to draft the fundamental documents (Regulation, PTOF, RAV ...) and communications to families in dialogical mode.

In every school–family interview, the presence of the student and of the family has always been included, as well as the class coordinator and the teachers concerned. Class councils dedicated to the analysis of problem cases always took place with the presence of the student and of the family.

The training program was accompanied by a dedicated platform to view webinars, with all training material. And the platform collected and proposed good practices, cases dealt with, everything to favor a dissemination of concepts and practices available to the educational communities. Communication was oriented to raise awareness but also to provide operational support for the dialogic construction of the PdCs and of the other fundamental documents, for the activity of the integrated team, for the analysis and supervision of actual cases presented by the 12 schools in the network.

And the educational and training communication and awareness-raising action has been aimed at documenting already existing initiatives and the best practices about inclusion and integration.

The project has some direct (DS, staff, class coordinators, families, and students) and indirect beneficiaries (all teachers, with actual consequences on the life of the school and on the entire educational community).

- Give actual tools to teachers (teacher as dialogic coach-facilitator) to improve the inclusion and participation processes for pupils and their families and improve relational processes and regenerate alliance.
- Improve a teaching–learning process and the work of the class council.
- Prevent truancy processes and the early leaving of the school and educational system.
- Improve incoming and outgoing orientation and reorientation pathways.
- Promote excellence processes.

The project has also promoted the “dialogic coach facilitator.” The possibility for managers and teachers, starting from the DS staff, instrumental functions, class coordinators, to become “dialogic coach facilitators” more focused on relations and processes than on contents. Knowing and learning to use some dialogic tools, starting from “generous and profound listening,” in order to facilitate and make more effective the various opportunities to construct and regenerate the alliance

between colleagues, teachers–students, and school–family–territory. Improve the management of class councils, the class, the co-construction of the co-responsibility agreement, the dialogues and the communication with families.

The Construction of Respect It means learning to learn to listen to the experience of the other from oneself [38]. In general, this phase is characterized by the time when people start to know each other through sharing and comparing experiences. Listening is obviously important in this period. Listening to the other means welcoming and recognizing him. For example, many difficult relations between teachers and parents stem from not listening, from the lack of mutual recognition.

For an adolescent, being listened to, welcomed and recognized is fundamental. Being accepted with his difficulties without being subject to a judgment of values. Suspension of judgment, practicing a healthy “epoché” facilitates mutual recognition and respect.

In this phase, attention to the construction and the climate of the group is fundamental. In particular, for the construction of the class Council, the skills of the school manager and his staff in creating the right chemistry are fundamental in this case. Then in the construction of the class group which will progressively go from being an informal group, by means of group projects, a working group, and then a team. A team where the inclusive integration of families cannot be absent, however they are made. For the construction of a new and effective educational alliance, it is necessary that the group identifies itself with a story, with a common and shared narration. The welcome network, if it has a recognized and recognizable story, is more flexible and capable of managing difficult and problem situations, also and especially with respect to the different “diversities” in the group, and unfortunately, with the usual teachers’ turnover and also with respect to new entrants in the group and inclusive processes.

We have seen that these processes can be facilitated by an external, ad hoc trained coordinator. We have trained class coordinators; then, we requested that the coordinator of I A would be the facilitator of I B. An external relationship enables the coordinator to access a “different” position with respect to the different participants. The fact of not being a member of the class council makes this decentralization easier, as well as voice polyphony.

The Construction of Trust Having trust is, first of all, a form of the relation. Getting engaged means having hope in oneself and in the other. It is the second step toward the repossession of the individual experience and of one’s future. Sharing similar experiences increases trust and generates a sense of belonging. Trust, after all, more than a subjective asset or an individual achievement, is the result of the relationship with others and develops in the relationship. If a person feels that his experience is acknowledged, if he feels he is able to share it, a possible effect is to have trust of the people you meet, while relational, oral, and behavioral actions can show routes toward change that people may put in place also as self-correction [39]. A good coordinator process facilitator stands out for his ability to imagine the

other/s, to have a positive vision, giving and mutually giving hope. In this process of construction of the group and of trust, the work between peers is fundamental. Not just student–student, but also between the group of teachers and the group of parents. Making and keeping spaces and times suitable for open and reflexive dialogue (RD) between peers appears to be a necessary and fundamental constituent element. In teams where there is mutual trust, people are not afraid to let themselves be involved in heated debates about important questions and decisions for the success of the organization.

They do not hesitate to disagree, to challenge each other, and to self-examine, with a spirit to find the best answers, to find the truth, and to take excellent decisions.

Healthy conflicts among the members of a team require trust in the fact that this is about discussing crucial issues without filters.

Even in the best teams, conflicts can sometimes generate discomfort.

Rules for conflict management vary from team to team and must be discussed and clarified within the team.

The fear of occasional conflicts should not be a deterrent for the possibility to dialogue systematically and productively, rather it should elicit it.

Solidarity among peers, mutually taking care of each other cements trust in the group. Trusting each other also means constructing responsibility. Being in a group means, first of all, being open to responsibilities. The same awareness by everyone of some frequent dynamics, fed by possible power games inside and outside the group, can evolve intentionally toward the construction of a relational climate of shared responsibility, where the deployment of a transformational service leadership makes sense. Trust also always leads to action, which is a fundamental element for the construction of the educational alliance.

In teams with mutual trust and responsibility, we are all involved in conflicts and decisions. It is very likely that individual agendas and needs are placed to one side and that we focus almost exclusively on what is best for the team.

They do not succumb to the temptation of preferring one's interest and one's aspirations in terms of status or career to the collective results that lead to the success of the team.

According to Zack, there are eight actions to generate relationships of trust in complex organizations of all sizes, that is, class councils and/or the Teachers Board [40]:

- (1) Recognize excellence.
- (2) Provide a challenge (challenging tasks outside the comfort zone).
- (3) Give freedom in the way of working.
- (4) Allow people to choose their way of working.
- (5) Facilitate the overall growth of persons.
- (6) Intentionally build relations.
- (7) Share information.
- (8) Show vulnerability.

Trust is not an excess of familiarity, it is not a vain presumption of oneself or of the other, it is not blind optimism, and it is not security. The strong meaning of the dialogical attitude of trust is a statement of the reality of the present moment (here and now). Trust implies taking risks; it means leaving the comfort zone, or as Vygotsky would say, going to the next learning zone [41]. Trust is based on sincerity, transparency-reliability, and competence. The task of the coordinator facilitator is to generate and preserve this “space” of trust as the basis of the process. The coordinator has trust that his group, his students–families can develop the abilities and means that he recognizes excellence (1). Dialogic relation aims at developing full trust of an integrated group. The coordinator also has full trust in his attitudes and skills to be able to develop the “fullness” of the group. Therefore, excellent teamwork can be defined as a process in a group of people who work together with mutual trust, involved in healthy conflicts, abiding by their decisions with mutual responsibility and focused on collective results.

Setting shared objectives with the family, making them achievable, and challenging (2) at the same time are very useful, thus allowing self-organizational and recognizing excellence, and the effort is made directly, simply, and sometimes publicly. Instead of celebrating a birthday, why not, as Marlo Morgan would say in “Mutant Message Down Under,” celebrate the acquisition of a new skill?

This would create a culture of excellence and would trigger also inter-familial pathways of development.

Choosing to make people independent, providing the freedom to decide on which side to play, to define methods making controlled mistakes and also experimenting with unknown ways, respecting at the same time the policies and achieving in reasonable times the defined results and giving freedom to the way of working (3) + letting people choose their own work (4) + Facilitating the overall growth of the person (5) and the development of one’s talents (feeling that you are evolving and improving is an incredible feeling) are two very important keys for developing solid and lasting bonds of trust.

Trust can only come from the pleasure of establishing networks of mutual relationships and of support. Relationships do not always work, we do not always like the people we work with, with whom we spend our free time (maybe they are only people with whom we share a passion, but who we do not see often because no spark was triggered). Basically, it is not taken for granted that you can always get something from individual persons, meaning joy, help, collaboration, but in the long term, by staying hungry and ready, we will find those people with whom there will be chemistry and then we would be right. Or we would even turn those who are normally not trusting into confident people and the magic will be real (Intentionally build relations) (6).

What is one of the most important elements that build trust in a family as in any organization? Sharing information (7). Therefore, do I share information when I trust or do I trust when I share information? Actually, both processes are true. When I already have a bond of trust, I can give information faster and more rapidly, but the opposite is also true. That is, when I manage to provide information promptly, I build in that moment a future bond of trust, something like when I give water to a plant to help it grow (*Share information*).

Vulnerability is another key point (8). Educational leaders, teachers, have weaknesses like all human beings. They make mistakes, have exaggerated reactions, sometimes impossible to understand. Something makes them different from those who have no leadership. They can ask for help and they can admit they had problems. They can say I am sorry, admitting their mistakes (Showing vulnerability). It is of no surprise that now we increasingly talk of emotional leaders and not of charismatic leaders. Admitting not to be perfect and teaching through example to see mistakes as a tool for development, the university of life, contributes to establishing the culture of excellence I mentioned above.

The interesting and surprising thing is that all these roads produce at physical, or physiological, level important chemical reactions. Oxytocin is produced, which can be seen as the hormone of trust. When there is a high concentration of oxytocin, our body tends to show more trust, because it has less fear of trusting other people and therefore it lets itself go more easily. Imagine what the implications in economy can be of such a finding. Our decisions can be affected by our body chemistry and not only by our reason.

Trust is never final; it needs maintenance over time.

The construction of a group bond: the outcome of the development of respect and trust by taking shared responsibility is the establishment of new bonds. Repossession and integration of experiences, which, at least in the initial stage, are often experienced as foreign and with a potential alienating effect, can be fostered by the process of recognition, sharing, and by concrete actions of help among group members.

A bond is the effect of continuous relations that develop in groups. Participating in the generative process of the educational alliance promotes a relational mode that develops affection, that is, a mode of bond mediated in the first instance by sharing experience, secondly, by searching adaptive solutions and finally by the possibility of communicating in applying together the ethical and cultural heritage that we are accruing and experiencing.

The educational alliance should not be seen as a “repair” process, as a place where you enter because you have a problem and once resolved, greet and leave. If the mechanical “reparatory” logic prevails, then people use the group, they do not participate as being responsible for a process that deals first of all with themselves, the group, and their community. If we proceed with a “reparatory” logic, it is difficult to give space to an appropriate autonomy and to the continuity of the community. The educational alliance is first of all a service for the whole community to which we belong and especially a service to train young people and for their process of social and educational inclusion. In front of a liquid modernity, building educational alliances is strategically relevant [42]. In a society where everything that once was a solid and reassuring reference has now liquefied, relations have fluidized, human relations are less and less binding, more numerous but also more often shallow. The speed and new media that characterize many lifestyles do not allow to listen and to listen to oneself, and this often turns into anxiety and insecurity. Those who are part of an alliance process often break the life rhythm that chokes them and get ready to build a new one. Building educational alliances means offering regenerative spaces, times, and opportunities to slow down and to be able to rethink relations anew, and later, stabilize and reorganize life.

In the process of construction of the educational alliance, there is the possibility to avoid the phenomenon of the “fading away of expert witnesses.” Students, families, and teachers participating in the generative process remain available to the community as expert witness, and do not let their multiple skills and experiences acquired fade away.

The construction of the educational alliance in any individual class group takes place in these five steps:

1. Build trust starting from the exploration of shared values.
2. Transform and manage conflicts creatively and without violence.
3. Obtain commitment.
4. Accept responsibilities.
5. Focus on process results (performance) more than on individual performance.

Experiences in dialogical relationships strengthen a dialogic attitude, dialogic culture, and will push to mutually extend the specific fields of activity.

Dialogic practices require “responsiveness” (the ability to provide prompt, sensitive, conscious, and aware responses), the awareness to experience polyphony and not only to follow preset guidelines. Dialogic practices produce facts, actual educational facts.

The Finnish, with their almost 30 years of dialogic work, have shown that this approach produces facts. “Fact,” in the scientific sense of the word, as Latour and others mean it. A fact that has had an impact certainly on persons but also on the social organization and structure. In Finland, thanks to the dialogic approach, facts having a social impact have been produced. The destiny of facts and “artifacts” of communities that face the dialogic work of support to networks is in the hands of the users. Research-action can contribute to generate a “new fact” in dialogic terms in the governance of local networks and in public services in Italy, as we shall see below in this article.

According to the literature and experience, at the basis of any action of learning-teaching, there are dialogue, languages, conversation, relationship. A dialogic approach, with its bold and strong proposal of determined, gentle and meek awareness, can be seen as the basis, the foundation of the processes of learning-teaching, of all processes of interrelation, perhaps its *raison d'être*, though this at the moment remains rather implicit knowledge. Dialogic thinking often supports, consciously or not, the work of any person dealing with relation of help, starting with the parents. We like to think that there is dialogicity at the bottom of the “black box” of every responsible adult, of every teacher, and of processes of learning-teaching.

In order to make the dialogical alliance, besides exploring and enhancing existing resources, we need to highlight the direct relationship between the quantity of external resources recruited and the quantity of the work of action and research that we can do; therefore, it is fundamental that all channels are activated and all suitable activities are developed so that the alliance is supported. An isolated and poor alliance is a contradiction.

Ultimately, the action-research causes a positive social impact and may be “politically” defined as social innovation and therefore have access to the funds for social innovation to make a dialogic school (Box 9.11).

Box 9.11 The Three Features for a Dialogic School

1	<i>Listen</i> : show sensitivity for the entire “being” of the student—not only for his intellectual abilities.
2	<i>Becoming aware</i> : of the specific requirements of growing people.
3	<i>Unconditionally accept and respect</i> the life of the adolescent in its uniqueness.

9.9 The Stages of the Pathway of Research-Action on Educational Alliance

1. Open Dialogue in presence: presentation of the dialogic approach and sharing, with the participating school managers, the need to build a new educational alliance in the community. Definition of lines and operating steps and times and ways of presenting the proposal to the educating community. Duration 3 h;
2. Presentation of the proposal via a webinar to all school managers and their combined staff, reflexive dialogue and collection of remarks and reformulation of the pathway according to what emerged during the webinar. Duration 2 h;
3. Webinar for DS staff (average 10 teachers) and class coordinators involved (including control classes, average 6 teachers) to prepare the “world cafés” of the Teachers Boards and of those dedicated to students and families. Staff teachers and class coordinators will facilitate the tables of the “world café.” Duration 2 h;
 - (a) Creation of the “world cafés” of the teachers boards in the various schools, questions on how to implement the new alliance with students and families, in particular on how to reorganize times and spaces for meetings and communications with families, how to build the class group and improve its climate, duration 3 h;
 - (b) Presentation of “World Café” results in webinar for all the schools involved. Duration 2 h.
 - (c) Communication about the Classes that will participate in the project (normally three classes in the same section) and the control classes (three classes in parallel in the same section);
 - (d) Training the middle management: DS staff, instrumental functions and class coordinators of the 6 classes involved (3 + 3 control): these are the dialogic facilitators for each school. Three (3) 2-h webinars plus 2 meetings of 3 (3) h. The coordinators of the parallel control classes will be the facilitators in the classes directly involved in the project.
 - (e) Simultaneous webinars for the entire class councils directly involved, with students, teachers, and families. Duration 2 h;

- (f) Start of experimentation of space and time organization devoted to meetings with families to draft the fundamental documents. Three (3) meetings are planned, facilitated by the members of the DPCM staff and then a webinar dedicated to each School for a “supervision” of the cases tackled. Interviews with the family:
- Individual: with the presence of the teacher concerned, the class coordinator, the student and the family,
 - General interviews: With the presence of the coordinator and at least 3 teachers of the class council.
 - Anticipatory dialogues for concerns and/or problem cases: The entire class council coordinated as facilitator by the parallel control class coordinator.
10. The school manager and his staff in partnership with the Teachers Board prepare work teams to prepare and draft the fundamental documents. The groups consist of 8 teachers, 2 students, and 2 parents and are coordinated by two facilitators: the class coordinator and the parallel class coordinator. The groups are as follows:
- (a) School regulation.
 - (b) PTOF.
 - (c) RAV and improvement plan.
 - (d) Shared responsibility covenant (that will then be drafted in each class for each student in the first weeks of September in a shared and participated way with students and families).
 - (e) Welcome plan.
 - (f) Orientation—Reorientation—prevention of truancy and leaving.
 - (g) NB Every school, notwithstanding the fundamental documents, can autonomously decide which groups to activate.
11. During the year after the first Teachers Board in the form of a “world café,” two more are planned in the form of a dialogue of 3 (3) h each: the first to work on the documents prepared by the groups on fundamental documents; the second in May to monitor the planned actions and what had been decided.
- (a) During the year, the pathway is supported also by three webinars of 2 (2) h each. Webinars are open to all the members of the institutions involved to further analyze the dialogic culture and answer questions live.
 - (b) Two dialogic focus groups are planned of 2 (2) h, one at the beginning and one at the end, for each class council involved for all teachers facilitated by a DPCM member.
 - (c) Teachers of the class councils involved have two/three “intervision” meetings available of 1 h each. (A practice that takes place among peers, experimented in training. The teacher asks for intervision from a colleague who will be his facilitator, and from another colleague with observer tasks).
 - (d) School Managers have available, during the entire pathway, 6 individual coaching sessions (one every month from October to April) via Skype with a professional coach supplied by DPCM;

- (e) For each School, there will be two ritual, aggregating and strongly symbolic and convivial moments of all the three class councils with all their members: teachers, students, and families, in the presence of the DS, a DPCM member and parallel class coordinators (facilitators) and of DS staff. These moments are called “Puimala” (from the Finnish: separate the chaff from the wheat), these are moments of mutual exchange, monitoring change processes under way. There are two moments, one in December, before the Christmas holidays, and one at the end of May. The puimala takes place for a whole day (7 h) and is structured as a “World Café” and ends with a convivial dinner.

At the end of the first year of research-action, the following members participated in the project:

- 12 School Managers.
- 120 staff teachers.
- 206 teachers, of which 72 class coordinators trained as facilitators.
- 972 students with their families.

On average, every School held more than 70 interviews with families in dialogic mode and tackled three complex cases per class by anticipating concerns (Early Open Cooperation—EOC): a total of 108 cases.

The classes concerned have managed to co-construct the shared responsibility covenant thanks to the dialogic approach.

Class councils concerned have changed the mode of formal communication with families, in written and in oral form. The function of the class coordinator is important as facilitator and guardian of relationships.

The classes concerned have changed spaces and times to propose interviews with families: once every month, teachers are available for 4 h (all the hours planned on a weekly basis for individual interviews from October to May are put together once every month). Most schools chose Saturday afternoon from 3 pm to 7 pm to enable the highest number of families to participate. General family interviews have been replaced by the “Puimala” described above.

The process was monitored and assessed by direct observation and by dialogic focus groups, and by the following analysis tools:

- Outcome Rating Scale (ORS) Session Rating Scale (SRS), administered before and after each session.
- Final assessment and satisfaction questionnaire.
- Questionnaire on group climate and cohesion (Group Climate Questionnaire), administered to the glass groups committed in research-action and to control class groups.

Questionnaires have been administered to the following population:

- 12 school managers.
- 120 staff teachers.
- 206 teachers (of which 72 class coordinators trained as facilitators).
- 972 students.
- 855 parents (families).

The ORS showed a high score with respect to personal well-being in general:

- *How did you feel before coming here:* average score 6 out of 10; after the session average score 8 out of 10.
- *How did you feel in general before the session:* average score 7 out of 10; after the session average score 8 out of 10.
- *How did you feel about your social relations before the session:* average score 5 out of 10; after the session average score 7 out of 10.

The SRS showed a clear position of satisfaction with respect to the following:

- Relations at school.
- Objectives and topics dealt with.
- Approach used and experienced.
- Experience in general.

The questionnaire on group climate and cohesion showed reliability and validity for the scales “Involvement” and “Conflict.” Reproducibility was very good (intra-class correlation coefficient 0.87 and 0.82, respectively). Also, internal consistence was satisfactory (Cronbach Alpha 0.75 and 0.63, respectively). The “Avoidance” scale was not homogeneous (alpha 0.13), or reproducible (intra-class correlation coefficient 0.34). Factor analysis showed the existence of two fundamental dimensions like one overlaps the “Involvement” scale, the other includes the items of the “Conflict” scale and also two items of the “Avoidance” scale. The tool appears potentially very useful in educational practice and in research, since it is able to measure validly and reliably the participants’ involvement in a glass group, the cohesion level and in general a positive climate, and the conflict in a group and in general a negative climate of distrust, tension, refusal.

9.10 Conclusion

We can draw two profound lessons from scientific thinking: the first is that success comes when people collaborate. The scientific community is international and without borders; it continues to establish networks and alliances. The second is that there are no certainties. As is taught by mathematician and philosopher Bruno De Finetti [43], undervalued in Italy, uncertainty cannot be eliminated. Uncertainty concerns

all of us, our daily life. We can reduce it, not eliminate it. Uncertainty, our companion in travel, makes our life interesting and worthwhile. The more we co-construct alliances, the more uncertainty becomes our friend, pushes us toward new questions, new discoveries, and new opportunities. Hearing uncertainty is a good starting point to open up to dialogue.

Students must always be listened to, and I would add, also their families.

Students have much potential, as do teachers and obviously families, but they cannot take different routes. School can be again a reliable node, a possible place of research and change.

Making an effort to build, open and keep dialogue open, promote a pedagogy of hope, a pedagogy of love for life in all its forms and dimensions, develop hope as memory of the future, I believe it is a common objective of the new educational alliance.

Co-constructing alliances enables us to discover that working for the well-being of others gives joy and a purpose to life. Actually, perhaps, we were born to take care of each other and establish bonds among ourselves.

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Adolescence and the Social Determinants of Health

Abstract

Adolescent development takes place within a complex web of family, peer, school, community, media, and broader cultural influences. Currently, many evidences reinforce the viewpoint that social determinants are particularly important in well-being among adolescents, opening to the need to assist adolescents in learning about their health through the active involvement in the different social settings.

In particular, growing evidence from education, public health, medicine, psychology, and sociology indicates that well-designed health strategies must fit into the social context in which the adolescent relates. In this regard, family provide the primary structure, in the context of the community, from which adolescent transits to adult lives (Chap. 10). During adolescence, the influence of families remains strong, although family relationships change markedly in order to potentiate autonomy. However, from the World Health Organization perspective in which school takes on the role of “setting for health”, the impact of the “health-promoting school” on improvement in adolescent health can be described. This holistic approach, which implements health education programs in the environment and ethos of the school, moves beyond individual behavioural change to improve social environment of the school with particular attention to its curricula and learning methods (Chap. 11). Also, the emergence of strong peer relationships is a central feature of adolescence, with important implications for health and well-being (Chap. 12). However, peers can have strong positive or negative influences on adolescent’s health; peer connection and peer modelling can be protective against violence, substance abuse, but at the same time peer can also increase risk factors such as smoking initiation and persistence, alcohol initiation and use, sexual risks.

Evidence from neuroimaging, genetic, and behavioural studies indicates that not only the social milieu modulates physiological responses, but also individual differences in brain structure and function influence the nature of social relationships.

Understanding the mutual interactions between neurobiological and social development may shed light on development pathways linked to risk or resilience for health outcomes; however, the nature of this close and dynamic relationship is still partially unknown.



Adolescence and Social Determinants of Health: Family and Community

10

Claudia Cappa and Sara Giulivi

The disparities in life expectation present worldwide, within the same country and in some cases, within the same city (see [1]), provide clear evidence that individuals' health is not just related to biological factors, but also to aspects of society that can significantly impact on people's well-being. Social inequalities are at the basis of inequalities in individuals' health, defined by the World Health Organization (WHO) as not simply "the absence of disease or infirmity," but a "state of complete physical, mental and social well-being" (see [2, p. 1]).

Awareness about the role of social factors on people's health dates back to the 1800s, when the founding fathers of modern public health began reflecting on the strong relationship between people's social position, life conditions, and health outcomes [3]. Later on, in 1946 when WHO declared, in its Constitution document, that its objective was "the attainment by all peoples of the highest possible level of health," the latter stopped being conceived as a merely biomedical issue and started being considered as something strongly related to social justice. A few years later, however, progress in pharmaceutical technique and industry (discovery of new antibiotics and vaccines) reinforced again the biomedical approach to health. For a few decades, the biomedical and the social approach alternated their prevalence on one another. In the late 1960s and early 1970s, the biomedical approach proved inadequate to respond to the health needs of all people worldwide, especially of the most disadvantaged, and the so-called *community-based health programs*, connecting health to human rights, began to emerge. However, during the 1980s, privatization and free trade weakened this impulse to improve health through the improvement of

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social conditions. Only during the late 1990s did scientific evidence demonstrate the relevance of the so-called social determinants of people's health. In 2005, a Commission on Social Determinants of Health was established by WHO, with the aim to "marshal the evidence on what can be done to promote health equity, and to foster a global movement to achieve it" [4].

The commission defined social determinants as "the conditions in which people are born, grow, live, work, and age" [4]. Social determinants involve several intertwined factors that are at the basis of the health inequities observed among and within countries: income, education, occupation, discrimination based on ethnicity, gender, religion, and sexual orientation, geographical origin, and physical or mental disabilities. For a detailed historical overview on social determinants of health, see Irwin and Scali [5].

Nowadays, across the world, several actions are being taken, at national as well as local level, to improve the social determinants of health in order to reduce health inequalities. A review on the progress made in this sense is explained in Donkin et al. [6].

The effects of social determinants vary throughout life [7, 8]. They can influence people in different ways depending on age, gender, and life stage [9]. Here we focus on social determinants of health in adolescence, a period of development, education, and growth that is very much influenced by preceding childhood and that is critical for future adulthood [10]. Adolescence is a period that can benefit or be undermined by a myriad of factors, "a period in which development is particularly sensitive to contextual influences making youth especially vulnerable to social determinants that impact their health" [11]. It is a period of challenges, expression of new capacities and creativity, and involves rapid and dramatic changes at physical, cognitive, and socioemotional level. Adolescence is indeed a crucial period for learning due to the influence that biological as well as environmental factors have on brain development in the second decade of life [11]. It is also a period when mortality increases dramatically in comparison to childhood [12]. As a matter of fact, as "young people enter adolescence, they bring with them resources and vulnerabilities, both biological (genetics, epigenetics, natural endowments) and environmental (national and local policies, as well as community, school, workplace, peers, neighbourhood, and family influences)" ([13, p. 1567]). For example, low family income is associated with reduced access to formal education and low education is, on its turn, associated with poorer health conditions, with premature access to labor force in informal economy (not regulated or protected by the state) and with reduced chances of living a self-sufficient life. Poverty and social disadvantage is also associated with rise in sexually transmitted infections, mental disorders, suicide and homicide, obesity, and other pathologies [14].

Access to Internet and the social media is associated not only with benefits and advantages for young people, but also with a number of risks, like contact or easier access to illicit materials [13].

Almost all aspects of adolescence health (from HIV infection to death due to violence, suicide, or traffic-related injuries, from malnutrition to obesity, from tobacco use to alcohol misuse) show great variability worldwide, from region to

region (e.g., the sub-Saharan Africa vs. Central Europe) and country to country within the same region [8].

Several models of social determinants of adolescent's health have been elaborated recently [15–17]. Here, we consider the model of social determinants of health proposed by WHO [9], as reported in Fig. 10.1.

The WHO model includes the numerous factors that can affect adolescent health. The center of the figure reports factors at personal/individual, interpersonal, and community levels. Individual factors include age, gender, knowledge, skills, self-efficacy, and expectations; the interpersonal level concerns the contexts and people with whom adolescents establish their most significant relationships: social networks, peers, teachers, and family; the community level involves community values, norms, networks, and support.

During adolescence, the influence of community and structural determinants tends to remain stable, whereas proximal social determinants outside the family (media, peers, employment, education) become progressively more influential, as represented in Fig. 10.2.

Below, we are going to deal in particular with the influence of family and community on adolescent health.

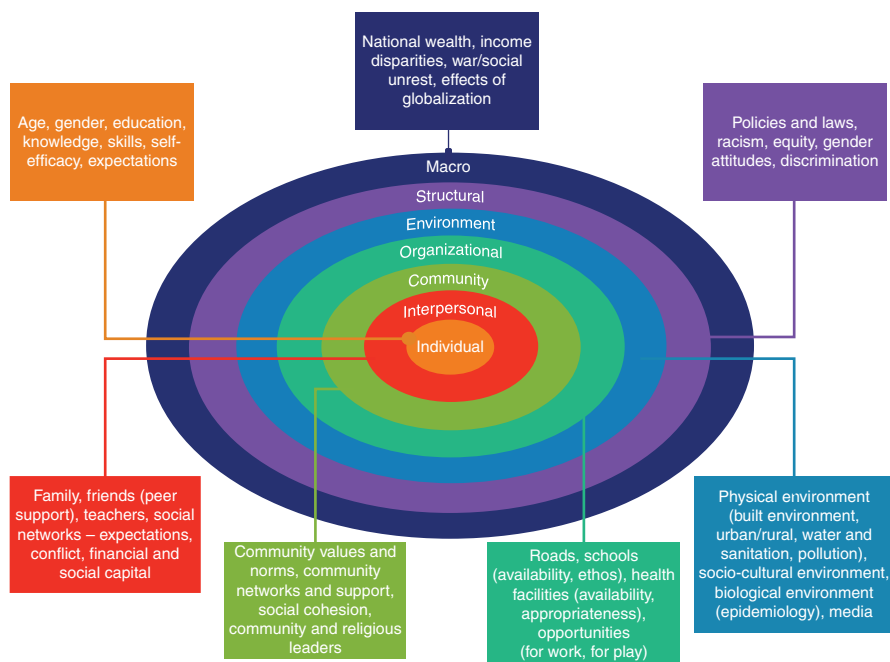


Fig. 10.1 Ecological model of social determinants of health (reproduced from [9])

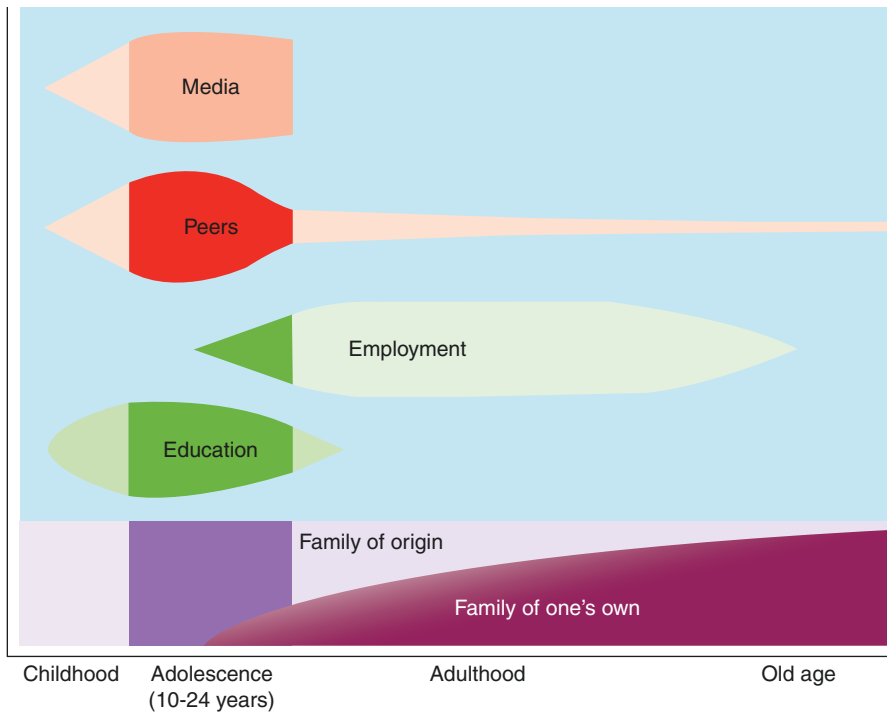


Fig. 10.2 The change of proximal social determinants of health throughout the life span (reproduced from [18])

10.1 The Effect of Family on Adolescent Health

Family is the environment where kids grow, develop, and transition from being dependent children to semiautonomous young people [19]. It is the structure where adolescents can build a sense of identity and acquire a set of spiritual and political values, as well as values concerning relationships to other people or professional goals. Family can provide protection and create the conditions for children's health and stability. However, depending on several factors, it can also prove detrimental. As a matter of facts, family is the context where good or bad habits related to later health are established. Parents' healthy behaviors will positively influence adolescent health, while unhealthy behaviors will have a negative impact [20]. Several studies, for instance, have found a connection between parents' habits concerning physical activity and the same habit in their children. Parents who do more physical activity will be more likely to have children who spend time doing independent outdoor activities [21–23]; similarly, parents who generally follow healthy eating behaviors will foster healthier dietary habits in their kids.

However, the impact of family on adolescent's health can vary significantly depending on several intertwined factors (see Fig. 10.3).

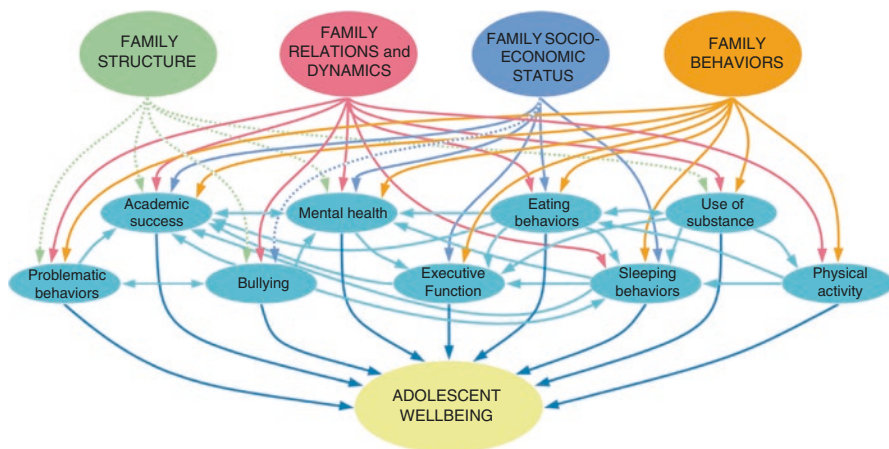


Fig. 10.3 The complex network of interconnections between aspects of the family environment (family structure, relations/dynamics, socioeconomic status, behaviors) and behaviors (sleep and eating habits, use of substance, physical activity, etc.) affecting positively or negatively adolescent well-being. Solid and dashed arrows represent stronger and weaker connections, respectively

Below, we will try to provide a description of such factors and of the ways they can impact on adolescents' health.

10.1.1 Family Structure

Family structure can affect adolescents' well-being in several ways. In the last 50–60 years, family has undergone significant changes. In OECD (Organisation for Economic Co-operation and Development) countries, the extended family, including relatives outside the nuclear family, has disappeared and has remained common only in sub-Saharan Africa, Asia, Middle East, and central and south America [24]. With the increase of divorce rate, single parenthood, and homosexual partnership in OECD countries, the so-called traditional family, made up of two parents with children, has also become less common. OECD [25] predicts that, by 2030, monoparental families will reach 40% in several countries, with consequent increase of exposure to poverty and other consequences deriving from family instability, like early marriage and parenthood [18]. In addition, increased women employment and the desire for man and woman to first establish themselves in the labor market have caused widespread postponement of family formation and childbearing [26]. However, the two-parent family is still the most common around the world. It is more widespread in Asia and the Middle East, whereas children are more likely to be grown up by one or no parents in Europe, Oceania, the Americas and sub-Saharan Africa (here children are more likely to live apart from both parents) [24].

As already mentioned, several studies have shown how health and well-being of adolescents are affected by the people they live with. Two-parent households are more likely to guarantee adequate monitoring on their children and less likely to live in poverty in comparison to other family structures (see, e.g., [27]). Nuclear family seems to be the most protective for mental health disorders, physical disabilities, problematic behavior, low academic achievement, learning disabilities, and alcohol, tobacco, and marijuana use [28]. Also, living with both father and mother has been found to reduce in adolescents the risk of making use of substance [29].

In a study carried out on 278 adolescent subjects (mean age = 14.78 years), Phillips [30] explored adolescent well-being (measured in terms of self-esteem, hopelessness, delinquent attitudes, optimism, educational expectations) as a function of family structure (nuclear family, single parent family, stepfamily) and family climate (satisfaction with the family and negative emotions in the family). He found that family structure is less important for adolescents' well-being than family climate. The latter was found to be significantly related to all indicators of well-being except for educational expectations. Family structure, instead, did not significantly relate to any of them. This means that, according to the above-mentioned study, what happens within the family, the familial atmosphere, and the processes that concern the family are more important for adolescents' well-being than the people who make up the family structure.

Below, we report findings concerning the effects of family relations and dynamics on several aspects of adolescent health and well-being .

10.1.2 Family Relations and Dynamics

Several studies have shown that family connectedness has several positive effects on adolescents' well-being. According to Santrock [20], families where parents experience higher levels of marital satisfaction are more likely to offer greater affection, responsiveness, and familial warmth to their children, with positive effects on the latter's general health and well-being.

Studies carried out in the United States have shown how adolescents' connectedness to parents is associated with delayed sexual initiation and lower levels of tobacco, alcohol, and marijuana use [31–33], as well as to reduced likeliness to engage in violent behaviors [34]. Other findings [35] have shown that increased connectedness to fathers is associated with reduced risk of suicidal thoughts and behaviors (SBT). Other dynamics within the family can have significant impact on several adolescents' outcomes.

In a study carried out on a sample of almost 200 low-income adolescent girls living in the United States, Milan and Wortel [36] investigated the role of family obligation values in relation to adolescents' risk behaviors and mental health. In particular, they investigated the perceived importance of offering help and assistance to the family (e.g., in taking care of siblings), the importance of respect for the family, and the importance of offering future support to the family, for instance

financial support. They found that girls with high family obligation values were more protected than girls with low-to-moderate obligation values against certain risky behaviors relating to alcohol use or sexual activity. Another finding was that girls feeling higher respect for adult family members were less concerned about peers' opinions and behaviors and did better at dealing with peers' pressure. However, authors also found that girls with high obligation values, and who were more exposed to negative life events, tended to manifest more mental health symptoms, for example, depression or post-traumatic stress disorders.

The quality of relation between adolescents and adults may have a significant impact on another phenomenon increasingly present in our society: bullying and the cyber variant of it. Bullying is defined as "repeated harmful behavior, characterized by an imbalance of power between the victim and perpetrator(s)" [37, 38] and can be verbal, physical, and psychological; cyberbullying involves "aggressive, repetitive and deliberate behavior between peers, where a person or group uses electronic devices (electronic communication technologies) to abuse a victim who cannot easily defend him/herself" [39]. So cyberbullying incorporates defenselessness on the part of the cybervictim (see [40]) and includes a variety of behaviors like threatening messages, rumors spreading, identity theft, and others (see [41–43]).

Divergent considerations and results can be found in the scientific literature regarding the degree of overlap between traditional bullying and cyberbullying behavior, both in terms of prevalence (bullies or victims at school, e.g., tend to be bullies and victims also in the cyberspace) and psychosocial problems (being a victim of school bullying behavior can be a predictor of social anxiety, e.g., just as being a victim in the cyber space). Several studies provide results sustaining the overlap hypothesis (see, e.g., [44–47]), while others support the differentiation between these two kinds of behaviors (see, e.g., [48–51]).

Beyond the above-mentioned dimensions, Kubiszewski et al. [52] highlight several aspects that distinguish cyberbullying from traditional bullying behavior. Cyberbullies can make themselves anonymous (through pseudonyms, etc.), while traditional bullies can be more easily identified (see [53]). In addition, cyberbullying aggressions can take place with no limitation. They can be perpetrated at any-time and anywhere and can follow the victim outside the school, to their homes, and bedrooms (see [54]), while traditional bullying behaviors are necessarily more restricted in space and time (e.g., at school, during school hours). Furthermore, the information (messages, files, videos, etc.) through which aggressions in the cyber space are perpetrated can be spread massively and remain available to an extremely large audience for a long time. The same is not true for traditional bullying aggressions (see [42, 55]). Finally, cyberbullying involves no nonverbal communication: bullies in the cyber space receive no immediate feedback and cannot see the emotional pain inflicted on their victims. This can lead to perpetration of even more aggressive behaviors against cybervictims.

Kubiszewski et al. [52] speculate that, given the above-mentioned differences between cyberbullying and traditional bullying, separate but simultaneous sets of actions should be taken in order to protect adolescents from these two kinds of aggressive behaviors.

A study carried out on 1582 fifteen-year-old respondents, enrolled in high school students in Turkey (Istanbul), found that poor monitoring by the father was a risk factor for being bully and bullying victim; it also found that poor communication with family members was a risk factor for being bully [56].

Buelga et al. [39] investigated family climate and communication between parents and adolescents, and their relation to cyberbullying. The latter involves four different roles: cyberbully, cybervictim, cyberbully victim (an individual who is both victim and perpetrator), noninvolved individual. The study was carried out on a total of 1062 Spanish adolescents and revealed that over half of participants were involved in cyberbullying, with 28.4% of them behaving as cyberbullies and 18.64% as cyberbully victims. Results showed that family climate played a very important role in cyberbullying behaviors. In particular, cyberbully victim behaviors seemed to be favored by a negative family climate (greater conflicts within the family), scarce family cohesion and expressiveness, and offensive parent–child communication. In addition, the study showed that greater family conflict increased the chance of cyberbully behavior in boys, rather than in girls, and that avoidant communication with fathers and scarcely open communication with mothers favored cyber-victim behavior.

Bjereld et al. [57] investigated the perception bullied and not bullied children had of their relationship with adults, in particular, teachers and parents. The study was carried out on a sample of 7867 Swedish kids of 11, 13, and 15 years of age, and considered both bullying and cyberbullying victimization in relation to confidence in teachers (feeling of acceptance and care by the teacher, feeling of trust toward the teacher) and to quality of relationship to parents (feeling at ease when talking to parents about difficult subjects, being listened to and understood by parents when talking about problems and worries). Data analysis allowed identification of five subgroups: occasional traditional victims, occasional cybervictims, frequent traditional victims, frequent cybervictims, and nonvictims. Results showed that frequent victims had higher probability than nonvictims of having poorer relationships with both teachers and parents in all the variables mentioned above. Occasional victims had higher probability than nonvictims of not feeling confidence in teachers and of not being listened to by parents.

In a study carried out in seven European countries (Germany, Greece, Iceland, the Netherlands, Poland, Romania, and Spain), Athanasiou et al. [58] investigated cyberbullying in relation to sociodemographic characteristics, in particular, age, gender, parents' educational level, and parental marital status (married/living together, divorced/separated/single parent family). They found that, in all countries, the prevalence of cyberbullism is lower in families where parents are married or live together. Findings regarding all other variables differ from country to country.

Parent–child relationship has been investigated in relation to other adolescent behaviors and outcomes like depression or suicidal thoughts. Investigation around possible factors involved in suicidal behaviors is particularly relevant, suicide being the second leading cause of death among adolescents and the tenth leading cause of death in the general population (see [59]). Family and parenting can act either as a protective or risk factor depending on the style adopted with children. Tendency to

overcontrol or to adopt an authoritarian style with children seem to favor suicidal ideation in adolescents. Positive family relations, instead, turn out to be protective against this kind of behavior (see, e.g., [60]). Other studies show that family and adult connectedness or perceived connectedness are protective from self-directed violence and suicidal thoughts or attempts (see [61–63]). Gunn et al. [64] explored parental connectedness, school connectedness, and social integration in relation to suicidal thoughts and behaviors in adolescents of 12–21 years of age. Unlike previous studies, the study by Gunn et al. [64] explored the effects of changes in the degree of connectivity over time. They found that adolescents who reported an increase in the level of connectedness to parents also reported a decrease in suicidal ideation episodes. The same was observed in adolescents who reported an increase in social integration. Increased school connectivity turned out to be significant in predicting a decrease in suicide attempts in those subjects who had reported suicide ideation.

10.1.3 Family and Eating Related Habits

Parents' habits concerning food, parents' relations to their children (mentioned above with respect to other adolescent outcomes) and other dynamics within the family, or characteristics of the family may have a significant impact on adolescents' weight, eating, and noneating related behaviors, and ultimately, on their health.

Findings by Haines et al. [65] show that high-functioning families and good relationships between sons/daughters and their parents foster better weight status and weight-related behaviors. More specifically, females who have a good relationship with both father and mother have less probability to experience weight problems (obesity or overweight) and unhealthy weight-related habits (disordered eating, fast food eating, insufficient sleep). In case of males, a good relationship with both parents has positive effects on weight-related habits (quality of eating, amount of sleep, and amount of physical activity), while weight status seems to be positively affected (less probability of obesity/overweight) by a good relationship with fathers only.

Family habits concerning eating and food preparation may also affect significantly adolescents' health and well-being. Findings by Berge et al. [66] suggest that involvement of adolescents in food preparation within the family has positive effects on dietary quality and eating patterns. Watts et al. [67] found correlations between the family food and eating habits (quality of food, meals consumed together with parents, the habit of eating in front of the television) experienced by the subjects during adolescence and those practiced by those same subjects once they became parents. In general, subjects exposed to healthy habits as adolescents reported even healthier family food and mealtime practices once they had children of their own. This turned out to be true especially for females, who reported, as parents, greater use of the good family food or mealtime practices experienced as adolescents. As for males, the one positive association found concerned consumption of healthy

food: those who reported having healthier food at home as adolescents, reported eating healthier food also in their homes as parents.

A study by Larson et al. [68] investigated the effects of frequency of family meals during adolescence on the intake of certain types of food and on other eating related habits in adulthood. In particular, they found that higher frequency of family meals predicted higher intake of fruit, vegetables, in particular, dark green and orange vegetables, and other types of food containing key nutrients like fiber, calcium, potassium, magnesium, and vitamin B6 during adulthood. In addition, higher frequency of family meals in adolescence was found to predict greater meal structure and greater importance attributed to social eating.

In a meta-analysis carried out on 14 peer-reviewed papers concerning the effects of family meals on psychosocial outcomes in children and adolescents, Harrison et al. [69] concluded that frequency of family meals was inversely associated with disordered eating. The latter included behaviors like binge eating, chronic dieting, extreme weight control behaviors—for example, diet pill or laxatives ingestion, self-induced vomiting, assumption of diuretics—and other less extreme weight control behaviors, like fasting or eating very little, smoking to control weight, or using food substitutes. Frequent family meals were also found to have positive effects on self-esteem, self-efficacy, commitment to learn, and academic success. In addition, they associated negatively with other internalizing behaviors like suicidal thoughts and depressive symptoms. Finally, more frequent family meals were found to inversely associate with externalizing behaviors like frequency of violence (injuring people, carrying or using weapons, or threatening of physical harm) and use of alcohol, tobacco, marijuana, and other illegal drugs.

Neumark-Sztainer et al. [70], in a study on over 1900 parents or guardians of adolescents of diverse ethnicity (68.5% of ethnic minority), investigated the association between food served at family dinners and the characteristics of parents/families. They found that parents with lower education level were more likely to serve fast food and sugared drinks at dinner and less likely to serve vegetables. The association between food healthfulness at family meals and other sociodemographic factors (ethnicity or work status) were not statistically significant. In contrast, psychological factors like depression and stress deriving from work life were strongly associated with the healthfulness of family meals. In particular, authors found that vegetables were less likely to be served in families where parents reported higher levels of stress deriving from work. Fast food, instead, was served more often. The same was true for families with parents reporting depressive symptoms. These families were also more likely to serve sugared beverages during family meals. The authors also found positive associations between healthfulness of family meals and several meal-specific variables like perceived importance of family meals, time spent in cooking, enjoyment of cooking, and meal planning. Finally, greater food purchasing barriers were found to be associated with lower levels of meals healthfulness.

Bauer et al. [71] investigated the relation between mothers' executive functions and the characteristics of family food environment. While the focus of this chapter is on adolescence, the study by Bauer et al. was carried out on 492 mothers of young

children from 2 to 9 years of age. However, we report it here since the influence of childhood on adolescence is very well known (a study by Geserik et al. [72], e.g., found a very high correlation [87%] between obesity at age 3 and obesity or overweight in adolescence) and since, to our knowledge, no similar studies have been carried out on the relation between family food environment and executive functions of mothers of adolescents. Bauer et al. found that greater executive functions problems associated with lower frequency of family meals and higher frequency of family meals made with food purchased in fast food restaurants. In addition, greater executive functions problems in mothers correlated with less structured meals, less consistent mealtime schedule, greater reported likeliness of regulating children's emotions with food, and lower reported likeliness of monitoring children's eating. Finally, mothers' problems in executive functions were found to be associated with lower availability of healthy food and higher availability of unhealthy food in the home environment.

Iguacel et al. [73] investigated the association between children's social vulnerabilities and weight status on a cohort of 16,229 children when they were 2–9.9 years old, and in a follow-up, at ages 4–11 years (cohort reduced to 11,041 children). Children were considered vulnerable if they met at least one of the following conditions:

- (a) their family had only one or no people to rely on in case of necessity,
- (b) the family was nontraditional (children living with only one parent, stepparents, or other relatives),
- (c) one or both parents were migrants,
- (d) at least one of the parents was unemployed or on social assistance.

The study showed that a higher percentage of overweight or obesity was found among children considered vulnerable compared to the nonvulnerable ones. In addition, children whose parents lost social network between the first study and the follow-up were more likely to be thin in comparison to children of families reporting good social network. Also, among children belonging to high socioeconomic status families (high parents' level of education and income), not only a lower percentage of overweight, but also a higher percentage of underweight was observed. Finally, in the same study, authors found that overweight and obese children were more likely to have mothers with higher body mass index or who reported higher screen time.

Parents' employment status was also found to affect adolescents' health in different ways, including food-related habits and practices. While mothers' and fathers' employment has undeniably beneficial effects for families, Bauer et al. [74] found that stress deriving from work life and the need to balance work and family obligations had negative effects on food-related behaviors. Families where both parents had higher levels of work stress spent less time in food preparation, ate with their families fewer times per week, and consumed less fruit and vegetables. Parents' employment status was also found to affect food environment, though not equally for fathers and mothers. More specifically, mothers' full-time

employment affected food habits and practices in many ways. This was not true for fathers. Full-time employed mothers spent less time in food preparation, had fewer family meals per week, ate fast food more often with their family, offered their children less encouragement to healthy eating, and had lower fruit and vegetable intake. As for full-time employed fathers, an effect was observed only on the time spent weekly on food preparation. Interestingly, full-time employed fathers seemed to spend less time cooking than part-time or unemployed fathers who, however, spent in food preparation less time than part-time or full-time employed mothers. The only negative effect mothers' lack of employment seemed to have on food habits concerned consumption of sugar-sweetened beverages. Unemployed mothers' intake of such beverages was higher than part-time or full-time employed mothers.

Ziol-Guest et al. [75] in a study carried out on a sample of 4192 children, made up of female respondents to the U.S. National Longitudinal Survey of Youth (NLSY79) and their children, investigated the relation between parents' employment over a child's lifetime and that child's weight status at ages 13–14. The study showed that the number of work hours per week done by the mother over the child's life span significantly associated with children's higher body mass index (BMI) and increased probability of overweight or obesity at age 13 or 14. This was found to be true especially for children of highly educated mothers. Interestingly, husband's or partner's amount of work hours showed no significant association with children's BMI.

10.1.4 Family and Sleep-Related Habits

It is well known that sufficient and good-quality sleep is, as much as a healthy diet, crucial for children and adolescents' health, growth, learning, and general well-being. However, adolescents often do not get enough sleep. They seem to get 7–7.5 h of sleep on average, while the World Association of Sleep Medicine in 2011 raised the amount of sleep considered necessary for 12- to 18-year-old kids to 8.5–9.5 h per night. According to the National Sleep Foundation (USA), only 10% of adolescents get enough sleep [76]; according to Mencacci and Migliarese [77], in Italy this percentage is as low as 3%.

Lack of sleep in adolescents is due to biological factors intertwined with reasons related to social life and school organization: on the one hand, adolescence involves a biological shift in the internal clock that leads to postponement of the time when adolescents are able to fall asleep; on the other hand, school starting early and extra-school activities (sport, socialization activities, etc.) lead young boys and girls to bedtime delays.

Sleep deprivation leads to several consequences like difficulties in attention, memory, reaction time, creativity, with negative effects on school performance, weight status, and mood regulation. In addition, insufficient sleep leads to increased daytime sleepiness and greater probability to engage in risky behaviors like drinking, fast driving, and drowsy driving.

Sleep-related habits and routines established within the family as well as parents' beliefs about sleep (interestingly, in the United States, only 35% of parents believe that adolescents should sleep at least 9 h per night) can have a significant impact on youths' sleep. Buxton et al. [78] investigated such routines as well as the perceived importance of sleep among 1103 parents or guardians of 6- to 17-year-old children. In particular, through a survey administered to parents, authors obtained information about their perceived importance of sleep, both for their own and for their children's mood, health, performance, and behavior. In addition, they collected information about children's amount of sleep, sleep quality, sleeping arrangements (whether children shared or not the same bed or bedroom), presence of technology devices kept on in the bedroom, impact of technology on the child's sleep, habits like texting or e-mailing after going to bed, presence of sleep-related rules and routines (fixed bedtime, use of caffeine, use of computer, tablet, smartphone, video-games), and relation between regularity of schedule and sleep. Authors found that over 90% of parents believed sleep is very or extremely important both for themselves and for their children. According to parents' reports, authors concluded that children tended to have better age-appropriate sleep (at least 9 h for children between 6 and 11 years old, and at least 8 h for those between 12 and 17 years of age) in families where rules and sleep-wake routines were well established, and when other rules and regularities were enforced. They found that both quantity and quality of sleep could benefit from arranging sleeping spaces in a way that prevented children from being exposed to inside noise (children sleeping in nonshared bedrooms, for example, had less difficulties in sleeping), from enforcing rules that limited caffeine intake from coffee, colas, or other sources, from avoiding to keep electronic devices on in the bedroom after bedtime, from avoiding television and use of technology (texting or emailing) after going to sleep, and from having a regular meal schedule.

10.1.5 Family Socioeconomic Status

Family socioeconomic status (SES) may impact on several aspects of adolescent health, from sociopsychological and relational outcomes to the above-mentioned food- and sleep-related habits.

Marco et al. [79], for example, investigated the relation between SES and sleep patterns in 62 male and 93 female adolescents. As indicators of SES, authors considered total household income, education level, and employment status (full time, part time, or no employment) of the head of household. The study included other measures, like neighborhood environment (type of house, quality of public space, etc.), household environment (number of people living in the house, presence of TV or computer in the bedroom, presence of sleep hygiene practices), sleep patterns (sleep onset and offset, total sleep period from onset to offset, total minutes asleep). Results showed that lower SES was associated with later sleep onset and fewer minutes asleep. In addition, SES also predicted consistency of school night sleep. More specifically, lower SES associated with greater night-to-night sleep variability

and greater differences between sleep preceding school and weekend sleep. As for weekend sleep patterns, they seemed to be affected only by aspects of SES relating to neighborhood (in particular, the street environment).

Sivertsen et al. [80], in a study conducted on a sample of 9338 Norwegian adolescents, also found that poorer family economy is a predictor of delayed sleep phase syndrome (DSPS), a disorder that can be diagnosed as such when a subject experiences a shift in the sleep/wake cycle, with insomnia or excessive sleepiness and significant impairment in daytime activities, social functioning, or other [81]. In the above-mentioned study, a higher percentage of subjects with DSPS, in comparison to subjects without DSPS, reported more disadvantaged family economy. In addition, among potential predictors of DSPS, authors identified fathers' education. A higher percentage of adolescents with DSPS had fathers with a higher educational level (university/college degree). Interestingly, no significant difference was found between DSPS and non-DSPS adolescents in relation to mothers' education. Other significant predictors of DSPS were found to be ADHD symptoms, lack of personal structure, and parents not living together.

Childhood SES has also been found to impact on cognitive achievement throughout the life span. It influences the experiences an individual can make from childhood through adulthood and those experiences influence, on their turn, brain structure and function (see [82]), with consequences on psychological, emotional, and cognitive development throughout life [83–85]. Ardila et al. [86] carried out a study on the influence of parents' educational level, one of the dimensions of SES (see above), on children's executive functions, an extremely important complex of cognitive processes for individuals' future academic and professional achievements. The study was carried out on 622 children of 5–14 years of age, recruited in private and public schools in Colombia and Mexico. Children were administered several tests, aimed to assess performance on several executive functions (i.e., phonemic verbal fluency, semantic and non-semantic graphic fluency, categorization, shift, planning). Authors found a significant correlation between parents' educational level and most of the measures of executive functions considered, especially verbal executive functions. Parents' educational level proved a stronger predictor of executive functions performance than school type (private vs. public school). Authors speculate that parents with a higher level of education (interestingly, the education level of parents within the same family was usually very homogeneous, with mean difference of <1 year of education between mother and father) tend to create a more stimulating environment, under an intellectual point of view, that ultimately results in children's more efficient executive functions.

A review by Reiss [87] on over 50 papers concerning the relationship between indicators of SES and mental health outcomes in children between 4 and 18 years of age highlighted that kids coming from low SES families were two to three times more likely to develop mental health problems in comparison to peers belonging to nonsocioeconomically disadvantaged families. It also showed that low SES and low parental education were the strongest predictors of mental health problems and that SES tended to associate more strongly with externalizing than internalizing

behaviors. Authors identified two possible theoretical approaches that might explain the association between disadvantaged SES and development of mental health problems:

1. the social causation hypothesis that attributes the emergence of mental health problems to the stress caused by low SES.
2. the social selection hypothesis, according to which a genetically determined predisposition causes some individual to drift down to low SES condition.

According to the author, data suggest that causal and selection effects are deeply intertwined, as “SES contributes significantly to the initial appearance of mental health problems, and the failure to recover from these problems leads to a downward drift in SES in adulthood” (p. 28).

A meta-analysis by Tippett and Wolke [38] explored the association between SES and school bullying. Overall, significant but weak associations were found between SES and bullying. Very weak associations were found for the bullying role. Victims and bully victims were more likely to come from low SES. The authors speculate that low SES could be the cause of victimization in two ways: low SES children, who may be unable to afford goods available to peers, are perceived as different and are more likely to be singled out for victimization; alternatively, low SES children may be more likely to have experienced, in the home environment, more violence, abuse, authoritarian parenting practices, with negative effects on their abilities to build positive relationships with peers [88–91].

The SES role has been found to associate also with aspects of learning and mental health [92, 93]. Poole-Di Salvo et al. [94], for example, in a study on about 8600 adolescents found a correlation between household food insecurity, strictly related to SES, and risk of parent-reported mental health problems.

10.1.6 Family Unhealthy Behaviors and Adolescent Outcomes

Several parenting behaviors can have positive or detrimental effects on adolescent well-being. Parents’ unhealthy habits like smoking or alcohol use have been explored by several studies and have been found to lead to negative outcomes in adolescents. In particular, exposure to environmental tobacco smoke (with parental smoking being more frequent in single parents, parents with low income and with lower levels of education) was found to associate with poorer academic achievement (see [95]). Also, parents’ nicotine dependence was found to associate with children becoming earlier and more intense smokers [96].

Li et al. [97] carried out a review on 23 studies concerning parents’ nonstandard work schedule in relation to several children and adolescents’ developmental outcomes, in particular, internalizing and externalizing behaviors, cognitive development, and body mass index, but also other outcomes like sleep patterns, school engagement, and extracurricular activities. They report significant associations between parents’ nonstandard work schedule and at least one of the above

variables. The strongest negative associations were found with cognitive and mental health/behavioral problems in preschoolers and with risky behaviors in adolescents. Negative associations were particularly strong in low SES families, which may suggest that families with greater economical resources may be better able to cope with the challenges of nonstandard work schedule. In addition, the associations were stronger when parent worked full time than when they worked part time.

A report on the impact of adverse childhood experiences (ACEs) on children and adolescents in England [10] identified poor parenting skills, family isolation, and disadvantaged economic conditions, low parental age, household adversities (misuse of alcohol, use of drugs, domestic violence, separation or divorce, etc.) among the factors that correlate with the prevalence of ACEs, situations that may negatively impact on young people's health and well-being and that can lead to other negative social outcomes throughout life.

Voerman et al. [98] found a relation between adolescents' conflicts with parents and chronic pain. The latter is a common experience among adolescents (mostly girls between 12 and 14 years of age), and involves continuous or intermittent pain (mostly headache, limb pain, and abdominal pain) persisting for a minimum of 3 months [99]. Voerman et al. [98] detected a prevalence of conflict with parents among adolescents experiencing this kind of syndrome.

10.2 The Effect of Community on Adolescent Health

Community plays a crucial role in adolescence, a period in which connections beyond the home environment become increasingly important and in which young people shift from prevailing family-centered relationships to increasingly more significant interactions with other social and institutional contexts. Defining community has been challenging both for researchers and for other professionals outside the scientific world. The concept of community may encompass the identification of a geographical area, like a city, a village, or a neighborhood, but also a group of individuals' shared goals or experiences that may derive and be related to people's culture or religion (and the particular views and practices these may involve), their ethnicity, their socioeconomic status, their profession or employment conditions (that may lead, e.g., to specific health issues), and their belonging to socially disadvantaged or excluded groups (who may be fighting for their rights or equal access to resources).

According to Frohlich et al. [100], adolescents outcomes are significantly influenced by the community contexts they live in, but on their turn, they can influence and shape those contexts while interacting with them (see Fig.10.4). Numerous intertwined factors (interactions with peers, degree of safety of the neighborhood, hygienic conditions, presence vs. absence of childcare, schools and other educational services for young people, etc.) within a community can make a difference in the life of adolescents, with significant effects on their well-being throughout adulthood [101].

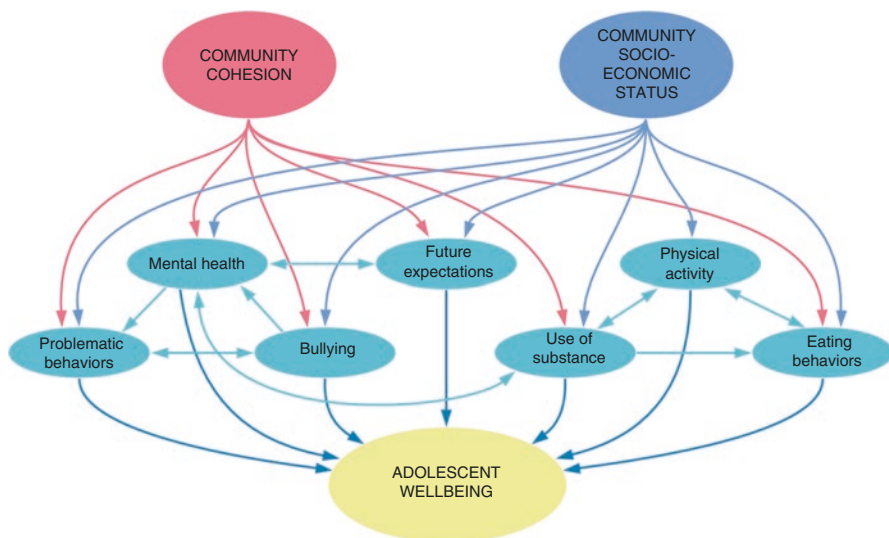


Fig. 10.4 represents the complex network of interconnections between aspects of community (cohesion and socioeconomic status) and behaviors (future expectations, use of substance, physical activity, mental health, etc.) affecting positively or negatively adolescent well-being. Solid and dashed arrows represent stronger and weaker connections, respectively

Although the effects of community in adults have largely been studied, documentation concerning adolescents' needs more attention and work on the part of the scientific world. Below, we report a summary of some of the most recent research studies on this topic.

10.2.1 Community Cohesion

In a study conducted on 176 students of seventh grade from one Midwestern U.S. middle school, Schmidt et al. [102] found that a stronger sense of cohesion and support within the neighborhood was associated with less adolescent involvement in bullying behaviors. Findings from the same study showed that neighborhood collective efficacy highly correlated with positive expectations for the future, the latter correlating on their turn with reduced chance of engaging in bullying behavior.

Other less recent studies, also reported in Schmidt et al. [102], found that good relations with caring and competent adults, who could provide advice and act as mentors, favored the development of positive expectations for the future (see [103, 104]).

Jose et al. [105] showed that community connectedness had positive effects on adolescents' well-being, measured in terms of future orientation, confidence, life satisfaction, and positive affect (the same study, however, found that the effects of family and school on adolescents' well-being were even greater than those of community or peers). Schmidt et al. [102] speculate that this relationship could be

explained by the fact that “in neighborhoods with strong cohesion and informal social control, adults may be more likely to want the best for youth in their community and, therefore, may act as natural mentors, offering advice and guidance to youth” (p. 242).

Mann et al. [106] investigated the role of community, family, peers, and school in perpetration of bullying behavior and victimization. They found that more time spent with parents, greater parental support, intergenerational community closure, and compliance to community values were protective factors against bullying behaviors. In addition, they found that chances of experiencing victimization increased if community closure and parental and peer support decreased.

Arango et al. [107], in a study on 321 adolescents of 12–15 years of age, found that lower level of social connectedness and higher levels of perpetration of bullying behaviors and victimization significantly associated with greater odds of suicidal ideation and attempts.

Foshee et al. [108] highlighted significant protective effects of social bonding on adolescents. It showed that odds of perpetrating peer and dates violence decreased with the increase of social bonding, though peer social control seemed to have an effect for boys but not for girls. The same study also showed that use of alcohol or drugs, or being exposed to deviant behavior models in the neighborhood also increased odds of violence perpetration. Similarly, family conflicts or deviant behavior models in the school environment acted as risk factors and increased odds of violence, with associations being generally stronger for boys than girls.

10.2.2 Community Socioeconomics Status

Community SES can impact on adolescent well-being in several ways. Several studies have shown that neighborhoods that generate high levels of social capital foster greater well-being under several point of views: better mental health, greater likelihood of spending time in physical activity, more health promoting, and less risk-taking behaviors [109]. A study by Sorhagen and Wurster [110], carried out on over 900 of 15-year-old subjects, identified a relation between SES and internalizing/externalizing behaviors in adolescents. In particular, it showed that when family income fell below the normative for their neighborhood, adolescents belonging to those families experienced stronger feelings of loneliness and social dissatisfaction that caused greater internalizing and externalizing behaviors.

Quon and McGrath [111] explored the relation between relative SES, a combined measure of subjective SES, community SES, and income inequality, and several health outcomes in adolescents. The study was conducted on a sample of 2199 thirteen- to sixteen-year-old adolescents from the Quebec Child and Adolescent Health and Social Survey. Authors found that lower subjective SES related to less physical activity level, less fruit and vegetable intake, more general health symptoms, more asthma, and more mental health problems like depression, anxiety, anger, and low self-esteem. Another interesting finding was that adolescents rated their subjective SES higher when family SES was higher and community SES

lower. In addition, authors found that a higher SES school and better employment status of classmates' parents had protective effects on adolescents, who tended to be less physically inactive, follow a better diet, have better blood pressure, and reduced alcohol use. Finally, authors found an association between income inequality and adolescents' mental health. In particular, they found that greater income inequality associated with lower self-esteem and greater anger.

10.3 Conclusion

Adolescence is period of opportunity or risk, depending on the positive or negative impact the various intertwined factors mentioned previously may have on individuals. We have touched upon the effects of family structure, relations, habits (like those relating to eating and sleeping, or other behaviors like those concerning smoke or alcohol use), and socioeconomic status on adolescent health; we have also considered the effects of community cohesion and SES on young people's well-being. The complexity of interrelations among different factors both within and between family and community is such that drawing conclusions or making generalizations is nearly impossible. As highlighted in Patton [18], adolescents grow up and develop "within a complex web of family, peer, school, community, media, and broader cultural influences" (p. 12) and experience social engagement "beyond an individual's family, with a shift to peers, youth cultures, and the social environments created and fostered by new media. This wider social engagement is an important aspect of healthy development in which young people test the values and ideas that have shaped their childhood lives. Not only is the range of social influences greater and more complex, but also an extended adolescence increases the duration of their effect into young adulthood and ultimately their significance for health and well-being" (p. 12).

The complexity of interconnections among all the factors involved in adolescent well-being calls for the necessity to identify and measure a wide range of indicators of adolescent health, reach comparability of measures by identifying consistent thresholds or age categories, harmonize national and international surveys in order to make better use of collected data, and obtain regular reports by different countries on adolescent health (see [18]). All this will allow identifying risk processes, while informing and guiding policymakers in the identification of strategies, provisions, and programs that could reduce opportunity inequalities and improve adolescent health in the future years.

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The Role of Well-Being in the School of Inclusion

11

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11.1 Introduction

In recent decades, there has been both a gradual increase in the number of years of compulsory schooling and the demand for ever-higher levels of education in the labor market in countries with more advanced economies.

This has profoundly changed the nature and significance of the scholastic path: although at the beginning of the last century schools selected those who for aptitude, motivation, and ability wished to undertake an academic career, currently school is a path that is addressed to everyone.

By now, in industrialized countries, the population attends school from a young age and for several years. In 2011, for example, in the EU-28 93% of children begin schooling just before the age of four. In more than one third of European countries, the participation rate is higher than the EU benchmark [1]. We have therefore moved from a model of a selective school to a school that has to achieve and guarantee educational success for everyone. In this paper, *selective school* refers to a school model whose fundamental function is the transmission of knowledge that is important for an academic and professional course of study. Its objective is not to guarantee educational success to all but to select students on the basis of achieved results. For *inclusive school*, instead, we intend to refer to a school model whose function is to guarantee educational success to everyone. Obviously, an inclusive school cannot limit itself to proposing only academic competence, because it must educate students who have a multiplicity of attitudes, styles of learning, and interests.

School counseling programs thus becomes a fundamental task of the school and continues throughout the entire educational path. Furthermore, inclusive education

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cannot be limited to passing on knowledge, but must be able to promote the students' motivation. Venuleo says that the role of a teacher in an inclusive school is not only didactic but he/she has also competences in building the school setting and the conditions for relationships [2].

It is, therefore, no coincidence that the theme of motivation has become increasingly important in recent decades.

In a selective school, in fact, the student's motivation was considered a necessary prerequisite for the scholastic path and not an outcome that the school is required to produce; even the school counseling programs were superficial and confined themselves to certifying the failure of the students who proved to be unsuitable for a certain type of path. Ultimately, therefore, there was no interest in the student's individual abilities and the effect they might have on the student's learning ability.

The student had to adapt to the proposed content and methods. In fact, in the most prestigious and strict schools, a certain level of demotivating behavior, put in place by the teachers, was considered useful in order to select only truly motivated students. Paradoxically, the student was required to stay motivated to study "despite the school," and not "thanks to" the school.

However, ever since school has become more and more inclusive and school failure is considered a problem to be solved, motivation has become the most important factor on which to intervene. In fact, it is the factor that most affects academic success immediately after general intelligence [3].

The focal point of school remains to learn solely for knowledge's sake. In particular, in almost all European countries, teachers focus on learning typical "academic" disciplines. In Italy, for example, humanistic (Italian language, literature, geography, and history) and scientific (mathematics and science) disciplines are dominant compared to all other disciplines not only in primary and secondary schools (age of students between 6 and 13 years), but also in vocational schools.

However, it is believed that schools should motivate the students, so as to ensure their educational success.

The way in which schools concretely motivate students varies in different European countries and from school to school, especially in countries where schools have greater autonomy. Moreover, teaching quality is determined largely by the relationship between teachers and students, which in turn depends on the personality of the teachers. There is therefore also a large individual variation.

Furthermore, school systems, in general, share the same organization, which includes exams and rejection. These elements create a framework—we could also say a "setting"—within which teachers and students move.

We are going to see how, in most European school systems, "inclusive" elements have been inserted over time into a general structure that has been inherited from the selective school. The transition from a selective scholastic model to an inclusive one is therefore still evolving.

11.2 From Selective School to Inclusive School

The selective school was based on the idea that there was a privileged and more qualified study path, designed for a few students who were destined to be the future ruling classes. This scholastic path, therefore, had to train young people for intellectual and academic professions. The role of the school was not to guarantee formative success to everyone and promote study motivation through a personalized and adaptive teaching method. Instead, the role of the school was to evaluate the students' performance so as to select only those actually motivated and capable. Performance evaluation was, therefore, an essential part of the school's selective function.

Those who were not fit for the most strict schooling could access simplified, shorter paths that granted access to less qualified professions. No particular scholastic competence was required for manual and simply executive professions.

Such a model is widely outmoded. It is not conceivable in the first place because of the fact that nowadays school is aimed at everyone. The progressive elevation of compulsory education and the demand for increasingly qualified professions make a selective system, such as the one we have briefly described, impossible. At the same time as this economic and regulatory change, the interest in the problem of school dropout has increased more and more.

Although in the selective school model the dropout rate is a natural part of the process, in recent years, the dropout rate is considered an indicator of the school system's failure and represents a significant economic cost. It is, therefore, no coincidence that studies on dropout rates, training failure, study motivation, and student engagement have also increased in the scientific literature.

However, if one looks at how the selective school was structured to play its role, important lines of continuity emerge with the current school systems.

In the selective school model, the academic path of excellence was the reference point of the other paths, from which all the others differed to address students with inferior capacities. It is no coincidence, for example, that a university college of excellence, the *École normale Française supérieure*, brought to Italy in the Napoleonic era, is called this way: academic excellence has always defined the *norm* of knowledge. In Italy, the term *normal school* was applied both to the normal upper school, university college of excellence, and to the unpretentious schools designed to prepare elementary school teachers. These schools, however, had to know how to refer to excellence and the ideal of knowledge in order to fulfill their educational function.

In Italy, for example, the Ministry centrally defined the scholastic programs and verification methods, ensuring that various professions could only be accessed by those who had attained adequate skills. For the same reason, great importance was given to verifying the learning process, mostly through exams. Some of these exams were of particular importance and were therefore called "state exams", because they were carried out with particular rigor, mostly by teachers outside the school, and because they allowed those who passed them to obtain a legal qualification.

Naturally, evaluation was central to the student's life, not just during exams, but in everyday life at school. There was a substantial homogeneity between the assessment methods of the exams, and those of the teachers during the year, as both carried out the same function (ascertaining an adequate skill level).

School marks were charged with expectations and therefore played an accessory role to promote study motivation: good grades/marks were the incentives that encouraged those who were hard working and could develop skills; the bad grades/marks were intended as sanctions and discouraged poor effort. Much of this brief description still fits most of the European school systems.

Furthermore, school is still designed as a path, with levels of learning to be achieved and an assessment that requires monitoring and certifying achievement. Thus, although great strides have been made in recognizing the existence of a plurality of intelligences, school is still based on the idea of a pre-established "standard" path to which students must adapt.

The standard path is modeled mostly on one type of academic knowledge. Furthermore, the idea remains that the academic path is the point of reference for all the others. So even in professional paths, theoretical subjects such as mathematics, science, and literature are predominant. Professional paths, therefore, are characterized in part by vocational subjects, but in part simply to be easier than high school paths. In some countries, the choice between different paths occurs very early (Switzerland and Germany are the European examples of this), whereas other countries prefer to differentiate the routes after middle school (as is the case in Italy and France), in order to allow families of lower sociocultural level to spend more time in common school paths where students can acquire the right skills for choosing even the most difficult routes.

Naturally, even in this system, evaluation remains central. In fact, it is the assessment itself that certifies the achievement of learning objectives and therefore guides the students to choose one path rather than another.

What has changed in the transition from a selective model to an inclusive one is not, therefore, the general structure of the school. Rather, the way in which this general system is applied in reality and the presence of some changes that allow—or should allow—all students to achieve educational success has changed.

Thus, while in the selective school the subjects and the required learning levels were established in a rigid and centralized way, currently, all European countries give considerable margins of autonomy both to the schools and to the individual teachers to personalize didactic activities and adapt the teaching to the needs of individual students.

In many countries, it is possible for students to repeat a school year, but it is a much more uncommon event.

In all countries, recovery programs are implemented to avoid the unsuccessful schooling of students in difficulty. Furthermore, the concept of a school counseling program has changed. It is no longer seen in negative terms (such as giving the student a signal about what he is not able to do), but positively (such as exploring different paths so that the student consciously chooses what she/he wants to do).

Forcing students to repeat school years is not considered a good way to provide support in choosing the right path.

In this context, the role of evaluation has also partly changed. Although in the past evaluation had mainly a selective role, with the motivational role being purely collateral, now it should be exactly the opposite.

11.3 Motivation and Evaluation in the School

From the student's point of view, good marks are the tangible result of his/her effort and are seen as the goal to be achieved; bad marks, on the contrary, are deemed as a failure.

In the current Italian system of education, therefore, evaluation plays a central role and is the main factor that promotes a student's motivation.

The new rules recognize the "training" role of the evaluation: the teacher is required to evaluate not only the performance but also the progress made by the student.

There are greater flexibility and discretion in the assessment, which allows teachers to enhance the commitment of the students even in the face of difficulties in achieving adequate performance. This allows all students to be recognized for their efforts and attitudes and to achieve educational success.

Essentially, therefore, motivation is promoted by rewards and punishments.

From the pedagogical point of view, however, the refunctionalization of an evaluation system conceived with an essentially selective purpose leads to inconsistencies.

The first incongruity is that a reward system and a feedback system are conceptually oriented to different purposes: the reward system is centered on the student's merit and on the idea that the reward itself is the student's motivation; a training feedback system is instead centered on utilizing errors as an opportunity for improvement.

Dweck introduced the idea that there are two different orientations of students with respect to schoolwork: one centered on performance and one centered on learning [4].

The two types of students, according to Dweck's studies, exhibit opposite behaviors. Performance-centered students are generally less flexible, have less interest in exploring new and risky methods, and prefer to tackle tasks that are sure to be successful. These students tend to become discouraged if they cannot perform a task because for them difficulties are just obstacles to their goal of a good performance. Learning-centered students are eager to deal with challenging tasks. They are curious and flexible and tend to explore new approaches to learning; they are less discouraged by difficulties, which they see as an opportunity to learn new things.

However, the school evaluation system directly rewards performance, and only indirectly rewards the student's commitment and interest. Good performance leads to good marks, while errors lead to lower marks. The errors, however, indicate the

fact that the student is venturing into new lands and should, therefore, be viewed as learning opportunities, not sanctioned with poor evaluation.

Another incongruity we come across is that the evaluation function in an inclusive school should be that of motivating students, an essentially motivating function, but the evaluation system nowadays is still that of selective school, albeit with elements of greater flexibility.

The concept of *internal motivation* stems from the crisis of the theory of behaviorism. From a behaviorist point of view, individual behaviors are shaped by environmental responses. In particular, they are strengthened if they lead to a pleasant situation while they are extinguished if they lead to unpleasant situations.

In this perspective, a system of rewards and punishments such as school assessments should work very well in guiding students toward functional behaviors. The students are motivated by the desire for positive school assessments (prizes) and to avoid negative school assessments (punishments) and then, ultimately, develop behaviors that lead toward the established learning levels.

Toward the 1960s, this vision entered a crisis because the emphasis was also placed on internal factors within the individual, and not only on external factors.

Many activities are done for the satisfaction that one feels for them, and even what the individual considers a reward or a punishment depends on beliefs, expectations, and values.

So, building on Vroom's [5] expectancy–valence theory of motivation, Porter and Lawler [6] proposed a model of intrinsic and extrinsic work motivation.

By intrinsic motivation, we mean the urge to perform a task or activity for the satisfaction that the individual derives from the activity in itself; by extrinsic motivation, we mean the urge to perform a task or an activity in an instrumental way, with the aim of obtaining something.

In Porter and Lawler's vision, intrinsic motivation was added to extrinsic motivation: thus, a reward system associated with an interest in performing a given task would generate a stronger and more effective motivational drive.

Surprisingly, however, some authors found that external reward systems were not always simply added to internal motivational factors: instead, sometimes, extrinsic motivation led to a decrease in intrinsic motivation [7]. A complex picture emerged, in which the two types of motivation could strengthen or weaken each other, depending on the circumstances (for a review see also [8, 9]).

11.4 Reward Systems and Internal Motivation

A theoretical perspective that began to provide an interpretation of these data was the Self-Determination Theory (SDT).

SDT is an approach to human motivation that uses traditional empirical methods and emphasizes humans' evolved inner resources for personality development and behavioral self-regulation [10]. According to SDT, there are three main needs that appear to be essential for facilitating optimal functioning of inner resources: the needs for competence, autonomy, and relatedness.

When these needs are met, a clear internal motivation for curiosity, learning, and creativity emerges. SDT predicts, therefore, that a student will develop a greater internal motivation for schoolwork if he/she feels able to:

- self-manage his/her own choices in relation to the work to be done;
- express his/her creativity;
- have a perception of his/her own competence;
- belong to a group in which he/she is supported.

The distinction between intrinsic motivation for the performance of a task (i.e., when the task is done because it is considered interesting in itself) and extrinsic motivation (when the outcome of the task is reinforced) is of central importance: according to SDT, intrinsic motivation is more persistent and effective, and even reward systems can have counterproductive effects since intrinsic motivation can decrease [11].

It is therefore important to both support intrinsic motivation when it is already present and, when not present, to promote the internalization of motivation by explaining the importance of the task [12].

According to the SDT, enhancing intrinsic motivation requires not only that people feel that they are competent with respect to a given task, but also that they feel autonomous. Conversely, incentive systems may have the effect of decreasing intrinsic motivation if they are perceived as external motivation.

Two aspects of external events are important in our discussion, each with a significant function.

The informational aspect facilitates an internal perceived locus of causality and perceived competence, thus positively influencing intrinsic motivation.

The controlling aspect facilitates an external perceived locus of causality (a person's perception of the cause of success or failure), thus negatively influencing intrinsic motivation and increasing extrinsic compliance or defiance.

According to the CET (Cognitive Evaluation Theory), an evaluation system can be interpreted as a form of pressure and control and, therefore, tends to decrease internal motivation; or, it can be interpreted as feedback on performance and, in this case, does not have a negative influence on internal motivation.

Several empirical studies have confirmed the expectation of the CET showing how reward systems that include social pressure, such as deadlines [13], surveillance [14], and evaluations [15], tend to diminish the sense of individual autonomy and undermine intrinsic motivation. Conversely, reward systems based on enhancing autonomy or on the possibility of choosing aspects of one's work, tend to increase intrinsic motivation [16].

In schools, the evaluation system leaves little room for flexibility. It is based on the timing of the program, is the meter by which parents and teachers gauge the students' achievements and is therefore, essentially, a behavioral control system that leaves little room for students' needs for autonomy.

Although it is simple to show the limits of the current school model, it is more difficult to think about how they can be overcome, because some of these limits seem to derive from the school's mission.

If a school's task is to educate, it seems completely necessary to clearly define what type of knowledge should be imparted. Thus, the need for a scholastic path and an evaluation system to which the students must adapt emerges. The structure of the school, therefore, seems to necessarily have rigidities.

An interesting reflection on the rigidity of the school setting and how it can be rethought was put forward a few years ago by a group of Italian researchers [2].

The practice of a profession generally presupposes a set of expectations that are the prerequisite for the exercise of that profession. Because of this, a professional does not aim to create the necessary conditions and social meaning for the exercise of his profession but expresses it within an already given framework.

According to Venuleo, this also happens at school. The author analyzes a series of communicative interactions between students and teachers, showing how the teacher continually brings back the students' communications to a set of rules that are not negotiated. On the other hand, each student's communications are often aimed at questioning that framework, as if it were not really a truly shared framework of meaning. The teacher then tends to consider the student's lack of adhesion to school rules, customs, and meanings, as a perturbation that must somehow be brought back to normal.

In this way, the existing educational model is not questioned.

Venuleo's theory, however, does not take into account the fact that users have become increasingly heterogeneous and that it is therefore not possible to take for granted the acceptance of a unilaterally proposed school model. However, according to Venuleo, there is the possibility of assuming the heterogeneity of the user as a constitutive factor of the school and not as a factor of disorder. In this sense, in the face of communications from students who more or less implicitly question the setting, the task of the teacher is no longer to treat these communications as moments of class disruption. Instead, these communications are intended as opportunities to renegotiate the objective of what is being done. Thus, we move from an unchallenged and already established setting to what the authors call a *setting in progress*.

The idea is that a school can function, therefore, as a setting in progress, in which the task of the teacher is not only to teach within a shared and already given framework, but also to "build, develop, monitor and verify the organizational and relationship conditions with the users that enable him/her to teach" [2] (Table 11.1).

The idea is to see school as a particular setting compared to that of other professions. It consists of procedures, objects, and rules that do not define a set of shared and already given meanings, but that structure a negotiation between the social actors on the meaning of their action. This presupposes the questioning of the very rigid elements that have remained since the transition from the selective school system to an inclusive school system.

However, there is a fundamental problem: what is the mission of a school? What is the result that teachers need to achieve?

Table 11.1 Differences between selective school and inclusive school

	Selective school	Inclusive school
School mission	Select students suitable for an academic path	Guarantee educational success to everyone
Teachers' goal	Transmission of knowledge that is important for an academic and professional course of study	Promotion of the students' motivation, promotion of life skills, promotion of different skills in relation to different attitudes of the students
Skills development	Skills development is a task for the student, not a task for the school	Promoting students' skills is a task for the school
School counseling programs	Absent	Present
Goal of evaluation	Evaluate the students' performances	Evaluate the students' progresses
Drop-out	Drop-out is a natural part of the process	Drop-out is considered an indicator of the school system's failure
The school is centered on	Transmission of knowledge	Promotion of students' Well-being

If, in fact, school is structured as a path that must make its students reach certain levels of learning, the teachers do not have margins of flexibility that allow them to negotiate the meaning and direction of the path with their students.

It should be noted, however, that the idea of a rigid path also contradicts the mission that an inclusive school should have.

It is unthinkable, in fact, that everyone has the same education, the same levels of learning, and the same attitudes. A school that caters to everyone should, therefore, offer different possibilities for learning.

There is an implicit assumption underlying the idea that the school can offer a setting in progress, and it is the same assumption that underlies the idea that school can be effectively inclusive. If, in fact, the teachers have to treat the differences of the students as the starting point for planning a significant educational path, it is necessary that this path is not established a priori.

It is, therefore, necessary to renounce the idea that the goal of school consists of reaching certain levels of learning. Rather, the objective of a school should be to guarantee everyone a satisfactory learning path.

Here, the difficulty in clearly defining the outcome of the school emerges: what does "satisfactory" mean? It is clearly much easier to define outcomes using standard learning levels and assessment tools. But it is precisely this that forces students to adapt to a rigid setting, prevents teachers from negotiating the meaning and direction of the path, and forces an evaluation system that replaces the pleasure of learning in motivating students to study.

However, the fact that school outcome is more difficult to define in an inclusive school than in a selective school does not mean that it is an impossible task.

11.5 Conclusion: The Role of Well-Being in the School of Inclusion

At the root of the ambiguities, we have shown in the transition from an inclusive school to a selective school, there is the fact that, as we have shown in the previous pages, in an inclusive school, it is not easy to define a path and levels of learning to reach.

But the fundamental point is that, if a school is inclusive, each student must be able to find his/her own educational path. The logical consequence of this is that the school can no longer require identical levels of learning to be achieved by everyone.

This does not mean that learning is not part of the school's mission: it means that it can no longer be the starting point for defining the school's mission.

In an inclusive school, the school's mission is to be able to guide each student on a life path that can fully satisfy her/his aspirations, inclinations, and ideas. This clearly means achieving certain competencies. However, it does not mean that the skills to be achieved are the same for everyone: on the contrary, it means allowing each student to follow their (his/her) own educational path.

The result is that a school's mission cannot start by defining certain levels of learning that must be achieved: rather, it needs to focus on well-being and health.

If we refer not only to the biological dimension, but also to the psychosocial dimension of well-being, and to the definitions of health in *International Classification of Functioning, Disability and Health* (unlike the 1980 *International Classification of Impairments, Disabilities and Handicaps*), it does not constitute a classification of the "consequences of diseases," but a classification of the "components of health." In this definition, well-being is not the absence of disease, but the possibility of expressing one's own potential while interacting with the external environment.

The school, taking on the mission of promoting well-being, does not renounce the promotion of learning, because the development of certain skills is necessary for full inclusion in society and the expression of one's own potential. Rather the necessary skills are not defined a priori and independently of the consideration of the needs of individual students, but are identified starting from the attitudes and aspirations of each student within an educational path aimed at promoting the well-being and the full development of all.

Health education, correct lifestyles, and correct relations with others are not additional moments on the fringes of the school path, but an integral part of it. Hence, there is the need to integrate correct lifestyle promotion with the promotion of skills and awareness of oneself and one's choices. Hence, finally, the importance of monitoring the well-being of students through validated tools. A transition to a truly inclusive school will be possible only by acquiring assessment tools that are not focused exclusively on learning.

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Two-Faced Janus: The Role of Peers in Adolescence

12

Marta Pozzi, Mario Becciu, and Anna Rita Colasanti

12.1 The Peer Group: Definition and Characteristics

The influence of peers on adolescents' wellbeing is included among the "social determinants of health," defined by the World Health Organization (WHO) [1] as the conditions in which people live, that is, the economical, political, social, environmental, and cultural conditions influencing their health. Specifically, relationships with peers, along with family, school, and neighborhood, fall within the category of "proximal determinants," which affect everyday life and thus play a significant role in orienting adolescents' health behaviors [2].

In social science, the peer group is usually described as a group of *limited size* (3–10 members), characterized by a certain *stability* (members meet frequently in conditions allowing face-to-face interaction and the creation of more or less profound bonds), a strong *sense of belonging* (members experience a "sense of Us" and mostly share common goals and values), and a *structured reality* of roles and functions having a *recognizable functioning and history*.

In the peer group, parity does not depend on age (members can vary in age); rather, it depends on *sharing the same social status*, and thus having the same rights, advantages, or privileges and *being bound by role to the same rules and duties* aimed to meet specific social expectations [3].

Peer relationships take on different forms across development (ivi) [3], as shown in Table 12.1. Children *aged 6–10* usually gather in *informal groups*, characterized by few rules that mostly apply to playing and shared activities, with members frequently alternating and an extremely flexible structure and leadership. From *ages 11*

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Table 12.1 Types and characteristics of peer groups at different ages (source: the authors)

Informal group (6–10 years)	Formal group (11–15 years)	Companionship or party (16–24 years)
<ul style="list-style-type: none"> • Few rules, regarding playing and other activities • Alternation of members • Flexible structure and leadership • Expectations on friendship bonds: shared activities and conventional morality 	<ul style="list-style-type: none"> • Strict rules, which warrant inclusion • Definite roles and functions • Requisites for membership are situational • Maximum influence on behaviors, likings, forms of communication, and clothing styles • Strong sense of belonging • Gender specificity (males and females gather in separate groups) • Expectations on friendship bonds: self-disclosure, intimacy, mutual help, coping with problems, satisfaction of emotional needs • Trait features: symbiosis, possessiveness, exclusiveness, jealousy, and conflict 	<ul style="list-style-type: none"> • Affiliation based on shared interests or affinities • Greater flexibility of norms and structure • Presence of both genders • Homogeneity of social status across members • Formation of couples within the group

to 15, groups become *more formal*, being regulated by strict rules (in order to warrant belonging and inclusion), along with definite roles and functions.

Factors determining the group's formation and requisites for being part of it are mostly situational: living in the same neighborhood, attending the same school, sharing the same extracurricular activities, and enjoying more or less freedom from family restrictions [4]. At this age, the group exerts its maximum influence on members, dictating their behaviors, likings, forms of communication, and clothing styles; awareness of belonging is very strong and the arrival of new members or departure of old ones is deeply felt. Formal groups are mostly gender-specific: boys and girls usually gather separately.

According to Clark and Bittle [5], expectations toward friendship bonds are modified in the transition from informal to formal groups. While in informal groups they are based on shared activities and conventional morality, in formal ones different factors become predominant, such as self-disclosure, intimacy, mutual help, coping with problems, and satisfaction of emotional needs.

From ages 16–24, peer groups become *companionships* or *parties*. These are built according to selective criteria, being based on shared interests or affinities; they are more flexible in terms of rules and structure and are not gender-specific; also, members are quite homogeneous in social background. Couples are often formed within these groups. Traits that are typical of the previous age groups, such as symbiosis, possessiveness, exclusiveness, often jealousy, and conflict, tend to attenuate while the main interest moves to romantic relationships [6]. Thanks to its less rigid structure, “the companionship favors the processes of identification and differentiation which serve to achieve autonomy...[it] represents for the individual an important occasion to confront with others, sustain different roles and gradually build a greater knowledge of himself and others” [4, p. 72].

Finally, we must mention a few gender differences in peer interaction, which influence identification and differentiation processes. At variance with boys, girls tend to form very small (3–4 members), exclusive, and intimate groups, in which closeness and confidentiality are greatly important. While male groups are characterized by a predominant interest in external action, female ones are more centered on cohesiveness based on shared values and internal roles. Even at later ages, when groups become mixed, modes of interaction differ between boys and girls. The first group comprising of boys still privilege pragmatic action, assuming in turn various roles and functions. Girls, instead, prefer verbal communication as an occasion to exchange views with others (*ivi*) [4].

12.2 Functions of the Peer Group in Adolescence

Throughout preadolescence and adolescence, the peer group (at first *formal*, then in the form of *companionship*) appears particularly important and plays a crucial role in psychosocial adjustment [7], so much so that it represents one of the most significant experiences of development (Fig. 12.1).

A *first major function* it serves is to favor the gradual increase of autonomy from parents (what Ausubel calls “desatellization;” [8]), along with affirmation of personal identity [9]. Indeed, achieving emancipation from parents and building up a

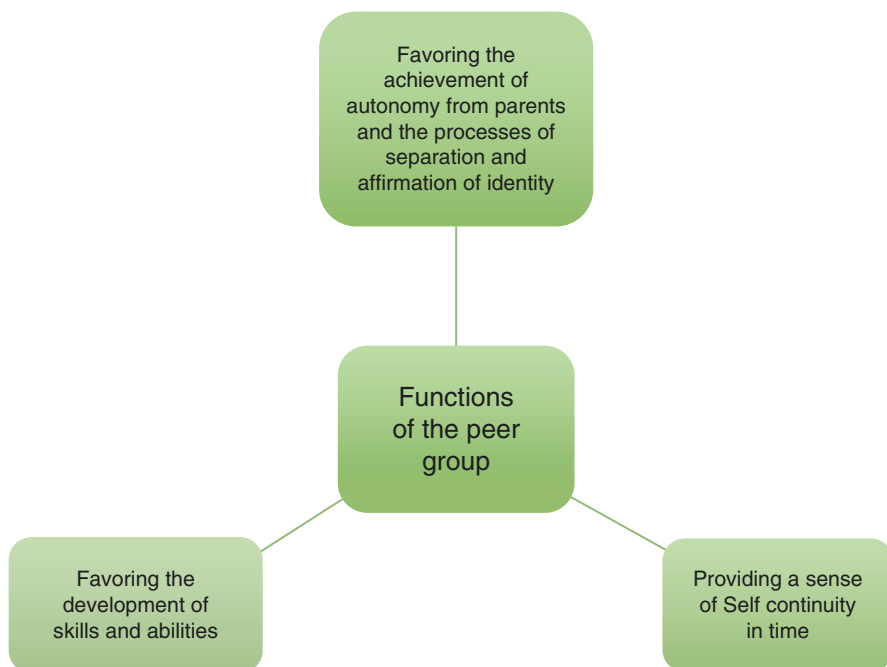


Fig. 12.1 Functions of the peer group (source: the authors)

structured identity represent the main developmental goals in this phase. As highlighted by Fonzi and Tani [6, pp. 93–94], “in front of the abrupt changes simultaneously occurring in too many areas of their life, adolescents feel...the need to develop a new, more independent self-awareness, which is no longer based on images reflected by judgments of significant adults, but founded on a gradual self-definition process...When the urge toward autonomy boosts the desire to break free of parents’ influence and of the limitations of dependence, the intimate bond with peers provides the adolescent with the necessary reassurance to sustain him in the effort of the separation-identification process.”

In other words, friends become a sort of “social uterus,” able to contain the numerous and inevitable anxieties emerging both in front of the varied internal experiences and of the new and unknown ones of the world outside the family boundaries. In this way, dependence on parents and adults is gradually transferred on peers, who allow the adolescent to expand his life space and explore, as well as to experience new roles, test new rules, develop personal values, and define his own likings, attitudes, and behaviors. Thus, as exploration of the outside world parallels self-discovery, friends create the ideal supportive environment to test oneself and familiarize with wider reality. As stated by Freddi [10], the peer group is a transitional space in which, thanks to the relationships and constant exchanges with peers, the adolescent is able to live multiple experiences of identification, kinship, and fusion; he can alleviate feelings of loneliness and discontinuity; he can look for and build new models and values proper to his generation; he can experience relationships with the opposite sex. All of this plays a central role in supporting and enhancing processes of differentiation, identification, and separation. In sum, the peer group’s primary function is that of “social uterus,” sustaining the delicate process of achieving autonomy from parents on one hand and developing identity on the other.

A *second function* of the peer group in adolescence is *favoring the acquisition of social skills*. The group allows the individual to practice tasks and functions representing a sort of premise to future social roles; in this way, he is able to learn and interiorize values such as loyalty, reciprocity, solidarity, and cooperation [6].

Fine [11] suggests that friendship, because of its horizontal nature, allows individuals to experience parity in relationships, providing them with a precious space in which to practice behavior and with a safe context for the development of one’s social Self. In this space, individuals may share and process social representations that guide their actions and may select the most appropriate self-image to show outside. In this sense, getting together is relevant both on the affective level and on the cognitive and social ones [12].

Finally, a *third function* of the peer group is to help the adolescent to *maintain in time a sense of continuity of the Self*, which enables him to attribute meaning and coherence to his existence [13]. According to Erikson [14], the main developmental goal in adolescence is to overcome the bipolarity between identity and identity confusion, by developing a sense of continuity between what one was and what one wants to be, by integrating past experiences with present ones and with future goals. “The adolescent’s self-reflection may express itself through feelings of continuity

and discontinuity, coherence and fragmentation, activation towards future projects, purposes and goals” [4, p. 68].

Friends help the adolescent to give meaning to his present experiences, to find certainty among his doubts, to be confirmed in his behaviors, and to cope with his internal dissonance states; this enables the individual to experience a variety of possible Selves and to manage change without discontinuity. By narrating themselves to friends, adolescents have the “possibility to represent their life, to give it meaning in a specific cultural context and to render explicit what is implicit” [15, p. 51]. “Friends are there to guide towards the future, though with no haste; they are there to reassure on the present by sharing it” [6, p. 96].

In light of the three functions described above, we may conclude that peer relationships represent an important aid for adolescents in achieving the main developmental goals of their age: to gradually break free of adults’ and especially parent’s guidance, to learn to relate to social institutions, to assess oneself in the different intra- and interpersonal aspects, and to build one’s adult identity [16].

Data from research on social-cognitive development in adolescence and its neurofunctional correlates support the importance of the peer group at this age. The neurological bases of the “social brain,” that is, the brain areas sustaining the ability to understand and interact with others, have received growing attention in the last decades. Research in this field has been boosted by neuroimaging techniques, such as functional magnetic resonance imaging (fMRI), which offer important insights into the understanding of cognitive and emotional mechanisms sustaining adolescents’ behavior in their social context. For instance, during adolescence the relevance of rewards is particularly increased due to the maturation of the dopaminergic system; therefore, on the behavioral level, adolescents, compared to adults, appear more sensible to gratification and they tend to seek rewards and sensations more frequently and intensely. Considering the importance of friends as significant alternative attachment figures during the gradual disengagement from parents (as said above), we may easily explain how social rewards become especially relevant at this age and particularly intense at the emotional level. Feeling acknowledged by peers, receiving their approval and confirmation represent for the adolescent a significant source of gratification and security, providing him with necessary feedback on his social desirability and personal identity. Furthermore, the adolescent’s social brain is continuously evolving and busy developing an ever more complex theory of mind, trying to understand the others’ functioning, judgments, expectations, and intentions. Therefore, when facing choices, adolescents are strongly oriented both to seek out immediate reward and to avoid possible social rejection, which their mind tends to anticipate frequently [17–20]. It is thus evident how the exposition to peers at this age influences to a large extent the individual’s choices and consequently his health-related behaviors.

In the next paragraphs, we will analyze, through the contribution of related research, when and how peer relationships contribute to adolescents’ wellbeing and health and, following that, when and how they constitute, instead, a risk factor for transgressive or deviant behaviors.

12.3 Peer Relationships as a Source of Wellbeing

Research has long documented the protective role of peers for psychological development and their positive effects on wellbeing [6, 21]. The main protective factors are summarized in Table 12.2.

Among the situational determinants of wellbeing, perceived social support is considered the main one. In this sense, as described above, the peer group represents a significant source of support on different levels: emotional, psychological, instrumental, behavioral, cognitive, and affective. In the peer group, the adolescent may achieve a better understanding of his problems and may develop skills for coping with them [16].

In this regard, “best friends” are particularly relevant. With his best friend, the adolescent may experience a space for self-disclosure and authentic expression of personal difficulties and conflicts. Best friends become, indeed, the preferred depositories of aspects of the Self that adults are no longer able to understand and accept [6]. Older, more than younger, adolescents tend to seek proximity of best friends since, because of the multiple changes intervening, they feel a particular urge to talk, seek confrontation, and confide their secrets in someone. “The relationship with a best friend offers the adolescent an occasion to significantly broaden his self-consciousness and allows a gradual integration of new parts of the Self” (*ivi*, 98) [6].

Wellbeing is also associated to the experience of friends of the opposite sex. Same-gender friends enable the individuals to identify and compare with each other,

Table 12.2 Protective, risk, and moderating factors related to peer relationships (source: the authors)

Protective factors	Risk factors	Moderating factors
<ul style="list-style-type: none"> • Perceived support • Having a best friend • Having friends of both same and opposite gender • Positive perception of one’s relationships with peers • Having a stable romantic relationship (for older adolescents) • Having peers who experience school in a positive manner • Having peers who are prosocially oriented 	<ul style="list-style-type: none"> • Negative dysfunctional mechanisms leading to blindly accept and comply to group thinking with no questioning, to annul one’s critical thinking • Exclusion and rejection from peers • Encouragement of risk behaviors 	<ul style="list-style-type: none"> • Situational factors: <ul style="list-style-type: none"> – Parents’ monitoring and positive parent–child communication – Positive school setting (fostering personal development and the creation of constructive relationships) • Personal factors: <ul style="list-style-type: none"> – Regulatory self-efficacy – Assertive refusal – Confiding in one’s own coping abilities – Orientation to religion – Orientation to health – Positive attitude toward school

while friends of the opposite gender allow adolescents to explore differences, discover complementarities, and familiarize with sexual and romantic relationships (*ivi*, 99) [6].

A study by Cattelino [22] on 2273 adolescents (both males and females) aimed to investigate to what extent relationships with friends and partners are associated to promotion of wellbeing and reduction of psychological distress. Results showed that positive judgments on peer relationships were correlated with greater general satisfaction, more positive expectations of success in different areas of life, and less discomfort in each of the explored dimensions: stress, depressive feelings, and feelings of alienation. Also, peer support was associated to greater confidence in one's coping abilities and to a decrease of feelings of alienation, especially in the subgroup of females and in that of older adolescents. As for stable couple relationships, which play an important role in the process of disengagement from parents and in the development of self-esteem (since feeling attractive and desirable to someone of the opposite sex positively affects self-perception and self-confidence) [23], the study showed differential effects on wellbeing in the different subgroups. On one hand, couple relationships were positively correlated to wellbeing in older males and to decreased distress in older females; on the other hand, they were associated to greater psychological discomfort (namely, stress and depressive feelings) in younger females. It is hypothesized that, at younger ages, romantic involvement may represent a source of fears and insecurity and hinder occasions of personal satisfaction. This would not be true at later ages, when, instead, the presence of a stable relationship may integrate with personal goals and thus play a protective role for psychological wellbeing.

In addition to its adaptive value in supporting the transition from infancy to adulthood and to its protective role against psychological distress [24], peer friendship is a source of wellbeing because it offers the possibility to experience and share positive emotions [15]. As shown by Diener [25], the frequency of positive emotions represents, along with general life satisfaction, the main parameter indexing subjective wellbeing. Thus, it is not surprising that the possibility to share positive feelings with peers has a significant effect on wellbeing.

Also, the quality of peer relationships appears to positively affect school performance. According to Vaquera and Kao [26], adolescents experiencing positive relationships and reciprocity with peers report a greater sense of belonging to their school and display higher school performance. In line with this, Camacho et al. [27] observed that, while adolescents who do not like school display a lack of friendship, those who report to like it usually belong to a peer group that is not involved in risk behaviors. Similar results come from Lynch et al.'s study [28], showing that a school's peer culture (defined as the quality and nature of student interactions, along with the academic behaviors of the student body as a whole) is robustly related to present and future individual academic achievement and school engagement. Therefore, it seems that good friends provide adolescents with the appropriate environment to be able to experience school in a positive manner both in terms of sense of belonging and performance.

Finally, peer relationships appear to have positive effects on the acquisition of skills and the development of social responsiveness, since they represent one of the main avenues for practicing social interactions [29–31]. Also, they seem to enhance prosocial traits such as altruism, empathy, and cooperation. In this regard, an interesting experimental study Choukas-Bradley et al. [32] showed that peer relationships influence the intention to engage in voluntary work. The latter was measured in a group of adolescents at baseline (individual self-reports) and in two experimental conditions: in the *public* condition, adolescents believed they were interacting through a chat room with same-gender grademates (“e-confederates”); in the *private* condition, subjects were told that peers could not view their answers since they were disconnected from the chat room. Popularity of peers was also manipulated to investigate whether it affected subjects’ conformity behaviors. In the public condition, both male and female adolescents adhered to peers’ prosocial attitudes: their intention to engage in voluntary work was increased after interacting with prosocial peers. However, this effect was moderated by peer status, such that subjects more strongly conformed to the high-status e-confederates than to the low-status ones. These peer influence effects, including those of peer status, appeared to be maintained in the private condition as well, indicating potential internalization of prosocial peer norms. These findings support the importance of the peer group in influencing prosocial and proactive behaviors and the role of peer status in moderating this association. The latter aspect suggests that the involvement of high-status peers in campaigns and initiatives aimed to increase prosocial and healthy behaviors may represent a promising strategy in prevention and promotion of positive youth outcomes (an issue we will discuss in the last section of the chapter).

12.4 Peer Relationships as a Risk Factor

Peers may also negatively influence psychosocial development in the adolescent (Table 12.2). This happens when dysfunctional mechanisms and exclusion processes become active in the peer group and when the engagement in unhealthy behaviors is encouraged by the group.

12.4.1 Dysfunctional Mechanisms Within the Peer Group and Exclusion Processes

Undesirable effects of the peer group may appear, for instance, when too exclusive bonds develop among some members, hindering openness to others and the possibility to interact with wider social networks [6]. Regoliosi [33] synthesizes as follows the possible dysfunctional mechanisms that may arise in the peer group: excessive closure toward external relationships, excessive and rigid internal cohesion, and development of values that are not interactively shared. As for the first mechanism, some instances are: considering friends as more important than one’s

parents, hiding from external figures (especially adults) possible weaknesses or errors made by some group member, and avoiding to seek external help for coping with problems. The second case, instead, may be described by some dysfunctional attitudes, such as valuing peers as the most important thing in one's life, feeling lost or bewildered when outside the group, justifying any offense received by group members, avoiding any initiative outside of those approved by the group, and admiring the group's leader unconditionally. Finally, accepting group thinking with no questioning, considering the group's values as expression of one's personal identity, and having blind faith in the group's values with no comparison to other groups are examples of the third mechanism. Thus, when peer relationships take on these characteristics, they may become a source of distress and psychological difficulties.

Furthermore, exclusion processes are often a determinant of psychological discomfort: feelings of rejection and exclusion from peers constitute a risk factor for more or less marked maladjustment and for multiple psychological issues. The lack of friends deprives the adolescent of an important source of gratifications and learning possibilities, as well as generating feelings of worthlessness, inadequacy, anger, shame, and withdrawal behaviors. Without friends, the adolescent appears as a turtle deprived of its shell: he is vulnerable and fragile, devoid of his social support network which should help him cope with the numerous stresses (normative and not) characterizing this delicate age [6]. Determinants of exclusion may be various. Sometimes they are linked to dysfunctional processes of stigmatization of some members, other times to rejection associated to certain physical characteristics, or to social inabilities of the excluded individual (e.g., bullying attitudes, arrogance, clumsiness, social awkwardness, unassertiveness). That is why it is important for adolescents to develop the social skills necessary to build friendship bonds, such as expressiveness, emotional stability, sociability, loyalty, decentering, empathy, and ability to conform to group norms.

12.4.2 Involvement of the Group in Unhealthy Behaviors

As said before, negative peer conditioning may take the form of involvement in risk behaviors. Risk behaviors are those that may hinder health and wellbeing (e.g., dangerous driving, incautious use of the web, use of psychoactive substances, unhealthy eating, antisocial behaviors); adolescents may engage in these behaviors in the attempt to cope with their developmental efforts.

It is well known that adolescents tend to seek risk with the intent to understand themselves, what they want and want to be, what their limits and resources are, and to build up a new image of their Self that will be proposed to the wider group, their new social family. As stated by Bonino et al. [34], risk behaviors in adolescence have a functional meaning; as in the case of adaptive behaviors, they are undertaken by some adolescents in order to affirm their identity and participate in social interactions. Their functional significance is confirmed by the fact that they are often abandoned with the progression to adulthood, revealing their transient rather than

permanent nature. Nevertheless, they must not be underestimated because of their potential to determine negative outcomes on health and wellbeing.

Peer-to-peer contagion of risk behaviors is widely documented. It is well known that, at variance with adulthood, during adolescence harmful and unhealthy behaviors are often pursued together with peers [35], a fact which enhances diffusion of responsibility. For instance, antisocial adolescent behaviors and juvenile crimes are usually perpetrated in groups [36]. Another example refers to dangerous driving: experimental research has shown that adolescents risk more when in friends' company compared to driving alone, while no differences in risk-taking are observed between social and solitary conditions in adult subjects [18].

Below, we will analyze the influence of peers on a few specific risk behaviors.

A bulk of research is available on *substance use*, especially tobacco, alcohol, and cannabis, the most frequent in adolescence. The desire to have new experiences, to feel older, and to violate rules are natural developmental needs that may easily be fulfilled by experimenting with legal or illegal substances. When substance use is not limited to occasional experimentation and turns into problematic or addictive behavior, negative implications for the adolescent's health and his life environment become relevant and sometimes persistent [37]. The most recent Italian survey on teens aged 15–19 reports that individual substance use (as well as other risk behaviors) is influenced by peer group behavior. Specifically, having friends who abuse alcohol or drugs is positively correlated with use of substances during the last year (the correlation is even stronger with frequent use), as well as with smoking at least one cigarette per day during the last year, getting drunk during the past month, engaging in unprotected sexual intercourse, use of tranquilizers and/or sedatives without prescription, and being involved in driving accidents and in fights [38].

Among the substances used in adolescence, *tobacco* is particularly common. According to the European School Survey Project on Alcohol and Other Drugs (ESPAD) Report [39], 21% of European adolescents has smoked tobacco during the past month. A review of literature examining 10 years of studies on peer group influence on smoking [40] concludes that this behavior is quite homogeneous among peers, as it happens for the use of other types of substances. Adolescents with smoking friends are more inclined to smoke or to start smoking in time. "Best friend" relationships appear to be more influential compared to significant friends or general group affiliation, although the authors underline the need for further investigations on the weight of these relational factors. A recent European retrospective study Filippidis et al. [41] analyzed the impact of peer groups, parents' influence, and cigarette characteristics on the age of onset of smoking behavior in adult regular smokers. Overall, most smokers (80.6%) in all the 27 countries of the European Community cite smoking in the peer group, especially during late adolescence, as a significant factor in determining the onset of their smoking habit. The other two factors (parents' influence and cigarette characteristics) were reported by a minority of subjects, most of them having started to smoke later than the age of 18. Another recent study [42], conducted on a sample of 5600 adolescents, investigated parents' and peers' influence on smoking behavior. All four factors considered, that is,

behavioral models (descriptive norms) and perceived approval (injunctive norms) by both parents and peers, revealed significant effects on subjects' intention to smoke. However, peers' behavior was more significant relative both to parents' behavior and peers' approval. In other words, observing peers who smoke exerts a greater effect compared to what peers declare or think and to parents' smoking behavior. Also, the effect appears to increase with age. Finally, a study conducted in six European countries [43] explored the factors determining adolescents' perception of the prevalence of smoking behavior among peers. Results showed that adolescents generally overestimate the percentage of smokers in their school setting and this overestimation is associated to a greater probability to start smoking.

Alcohol use in adolescence is also the object of many research studies because of its numerous negative outcomes [44]. In particular, *binge drinking* (the consumption of five or more drinks at a time) is correlated to future drinking-related problems, including higher risk of morbidity and mortality [45, 46]. It is well documented that the peer group may act as one of the major risk factors for alcohol abuse in adolescence [47–49], especially through the expression of pro-alcohol peer norms [50]. Adolescents who consume alcohol tend to associate with peer drinkers: on one hand, they seek peers with similar behaviors, on the other they are influenced by them [51, 52]. In fact, alcohol consumption (as well as that of other substances) in adolescence seems to be regulated by at least two mechanisms: one regarding selection (adolescents are similar to each other since they select friends who resemble them), the other referring to reciprocal influence (adolescents take on similar behaviors because of their association to each other) [53]. Adolescent drinkers appear more popular and attractive to others; thus, alcohol use in youth seems to be linked to friendship schemes, with their processes of selection and reciprocal influence, so that the behavior spreads across social networks [52, 54]. Adolescents, who spend more time with peers, experience pressures toward drinking, and have friends who drink, show a higher probability to be involved in alcohol abuse episodes [55]. Furthermore, a correlation between early onset of behavior (along with genetic factors, personal and family characteristics) and future risk of addiction has also been observed for alcohol consumption [56]. In this regard, one study showed that teens lacking adequate parents' monitoring start drinking relatively early and provide an environmental cue for alcohol consumption to other predisposed adolescents [57].

As for the consumption of *cannabis* (the most common illegal substance), it is often experienced first during adolescence and, in more than 75% of cases, in the context of peer relationships [58]. A recent systematic review [59] highlights that exposition to peer cannabis users affects both the probability of individual engagement in consuming behavior and consumption levels. In general, real or perceived consumption levels in the peer group appear to have regulatory effects on individual levels of consumption [60, 61]. Another moderating factor is represented by perceived attitudes and beliefs of the peer group on cannabis use [62, 63]. The group may affect individuals' behaviors through different mechanisms: by providing opportunity to use cannabis, through modeling, by exercising pressure toward consumption, and by creating a social context in which that behavior becomes “normative.”

Transgressive behaviors (those violating social norms) may be of moderate (lying) or extreme (stealing, assaulting) severity. Association with deviant peer groups is considered a strong risk factor, as well as a maintaining and reinforcing factor, of this type of behavior [36]. Dishion et al. [64, 65] describe the process of “peer deviance training,” through which peer groups give rise to, guide, and encourage the undertaking of deviant behaviors. The process mainly involves adolescents with a history of environmental and family deprivation, as well as difficulties in the development of social skills since early age, which hinder integration within peer networks and foster mechanisms of social rejection and consequent marginalization. Thus, marginalized and lacking adequate social skills, these individuals seek social experiences in “niche” contexts, involving peers with their same difficulties who are willing to accept them, though superficially. In these specific social settings, their relational difficulties and aggressive behaviors promote affiliation, instead of marginalization. In deviant groups, commonalities between members do not necessarily reside in personal characteristics, but rather in shared emotional experiences. For instance, adolescents may share a history of early loss or the experience of a distant and unreliable parent. The deviant group often plays a vicar role for supportive functions that are lacking in the individual’s family, in a context of strong feelings of friendship and solidarity [36]. The process of “peer deviance training” occurs when deviant conversations (e.g., regarding antisocial behaviors) and antisocial conducts receive positive attention (e.g., laughing). The latter acts as positive reinforcement, increasing the probability to repeat the same behaviors, through a mechanism of “social augmentation” [65]. In this way, negative behaviors are gradually learned and maintained. Another proposed mechanism characterizing deviant groups is that of coercion (“coercive joining” [66]): in this case, aggressive and aversive conducts are used as means to control and subdue other members. The subdued members are usually induced to undertake deviant behaviors, which are often “covert” (e.g., lying, stealing; [67]). At variance with social augmentation, the mechanism at play is based on conditioned avoidance rather than positive reinforcement.

Affiliation to deviant groups is correlated with *premature and unprotected sexual behaviors*, with various negative outcomes such as undesired pregnancy and sexual infections [68]. In fact, in addition to fulfilling developmental needs of belonging and social status, deviant groups provide adolescents with increased access to sexual partners. In general terms, adolescents’ engagement in sexual behaviors is strongly influenced by cognitive factors like peers’ attitudes toward sex and perceived sexual norms of the peer group [69]. According to Potard et al. [70], the belief seems to be perceived that peers are sexually active or display permissive sexual attitudes which are predictors of the onset of sexual behavior. Permissive attitudes perceived in peers and approval of occasional intercourse appear to have an enhancing effect on different aspects: perceived pressure to engage in sexual intercourse for the first time, the probability to experience different sexual partners, and the incidence of nonlasting sexual relationships. On the other hand, having peers who engage in sex acts as a protective factor on the use of condoms during the first sexual intercourse.

Dysfunctional eating behaviors also represent a relevant issue at this delicate age [71]. This field of research has received much attention, especially in reference to weight control practices (fasting, vomiting, use of laxatives), obesity, and eating disorders. Adolescents tend to share food with friends, they discuss types and quantity of food, and often undertake similar eating-related choices and habits [72]. In general, people tend to eat more when in company of others, especially of family or friends. On the other hand, overweight individuals mostly eat alone if they fear social stigmatization, while they conform to others when eating with peers having similar body mass indexes (BMI). In fact, family and peers are primary social contexts which contribute to outline norms on weight and related behaviors, such as physical activity. The role played by peers on the latter behavior depends on the quality of relationships and on perceived support: in the context of good relationships and team spirit, peers may be positive models encouraging participation. On the contrary, when criticism or victimization intervenes, often toward overweight adolescents, these individuals tend to withdraw and avoid engaging in physical activities which could expose them to further mockery or derision [73]. As it happens with other unhealthy behaviors, the diffusion of obesity also seems to be significantly affected by peers. Adolescents with high BMI tend to associate in groups and correlations between peers' BMI are significant for both genders, especially for females [74]. In a recent systematic review on peers' influence on diet and physical activity, Chung et al. [72] conclude that peers represent a potential intervention target to reduce prevalence of obesity in adolescence. In fact, individual eating behaviors and physical activity are correlated to those of significant peers (the association stays significantly up to 5 years); the effect varies according to gender, type of eating behavior and physical activity habits, and perceived intensity of friendship bonds. Other studies have explored the impact of beliefs regarding weight and the perception of peers' attitudes toward it. The belief that peers are interested in weight and body form and that being thin is an advantage within the peer group is correlated with restrictive eating conducts, aimed to obtain approval and social acceptance [75, 76]. In girls, negative friendship bonds (characterized by conflict and alienation) are associated to body dissatisfaction and eating disturbances [76]. The onset of eating disorders is correlated to low levels of trust in attachment relationships with parents and peers; in boys, peers appear to have an even greater impact than parents [77]. A recent study Thompson et al. [78] focused on peer influence on emotional eating, defined as the act of eating in response to unpleasant emotions. Emotional eating is considered a risk behavior since it is correlated to excessive weight, eating disorders, and depressive symptoms. Data show that pressure toward being thin or muscly, exerted by same-gender peers, produces in adolescents feelings of anger, frustration, and uneasiness, which are associated to emotional eating. In both genders, peer pressure on physical appearance is correlated with emotional eating and mediated by the internalization of ideals on body form and appearance.

In sum, research findings support the idea that peer influence may represent a risk factor in several domains: substance use, antisocial conducts, sexuality, and eating habits. Similarly, other studies suggest a relevant role of peers in affecting

other risk behaviors, such as bullying and victimization [79, 80], or internalizing behaviors such as nonsuicidal self-harm conducts [81, 82] and depressive symptoms [83, 84].

12.5 The Role of the Web in Mediating the Relationship Between Peer Groups and Health Behaviors

As described above, the peer group deeply affects individual behavior, either as a protective or as a risk factor, since it reinforces, modulates, and modifies values, cultural models, and lifestyles. In light of the importance of social networking websites in adolescents' lives, their impact on socializing trajectories and on the acquisition of health-related attitudes and behaviors cannot be neglected [85–87].

Indeed, since adolescents are early web users, spend much time online, and are very sensible to peer influence, their subjective experience is highly exposed to the effects of social media [88]. The attempt to describe the complex interactions among these factors is currently the aim of research in this field.

We may say that interactions on the web represent a continuation of group phenomena going on in everyday life, to the point that the separation between real and virtual world appears forced and artificial. In this sense, social networking websites constitute an amplifier of what the adolescent experiences with peers, with adults, and within himself [89]. These websites provide an additional space where adolescents may spend time and communicate with peers, so that new technologies support and integrate face-to-face interactions. At variance with authors interpreting the web as a means of escape from the real world, we agree with Boyd (ivi) [89] who highlights that teens' use of media fulfills the need to broaden occasions of communication and sharing among peers. In this way, digital devices represent a resource, a wider space for their interpersonal relationships.

An interesting issue we would like to address is whether and to what extent social networking websites affect peer socialization and whether a direct or indirect association exists between the use of the web, peer relationships, and modulation of protective and risk factors for adolescents' health and wellbeing. It must be noted, however, that data on this issue are scarce and most studies have focused on the frequency and duration of teens' accesses to the web, on the role of new technologies in psychological development, on their educational value, and on possible risks for psychological and social outcomes [90–97]. For instance, an unresolved question is whether the adolescent's preexisting resources or difficulties determine a healthy or dangerous use of the web or whether it is the web to determine the onset and maintenance of undesirable outcomes [98, 99]. In other words, while it is probable that the web, as an amplifier of shared time and space among peers, affects intensity and probability of engaging in positive or negative health-related behaviors, it is still unclear whether and to what extent it functions as a cause, a means, or an effect.

Thus, the same protective and risk factors modulated by peer relationships [53, 68, 100–105] may be affected by the use of social networking websites either in a pathogenic or in a healthful direction. But how?

Referring to Social Learning Theory [106] and to the Media Practice Model [107], processes of observation and direct experience as well as reading media according to personal interests and history (which tends to reinforce and maintain self-representations) have a relevant influence on individual and group behaviors related to health.

First of all, the use of the web facilitates several processes: the construction of social relationships, the refinement of social skills, the promotion of prosocial behaviors [105], the increase of knowledge in all fields, the participation in social, political, and democratic life at a local, national, and international level, and the broadening of relationships and of time spent in social interactions. Moreover, at a cognitive level, "... the web trains the individual at multitasking, contributes to the development of complex problem solving strategies, helps to structure network relations among concepts" [108]. An interesting review by Milani [109], on 113 scientific studies published in English between 2004 and 2013 regarding the role of Facebook in adolescents' personal and social life, highlights how Facebook promotes the formation and broadening of social networks in youth, contributes to the development of self-esteem, and positively affects wellbeing and emotional experiences of users.

On the other hand, the negative role of social networking websites in increasing the risk of unhealthy behaviors is undeniable. Research data highlight the associations between peer socialization, use of electronic devices, and risk for health. In particular, the use of the web appears to negatively affect socialization when it increases social isolation, favoring processes of disconnection from reality. Time spent online may, in fact, compensate if not substitute relationships with peers. Furthermore, it has been shown that adolescent drinkers or those who intend to start drinking have a higher probability to use the web to search for peer groups with pro-drinking attitudes [110]. In line with this, Moreno and Whitehill [111] observed that adolescents who flaunt alcohol abuse conducts on the web tend to engage in other risk behaviors as well (e.g., unprotected sexual intercourse, use of illegal psychoactive substances) when the online peer group normalizes these behaviors. An additional aspect of the relationship between the web and risk behaviors refers to phenomena that are specifically determined by social media technologies, such as cyberbullying, sexting, the instigation to eating disorders through websites like pro-Ana [112–115], online gambling [116], and severe forms of social withdrawal like the Hikikomori syndrome [117].

We have underlined that adolescents' exposition to the web and their engagement in online peer interactions bear some relationship to health-related behaviors, although research data have not yet clarified these associations. Nevertheless, in a preventive and promotional perspective, it is important to exploit the web's positive potential, by exposing young users to multimedia messages that foster engagement in healthy lifestyles [118, 119].

12.6 Processes of Reciprocal Influence Among Peers and Modulation of Risk Behaviors

In examining the effects of the peer group on adolescents' attitudes, conducts, and life choices, most studies have focused on conformism and imitation as the factors leading individuals to interiorize peers' behavioral models.

An interesting review [52] of the past 10 years of research on the influence of peers in adolescence summarizes the main mechanisms sustaining compliance to norms in the peer group. Besides processes of modeling and positive reinforcement (mentioned above), the authors underline that adolescents tend to adopt those behaviors that are associated to a higher status in the group and that enhance their self-image. Many adolescents seem to engage in behaviors learned from who, in their perception, occupies a higher position in the group hierarchy, guided by the belief that this will increase their popularity. Indeed, some behaviors, albeit dangerous, are considered "cool" and thus perceived as attractive and admirable [51]. Moreover, undertaking actions that are object of approval by valued peers would enhance a positive self-image, which appears particularly important at this age in which identity is being gradually structured.

What said so far induces to conceptualize the relationship between the peer group and individuals in a unidirectional, top-down manner: from the norms to single members who would just adhere to group logic. The resulting image is that of a passive adolescent who achieves his emancipation from family through mechanisms of fusion and adaptation to the group [4]. However, it has been shown that active selection processes intervene in choosing friends: the adolescent tends to choose peers he perceives as similar to himself [120]. Moreover, in relating to peers, the individual also plays an active role in building up his skills and developing cognitive, social, and emotional schemes that are necessary to a gradual differentiation process. Therefore, interactions among peers involve different interwoven functions: fusion and reciprocal identification on one side, differentiation and self-expression on the other, in a dynamic interplay between conformity and autonomy [4]. Similarly, commonalities between individual and peer group behaviors rely on two processes operating sequentially: reciprocal influence and selection [120, 121].

As for peer influence on transgressive and deviant conducts, research findings show that peer models are the main risk factor for these behaviors and that the effect is proportional to the intensity of emotional bonds with the models [122]. However, the global picture emerging from literature in the field is quite complex, since the peer group's negative effects appear to vary as a function of different moderating factors, both situational and personal [122, 123].

The main *situational factors* (Table 12.2) appear to be *parents' monitoring and their communication style* [124]. Even in the presence of deviant peers, parents monitoring their children and maintaining with them a warm and authoritative relationship are able to mitigate peers' influence and limit the adolescent's engagement in risk conducts [120, 125, 126], functioning as a deterrent against transgressive behaviors [127, 128]. Also, a positive *school* setting (fostering personal

development and the creation of constructive relationships with peers and adults) favors the achievement of developmental goals and may thus contrast the emergence of risk behaviors as well as reduce negative peer conditioning processes [129, 130].

Several *personal factors* appear able to attenuate the possible negative effects of the peer group, as shown in Table 12.2. The first one is *regulatory self-efficacy*, that is the ability to resist to peer pressure and preserve one's decision-making autonomy [120, 128, 131], along with *assertive refusal* [132] and *confiding in one's own coping abilities* [34]. Other protective factors against the influence of deviant peers are: *orientation to religion* [133, 134], *orientation to health* [34, 135], and *positive attitude toward school*. As for the first one, religious faith serves different protective functions: it gives meaning to one's existence, provides a sense of personal fulfillment, promotes social relationships, and proposes positive values (universalism, benevolence, tradition, conformity) as a guide to behavior [136]. Orientation to health tends to discourage unhealthy behaviors, while, in the third case, engagement in school programs and activities contributes to increase self-worth and strengthen personal identity, so that adolescents do not need to seek alternative means to feel successful and affirm their adulthood [34].

It is extremely important to promote these factors among adolescents, in order to protect especially those who, for various reasons, may come into contact with risk contexts. In the next paragraph, we will discuss how peers themselves may be a resource in this direction, by using their power of influence in the service of health and wellbeing.

12.7 Peer Education and Peer Self-Help Groups as a Means to Promote Wellbeing in Adolescence

Understanding the mechanisms through which peer influence affects adolescents' behaviors is important in order to plan interventions for prevention and promotion of wellbeing.

It is well known that the acquisition and modification of attitudes and behaviors occur within a network of social influences at any age, and particularly during development. Therefore, the peer group may become a precious resource in the attempt to promote positive behaviors in the direction of health and wellbeing.

Peer-based health education programs seem to be characterized by some specific factors contributing to their effectiveness: the socio-emotional function performed by the group, the role played by each member as a source of information for others, the practice of tutoring, the broadening of coping strategies, the opportunity for mutual help, the increase in the intensity of relationships, and the promotion of mastery and self-efficacy.

Thanks to the symmetric and complementary nature of interactions taking place within it, the peer group offers the ideal space in which to open up to others, share resources and vulnerabilities, acquire and practice skills, initiate and experience change. Among their peers, adolescents have the possibility to communicate in a

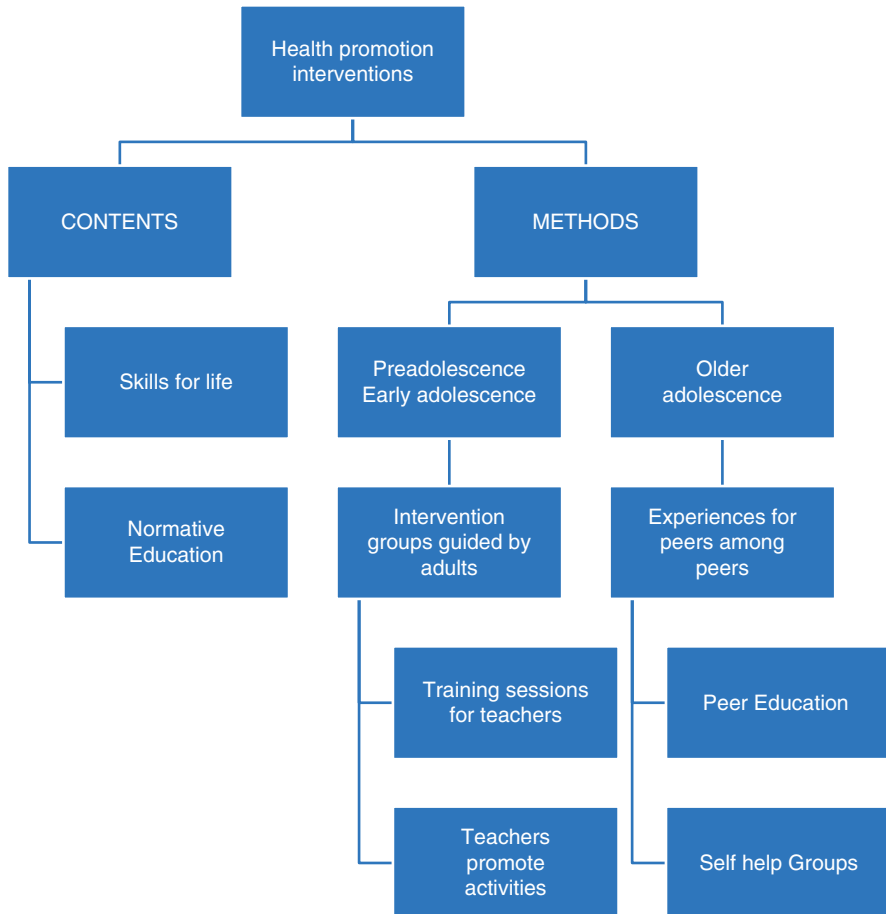


Fig. 12.2 Health promotion interventions (source: the authors)

more direct and unrestrained manner, to recognize themselves in other's experiences, to exchange information, knowledge, and feedback, and to structure behavioral strategies based on reciprocal confrontation [137, 138].

The group may be employed in different manners according to members' age, as illustrated in Fig. 12.2. In preadolescence and early adolescence, intervention groups are usually guided by an adult conductor, who promotes activities and stimulates group dynamics. In fact, the guidelines for substance abuse prevention indicate, for middle schools, programs like "Unplugged" [139] and "Life Skills Training" [140, 141], both including specific training sessions for teachers, who will then lead activities in their classes.

Instead, in interventions targeting older adolescents, the conduction and management of activities and processes are mainly assigned to the adolescents themselves;

adults, when included, operate exclusively as facilitators. Indeed, in this conclusive paragraph we will discuss two types of interventions for the prevention of risk behaviors and the promotion of health that are based on adolescents' autonomy: peer education and self-help groups. For each one, we will describe specific features, contents, methods, and settings.

Peer education is a strategy aimed at health promotion that positively exploits peer influence. It is defined as the process by which same-age or same-status peers educate other peers by sharing with them health-related information, values, and behaviors [142]. In peer education interventions, a few trained facilitators work with target adolescents, so that the latter may intervene on their peers in different ways: by timely identifying risks and contacting competent figures for assistance, by providing information, and by promoting health choices through positive modeling. The efficacy of peer education is based on the feelings of trust, mutual recognition, and familiarity that adolescents more easily experience with peers rather than adults [143]. Peer education has been repeatedly proven effective in different contexts of health promotion and in different geographical areas [144, 145].

Self-help groups are another peer-based strategy for health promotion in adolescence. The interventions involve psycho-educational programs carried out in groups with the aim of enhancing autoregulatory abilities and coping strategies. The activities are usually inspired by cognitive-behavioral theory and practices and are centered on the use of self-training manuals, which stimulate group members to activate self-reflection and psychological development both at the personal and collective level in the direction of wellbeing [137, 146].

Peer education and self-help groups are characterized by horizontality: they represent an *experience for peers among peers*, in which relationships are symmetric and based on positive interdependence.

As far as *contents* are concerned, in line with the WHO's indications, both types of interventions are grounded in the social influence model and are aimed at the development of personal and relational skills [147]. It is worth reminding that a main element of the social influence model is the social norm, which is among the principal determinants of conformity to the group. In fact, the so-called "normative education" is a prevention strategy that targets the modification of false perceptions and the de-normalization of negative behaviors like substance use [42].

In addition to normative education, peer education and self-help groups focus on the development of the cluster of skills that the WHO [148] defines "Skills for Life," that is, a set of cognitive, emotional, and relational abilities that enable the individual to cope effectively with the demands and challenges of everyday life. Specifically, they refer to: decision making (the ability to make choices by assessing options and their possible consequences), problem solving, creative thinking (the ability to think in a divergent and flexible fashion, exploring alternatives and consequences of actions or nonactions), critical thinking (the ability to analyze information and experiences in an objective manner), effective communication (the ability to express oneself both verbally and nonverbally in ways that are appropriate to the culture and situation), interpersonal relationship skills (the ability to initiate, maintain, and interrupt relationships with others in a positive and constructive way), self-awareness (the

ability to recognize and assess one's own strengths and weaknesses, desires, aims), empathy (the ability to imagine what life is like for another person, even in a situation one is not familiar with), coping with emotions (the ability to recognize emotions in ourselves and others, to be aware of how they influence behavior, and to respond to them appropriately), coping with stress (the ability to recognize the sources of stress in our lives and act in ways that help control them). Since the 1990s, all international institutions involved in substance use, health, and prevention—the National Institute on Drug Abuse [149] and the Canadian Centre on Substance Abuse [150]—recommend the promotion of these abilities [147]. These personal and social skills enable the adolescent to exercise self-regulation at the emotional level, to communicate assertively, and to participate in the peer group in constructive ways, reducing the probability of affiliation to deviant peers with all the associated risks.

As for methods, both types of interventions are centered on adolescents playing the prominent role. A recent systematic review [151] concludes that students' participation in health promotion interventions (in terms of planning, implementation, and evaluation) increases programs' effectiveness. Indeed, it has long been observed that intervention modalities based on adolescents' active involvement (through role playing, games, and discussions) yield significantly higher and long-term effects compared to purely informative interventions, which sometimes even produce iatrogenic effects. That is why both peer education and self-help groups are designed to exploit adolescents' attention-seeking by constantly stimulating their active participation [137, 138, 147].

Finally, both types of interventions are mostly implemented in the school setting in light of its several advantages: first, at school adolescents are part of a stable group of peers which provides the necessary continuity to programs; also, this setting allows to reach a great number of participants; finally, school is a natural, everyday life setting which allows to deinstitutionalize work on psychological variables that could create resistance and uneasiness in adolescents if conducted in a therapeutic setting [147, 152].

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Part IV

The Digital Era in Adolescent's Health and Well-Being

Abstract

Innovative and current population-based preventive strategies are needed for the adoption of healthy lifestyle to prevent the onset of chronic degenerative diseases during adolescence. The global influence of digital technologies in the lives of today's adolescents has the potential to deliver platform prevention interventions *en masse*. According to this perspective, Z-Generation (born after 2000) and the previous Y-Generation or Millennial (born between 1980 and 2000) are considered digital frontrunners (Chap. 13). A key strategy to increase adolescent's engagement with digital services, involving personal, cognitive, and social skills, is to engage them in the co-creation process due to their understanding of digital technologies and continuous capacity to adapt to change. In this frame, health, well-being, and other health-related fields are ideally suited topics for serious games, such as Gamification tools, in order to engage and motivate subjects (Chap. 14). In this context, adolescence is thought to bring new potentials for emotional knowledge and management skills. In particular, play, from neurobiological and sociological point of view, is considered to be involved in understanding emotions in relationship to complex interacting environment, including interpersonal (self, others, social groups), cultural, and internal biopsychosystems (Chap. 15). Regardless of the type of digital strategy, must be implemented platforms and newer assessment instruments to make services "adolescent friendly", promoting positive psychosocial well-being. In this view, school-based delivery strategies appear to be highly effective for promoting and improving adolescent health. The need to engage adolescents in planning and decision-making processes that will affect their health, now and in future, must lead to a transition from a clinically oriented system to an education-based model that considers individuals in all aspects of experience and in different social contexts (Chap. 16). A new model of integration between components of health and well-being can be evolved to make services for disease prevention and health promotion more student-friendly, moving from health facilities to more school-based and student-centred.



Cesare Porcelli and Angela Palumbo

13.1 The Origins

The concept of adolescence develops toward the end of the nineteenth century; the first article reviewed on a scientific journal dates back to 1886 [1] and it was entitled “Some Remarks on Asthenopia and the Changes in Refraction in Adolescent and Adult Eyes.” The article dealt with the progress of “weariness sight” from adolescence to the adult age.

The number of articles published, concerning the problems of adolescence, was never higher than four per year until 1944; no more than 500 scientific publications were reviewed until 1962. The turning-point year will be 1963 when special attention to the problems of adolescence will result in the publication of more than 3000 articles, with a big qualitative leap. The trend has gone increased to present day: during 2017 more than 60,000 scientific publications concerning issues about adolescence were released, which demonstrated both the interest in this age group and the complexity of the problems related to them as well as the lack of “solutions.”

The concept of adolescence has developed in coincidence with a number of factors which range from the progressive literacy to the increased average life expectancy, to the global changes that occurred as a consequence of the effects of the Second Industrial Revolution as well as to the delay young people suffer when entering the labor market, to end it with the disappearance of the usual rites of social passage, in the Western world, at least.

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The delay when entering the labor market, which is significantly present in our contemporary society, coincides with the advent of social media which have in turn heavily modified and influenced the experiences and the typical problems of adolescents. Several models for the description of typical adolescence behavior and experiences have been assumed over the years. These go from the first psychobiological model by Hall [2] to the socio-anthropological by Mead [3], and further to the application of Freud's psychoanalysis [4], to Piaget's cognitive model [5] to Erikson's psychosocial model [6].

Hall's theory refers to the concepts of Darwin's evolutionism according to which ontogenesis, or the development of an organism, traces the phylogeny, or the development, the evolution of the species of which that organism belongs since its origins distant. For Hall, adolescence is a "new birth" in the sense that in adolescence everything is renewed: while the physical appearance of the young man/woman changes, his personality changes, new needs, and new skills emerge; opens up to the world and increases its capacity for introspection. According to Hall, in adolescence we experience a dramatic condition also described as "Storm and stress" to indicate the typical emotional storms of that age and that would originate from biological changes. For Hall, biological and psychological evolutions are integrated and "create" a "new" individual: a "new birth."

For Margaret Mead, by contrast, adolescence is a culturally determined phenomenon. The typical conflicts of age, according to Mead, are the result of culture and have nothing to do with biological development. She arrives at these conclusions observing the social life of the inhabitants of the Samoa islands in the Pacific and compares them with the typical habits of the American society of the beginning of the XX century particularly restrictive on subjects such as morals, sexuality, and religion. The "bigotry" of American society at the beginning of the century would be at the base of the conflicts, anxieties, and other typical of the adolescent phase that would have nothing to do, therefore, with the biological changes of individuals. The merit of Mead's theories was the emphasis on the value of social customs and "rules" as determining and conditioning changes and the "being" of people.

In the "Three Essays on Sexual Theory," Sigmund Freud places the final stage of libido development in puberty. According to the founding father of psychoanalysis, the libidinal development of the person follows five phases which he calls: oral phase (0–18 months of life); anal phase (18–36 months of life); phallic phase (from 3 to 6 years); latency period (from 6 years until puberty), and genital phase which coincides with puberty. It is with puberty and then with adolescence that sex drive reaches its maturity, becoming "altruistic" and, turning on the outside, leads to the overcoming of the Oedipus complex.

For Anne Freud, adolescence is described as the phase of the first "recapitulation" of the development phases; the second recapitulation will occur at the end of the active sexual life and coincides with the climacteric period. In adolescence, the "defense mechanisms" are "mature." Anne Freud describes the following defense mechanisms: removal, regression, isolation, reactive formation, retroactive annulment, introjection, projection, conversion in the opposite, idealization, and sublimation. The defense mechanisms are the tools that the EGO uses to adapt to the environment and mediate the drives of the ES.

For Anne Freud, in adolescence, the conflict between the strength of the ES, that of the Ego with the mediation of defense mechanisms, determines the strength of the character or the appearance of “neuroses.” The adolescent “recapitulation” is therefore the critical moment for the development of the adult and mature individual with all his abilities and weaknesses.

Today, the model of behavior most widely used is Engel’s biopsychosocial model, developed in the 1980s [7]. This model has been, therefore, adopted by the WHO and it has become the principal point of reference for all the types of intervention and interpretation regarding problems concerning the individual being (Fig. 13.1).

The essential idea underlying this model is that a proper behavior of the individual being should result from the interaction between his or her biological and psychosocial components. Therefore, the individual being cannot and should not be seen only as the result either of his or her genetics or of the environment where he/she lives, nonetheless of his or her personality structure as if all these factors were indistinct. On the contrary, it is the result of a constant deep presence of all the three factors altogether. Hence, the need for a holistic approach to the individual being which, in order to be full and effective, should consider a cooperation among multidisciplinary professional teams at the same time, all of them working on a common single target.

Within this context, a question arises as follows: when does adolescence start and when does it end? However, if we consider the beginning of adolescence, the

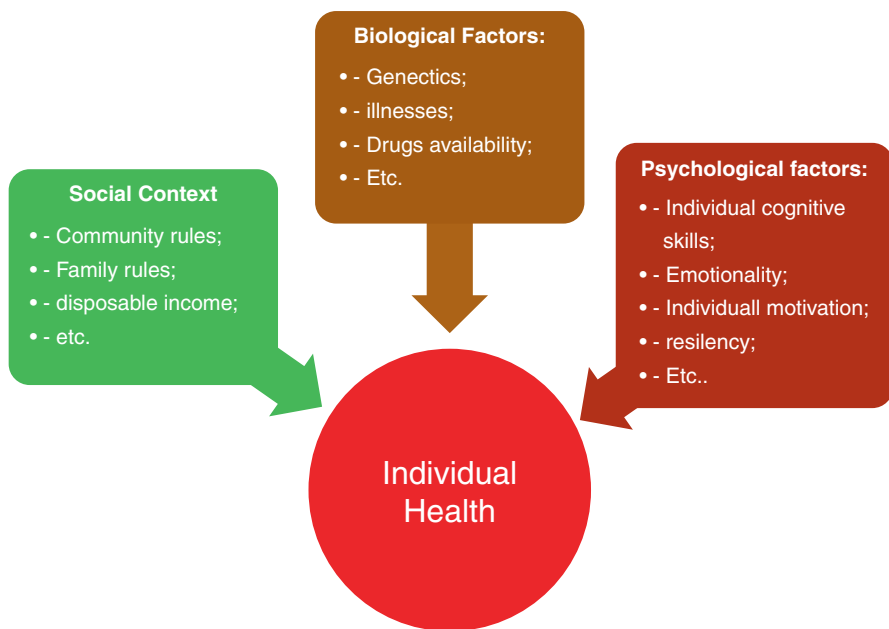


Fig. 13.1 Summary scheme of Engels’ Biopsychosocial model

opinions are more or less shared and they are mainly aimed at establishing an age between 10 and 12 with a progressive reduction of the age for females, notably. Where the border between the end of adolescence and the beginning of the adult age may be marked, however, it is a different matter. The International Encyclopedia of Adolescence (ed. J.J. Arnett, 2007) [8] gives the age of 25 to mark the end of adolescence. Certainly, the beginning of the adult age may not be defined by the legislation as it depends largely on social habits and customs. In our contemporary Western civilization, we run the risk of postponing the end of adolescence to an age as which by far nearer to the old age.

Therefore, we cannot define the end of this stage of our life by law. The transition to the adult age is to be considered more significantly as an important “subjective condition,” closely linked to the individual being’s personal awareness of being of reference for the people around him. Out of question the age for a rise of awareness in the individual being, it seems more likely to depend not only on each social context and cultural background but also on their employment opportunities and on the possibilities of genuine economical autonomy from their original families.

13.2 The Today Context

We live in an extremely fast changing world, as it has never happened before. The advent of new technology, of social media, especially, has radically changed both our lifestyle and that great amount of undeniable beliefs, which we considered adequate until very few decades ago.

Childhood, in the first instance, whereas children are especially vulnerable to early exposure to tablets and smartphones today: a corresponding effect of sensorial overstimulation, both aural and visual stimuli, is actually resulting in a new unknown model of childhood (https://www.lemonde.fr/sciences/article/2017/05/31/la-surexposition-des-jeunes-enfants-aux-ecrans-est-un-enjeu-majeur-de-sante-publique_5136297_1650684.html) [9]. A continuous flow of images and sounds on a tablet, which is often available to extremely little children, just few months old sometimes, is replacing the old habit of storytelling and it is consequently affecting the children perception of time. They are getting used to the idea of everything at once, becoming incapable of managing their time.

A research by the Pediatric and Adolescent Neuropsychiatric operating in Bari begun in December 2015 and completed in April 2016, highlighted an important difficulty in telling or reporting stories by a group of 112 5-year-old-children, all of them attending the last year of nursery school in the same town. Yet, the same pupils showed impressive school abilities for children of that age, such as the reading and writing abilities. The difficulty in reporting stories was clear in about 50% of the sample of children observed. The children, if capable of reading and writing with a basic competency of schoolchildren attending the first year of a primary school, were not able to tell a story (Fig. 13.2). That is, they showed difficulties in structuring a sentence and rearranging them to report a story; they were not able to report a linear, sequential tale. Although the end result of this research will be a verification

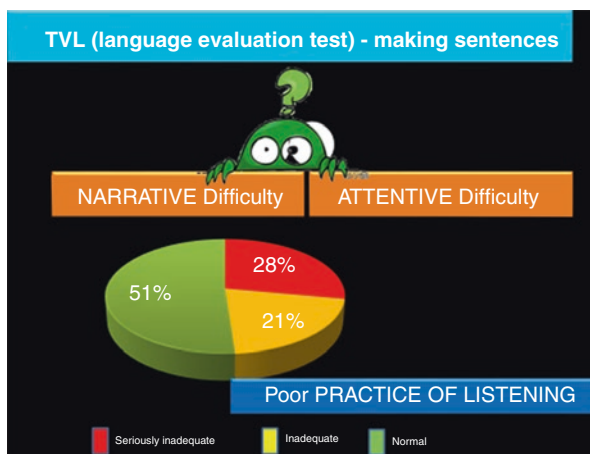


Fig. 13.2 Difficulties of narrative language as a consequence of a poor listening practice

report that will identify and monitor a wider number and range of children with more different cultural backgrounds, the results have been read and understood as the direct effect of the children's lack of experience in paying attention to the slow flowing of time. The most increasingly common habit according to which everything should or can be done all at once, the incapacity of being able to wait in order to get. However, the research is still going on at the moment and data are still unpublished.

Furthermore, the child under observation was born from those parents for whom a tablet and smartphone application were created not long ago: it allowed them to hear their baby crying and provided some hints on how to intervene. It seems as if they weren't considered able to stop what they were doing so as to hear their baby's cries, still less able to understand their child's discomfort and set up their own measures of support and help. Hence, the significant repercussions on the development of empathic, relational abilities [10].

Today, children are exposed to overstimulation of the senses which has replaced the traditional storytelling: sounds, images which quickly flow on a screen have replaced their parents' caresses and any form of emotional exchange. They can easily access any amount of information in a very short period of time, which has determined an impressive alteration of the perception of their time. In the past, children used to meet their friends, play with them, hang out with them, court their peers when in adolescence, and exchange ideas and opinions: all this has turned to be considered "a waste of time" compared to the great number of activities and to the feeling of hyperstimulation which, unfortunately, convey a sense of loss and emptiness. Hence, the spasmodic search for new stimuli and new information and the resulting new sense of emptiness. At the same time, more and more evident is the poor habit of complex thinking that translates into important difficulties in solving problems (<http://www.psychiatryonline.it/node/2031>) [9].

Today, the children's dopamine/endorphins neurotransmitter system that rules the mental processes of pleasure and gratification runs the risks of being heavily conditioned. The previously mentioned system is less and less under the positive effects of contact, which is typical of human relationships, while more and more under the negative influence of images and sounds coming from artificial devices. The inability to go through the amount of waiting time turns into a sort of anxiety caused by a sense of emptiness. In Western society, we are witnessing the disappearance of any form of spontaneous and creative play, which can only emphasize a number of small neuromotor difficulties (little movement coordination disturbances, minor concentration difficulties, etc.) transforming them into real disorders. The loud liveliness, today hardly ever channeled to playful activities, and which once was a sign of healthy and well-adjusted children, is less and less tolerated and often perceived as the diagnosis of Attention Deficit Hyperactivity Disorder (ADHD) (<https://www.anupitnpee.it/formazione/articoli-sulla-professione-del-tnpee/1268-disturbi-dell-attenzione-e-instabilita-motoria.html>).

Edelman's works and many others' work have clearly shown that our brain is continually changing and organizing according to the stimuli every day it receives and selects, therefore working on the body and adapting it to the environmental needs [11–13]. We seem to be deprived of the full knowledge of the context we live in. Furthermore, excessive use of technology is transforming our cognitive abilities into a plain ability to respond to external stimuli, only. As previously stated, the development of complex thought is due to pay the consequences of it.

Children and adolescents, overly exposed to the frequent use of technologies, and above all to the excessive use of social media, are gradually led to the risk of having difficulties if asked to decide whether a piece of information is true or false. Not being provided with direct experiences, children are led to believe everything they learn from their smartphone or read on the web. The same applies to adults.

And the human being, as with all the species in the animal kingdom, is genetically predisposed to respond to stimuli, especially in the case of warning and danger signals. Sudden auditory stimuli rapidly activate the neuroendocrine system of stress, notoriously involving the hypothalamus-pituitary-adrenal system, which in turn translates into the production of adrenalin and cortisol in order to cope with the initial reaction of alarm. Then, all the necessary conditions for the subject to attack or to escape are enabled. So, the sound of the smartphone that bursts into our daily routine will cause the activation of the stress reaction and the general adaptation syndrome will be enabled. It will happen any time a device produces light or sounds to alert you about the arrival of a message or of a voice call. A smartphone behaves much like an "evolutionary trap" (see [13]): we are genetically predisposed to respond to even lower stimuli. Each stimulus requires a reaction. We are constantly required to reschedule our level of attention after answering a phone call or just hearing a notification sound. However, constant exposure to stimuli over time automatically switches on the idea that unexpected sound might have rung, even though not significantly meaningful for the development yet requiring a reaction. Hence, the need for continuously monitoring the device, for enabling compulsive gestures, which intend to keep the device under control.

A report by the American Academy of Pediatrics of 2016 (<https://www.aap.org/en-us/advocacy-and-policy/aap-health-initiatives/pages/media-and-children.aspx>), concerning the role played by communication technologies on the development of early childhood general functioning capacities, has highlighted a series of data that still need to be elaborated and discussed. In the meantime, further elements have emerged as follows: in 2015, 97% of low-income children under 4 years old had access to a device and even 75% of the same children have a personal device, while in 2011, the percentage was of 10% and in 2013, of 38%. In addition, the children's parents were found to be engaged in activities related to the smartphone for 3 h a day, at least. And still, data on children's and parents' behavior in front of a TV show considerable information which should lead to profound reflections on the risks and the dangers our children run while being exposed to the mentioned model behavior. The verbal exchanges turn into poor conversation while watching TV, as it reduces any communication attempt for the watchers. Furthermore, the invasive background presence of the television set in the communication exchange between mother and child reduces the quality and the quantity of the verbal exchange itself. The use of language implies the direct manifestation of the thinking activity, which generates language, which, in turn, stimulates and activates the thinking activity. Any form of inappropriate conditioning for language development in the evolutionary stage results in difficulties in the thinking activity, usually implying lack of flexibility, rigidity, and low responses in the learning process.

In 2014, research of Radesky and colleagues [14] highlighted that the interaction between caregivers and young children was greatly influenced by the use of mobile devices. A clear alteration in the relationship has emerged resulting in more limited conversations, a latent reaction in the replies and a significant conflict increase. Another research by the same authors [15] highlighted a further 20% reduction of verbal communication, together with a 39% reduction of nonverbal communication and a decrease of encouragement patterns.

13.3 Relation with the School and Its Role

Now, it seems that school has been cut off from all this, so far. With regard to very few attempts of alternative teaching methodologies, the traditional frontal lesson together with that amount of traditional curricula which does not seem to be appealing for students is still largely in use. The easiest way to overcome the difficult search for alternative teaching strategies is commonly found in pointing out to "diseases and/or disorders" which are more largely used to justify any failure in the teaching approach. In Italy, for example, compulsory school attendance is for children until the age of 16. All children must attend school and they must be enabled to learn by law. We have no longer "special needs schools" in Italy and since 1977 (Law fourth August 1977, n. 51, GU 18th August 1977, n. 224), integration and inclusion patterns have been part of current school curricula, so allowing each minor to access school attendance. According to law, pupils and students should undergo a set of procedures ascertaining possible disabling situations, resulting in correct,

adequate pedagogical support. Law 170/2010 has been applied since 2010: it has been providing proper support to those cases of special needs and special learning difficulties children.

Maybe, Italy stands out as one of the countries with some of the most advanced legislations for minors' right to education.

Besides, specific support steps are taken for those children showing any learning difficulties (special educational needs, B.E.S. in Italy).

What is more serious and what should lead us experts to consider the matter more attentively is the growing number of disability diagnosis, which require the intervention of a support teacher. While in the school year 2004/2005 we had 1.89% of disabled minors attending school, it has risen to 3% in 2016/2017. We have registered a progressive reduction of the total amount of schoolchildren while an increase of disabled schoolchildren in these last few years.

And also, diagnoses have changed: the number of diagnoses reporting sensorial or neuro-motor disorders has remarkably lowered, probably because of a marked improvement tied up to childbirth and to a better assistance during the prenatal phase. On the contrary, we must register a sharp increase in diagnosis related to behavioral difficulties, which mark an increase in diagnosis from 21 to 27% in three school years, still increasing. The decline in the diagnosis of intellectual disability is associated with a significantly higher increase in the diagnoses of conditions tied up to autism spectrum disorders. Now, what can be the reasons for the marked increase in diagnosis related to behavioral problems? Can they be related to the real increase of ADHD-type pathologies? Can they be the result of important difficulties of the present school to manage children's inappropriate behaviors? What is of primary importance to understand is if these rates are related to increased pathology or to a serious educational emergency. Indeed, more and more frequent is the recourse to medical "diagnosis" for behavioral problems in the absence of other associated disability problems.

The Italian school then, relying on outdated educational models, does not seem able to develop new and updated learning approaches, but has taken refuge rather in the spasmodic search for a "diagnosis" almost to justify an increasingly evident destructuring incompetence. Yet, paradoxically, in some contexts, an early diagnosis may be considered a further labeling problem of major concern. It is exactly what unfortunately in the chapter dealing with "specific learning disorders" is emerging, whose treatment beyond the specific medical interventions (see speech therapy, occupational or neuro-psychomotor rehabilitation therapy) should involve a sharp change in the didactic approach. Binding "compensatory" or even "dispensation" approaches to a medical diagnosis is what helps to create a stigmatizing effect on cognitive and affective average children. The medical diagnosis even well accepted and well reported from the caretakers may happen to stigmatize the patients as soon as it spreads in the school environment, making things worse, with negative consequences for the minor. Speech difficulties, low arguing abilities, inability to access and articulate complex thought, possible reduction in direct social links unless they are media social filtered relations, all this may explain the increase of behavioral disorder diagnosis. In addition, one of the

most visible aspects is the absence of the adult figure who no longer represents a central referential figure to fight against in order to build their own identity as, being a child himself, he is often unable to understand the minors' problems, to face possible adolescents' crisis which are represented by the ambition of showing strength and being innovative by the minors. In the Western education model, the figure of the adult and the importance of their role have steadily declined. This seems to be the *primum movens* of young people's difficulties, of the so-called "digital natives" [16]. The typical adolescence crisis, which was normally considered part of an adolescent growth and of the changes this stage of life involves, is today counterbalanced by the crisis of "adult age." Today, as well immersed in a very rapidly changing world, which is unknown to them in many respects, adults are not able to be a precise point reference for adolescents. They tend, on the contrary, to rely on young children who, at least in terms of use of technologies, certainly possess considerably greater competence, a sort of know-how, trained since their early childhood. While, what they seem to lack of is a broad system of rules and values. On many sides, having failed to report and transmit that system of values is maybe the greater responsibility for today's adults. It does not imply that they do not have any but their set of values seem to be completely different even only if compared to 15–20 years ago. Love, friendship, faith, respect for rules and for people, co-sharing, the typical adolescent complicity, study and research, a wait-and-see attitude and much more, all this is strongly influenced and mediated by the use of technology and turned into something which appears similarly unknown to adults, not doing enough to restore adults' main role, being a precise point of reference.

13.4 Conclusions

Adolescence is just one of the many stages of life which characterize a person's life. In the specific case the transition, in fact, is between the childhood and the adult age. It is always a crucial and complex moment in the life of each of us. It's definitely not a disease.

The theme of adolescence became significant at the end of the Second World War and has become fatal in the last 10 years because of the strong impact that technology is having on both boys and adults. In fact, we are facing a new adolescence whose characters are completely different from what we used to believe. At least in relation to the male sex, the disappearance of compulsory military service has removed in fact one of the typical social rites of passage in the Western society.

In an article published in September 2017 [17], Twenge and Park describe and report how young Americans have changed their lifestyle in the last 40 years, after observing and studying a broad and representative range of them. A shift forward over the years, starting from 2008, of hitherto quite "typical" activities of young Americans is what emerges in their work. In particular, it seems that young Americans get their driving license 3 years later, along with consumption of alcohol or dating a girl or a boy. A reduction in work experiences has been remarked in the

same work. The sample included 17- to 18-year-old American students attending their last school year. The data show that today's 18-year-old students would have the same experience and skills as the 15-year-old students 40 years ago: an important slowdown in the ability to acquire skills seems to have occurred, those same ordinary skills, yet involving greater relational impact that, however, have been replaced by technical skills, which didn't exist 40 years ago. Again, any kind of critical approach has collapsed. The percentage of young men reading a book has gone from 60% in the 70s to 17% today. Children are now accustomed to reading short messages and show great difficulty reading longer texts. In summary, the amount of information we need must be in our mind not outside of it. Spending a lot of time in front of a screen may cause sleeping disorders. Getting enough sleep is essential for the activation of our memory consolidation mechanisms. The consequences of its failure may unquestionably cause learning as well as attention levels disorders.

Periods of rest and relaxation during the day, which is the time when we avoid thinking, are needed to redefine what we have learnt and reflect on "what I can see and what I know" in order to make a comparison and a choice of what should be preserved among the amount of memories I have gathered. Unless you stop and go through this mental activity, your mind will not be able to carry on its mechanisms to select.

Today's children are, in fact, immersed, in the unit of time, in a world of information which was totally unimaginable until 20 years ago—information that, however important and in some ways indispensable for people's growth, ends up becoming "noise" in a growing brain, in people in search for their own identity, which is not returned to them through another human being, but through what appears on a screen or through what is read on rapid messages, in a spasmodic succession, which, in their turn, produce no useful information, only more "noise." So, the biggest difficulty is defining and giving meaning to the value of information. Each message stimulates a response, which often lacks a cognitive filter. The answer is immediate, impulsive, therefore not mediated and strongly conditioned on being at that precise moment.

This also determines other responses that are equally immediate and unweighted, thus leading to a vortex of pseudo-information that determines a continuous alert condition, poor ability to read reality, determining rapid prompt passage to action.

Disorders of the emotional sphere such as anxiety and depression are constantly increasing in the age of development and tend to occur at an increasingly early age. More quickly than before, forms of discomfort tend therefore to become pathology, as a consequence of the absence of adults as stable and important referential figures, probably.

The crisis of the early twenty-first-century teenagers reflects the crisis of the today's adults, who are victims and executioners at the same time of what Baumann' calls "liquid society" [18], no longer able to create certainties in a world where the "only certainty is uncertainty" (cf. Bauman). A world in which the individual exists for himself, an individual disjointed from the context he lives in, continuously searching for things which turn to be ephemeral and destined to be swallowed up by

what represents something different or new. Things that do not help to consolidate a conquest, aiming at being a brick useful for someone's personal growth but that fade into the useless consequences of an unrestrained consumerism.

It looks as if the "autistic" component being part of each of us had overruled the relational and social sides of each of us. Bent over, on their smartphone or on their tablet, locked up in their personal selfish world, unable to look at each other, incapable of looking in someone else's eyes and "become" other for the world: all this can only determine a further folding in on themselves and proving unable to look at what surrenders them and at being with whoever around them.

How to get out of this? As Bauman would say, what may help adults and teenagers to come out of the vicious circle in which they are trapped is culture. Culture as an element of suspension of whirling tangled up in nothingness. Culture as the only means of stopping the passing of time, of allowing man to enjoy all the beauty, the real in the world.

Today's adolescents are the victims of this artificial world, technologically made up. Totally immersed in that world, adolescents do not seem able to grasp both limits and potentialities of this game, which will see them exploited and then discarded. It is adults' task to recover the values of culture and thinking, in order to spread this valuable set to the legitimate users.

Adolescence is not a disease. Therefore, the recovery of values is one of the fundamental steps, essential in supporting the boy/man's development, crucial for regaining their freedom.

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14.1 Introduction

According to the World Health Assembly resolution [1], “eHealth is the cost-effective and secure use of ICT in support of health and health-related fields, including health-care services, health surveillance, health literature, and health education, knowledge and research.”

This sector has gained ground over time, due to the development of new interactive technologies, comprising therapeutic, diagnostic, and analytical tools, as well as new information systems to support health and healthcare. However, “it should be remembered that digital health solutions should complement and enhance existing health service delivery models, strengthen integrated, people-centered health services and contribute to improved population health, and health equity, including gender equality, and addressing the lack of evidence on the impact of digital health in these respects” [2].

Interactive technologies have shown a huge potential within the specific framework of health promotion, intended as the promotion of awareness, self-management and treatment of diseases, health behavioral change, and promotion of healthy lifestyles [3]. Within the interactive technologies’ category, a growing and prominent role is played by games.

Market forecasts for 2022—more than \$230 billion game-related expenditure [4]—show that games are among the best effective media to engage young as well as adult players in an interactive environment, to provide immersive and compelling social, cognitive, and emotional experiences, and therefore to achieve the above-mentioned goals. In fact, although in the past scientific research has focused on the potential negative effects resulting from games—seen as the source of violent

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behaviors and addiction [5, 6], an increasing number of research findings are revealing the beneficial effects deriving from games such as cognitive skills enhancement, problem-solving, creativity, and optimistic motivational style [7].

14.2 Serious Games and Their Application in the Healthcare Sector

Of particular significance within the game context is the niche occupied by serious games (SGs), namely those games created for purposes that go beyond the pure entertainment. Indeed, this category comprises those tools (e.g., interactive computer applications, digital games, simulations, virtual environments, and mixed reality/media) [8] that inherit the *fun factor* from traditional videogames, but at the same time pursue new goals, such as educational or training purposes [7, 9].

Although SGs have been widely implemented in different domains, for example, the industrial [10], military [11], and professional training sector [12], in the last decades, they have been widely applied to the healthcare sector.

SGs developed for this last field embrace the health subject in all its shades, ranging from SGs focused on the disease and its different developmental stages, SGs that encourage healthy habits concerning nutrition and lifestyle, to SGs aimed at medical staff training.

For example, SGs may focus on different developmental stages of the disease, such as the following: the *susceptibility stage* (aimed at a subject still healthy, but that should be warned about the disease monitoring procedures); *pre-symptomatic stage* (when the disease is already ongoing, but it is still asymptomatic, and the game aims to show to the patient the relevant aspects of the disease and treatment); *clinical disease stage* (the game is addressed to patients in an acute or chronic phase, and aims to show disease progression and related treatments); and *recovery or disability stage* (where the game aims to show rehabilitative procedures or how to handle disability) [9].

SGs that encourage healthy habits may comprise *educational games* (increasing the knowledge on health problems and how to stay healthy) and *wellness games* (focused on lifestyle-related problems and their connection to health).

The last category mentioned is less widespread, and comprises *training and simulation games for professionals*, namely those virtual tools that allow to practice on surgical procedures or more generally on medical practice.

Although there are several methodologies and approaches to design and develop SGs, those that share educational purposes have frequently a common thread, namely that of being designed and structured following a *theory-driven design approach* [13].

Theoretical models that deal with the evaluation of both human behavior and of those elements that can affect it are the cornerstone of interventional strategies aimed at human behavior change. In fact, by including the most important elements of those theories it is possible to structure SGs able to take account of the end-user types (using suitable game genre and content), and of the therapeutics

needs to be met, encouraging therefore the player to achieve the preset educational objectives.

Among the most common motivational theories underlying SGs, the *Self-Determination Theory (SDT)* and the *Social Cognitive Theory (SCT)* are the most commonly used.

14.3 Behavioral Theories

14.3.1 Self-Determination Theory (SDT)

The *Self-Determination Theory* [14] is a theory developed by the psychologists Ryan and Deci that investigates the connections between the concept of motivation and human personality, deepening the force for change inherent in every man (and therefore its boost to growth) and the human psychological needs.

It should be remembered that in order to have the activation of a specific behavior, it is essential that human actions must be conducted in a supportive environment, able to meet three innate psychological needs:

1. *Need for competence*: pursuit of control on the outcomes and mastery of experiences: this need is satisfied and improved by learning over time through activities and practice;
2. *Need for relatedness*: will to interact, to establish meaningful relationships and take care of others;
3. *Need for autonomy*: desire of a human being to be causative agent in his own life and to act in harmony with the self. It is important to note that autonomy does not mean independency from others but rather implies the absence of an external control or constraints.

According to the authors, there are three main types of motivation—*amotivation*, *intrinsic motivation*, *extrinsic motivation*—distinguishable on the basis of the locus of causality perception (namely what gives rise to the actions undertaken), on the motivation internalization degree and the relative regulation type.

The different types of motivation can be summarized as follows:

- *Amotivation* is the one that describes the absence of an intention to action, for example, a state in which a subject does not carry out any action or carries out actions passively. In this case, the locus of causality is impersonal, and the people involved in this state can be defined as devoid of regulation. This state occurs when there is no sense of efficacy or control regarding the desired results, when the subject does not feel adequately competent, or when the subject does not give value to the activity.
- *Intrinsic motivations* are the ones that lead to start an activity for its own good, since it is interesting or satisfying; in this case, the locus of causality is recognized as internal, and the actions are regulated internally from the beginning.

Therefore, the intrinsic motivation is strictly connected to the concepts of autonomy and competence: in fact, it finds its full application in circumstances where people can pursue without external constrictions activities that they find interesting, able to provide new elements and to be a challenge.

- *Extrinsic motivations* are the ones at the basis of activities carried out to achieve a goal externally regulated; in this case, the locus of causality is external, and actions are realized in function of an external reward and there is a lower degree of autonomy.

However, it should be noted that a wide range of extrinsic motivations may occur, that differ in the degree of internalization and integration of values and behavioral regulations, namely the act of convert an extrinsic reason in a value personally adopted, absorbing external rules of conducts, so that they will originate from its own sense of self. The greater is the internalization, the greater is the persistence and quality of the engagement in the actions.

In the *Organismic Integration Theory (OIT)* [15]—subtheory deriving from SDT—Ryan and Deci have catalogued four types of regulation that underlie the extrinsically motivated behaviors, with regard to the degree of internalization and autonomy:

- *External Regulation*: actions are taken only to satisfy an external demand or to obtain an external reward (locus of casualty perceived as external).
- *Introjected Regulation*: actions are carried out only to demonstrate the owned abilities in relation to a specific request (ego involvement) or are carried out under pressure to avoid feeling guilty or anxious (locus of casualty still perceived as external).
- *Identified Regulation*: goals and rules are assessed in a conscious way and the requested action is accepted as personally important.
- *Integrated Regulation*: rules are completely integrated within the values and personal need self-assessment; it represents the most autonomous among the extrinsic motivations.

Over time, it has been noticed that the degree of internalization affects deeply the quality of an experience or a performance. In fact, whenever people are able to internalize an external locus of causality, they can integrate the external regulation within their ethical system and endorse the demands of society: this will increase the efficacy of behaviors, performances, and well-being.

A second SDT subtheory—called *Cognitive evaluation theory (CET)* [16]—looks into the influence of external forces on motivation, specifically considering the effect of events and interpersonal structures (rewards, feedback, and interpersonal communication) on intrinsic motivations.

All these structures, if are able to lead to autonomy and competence (or to the awareness of the locus of causality as an intern element) can strengthen the intrinsic motivation, because they allow the satisfaction of the three basic psychological needs.

For example, positive feedback concerning a specific performance enhances the intrinsic motivations, while negative feedback decreases them. Moreover, the occurrence of expected tangible rewards (but also threats, deadline, and competitive pressure) can result in a decrease of intrinsic motivation, since they undermine the sense of autonomy of the actions undertaken.

The key elements of Self-Determination Theory applied in SGs can be summarized as follows:

- *Players' internalization of extrinsic goals, rules, or information* provided during the game, resulting in an improvement of game performance and quality of experience. This element can be found especially in games that aim to raise awareness on health-related issues and healthy lifestyles: for example, it has been applied by making players' aware of good habits and making them choose firsthand those habits they want to pursue.
- *Satisfaction of the three physiological needs* (autonomy, competence, relatedness). Autonomy may be related to independent goals choice or more generally to choices carried out within the game, competence is related to the information gained through the game, while relatedness takes place in the connection with game characters or players.
- *Presence of feedback directly related to the performance* (rather than to the player), that are used to enhance the intrinsic motivation and refrain from provoking frustration in case of negative performances. Several kinds of feedback may occur in SGs, such as onomatopoeic sounds (in case of victory, defeat, crash, or grab of a power-up), signs, or audio (so that they can be understood by pre-school age players or players with hearing deficiency).

14.3.2 Social Cognitive Theory (SCT)

The *Social Cognitive Theory* [17] is a theory put forward by the psychologist Albert Bandura, which focuses on human behavior and in particular on how people gain and retain certain behavioral pattern.

For Bandura, three causal factors determine the human functioning and its variations: *environment* (intended both as physical and social), *personal factors* (cognitive, affective, and biological), and *behaviors*. These factors influence each other (reciprocal triadic causation) and therefore influence every human action.

This occurs because the human being is characterized by the *Human Agency*, which is the ability to actively intervene on reality exercising a causal power through its own human actions, to passively undergo external influences and affect the course of events. Human agency concerns all those acts intentionally performed, regardless of the outcome (e.g., actions are carried out in a targeted manner with regard to specific purposes).

People are therefore proactively involved thanks to their actions, as well as characterized by self-beliefs that act as internal control measures to monitor their own thoughts and actions: in this way, people become at the same time products and

producers of their own environment and social system. These latter do not affect directly human behavior but affect aspirations, personal standards, emotional states, and self-regulatory influences.

However, what makes human agency possible? At the basis of the definition of human being and the ability to act like one there is the presence of *personal skills* [18], such as the following:

- *Symbolize*: ability to symbolically represent knowledge (e.g., speech).
- *Forethought*: ability to devise alternative strategies and to predict future events.
- *Learn through vicarious experiences*: ability to gain knowledge or skills by observing other people.
- *Self-regulation*: ability to set goals and assess actions by referring to internal performance standards.
- *Self-reflection*: ability to reflect consciously on one's self.

The most influencing element on human agency is represented by self-efficacy [19]. *Self-efficacy*, milestone of SCT, consists of the confidence that people have in their abilities to arrange and perform actions, and is required to achieve specific results and performances. *Personal efficacy* is therefore defined as the generative ability in which cognitive, social, emotional, and behavioral secondary abilities are efficiently coordinated and arranged in order to carry out specific purposes.

Self-efficacy places itself at the basis of human motivation, well-being, and personal fulfillment: in fact, people will engage in a specific behavior and specific actions only if they believe both that they can carry them out successfully, and that these actions can deliver the expected outcomes (clearly, previous experiences and knowledge may affect this belief). What people think of themselves is a critical element in the exercise of control and personal agency: hence, they will tend to select tasks in which they feel more competent and confident. By doing so, the effort level deployed by people to carry on an activity or a behavior, the perseverance showed when obstacles come, the resilience in the face of adverse circumstances will be closely linked to the self-efficacy.

Self-efficacy develops through four information sources:

- *Mastery experience*: direct behavioral experiences of effectively managing, which acts as skills levels.
- *Vicarious experience*: knowledge transfer and comparison with other people performances.
- *Verbal and social persuasion*: exhortations and feedback by others.
- *Physiological states*: physiological and emotional states according to which people judge their strength level, vulnerability, reactivity against failure.

Note: the ability to select, ponder, and complete information related to previous experiences get better with age, thanks to the development of self-regulatory abilities.

14.3.2.1 Cognitive Behavioral Game Design (CBGD)

A new framework deriving from SCT is represented by Cognitive Behavioral Game Design [20], which examines the key elements for the health-related behavior change, indicated below.

- *Knowledge*: it concerns the information that the game wants to deliver; it may not represent the game main goal (e.g., often in exergames the first goal is to encourage fitness rather than convey knowledge on health);
- *Goals*: they may be related to both game goals and aims provided by the game in connection with real life;
- *Outcome expectations*: the game can mimic an outcome that the player would have in real life by acting in a specific way;
- *Encouragement*: it can be realized with sounds and signs to provide a positive feedback or praises provided by secondary characters that act as coaches;
- *Barriers*: virtual representation of physical barriers (e.g., fences or rocks) or puzzle to be solved, in which the players have to show that they have learned something previously in the game.

In SGs where behavior change framework is pursued, self-efficacy and its types of information sources are implemented, as well as aspects of CBGD. In fact, the elements embedded in SG include:

- *Enhancement of abilities underlying the human agency*: for example, *forethought* is incorporated by introducing elements that force the player to quickly produce a strategy (e.g., a countdown or a restricted number of moves) or *learn through vicarious experience* is carried out by a guide or a tutorial, from which the player can learn how to act.
- *Implementation of self-efficacy sources of information*: for example, *mastery experience* is put into practice by making game levels with incremental difficulty, where the players can exercise what they have previously learned. *Vicarious experience* is implemented through the comparison with other players or with a second character of the game (e.g., a tutorial at the beginning of the level that mimics the moves the player can do). *Verbal and social persuasions* are applied by means of several kinds of feedback. The game takes account of *physiological states* allowing in some cases to set up the degree of difficulty.
- *Implementation of CBGD aspects*: in almost every game, these elements can be found: the purpose to convey a piece of knowledge, the setting and review of goals, the representation of possible real-life outcome related to a specific behavior, the encouragement through feedback and the representation of physical or mental barriers.

14.3.3 Theories Assessment

SDT and SCT are two of the major theories inherent to human behavior and to the mechanisms underlying its functioning and variation; their application in serious games for health represents therefore a preferential manner to help users to achieve the therapeutic aims.

Although since the last decade the implementation of these theoretical frameworks is taking off, elements from both theories are not applied in SGs systematically or consciously. For example, the use of audiovisual feedback and encouragement, as well as the presence of mentors or characters that act as a guide within the game are elements that can be found in SGs as they relate and arise from the gaming world rather than from behavioral theories.

However, the tailored and targeted implementation of theories can take those same elements to the next level, improving their effectiveness in that they are incorporated in a context with clear educational goals, taking into account the effects arising from their implementation. In fact, a misuse of those principles may lead exactly to opposite effects, provoking frustration in the users so that they will hardly achieve their goals.

Therefore, particular attention must be paid from the earliest design phases to the educational and/or therapeutic goals that the game wants to promote and to which type of elements is best to use to this purpose.

14.4 Application of Theories in SGs

In scientific literature, there are several examples of SGs targeted at children and adolescents, whose design and implementation involve the key elements deriving from the abovementioned theoretical models (SDT and SCT), even if only a small portion of them explicitly makes reference to those theories. These games deal with different health areas, ranging from awareness-raising activities, through exergame, to disease management.

Each of the game proposed has been classified according to the type of end-user, game purpose, and theoretical framework aspects embedded (Table 14.1).

1. *Squire's Quest! II: Saving the Kingdom of Fivealot (SQ2)* [21]: 10-episode videogame that encourages fruits and vegetables (FVs) consumption in 9- to 11-year-old children.

Within the game, the players have to become knights of the realm of Fivealot: in order to do that, they have to pass two tests per episode (that is the increase the consumption of FVs and the preparation of a FV-based dish by choosing a recipe available in the "Virtual Kitchen"). Children are involved all along in the setup of goals, through the selection of ten favorite fruits and vegetables, three personal values, and way to eat FV able to prove the importance of value for the players. Based on the choices made, an algorithm adapts the game, introducing from time to time those choices during the game to increase players' motivation.

Table 14.1 Serious games descriptive elements

	Age group	Stage of disease	SDT elements	SCT elements
1	9–11	Susceptibility stage	<ul style="list-style-type: none"> – Enhancement of the three psychological innate needs (autonomy, competence, relatedness) – Enhancement of psychological innate needs and internal motivation through autonomous goal choice and control, competence, relatedness 	<ul style="list-style-type: none"> – Goal setting – Encouragement – Enhancement of knowledge – Goal setting (goal intention and goal implementation), problem solving, goal review (self-monitoring), modeling, and skill development – Presence of positive and specific feedback (encouragement)
2	10–12	Susceptibility stage		
3		Clinical stage disease	<ul style="list-style-type: none"> – Positive performance feedback 	<ul style="list-style-type: none"> – Positive performance feedback (encouragement)
4	13–29	Clinical stage disease	<ul style="list-style-type: none"> – Enhancement intrinsic motivation – Enhancement of need of competence 	<ul style="list-style-type: none"> – Enhancement of knowledge – Presence of outcome expectations
5	15–19	Clinical stage disease	<ul style="list-style-type: none"> – Enhancement of the three psychological innate needs (autonomy, competence, relatedness) 	
6	11–12	Susceptibility stage	<ul style="list-style-type: none"> – Enhancement intrinsic motivation – Enhancement of the three psychological innate needs (autonomy, competence, relatedness) 	

(continued)

Table 14.1 (continued)

	Age group	Stage of disease	SDT elements	SCT elements
7	7–14	Clinical stage disease		<ul style="list-style-type: none"> – Implementation of audiovisual feedback – Empowerment of physiological and affective states (through the fight of both fatigue and sadness) – Application of CBGD elements (obstacles to be overcome and encouragement)
8	11–13	Susceptibility stage	Enhancement of the three psychological innate needs (autonomy, competence, relatedness)	<ul style="list-style-type: none"> – Behavior and goal setting – Encouragement

After goals setup, children are divided into four groups: *Action* (this group creates an action plan after setting the goal of FVs consumption); *Coping* (this group creates an if/then plan to overcome obstacles after setting FVs consumption goal); *Action + coping* (this group creates both plans), and *Control* (this group establishes only a goal to be achieved).

During the game, a Wizard acts as mentor, leading the players through the choices to make, suggesting challenges and rewarding them with virtual badges; non-player characters give tailored feedback.

Underlying the game realization, there is the use of the Social Cognitive and Self-determination theories, applied through the Behavior Change Techniques [22]: *goal setting* (players are encouraged to set time-dependent highly specific goals, with increasing difficulty), *planning* (realization of action plan and coping plan), *self-monitoring* and *goal review* (through the record of the actual FVs consumption and the recipes realization), and *feedback* (both from the Wizard in terms of badges, and verbal feedback from other game characters).

2. *Escape from Diab* [23–25]: SG developed for 10- to 12-year-old children focused on reducing the risk of obesity and Type 2 diabetes through changes in diet and increase in physical exercise (i.e., increased consumption of low energy dense foods and beverages, and increased energy expenditure).

In *Escape from Diab*, the players are led into a fantasy world (*Diab*), where an antagonist maintains control over his subjects, by fostering unhealthy lifestyles and lack of physical activity. At the beginning of the game, the main character meets some children of the same age that help him to escape capture and to seek refuge in a town called Golden City; to return the favors, he decides to help his new friends by becoming their coach, and introducing them to healthy behaviors and physical activity, in order to help them to escape from *Diab*.

Within the game the players can investigate goals, values, and obstacles related to nutrition and physical exercise (versus poor nutrition and sedentary lifestyle), and choose the most important for them. Precisely by doing appropriate actions (related to nutrition and lifestyle), the players will help the main character to win; at the same time, the minigames in which they are involved represent a source of information useful to improve their lifestyle.

In the game design, both SDT and SCT elements have been used, including information on healthy diet and physical activities (leading to informed choices), goal setting within specific behaviors the player wants to attain (enhancement of internal motivation through autonomous choices), assistance in the connection between behavior and personal values, and improvement of self-efficacy through positive and specific feedback (sounds and graphic).

3. *Emotiplay* [26]: a SG for 6- to 9-year-old children diagnosed with autism spectrum conditions (ASC) that focuses on learning about emotions.

The game aims to overcome emotion recognition (ER) deficits, concerning facial expressions, vocal intonations, body languages and their integration within a specific context; this is made possible thanks to the implementation of tasks.

Within the game, the child plays the part of an explorer in an international research base camp in the jungle, looking for human behaviors and expressions.

In the different levels, the player receives positive feedback (suited to their level, status, and needs) in the form of animations, new minigames, items to be collected and virtual coins, that they can spend to buy equipment and customize their avatar.

Among the topics addressed, basic emotions, difficulty, and happiness in school environment and social relationship can be found.

ER has been tested using four types of tasks (these last are used to test the ER of six basic emotions and twelve complex emotions has been tested using four types of tasks: *a face task*, comprising facial expression video clips; *a voice task* with decontextualized vocal utterances; *a body language task* with face blurred whole-body video clips; and *an integrative task* with video clips of all three modalities presented jointly in context (with muffled voices to reduce reliance on verbal content).

Parents received an activity guide to make children carry out extracurricular activities, in order to strengthen the notions learned and apply them in real life.

In Emotiplay, SDT and SCT were applied, namely in the form of positive feedback related to the performance.

4. *Re-mission and Re-mission 2* [27]: PC videogame that aims to improve adherence to treatment and behavior change of adolescents and young adults (13–19 years old) diagnosed with malignancy (including leukemia, lymphoma, and soft tissue sarcoma); game content has been structured so as to address behavioral problems related to cancer treatments and care.

Within the game, the player controls a nanobot called “Roxxi” in a three-dimensional environment placed inside patients’ bodies suffering with different types of cancer commonly diagnosed in this age group. By using the robot, the player has to destroy cancer cells and to deal with side effect from treatment (e.g., bacterial infection, sickness, constipation related to chemotherapy or antibiotics, etc.); this ensures the patient’s commitment to positive behaviors.

Following the first desktop game, an online version has been released, called “Re-mission 2” (<http://www.re-mission2.org/>) [28], comprising six minigames wherein the young patients become protagonists in the fight against cancer, and at the same time helping them to better understand the disease, what happens inside their bodies and the relevance of the treatment strategies.

Several theories have been applied in the game, including the social cognitive theory and the self-regulation theory. In fact, the game provides knowledge related to the disease and therapy, improving therefore the competence feeling to be able to deal with the disease.

5. *SPARX* [29]: serious game for adolescents and young adults (12–19 years old) with mild-to-moderate depression symptoms, developed to apply Cognitive Behavioral Theory (CBT) and learning theory through PC. The game is set in a fantasy world, where players carry out missions while therapeutic information is provided to them by means of a mentor or a virtual therapist. Thanks to this approach, users learn skills based on CBT and approach therapy without feeling judged by society.

This SG is based on SDT and the satisfaction of its three pivotal constructs (autonomy, competence, relatedness), that are the core elements of the sense of self and key motivators for behavior change.

6. *Land of Secret Gardens* [30]: interactive serious game for 11- to 12-year-old boys and girls aimed at the promotion of knowledge of human papillomavirus (HPV) and the importance of vaccination. In fact, the game is part of a more comprehensive US program, called “Protect them,” intended to promote vaccination among 11- to 12-year-old children through the involvement of parents, caregivers and children themselves.

Within the game, users learn how to protect their bodies (namely the “secret gardens”) against HPV through vaccination. In fact, in the minigame, the players fight the virus that comes out in different forms, such as a latent virus in “find the hidden object” game, or a falling HPV virus to be removed before it hits the crops planted in the garden. As they play the minigames, the players obtain virtual coins, required to buy supplies needed to plant in the yard; by collecting more coins, the players can create potions (e.g., vaccines), which act as shields to protect the plants from disease (e.g., HPV).

This SG is based on SDT principles, such as the enhancement of intrinsic motivation through entertainment, engagement, and enjoyment, as well as the satisfaction of the three innate needs (autonomy, competence, relatedness).

7. *Empower Stars!* [3]: mobile videogame (designed to be played on iPadAir) that promotes physical activity, empowerment, and behavioral change in 7- to 14-year-old children, diagnosed with cancer and under treatment. The game takes place in a space location, where the player embodies an explorer who is about to start a journey, during which he will find himself to face different challenges (in the form of different minigames) before he can go back to the space station.

Game sessions comprise 30 min of activities, which consist of 20 min of physical activities realized by means of iPad and a tailored support. The aim of the physical activity is the achievement of specific moves in order to increase strength, while the empowerment is achieved by providing information and contents on the disease, and by putting the player in the best position to overcome obstacles, which are a metaphor for real disease-related challenges faced by patients.

In this game, SCT was mainly applied, in its different aspects, such as the implementation of audiovisual feedback, the empowerment of physiological and affective states (through the fight of both fatigue and sadness), the application of CBGD elements (the presence of spatial obstacles to be overcome—that are a metaphor for pediatric cancer real challenges—and the presence of glory rewards—to obtain player’s encouragement).

8. *Creature-101* [31]: SG that promotes energy-balanced behaviors (EBRB) among 11–13 years old children, such as increase of fruits, vegetables and water consumption, enhancement of physical activities and reduction of snacks and sugar-sweetened beverages intake, as well as the reduction of the screen time spent passively in front of a television or a computer.

In the game development, both SDT and SCT elements can be found. In fact, players are immersed in an *autonomy*-supportive environment as they enter into the game world in which they are saviors of their creatures. They gradually have to master the challenges intended to instill *competence*, and work toward improving their own health and that of their creatures (*relatedness*). At the same time, the player can experience behavior and goal setting, and continued encouragement and moral strengthening.

14.4.1 Critical Analysis of Theoretical Framework Implementation

Analyzing the available scientific literature concerning SGs applied in the healthcare sector aimed at adolescents, it appears that on average only few articles explicitly mention the implementation of SCT and/or SDT as a basis for SG design and development. The majority of those games aim at behaviors change related to correct nutrition and lifestyles (probably because these are the most requested behavioral changes, with faster and more easily results to be observed).

Within the SGs under analysis, the most common elements are the enhancement of the three psychological innate needs (autonomy, competence, and relatedness), the presence of positive feedback related to the performance, the knowledge enhancement, goal setting, and the presence of barriers that mimic the tangible obstacles that the player may encounter in real life. It should be noted that, although few elements formally and independently arise from SDT and SCT, the majority of them represent a nexus of how to apply those theories, achieving in practical terms the same results. For example, the satisfaction of the intrinsic desire of autonomy—typical of SDT—turns into the goal setting in SCT, namely the enhancement of the ability of taking autonomous decisions.

Similarly, the use of positive feedback related to the performance (subtheory CET) fits perfectly with the encouragement of the subtheory CBGD. Furthermore, the mastery experience (that is the knowledge gained over time through direct experience that makes people able and ready to face the next challenges) can be found as the basis of elements of both theories, both for satisfaction of the innate desire of competence (SDT) and for information source used to enhance self-efficacy (SCT).

Given the strong significance of the two theories, it becomes clear that it is necessary to implement them in a more methodical and planned way, starting at the beginning of game design. Most importantly, a unified vademecum of all possible elements applicable to the serious game field should be created, in order to work on behavioral change, regardless of the original theory: a kind of Rosetta Stone that allows a better communication among psychologists, therapists, and developers. This is essential to lay the foundation on which to start the assessment of the real educational or therapeutic effectiveness of SGs (or at least of their co-adjuvant action coupled with standard therapy).

14.5 Serious Games for Health in Grifo Multimedia

Grifo multimedia (<https://www.grifomultimedia.it/>) [32] is an Italian company with more than 20 years of experience in the ICT field; in the last 5 years, the R&D department has focused on the development of SGs for health, covering different application fields, such as ADHD (Attention-Deficit Hyperactivity Disorder) and learning disorders, and empowerment of patients suffering from chronic disease and cognitive and functional impairment. Among these, a prominent role is taken by the development of SGs targeting adolescents, precisely based on the standardization of the theoretical frameworks abovementioned. The main games by Grifo multimedia that adopt elements of those theories are described below.

14.5.1 SGs for ADHD and Learning Disorders

According to DMS-5 [33], ADHD is “A persistent pattern of inattention and/or hyperactivity-impulsivity that interferes with functioning or development,” that is a neurodevelopmental disorder observed in children and adolescent. This disorder is inherent to cognitive and behavioral self-regulation and is characterized by a number of symptoms falling within dimensions of inattention and hyperactivity-impulsivity, often interconnected.

ADHD is then a disorder frequently associated with school failure, difficulties in social relationships, oppositional or even aggressive behaviors, or it is connected with psychological issues such as sad or depressive mood, a negative self-image, absence of self-confidence. These critical issues make learning difficult and hamper social integration in the various contexts of life: family, school, games, or sport activities, etc.

Three serious games are being implemented on this subject, aimed at the creation of an advanced therapeutic environment able to help young patients (6–18 years old) to benefit from cognitive-behavioral tailored therapy (improving their adherence and therapy efficacy) and at the same time to support therapists in the treatment management. SGs will be administered during therapy sessions, precisely to help bridge patients’ therapeutic demands, improving therefore both cognitive and behavioral skills, and efficacy and intrinsic motivation levels. Users will be able to keep working at home on the same goals through an app with three minigames (focused on the enhancement of the same skills), and at the same time the therapists will be able to allocate tasks and monitor the achievements fulfilled.

The choice of each SG was based on the need to achieve different educational and speech goals (e.g., definition of topological or semantic categories) and behavioral goals (e.g., respect of the rules, ability to wait and stand still, prediction of the consequences of one’s own actions, improvement of attention span, patience and listening skills, improvement of confidence, autonomy and self-motivation). The presence of wearable equipment makes possible to monitor, besides the game performance, the player’s emotional state, and stress, in order to adapt game difficulty in accordance with the stress level detected during game performance.

14.5.1.1 Game on Topological Categories

Seven-level game that aims to teach or enhance player's topological categories skills (above–under; inside–outside; ahead–behind; near–far; right–left). The game is administered by the use of HTC Vive and controller, so that the player can move freely in the virtual space, as they are moving in the real space, and interact with the items present in the scene.

Three scenarios have been implemented (a bedroom, a garden, and a classroom): within each of them, the player will be asked to solve different tasks, that according to level difficulty level may be related to the positioning of items or the player itself in relation to other items (e.g., near, far, above, under, etc.) (e.g., Fig 14.1a, b). As the difficulty level increases, the game introduces a stoplight (to improve the ability to wait and to enhance the respect of the rules) as well as a countdown (to enhance the ability to focus and perform an action in a short time). For each level, the therapist can set different parameters (such as the number of tasks, the stoplight or countdown duration), according to the patient's needs.

14.5.1.2 Game Infinite Runner

Eight-level game (plus three bonus levels) that aims to teach the player to respect rules and to stand still, to listen actively and to be aware of their own limitations. At the same time, the game allows to release excessive body energy by running on the spot.

The game takes advantage of a Kinect sensor camera (connected to a laptop and a headlamp), a device that allows to implement gaming actions simply by using the body, enabling therefore to decode the player's moves without any equipment to wear: this is particularly useful in cases of patients that cannot bear wearable equipment.

Two scenarios are available, that is, a country road (Fig. 14.2) and a city road (Fig. 14.2b): within each level, the players will see a path in front of them, in which they will move forward by running on the spot. As the scenario moves forward, according to the level the player will have to step to the right or left or go back to the

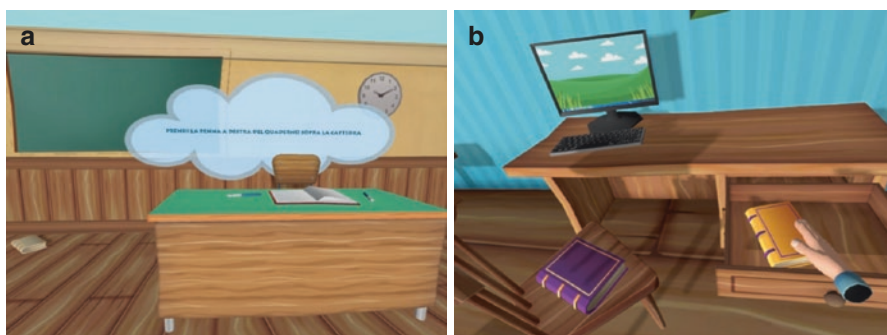


Fig. 14.1 (a) An example of assigned task: “Take the pen at the right of the book over the desk.” (b) A scene from an ongoing task set in the bedroom (take the yellow book in the desk drawer)

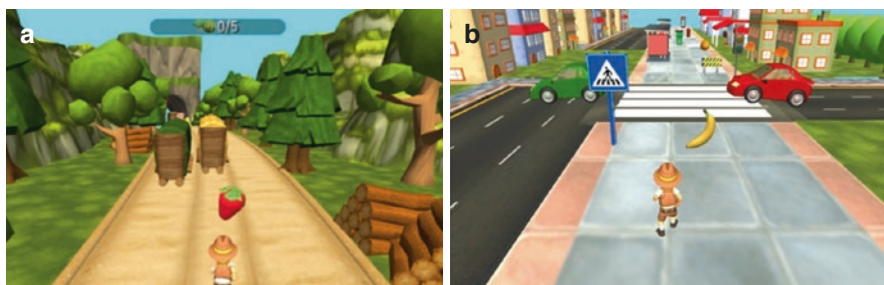


Fig. 14.2 (a) Infinite runner: An example of the country level and the semantic category learning training (e.g., fruits). (b) An example of city level and respect of the rules training (red traffic light)



Fig. 14.3 (a) An example of a positive feedback provided within the task accomplishment. (b) An example of assigned task in order to train planning strategies

center in order to avoid obstacles or collect the items required. Gradually the player will face new difficulties, such as the need to temporarily stop because of the presence of items of transit on the road. For example, in the levels that take place in the country, a flock of animals may cross the road, while in the city, there will be crosswalks and traffic lights, and therefore, the player will have to look left and right to verify the presence of cars, as well as to wait for the green light before crossing the street.

For players with mild motor skills problems, a tailored game mode is available, which allows them to play anyway without running but simply by standing and moving to the right or left to accomplish the task.

14.5.1.3 Game on Planning

Seven-level game that aims to teach the player to plan its own action and manage social relationships.

The game, usable by means of a Kinect sensor camera that detects moves, takes place in a spatial environment, in which the player embodies a skillful astronaut that has to take the spaceship and its friends to the target planet. In order to reach the destination, the players have to pass several tests along the road, during which they will have to make use of their ability to solve problems (e.g., Fig. 14.3a)—starting from reassembling their flight suit, assigning the right equipment to the right team member, up to facing the final enemy.

Therefore, it will become essential the ability to take the right decision at the right moment, as well as to engage in a dialogue with one's own team, in order to take the spaceship to destination (Fig. 14.3b).

14.5.2 SG for Chronic Patients' Empowerment

Tako Dojo Tako Dojo is a mobile device-game that combines serious games and gamification to enhance the empowerment and adherence of young patients of type I diabetes, improving therefore their quality of life and social inclusion. Type I diabetes is a chronic disease for which there is no definitive cure; it is possible only to mitigate its symptoms and effects with an appropriate treatment with insulin and a correct lifestyle: the game aims exactly to convey that knowledge to the patients and to enable them to better monitor their glycemic state. In fact, thanks to a partnership with a pharmaceutical company, Tako Dojo allows the medical staff and parents to monitor and be updated about the glycemic trend of the patient.

The world of Tako Dojo takes inspiration from the Japanese tradition, where the patient takes the shape of a little octopus (*tako*) that has the goal to train in a gym (*dojo*) in order to learn the skills to control the level of G-Energy (glycemia). In the dojo (Fig. 14.4a), five minigames are available, through which the player can learn virtuous behaviors and lifestyles to control glycemia:

- *Ramen master*: minigame in which different foods pop out of a big bowl where the Ramen soup is boiling. The player must decide whether to chop the food items



Fig. 14.4 (a) Tako dojo: main screen of the game. (b) Example of avatar customization. (c) Example of blood glucose diary and the available options. (d) A scene from Ramen master minigame

considering their glycemic value, and the general blood glucose level within the game (Fig. 14.4d). For example, to slice (and so intake) fruits and vegetables, as well as a little piece of cake makes glycemia increase but only by a small amount, while junk food produces a sugar rush and must be avoided. The vial of insulin takes glycemia to the right range, while sport equipment allows to enter in “sport mode,” that helps the player to keep the glycemia level at the right place.

- As the players score points, they improve their status, for example, ranging from novice to apprentice, and so on.
- *Tako memory*: a new version of the memory game, in which all the elements on the tiles are related to food.
- The game shows for each task a number of matching items to be flipped, aiming at improving player’s focus and short-term memory; as the game continues, the level of difficulty will increase because the number of tiles to be flipped increases.
- *Tako maze*: minigame settled in a 3D labyrinth, in which the players have to find the right path to take the ball to the finish line. In order to do so, they have to move the device (smartphone or tablet) to make the ball follow the path and reach the target, avoiding downhole and obstacles where the ball can fall down. When the target is reached, a question will appear inherent to the disease, nutrition, or lifestyle. In this way, the game allows the player to train patience, manual dexterity, and coordination.
- *Tako swipe*: minigame in which the little Tako can move with a swipe gesture in a 3x3 grid with the objective to reach the item required (glucose meter and test strip, fruits and vegetables, sport equipment), avoiding the cakes that are thrown at the Tako.
- *Bubble Tako*: the little Tako runs while the Big Volcano spits out all sorts of fruits and vegetables, which must be touched in order to gain points. Red bombs also come, and must be defused, in order to avoid the volcano from erupting.

Besides the five minigames, there is an adventure game available, “The Mystery of Tiki Tako,” a quest to come to the aid of other characters who are displaying signs of a strange G-energy imbalance. Throughout the quest, the player uses their problem-solving skills, carbohydrates, insulin, and exercise to maintain G-balance. The focus of game play is directed toward enhancing basic diabetes management skills and knowledge.

Besides the dojo, other scenarios are available, each having a different purpose:

- *The House*: where players can use the wardrobe to customize the avatar (Fig. 14.4b), check their personal goals progress and trophies, and browse the online blood glucose diary (Fig. 14.4c), with daily records of blood sugar levels automatically entered thanks to the synchronization with the glucose monitor;
- *The Library*: here, the players can take multimedia contents, which provide information about the world of diabetes, treatments, healthy lifestyles, and nutrition.
- *The Square*: here, the players can access the leaderboard and the link to Tako dojo Facebook page.

14.5.3 Critical Assessment of Grifo Multimedia SGs for Health

SGs designed by Grifo multimedia embrace several scopes of health sector, and therefore each of them aims at specific educational and therapeutic goals, implicitly making the players change their attitude toward the disease and treatments.

In order to do so, a preliminary analysis of behavioral theories has been made: the research has put in evidence all the criteria—common or specific to each theory—that, if implemented, would help the player prepare himself to reach the goal. It must be said that this analysis only represents an introductory survey of the debated elements, and that it will certainly need further reviews and updates before being completed.

After created a vademecum for internal use, it has been compared with the educational and therapeutic preset goals, and the chosen elements have been adapted and included within the games storyboard. A comparison between SGs, preset goals, criteria used, and storyboards' details is given below (Table 14.2).

Table 14.2 Grifo multimedia developed serious games and behavioral criteria incorporated

Serious game	Goals	Criteria used	Storyboard details
Game on topological categories	Enhance the knowledge of topological categories	Enhancement of knowledge and satisfaction of the need of competence	Create tasks that require topological categories learning in order to be completed
	Improve the ability to wait	Barriers	Introduction of green/red stoplights that mimic a circumstance in which player must be able to stand still
	Improvement of limits awareness	Mastery experience	Introduction of similar tasks with gradual increase of difficulty, so that the player can exploit the past experience and feel comfortable to solve the job
	Provide feedback about game performance and positive reinforcement	Encouragement through audiovisual feedback Verbal and social persuasion	Introduction of audiovisual feedback
	Learn how to plan quick strategies	Forethought	Introduction of countdown, that leads the player to plan the strategy to accomplish the task

Table 14.2 (continued)

Serious game	Goals	Criteria used	Storyboard details
Game infinite runner	Enhance the level of semantic categories	Enhancement of knowledge and satisfaction of the need of competence	For each level, introduction of items belonging to a specific semantic category
	Improve the ability to respect the rules	Enhancement of knowledge and satisfaction of the need of competence	Introduction of elements that lead the player to learn a specific rule (e.g., you must stop if the traffic light is red, pay attention to the people and items on the sidewalk)
	Learn how to face circumstances in real life	Outcome expectation	Introduction of elements that can mimic circumstances that the player may find itself in real life
	Learn how to plan quick strategies	Forethought	Close positioning of obstacles and items to be picked up, so that the player has to choose quickly which moves to make
	Provide feedback about game performance and positive reinforcement	Encouragement through audiovisual feedback Verbal and social persuasion	Introduction of audiovisual feedback
	Improve physical coordination	Physiological states	Creation of two game modes: Running on the spot for those players who have only to improve coordination of right-left moves; simple right-left moves (with the game avatar simulating running) for subjects with physical impairment
Game on planning	Learn how to plan actions	Forethought	Introduction for each level of complex problems broken down into simpler elements, on which the player has to understand how to act
	Learn how to handle relationships	Satisfaction of the need of relatedness	Introduction of a team, with which the player has to learn how to deal
	Provide a feedback about game performance and positive reinforcement	Encouragement through audiovisual feedback Verbal and social persuasion	Introduction of audiovisual feedback

(continued)

Table 14.2 (continued)

Serious game	Goals	Criteria used	Storyboard details
Tako Dojo	Provide knowledge about the disease and treatment	Enhancement of knowledge and satisfaction of the need of competence	Introduction of knowledge hints within the game (e.g., on food, insulin, glycemia measurement) Creation of the library, in which to store all the multimedia contents on disease and treatment
	Provide a feedback about game performance and positive reinforcement	Encouragement through audiovisual feedback Verbal and social persuasion	Introduction of audiovisual feedback
	Make the player aware of the status/level reached	Goal review	Creation of badges, trophies, and leaderboard
	Provide example of challenges	Barriers	Introduction of references to wrong food or negative lifestyles that affect the disease course
	Enhancement of autonomous decisions	Satisfaction of autonomy and goal setting	Possibility to choose autonomously the minigame to be played
	Put the player in the position to learn from previous experience	Mastery experience	Small variations among the levels or introduction of a single level that can be played until the available lives run out

14.6 Conclusion and Future Development

In the last decades, eHealth has represented a highly promising branch of the health-care sector, playing a crucial role in it. Among the different modes in which eHealth is applied, SGs represent by now a well-established way to seek to reach educational goals and to support long-standing therapeutic actions. As previously described, these games can enclose different aspects of the health topic, playing an educational, informative, or therapeutic role.

Compared to the development of entertaining games, the design of SGs demands even more the collaboration of a heterogeneous team, relying on the competence of different professionals such as psychologists, therapists, game and graphic designers, etc. In this respect, while the competence of the last category of profession is matter-of-factly required in game design and development, the implementation of behavioral theories is not yet completely spread, and therefore the application of their fundamental principles is mostly done without clear perception or strategy.

Among the most quoted and applied theories, the Self-determination Theory and Social Cognitive Theory can be found, both aiming at better understanding the human behavior and its variation, becoming therefore the most suitable tools to be deployed in order to help the patients-players changing their way to act and reach the preset goals.

However, we have noticed that, although these are two distinguishable theories, the elements relevant for SGs development show a common ground, and therefore their harmonization is needed for an easier and prompt application. The beginning of this operation—although highly complex—is what has been done in Grifo multimedia SGs for health: in fact, a first recap of the fundamental criteria deriving from both theories has been applied in these SGs, exactly on the basis of the therapeutic goals chosen by therapists.

In view of the work carried out, we believe that in order to fully validate the use of SGs in the healthcare field, two development lines must be followed.

The first line is represented by the establishment of a joint vademecum of all behavioral theories (and their branches), able to translate the fundamental principles in elements applicable in games; this will allow to make use of such theories in game design protocols well established and mainstream (luckily, early signs of this way of thinking are starting to emerge [34]).

The second line—that probably has a greater importance than the first—is the need to develop protocols to assess the therapeutic efficacy of SGs: in fact, the significance of the use of these products is strictly connected to their clinical validation, realized precisely through approved protocols. As eminent colleagues have stated [35], not only meticulous scientific researches and psychological theories must be used as a starting point, but most of all a precise management of patients' enrollment must be followed (e.g., statistically significant set parameters and results obtained), as well as the implementation of a trial randomization (including control groups). Although this results in higher development costs, only thus we will be able to create the conditions for SGs to be certified as medical device (or even as drugs), giving to these tools the prominent role in eHealth they deserve.

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Images and Perspectives of Play for Children's and Adolescents' Well-being

15

Maria Antonella Galanti

15.1 Why Do We Play? Images of Play Between Stereotypes and Scientific Interpretations

Why do we play? What is the meaning of play? It is not only human children who play, but also the young of higher animal species that often maintain forms of playful activity very similar to those of early life even in adulthood and advanced age, while in humans the forms of play are transformed with age.

Over time there have been many definitions and interpretations of this activity—philosophical, psychological, psychoanalytic, and pedagogical—which sometimes have also been translated into a vulgate of common sense. It has been considered a sort of surplus of energy [1], that is, the need to spend energy that is not necessary for survival, but remains in excess. This, according to the philosopher, would only occur in man and higher animals. However, for other scholars play functions as a sort of synthesis of the development of the species [2], while for still others play is spontaneous training that facilitates the maturation of some motor or mental activities [3].

A turning point with respect to this type of instrumental interpretation came along with the birth of psychoanalysis and thus with Freud, who put play in the dimension and the communicative and expressive register of the poet and the madman [4, 5]. It is an analogical register that only in the case of madness appears uncontrolled and involuntary, i.e., totally idiosyncratic, while in poetry and play the subject controls their entry and exit, i.e., the beginning and the end of the activity, a little like Alice in Wonderland who by eating one or the other side of a magical and mysterious mushroom becomes bigger or smaller, and comes and goes from one world to another through a mirror [6, 7].

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With Freud, play enters explicitly and finally the realm of the useless and the end in itself, which is also what gives pleasure and makes life more enjoyable. Freud's position is in some way continuous with that of Johan Huizinga [8] who in his most famous philosophical work first poses not only a parallel between play and creativity, but between culture and play. For him, culture—indeed, civilization—develops just as play and convention.

The Freudian point of view recalls the concept of the utility of the useless, which we also find in Edgar Morin, who along with Donald Winnicott is the main author of reference of the theoretical part of this article. According to Morin, human beings are both *sapiens* and *demens* [9] and a human is complex precisely because he is double: a rational and reasonable being, but also holding in his own internal world and expressing in his behavior many affections and impulses, so he is also irrational and bound to magical thinking.

A human being can experience the opposite affections of love and hate, reveal himself to be tender and violent, cast a realistic glance at the world, or on the contrary imagine an illusory one, the fruit of his creativity. However, even the madman shows glimmers of reasonableness that interrupt his idiosyncratic interpretation of reality and its bizarre ways of communicating. Moreover, a human being considered psychically healthy also possesses dark and despairing elements that he cannot express using words alone, but also making use of repetition, ritual, and habits, through analogical chains of meanings.

According to Morin, a human being defines himself partly not only through reason, but also uses play, fantasy and imagination, myth, and even the characteristic delirium of madness. According to the scholar, a life lived only in an extremely reasonable manner, without running risks, without ever making mistakes, and without exploring unusual paths cannot be considered as an index of mental health. On the contrary, only a harmful delusion of omnipotence could generate the arrogant claim of defining oneself as possessor of a totally coherent and unlimited rationality, able to explain everything and to control reality in all its aspects. Reason, on the contrary, proves its credibility only by recognizing that it is limited by the existence of madness as well as by the inevitable presence of mystery.

Homo sapiens is also *ludens*, according to Morin [9], because his tendency towards profit and reality is in constant dialogue with the opposite—towards the useless that is characteristic of the territories of imagination, and the gift. *Homo sapiens*, in Morin's vision, has created his own development and transformed the world, thanks to the dimension of madness and to his being partly *demens*, i.e., capable of generating disorder and the subsequent need to order. Once again, for the scholar it is necessary to draw from different sources far beyond the strictly scientific (and in particular, the literary) to understand the tension, both dialogic and conflicting, between *Homo sapiens* and *Homo demens* [10].

As Freud had previously argued, Morin strongly affirms that literary and poetic genres are able to grasp more deeply the hidden aspects of the human psyche and the disturbing interweaving of opposing affections that define it. In fact both scholars refer in particular to Dostoevskij [11] and to his unparalleled ability to portray the fragility of human beings.

In human development, play (except in cases of neuropsychic or psychophysical pathology) evolves spontaneously, transforming itself with the progression of age [12].

For example, a very young child in the first year of life engages in bodily play consisting of few sequences or just one; he grabs his own hands as they move in his field of vision, but without awareness, at least initially, that they are bodily segments belonging to him. Once he is able to move independently, his play will also evolve, assuming functional and realistic characteristics of an imitative type; in this stage of life children use their parents' clothes or accessories, but also common objects, to stage realistic sequences aimed at reproducing everyday domestic life, especially that of adults.

Functional play is an exploratory activity and one enters the real playful dimension when it becomes representative (functional-representative play) and begins to assume substitutive characteristics compared to the realistic ones, also through the use of dolls and puppets or miniaturized objects, i.e., smaller than those used in real life. From the end of the second year of life, the ability to replace absent objects with others that symbolically represent their existence becomes increasingly refined and no longer random, but becomes customary. Also contextual, in fact, is the child's ability to understand stories told by an adult or to tell them in turn, albeit with all the characteristics of age-typical egocentrism.

Dramatic play transfigures distressing situations of the child's life through imagination into fantasies in which scary figures appear (fierce, devouring animals or human monsters such as wolves, witches, ogres, etc.) flanked by others of a saving and protective nature such as wizards, fairies, elves or legendary characters such as Robin Hood or Zorro or even superheroes from comics and animated films.

Dramatic play performs a dual function: that of helping a child better understand the laws that regulate the life of adults from which he feels or actually is excluded, so that he can adapt, and that of elaborating the tensions and affections of his own internal world, exorcising the fear of his own wickedness and that of others and learning to live and express in socially acceptable ways his own physiological feelings of anger and aggression [13]. Through this type of play the child can stabilize, order and disorder, give meanings, and still look for new ones in his own memories but also in his present. The importance of this is evident when a child is ill or hospitalized.

Dramatic play and pretending are also a way to learn to orient oneself better in space and time, passing from the concrete dimension of the present to the temporal one of the past and the future, that is, of dimensions that in the here and now exist only on the psychic level. By mentally crossing through the dimension of the future, the child becomes a magician, creator of a reality of the possible, and therefore also exercises at the metacognitive level his ability to reason by abstractions and hypotheses, which according to Piaget will only assert itself starting from preadolescence and will characterize the thought and intelligence of the adult [14, 15].

Symbolic play, more complex play involving dramatization and narration, allows the child to work mentally on the question of roles, on his relationship with unexpressed feelings, on working through loss and fear, also through identification with

the aggressor. One of the many ways the latter is realized is the traditional “playing at doctor and patient” all the more important in the case of hospitalized children.

Especially by pretending, which contains many aspects but is above all linked to pleasure and gratification for its own sake, the child can finally live as a unit, perceive in dialogue rather than in conflict his own worlds and in particular the inner world of desires, fantasies, memories, and dreams, and that of his own real context of life, of his affections, and of the relationships that are important to him.

It is precisely by considering this particular kind of activity that one better understands the general nature of play. We do not play to practice performing a future role, but on the contrary, to create illusory worlds, which are real as dreams are real, in a third dimension halfway between objective and subjective reality.

This aspect also applies to the adolescent period, during which make-believe and dramatization play takes place, for example, through video games.

15.2 Adolescents, Video Games, and Emotional Intelligence

Video games often provoke obscure fears, often a priori, on the part of parents and teachers who consider them a negative distraction from learning commitments, an obstacle to the development of cognitive skills, and an element that can generate psychological dependence [16–20]. In reality, the dependence they generate is no different from that linked to other experiences such as dieting, consuming certain substances, unhealthy relationships, and even books. The complex problem of dependence cannot be tackled starting from the object of dependence, but from the person who is subject to it, from his existential fragility, and a tendency to cling to others or to specific situations and objects, in search of consolation and security. In short, a general critical education is needed and demonizing video games, which understandably attract adolescents (and even adults) for their fascinating plurality of co-existing languages, is certainly ineffective.

When adolescents play video games it stimulates their minds and improves their mood by channeling energy as well as aggressive tension or anger. They also encourage creativity because, like children’s games, they allow one to divert one’s attention from one thing to another without losing control of the situation. It is a way to experience the loss of space-time anchoring in the here and now, and one’s own ability to then recover it, that is, to find oneself. Therefore, it is an indirect way of reinforcing one’s identity and one’s creative capacity, made possible by distancing oneself and then coming closer, not focusing on details but on the overall situation. The latter aspect is related to mood, as people who have a low mood tend to focus on the analytical aspect of an experience or situation rather than on the whole.

Video games should not be considered a mere hobby, a negative motive for distraction and diminishing mental ability, but as important training aids that can help eliminate many learning problems caused by stress and anxiety. Video games increase emotional intelligence in some of its primary aspects, the very ones which among many scholars were first studied by Howard Gardner with his theory of

multiple intelligences [21–24], and Daniel Goleman [25–27], making a close correlation between emotional intelligence and introspective capacity on the one hand, and on the other hand empathic availability and aptitude for listening, decentralizing, and identifying with the point of view of another.

Video games relate to emotional intelligence since they strengthen decision-making ability and also stimulate emotions considered negative, such as anger, but allowing them to be expressed in an almost paradoxical form, that is, as something that is simultaneously real and not real. Aggressiveness, often present in video games and considered only in its negative aspect, instead allows one to carry out, but only as pretence, punishment, or revenge as bloody as it is harmless, given that they can only be realized in the virtual dimension of imagination and illusion.

The ability to play identifying with a dimension of virtual and illusory existence unites children, adolescents and, in a particular way, even adults.

The subject of video games stirs the individual as well as the collective imagination, highlighting not only our resistance and fears when faced with the new, but also possible fantasies of expiation or sin. Why do video games attract us so much? It probably depends on the fact that they amplify what is extraordinary that occurs in our mind when we read. Reading fiction involves not only our psychic but also our biological dimension, since emotions manifest themselves at the level of bodily signs.

Multimedia is somehow necessary for us to contact deep emotions and feelings, and when a stimulus uses some or only one of our sensory channels we translate what we read into a multimedia sense, and through the different kind of reading stimulate not only the areas of the brain related to verbal language, but also those of sensoriality, motor skills, and pleasure. The identification we feel with the characters in a story is much more intense and profound than simple identification as a psychic mechanism, because it is almost as if we really smelled and tasted certain foods or stroked certain objects.

This magic of multi-sensoriality, which in the case of written narration must be created by our mind, is instead a property already inherent in video games and is precisely what makes them so engaging. Adolescents in particular appreciate the opportunities for knowledge brought into play by multimedia, by the multiplicity and transformability of sensory stimulation in video games, many of which increasingly frequently resemble real films. In fact, they have a complex plot and characters that are well outlined psychologically, also thanks to certain sophisticated graphic and sound aspects. In this case, the protagonist is not another person with whom one identifies, while sitting in the dark and inactive from a psychomotor point of view, but is the player himself, who is no longer limited to psychologically simulating movements and actions, but actually moves around the scene.

These brief considerations contain important educational implications in relation to the current way of teaching and learning that the space and nature of this article do not allow us to analyze in depth. However, it is necessary to underline the incongruity between the possible value of video games in terms of cognitive and relational learning and creativity and the social disapproval to which they are instead subjected.

15.3 Play, Well-being, and Prevention in Adolescents

Therefore, play understood in its highest and in a certain sense philosophical meaning does not concern only children, but is a beneficial activity for the psychophysical health of everyone, including adults. This is especially true for adolescents, who move through that uncertain terrain between childhood and adulthood. They share with children the play of make-believe and narrative dramatization, which again in their case is expressed through the use of video games, and especially those related to stories and specific characters.

Ludic activity—play for children and teenagers, and culture in a broad sense (literary, artistic, theatrical, and cinematographic) for teenagers and adults—is an important means of overcoming fear and anxiety, but also for expressing in a constructive and socially acceptable way feelings of anger or aggression as well as painful experiences that are self-devaluing or depressive in relation to the future and fears of abandonment.

It is the dimension that Donald Winnicott calls *transitional* and that somehow approaches (but only as a starting point) the Freudian analysis as we know it in the aforementioned essay where he compares a child at play with the poet and the madman [28].

Aspects common to Freud and Winnicott and starting from the analysis of the latter are the analogical dimension, indefinite temporality of an eternal expanded present, and the use of metaphor as an expressive means.

However, Winnicott goes far beyond Freud's analysis. For them, play is the ideal line that determines a continuity and a similarity between two conditions of existence generally considered antithetical: the child/teenager and the adult.

Adults also play in their own way, using the same methods as children and creating like them a fictitious reality. They do this by reading novels and poems or by going to the theater and the cinema or even by listening to music, and in all these ways we can escape ourselves and even our own bodies, to inhabit another's and its history—undertaking, or rather continuing, a beneficial journey into a land of illusion that helps us to improve our quality of life. The theater makes it possible to break spatial and temporal boundaries and the story on stage from time to time becomes at the same time a story outside the viewer in which he can immerse himself and forget his present self, and an internal story through which he can redefine himself.

Going to the theater or to the cinema, as well as reading novels, are activities that just like child's play, inhabit the ambivalent border between rationality and emotionality. In the theater, the spectator, who at first seems to assume a passive role, undertakes a real initiatory and transformative path [29]. He is the actor and at the same time the character that the actor plays. The sense of the theater, like that of play, can never be completely grasped, just as that of Alice and her fantasy world are not grasped, because such situations represent a powerful metaphor for life and are life itself, just as they are replacing it. The child in play and us adults in the theater, at the cinema, or reading novels experience the possibility of changing context because the scene of our real situation is disassembled to make room for another one.

By identifying ourselves in a story that others have imagined and that still others stage, as occurs when we go to the cinema or theater, and just like what happens with children playing, we allow very profound and hidden processes to emerge. Thanks to our imagination we change the context in which we find ourselves and we accept going through Alice's looking glass [6, 7] to wander far beyond our familiar situation, in that other marvelous world where desires and hopes are born, and thus where we can arrange our evanescent memories in order to make sense of existence.

Encouraging immersion in a reality made of illusion, by means of a situation invented by others or by ourselves, as in the dramatic play of children, allows educational paths to use indirect ways of knowledge and thus to frighten us less. At the theater or the cinema, just as in children's play, we do not create an escape from reality, but follow particular itineraries within it that instead make it possible to process it more deeply, tolerate its contradictions, and understand the motivations and needs that generate conflict or make us feel bad.

Theater, cinema, and literature in general are adult recreational activities, and share with children's "pretend" play the ability to assume a narrative-cathartic value, given that they are situated in the dimension of the possible and also allow translating emotions and feelings that are considered reprehensible. All these activities are capable of consoling, of filling the void of separation, of restoring the reign of the continuum wherever a break occurs, and provide us with the necessary courage to face new or painful situations such as loss and sickness.

Theater, music, literature, cinema, and art for adults, and play for children, are formative activities that generate a temporary suspension of reality, allowing unconscious content to emerge, teaching us to live with it even when it is conflicting or distressing.

For this reason, play is a primary way for children to communicate and express themselves, but also to know the world. It must however be free, an end in itself, and not a mere instrument for achieving external objectives. By playing we learn better, it is true, and yet play should not be seen first and instrumentally as a means of learning this or that concept or as a function of scholastic learning. What unites intelligence and language to play, in fact, is the immaterial aspect of illusion.

Thus the most archaic mode of real play is *functional play*, that is, an activity that does not yet arrive at symbolism since it consists of the simulation of daily and trivial actions, such as answering the telephone or cooking, with real material objects, usually clothes and accessories or footwear of the affective figures of reference, but also domestic utensils. The next step is that of representative capacity, with the appearance of toys, that is, realistic objects identical to those used by adults, but different in size because they are small, miniaturized. Therefore, these are recognizable copies, but are not really functional except in the dimension of fiction of the imagination. Children love them: probably because they allow them to feel like giants, as adults appear in their eyes. The deformed relationship between the size of their body and those shadows of objects allows them to project themselves into us and to feel in their hands all the power they attribute to us: that of deciding rules, determining events, and managing people and things according to personal and idiosyncratic desires.

Later, children are able to use objects as metaphors in a symbolic function, as substitutes for what is missing, even when they lack a morphological-perceptive similarity to what is symbolized. The play activity of dramatic fiction is characterized by successive actions, understandable also to a real or hypothetical spectator, and by the appearance of typified characters, and is characterized by intense and profound emotional values. In fact, children dramatize their fear or terrors, desires, expectations, pain, and happiness.

At a certain point, in children at an age when they are about to enter primary school, they need to clarify the narrated situation, and so they begin to negotiate with their companions the sequences and possible resolutions of the staged conflicts, as well as hierarchies and roles.

In the narrative dramatization proper to this age, so real and at the same time imaginative and fantastic, but with a certain cathartic value, the body is at the center of the representation, while somewhere within this simulation in a scenic-playful form lies an irremediable conflict and the need for dialogue with one's own fears.

Children also play to exorcise anxiety, without denying it but instead attempting to live through it and process it. Even when we adults tend to think of them as free from feelings such as sadness or pain, they are actually pervaded by fears of a different consistency and nature, present since the dawn of life itself. To deny these feelings means that in some cases we metaphorically do them violence, fueling our perfectionist expectations towards them according to which we would like them to be perpetually happy and grateful, to preserve ourselves from anxiety and fear.

When we do so, we forget that all our adult anxieties originate from those we felt when we were children, or represent a re-elaboration. In fact, in many cases, if not elaborated, children's fears are destined to be translated into various forms of adult psychic suffering without revealing the obvious path they are taking, and therefore without any possibility of setting up preventive educational methodologies.

In the developmental age certain periods are characterized by specific and physiological fears, which can also become pathology if they persist beyond the age threshold for which they are characteristic, and play helps children to process them, that is, in a certain sense, in order to avoid becoming psychically ill. For example, in the first and second year of life, fears can be linked to sudden, intense and for children inexplicable sensory phenomena such as thunder, lightning, the roar of an airplane, or the siren of an ambulance, a dazzling light and even, sometimes, an unusual and strange taste or an unknown and too intense smell. These types of fears are followed, from the ages of 3 up to 7 years, by those relating to large, fierce, and devouring animals, sometimes replaced in school age, by fears of small animals that are in themselves nearly always harmless, like butterflies [30].

These are metaphors for our fears—in a certain sense the very same ones encountered throughout the cycle of life, namely the fear of loss of security and therefore of the new and the unexpected and especially the possibility of separation from figures of emotional reference. In childhood this last fear can manifest itself most intensely in school phobias, and at other times is expressed in the various symptoms of childhood depression.

Even infants feel anxiety in some way and express it through psychosomatic communication modalities such as the known phenomenon of gaseous colic, when the child's face becomes cyanotic with irritation, anger, and pain, and this is accompanied by agitated movements of the limbs and the violent, acute, and disruptive sounds of crying.

Children's anxieties are often linked to nameless fears or to the inability to understand the rules that govern their experiences and which are instead perceived as uncontrollable aspects of reality, brought about by dark and invisible powers. Children do not possess the words of reflective thought that could help give them meaning. However, like adults, they can express them after contacting them indirectly with the language of the imagination—inventing fantastic situations, plots, and characters and using “make-believe” itself almost as a simpler way of learning to think.

Winnicott defines as *transitional* the paradoxical regions of existence—play for children and culture for adults—in this way definitively breaking with the traditional psychoanalytic concept according to which an object can only be either internal or external to the psyche. Now the object can also inhabit both realities at the same time. In fact, the scholar affirms that it is necessary to add a further, intermediate dimension alongside internal reality and external reality, one which is real when we experience it and at the same time unreal because it is not defined by the usual temporospatial categories [31].

That is why children obtain a transitional object, generally a small doll with reassuring perceptive characteristics similar to those of the maternal body—warm, round, soft—to help cope with the solitude of night, when they learn to sleep in their own room while their parents remain in theirs.

In this sense, play allows them to express intelligence in its various aspects, to realize their capacity for self-determination, and to see themselves as non-serial and non-replaceable, because they are made stronger by the awareness of their right to exist.

Anthropology teaches us that this particular awareness somehow defines the boundary between normality and psychic fragility understood as the expression of a particular sensitivity sometimes so intense as to generate a real dimension of madness. The great Italian anthropologist Ernesto De Martino proposed the concept of “crisis of presence,” combining it with that of fragility [32, 33]. The crisis of presence must be understood as a condition of insecurity with respect to one's own existence, expressed via neurovegetative disorders with a high metaphoric resonance, such as vertigo, chills, sweating, falling to the ground, the feeling of loss of strength, or shortness of breath. It is a kind of ontological insecurity that especially possesses us when faced with our psychophysical fragility, as in the case of an illness (and in this essay we deal with hospitalized children) or a loss.

The concept of “crisis of presence” in relation to that of “ontological security (or insecurity) of existence” is a theme of one of Winnicott's main students, Ronald Laing, [34] and establishes for him the boundary with schizophrenic experience, that is, with a lasting and fairly static condition. On the other hand, in play a child experiences a crisis of presence as an intermittent and dynamic situation.

In this regard, we cannot fail to stress how adolescence is necessarily defined by De Martino's concept of *crisis of presence*. It is, in fact, an age in which one moves in a continuous coming and going between the past, now lost, and the future, uncertain and mysterious. It is not by chance that all adolescents go through a sort of physiological dysmorphophobia, no longer able to recognize themselves in their own changing body, in their own ways of processing sensory input, which are also different and more refined than those of children, and in new, previously unknown sexual tensions.

The ability to represent the existence of a child's reference figures even when they are not physically nearby allows the child to learn to tolerate separation from them and to await their return with confidence, thanks to the mental representation of the memory of all previous returns.

The *transitional space* identified by Winnicott [31, 35], that is, the earliest creation of a child who plays but is still unable to speak, is the imaginary bridge cast between the inner, invisible, and profound reality, and that of visible experience. In light of this consideration, play is the privileged territory of experience in which, in all stages of life, emotions and affections meet and integrate with the reflective and logical aspects of the psyche.

15.4 Images of Illness and Pedagogy: When Prevention Is Not Enough

We can understand the preventive function of play for psychophysical well-being if we agree on the meaning of health. Health is not the opposite of illness, but represents something more, namely being well with oneself and with others, the ability to accept one's own psychophysical limits and to project oneself into the future by giving voice to one's dreams and desires, but also managing to expressively channel one's negative tensions, the physiological feelings of anger or aggression and fear of the future.

It is no easy task to define a disease, since the issues surrounding it are complex; they involve not only the sick person, but also the relationship of care as well as the collective imagination and affections that arise around the existence of physical or psychophysical damage.

In the case of sick and hospitalized children and teenagers, if medical and pedagogical-educational approaches act separately they risk feeding new technicalities and reductionism, that is, transforming the technique from a means to the end of action, and reducing the condition of illness to its biological aspects alone. However, the necessary comparison between these two points of view must not be reduced to a sort of division of tasks in which medicine should only deal with the observation and interpretation of the organic semeiotics of the disease, while pedagogy should only step forward later, with consolatory tasks or simply aiming to distract the sufferer from their condition. In this case the educational task would only be debased and reduced to the dimension of welfare. Instead, it is necessary to

work together for the creation of a more complex and transversal definition of the condition of illness.

In the medical field, we can observe throughout history many contrasting accepted meanings of disease, of cures, of healing itself or, in some cases, of the impossibility of healing. In relation to these opposing points of view one can choose to accept or not, as an integral part of the scientific discourse, the subjective aspects of emotional involvement with respect to one's own illness or that of a loved one. Indeed, organic (and therefore deterministic) concepts of disease and the course of care coexist with other more complex and dynamic concepts, willing to also acknowledge the points of view of the human sciences regarding illness. The purely naturalistic concept of medicine in some way identifies the patient as "different" with respect to a standard model of health, by subjecting him to depersonalizing practices often implemented in a ritualistic manner and aimed at assimilating the person to his own social weakness due to a damaged and defective body, nearly cancelling out emotional subjectivity.

In this case, medical action seems to delimit one's own theoretical and operative field of the linear path of diagnosis, treatment, and healing, considering illness and health as opposite conditions, each defined by the absence of the other.

On the other hand, the disease is not only a technical-scientific fact, but at the same time is also a subjective experience [36]. The life experience of a sick person is realized in the complex interweaving of the biological and the existential. Feeling subjectively sick also means perceiving the decay of one's own planning ability and of one's physical and psychological energies. Thus the disease has both an organic dimension, which can sometimes also be unconscious, that is asymptomatic, and a psychic dimension, linked instead to the awareness of one's own psychophysical weakness.

The awareness of being sick also arises from the interaction with others. The illness, in this sense, is first of all an existential experience that has been inserted into the vital process of a person, also understood in the biological sense. This relational and systemic concept of the disease also leads to a different vision of the same healing process, no longer conceived as a return to a pre-existing state of well-being, but as a series of changes in the body and psyche that even in the case of a happy outcome makes it impossible to start again from where the normal flow of life was interrupted.

Even after recovery from a serious disease, one emerges transformed. Care, then, includes human solicitude for a person who undergoes the experience of illness—a solicitude not only technical, but overall and comprehensive and considers not only the damaged body or psyche, but also the concurrent subjective, reflective, and emotional experience of that damage. Therefore, when curing the body, one should also be concerned with how the subject lived before becoming ill and how he can continue to live without that painful sense of extraneousness that almost always arises from the experience of illness.

Medicine and pedagogy are distinguished by the different spaces that each concedes to the invisible, and to their particular ways of considering the clinical signs.

In order to make a diagnosis, medicine is forced to operate according to a descriptive methodology and by abstraction, leaving little space for other courses in which one attempts to recover the patient's subjectivity and to interpret the pathway, helping him to make sense of it.

When faced with a sick child and teenager, the difficult and controversial task of diagnosis and prognosis is the responsibility of the physician, as well as deciding on a course of treatment, but it is important for him to be supported in the latter by operators with psycho-pedagogical skills. These operators should be able to guarantee a hospitalized child and teenager the right to play, considering it an important contribution to the recovery process itself and more generally to better endure the illness.

How can we promote the well-being of children and adolescents when they are sick?

When faced with a sick hospitalized child and teenager, doctors and nursing staff risk being unable to combine scientific and necessarily detached thinking with aspects of emotional participation. On the other hand, figures with an educational function risk implementing hyper-identification processes and not knowing how to integrate emotional involvement with detached reflection and rational study. Even in the light of these considerations, a comparison between these different care skills is essential.

It is difficult to imagine a child and teenager playing in the hospital. The hospital environment is organized according to rigid rituals, at very limiting times, in coercion that frames the experiences of suffering.

What do a hospitalized child and teenager perceive emotionally? Often he breathes in the fear that his parents feel for him, which feeds into his own. Play is a physiological need for freedom, linked to the dimension of pleasure as an end in itself, but how can a child and teenager feel like playing if he is forced to stay in bed in a strange and aseptic hospital environment? Generally, in a hospitalized child the normal desire to venture into play is unfortunately replaced by regression to a state of dependence and constant requests for attention, seeking reassurance for his fears. Yet, only in play can he express these fears in a constructive and dynamic way, transforming his own internal world at least a little, and perhaps also others' perception of his condition. It occurs equally in the adolescent.

Sometimes a hospitalized child and teenager act out with angry and aggressive behavior, opposing the therapy, or alternatively become apathetic, disinterested, unable to get involved. Even in such cases, in order to channel anger or counteract disinterest, only play can be a valuable help.

An adult can use words, resorting to dialogue to vent his deepest anxieties and find comfort in the answers provided, but even when a child can speak, he is not yet really able to use verbal language for consolatory purposes or to elaborate his anxieties. His preferred expressive channels are different, especially graphic-pictorial activity and play. The adolescent is more familiar with words, but does not yet have enough introspective ability and therefore, also for him, the indirect expressive modalities with respect to his own internal world remain the most important and are music, art, and multimedia play.

Play in the hospital would allow both child and teenager to find meaning in the rules that define hospital rhythms and help them adapt to what appears to be a strange, cold environment, incomprehensible in its rigidity. Play could restore vital energy and help them affirm his desire to live, but also help offer a different image of himself to those around him and the people responsible for his care, reminding them that he is a child and a teenager like any other, even if ill, and therefore must first be considered not only as a body to be treated and hopefully cured, but as a person with a body now rendered more fragile by illness.

Objects used in his play could also, in the case of a child, be those same instruments used in his care, allowing him to provide them with a less frightening image, to familiarize himself with them also by manipulating and transforming them in play, inspired by his imagination or the suggestions of those who are able to get involved in his play. In conclusion, the shared play of the hospitalized child could turn suffering and fear into elements of closeness and solidarity, transforming these feelings into elements capable of creating bonds between people, rather than condemning him to loneliness and separation, already physically sanctioned by a place defined by precise architectonic boundaries and time limitations.

15.5 Conclusion

Play for children, culture understood in a broad sense—literary, artistic, theatrical, and cinematographic—for adults, and both for adolescents, Are activities of a playful type that can help us process fears and anxieties, but also allow us to express feelings of anger or aggression in a constructive and socially acceptable way. Through the experience of play, variously defined in relation to the life cycle, it is also possible to deal with the painful experiences of low self-esteem or depression in relation to the future typical of adolescence, and with fear of abandonment. In all its variegated facets, play activity stimulates emotional intelligence without which our reflexive and formal intelligence would become self-referential and useless in handling relationships with oneself, with others, and with the world.

This article discussed video games, a popular recreational activity for adolescents, but often considered by educators, parents and teachers, as an obstacle to learning thanks to, prejudice, stereotypes and not infrequently ignorance about their different types and quality. Instead, when appropriately selected for quality, video games can play a positive role both in stimulating cognitive skills, and in terms of the possibility of expressing virtually, and therefore in a painless form, one's own aggressive and more generally negative tensions.

The inconsistency between the possible value of video games in terms of creativity and cognitive and relational learning on the one hand, and the social disapproval to which they are subjected on the other hand generates a series of educational implications in relation to obsessive practices regarding controlling the time spent by young people in recreational activities, but without the ability of adults to get to the heart of it. An alliance is often created between parents and teachers based on reproach and prohibition with respect to preferential recreational activities, making

adolescents feel alone and misunderstood. These same adults could use their educational energy to get to know them better by selecting the best products in terms of psychophysical, cognitive, and relational stimulation, rather than banning the whole in a superficial way through generalizations. Certainly not all video games are of value, but the same selective reasoning can be applied to books, paintings, films, and music, all of which no one would ever dream of giving up.

Instead, it is necessary to consider the play activity of the child and adolescent and intellectual play not as opposed, but as intertwined in a physiological dialogue capable of enriching both.

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New Perspectives for Multidisciplinary and Integrated Strategies of Adolescent Health and Well-being

16

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16.1 From Biological Complexity to Homeostasis and Resilience

The complexity of a biological system can be defined as follows: a network of cooperating units, namely systems characterized by global properties independent of the details of the units in the absence of cooperation. The cooperation of the interacting units generates organized structures that from time to time undergo a temporary collapse, after which the complex networks reorganizes itself for an extended time [1]. This sentence highlights two fundamental aspects of the biological systems. First, all the components joining the same biological system are strictly integrated, and this cooperation have additive synergistic effects in respect to the function of the singular components. A typical example to this integration is the response to a stress stimulus that involves hormonal systems—adrenergic system, cortisol, thyroid, the hypothalamic–pituitary–adrenal axis—the autonomous nervous system, with the consequence of an overall participation of the organs to the stress response. Furthermore, the biological systems are dynamic since they have the opportunity to change in relation to the environment, adapting their internal organization to new conditions. Human body is a complex biological system that is comparable to a nonlinear, dynamic, and intertwined network of molecules, cells, organs, and systems [1]. They interact with each other and adapt continuously their function with respect to the function of the parts in order to maintain homeostasis, that is, to preserve internal stability through coordinated response to external or internal stimuli potentially altering normal condition or function. Hormesis defines the beneficial effects of repeated stimulations or stress potentially increasing defenses against deleterious processes. Specifically, this term means the induction of protective mechanisms in cells and organisms driven by low/mild and repeated stress-stimuli, which

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result in biological beneficial effects [2]. Actually, hormesis is a dose–response relationship in which effects at low doses are opposite to those at high doses. Therefore, hormetic dose–response curves are biphasic rather than being monotonic [3].

Contextually, resilience, which is defined as reduced vulnerability to environmental risk experiences and hazards, or the capability to overcome stress or adversity, with the result of a good outcome, is conceptually linked to homeostasis, that is, the process by which small stresses build resilience to large stresses [4–6]. It is also defined as the skill to prevent, minimize, or overcome the damaging effects of adversity [7]. A key requirement of resilience is the presence of both risks and promotive factors that either help bring about a positive outcome or reduce or avoid a negative outcome. Resilience is not merely characterized by the absence of pathology, but rather is a dynamic process that enables the individual to successfully adapt to severe adversity over the life course.

Resilience is not a fixed and reproducible attribute of overall subjects, but, rather, is largely dependent on the huge interindividual heterogeneity of the response to similar environmental hazards or stressors. Actually, the exposure to a similar stress can enhance vulnerability through a sensitization effect or reduce vulnerability through a “steeling effect” [5]. Generally, it is accepted that steeling effect is obtained from repeated and brief stress experiences. In animal experimental setting, for example, brief intermittent period of mother separation, during infancy, induced both a significant attenuation of physiological response, with cortisol release and noradrenergic activation reduction, as well as behavioral response, reduced vocalization, following social isolation in juvenile squirrel monkeys [8]. Contrarily, a more prolonged separation from mother induced an opposite response with the animals appearing hyperactive [9]. These results underpin the variable time of exposure to stress stimuli as determinant to induce resilience. However, resilience has to be considered a multifactorial process in which several variables, both risk and protective factors, at different individual weight, play a key role. These include not only genetics, epigenetics, coping skills, family, as well as mental health promotion [10–13] but also external resources such as social environment and community or organizations that promote positive development. Improving the understanding of the links between genetic, environmental, and social interactions is crucial for elucidating the neurobiological and psychological underpinnings of resilience in health and well-being field (Fig. 16.1).

16.2 Quality of Life and Well-Being Assessment

The concept of human complexity matches the definition of health that, according to World Health Organization (WHO), cannot be considered only as the absence of disease, or infirmity, but rather a status of maintenance of physical, mental, and social well-being. This definition harks back to the physiological definition of homeostasis and resilience. In this regard, it is intriguing the hypothesis that subjective health perception or well-being has a genetic set point that is homeostatically

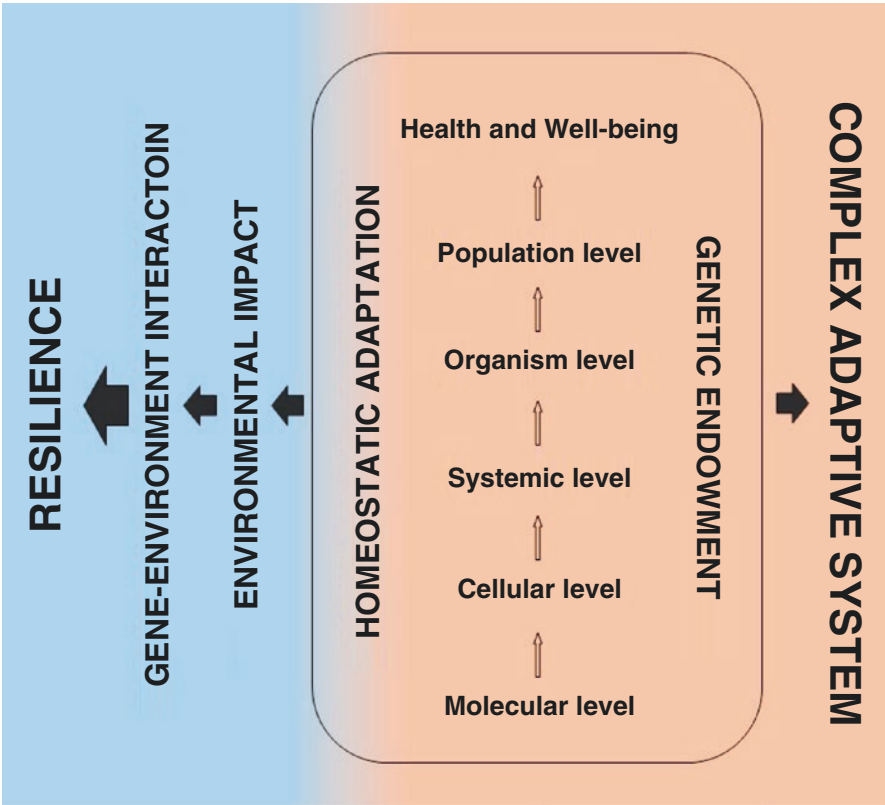


Fig. 16.1 A complex network in biological systems

protected [14]. This means that similarly to the control of physiological systems, such as blood pressure or body temperature, this homeostatic mechanism maintains subjective well-being or returns it to its normal range after a positive or negative emotional experience. In this context, it is intriguing evidence of a heritability of well-being, based on twin design studies, which weight results of 36% on average, ranging from 0% to 64%, according to a meta-analysis of heritability studies [15].

The mechanism of homeostatic control of subjective well-being is based on three main automatic internal psychological processes: (1) behavior, to disengage from the source of the challenge, a typical process to avoid negative challenges; (2) habituation, to decrease psychophysiological response to a repeated stimulus [16]; and (3) adaptation, to modulate its functions in response to environment with the development of a feedback relationship between the organism and its biological role and the selection force, that is, the demand placed on the organism by the environment [17].

Often, the terms of well-being and quality of life are used interchangeably. The office of economic cooperation and development (OECD) defines subjective

well-being as a *good mental states, including all of the various evaluations, positive and negative, that people make of their lives, and the affective reactions of people to their experiences*. Indeed, the WHO defines quality of life as “*an individual’s perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns*” [18]. The broad definition of both well-being and quality of life, that is, in line with that of health, highlights the issue of how to measure both well-being and quality of life. This is a key point that is becoming a focus in public health policy, due to the potential socio-economic issues and development [19, 20]. Within the construct of subjective well-being, well-being assessment can be shared into three different approaches: evaluative (corresponding to life satisfaction assessment), hedonic (corresponding to feeling such as happiness, sadness, pain, and anger), and eudaimonic ones (sense of purpose and meaning in life) [21].

Quality-of-life assessment can include both objective and subjective perspectives. The objective evaluation focuses on what the individual can do, and is important in defining the degree of health, while the subjective one includes the meaning to the individual; in particular, it involves the translation or appraisal of the more objective measurement of health status into the experience of quality of life.

Encompassed within quality of life is health-related quality of life (HRQL), that is, the quality of life in the setting of one’s health and/or illness. In this context, the Lancet Commission in 2016 has centered global attention on the health and well-being of adolescents (10–19 years) [22]. Adolescence is typically considered a time of optimal health; yet, it directly accounts for 35% of the global burden of disease, mostly from noncommunicable diseases such as obesity and poor mental health [23].

In this context, the construction of HRQL instruments, both in adolescents and in adults, has been guided by a consensus statement that four fundamental dimensions are essential to any HRQL measure, including physical, mental/psychological (or emotional), social health, as well as global perceptions of function and well-being [24]. Therefore, HRQL assessment requires a multidimensional and integrated framework that includes variables of different aspects of the individual life, including variables belonging to emotional status, cognitive skills, socioeconomic context, and lifestyle habits. This is in line with the scientific evidences that health is largely influenced by the above-mentioned aspects and by a strong link between human subject and the environment in which the subject lives, understood as social environment. Relative to socially isolated individuals, socially connected individuals live longer and show increased resistance to a variety of somatic diseases ranging from heart disease to cancer [25]. However, what is less clear is why the “macro” environment should be capable of influencing the internal “micro” cellular and molecular processes and responses that mediate health and disease. Neurobiological, epidemiological, and behavioral data suggest how social environment, in terms of relationships and multiple social aspects, promotes physical health and well-being, especially during a period of pronounced physical, emotional, and social

transformation such as the adolescence age [26]. Environment, according to a perspective of social support on health, is consistently one of the most important predictors of health and well-being, and thus of HRQL.

Unfortunately, the concept of HRQL was based mostly on adult literature, and it did not allow the developmental changes, language level, or adolescents' construction of health and illness. These are key factors that should be considered when assessing HRQL in children and young people [27]. More in detail, the specific dimensions of HRQL considered (e.g., psychological well-being, self-esteem, body image, cognitive functioning, mobility, energy/vitality, social relations, and family/home function) are related to aspects of physical, mental, and social health.

However, most HRQL instruments are developed for children with a chronic illness, such as congestive heart failure and multiple sclerosis [28, 29]. In fact, a key point is the presence or absence of diseases which clinical characteristics and limitations can alter specific physiological functions, that, in turn, have an impact on certain HRQL domains. This adaptation process to the state of illness that induces changes in the meaning, values, and conceptualization of quality-of-life parameters, is called "response shift," that is subjective depending on the personality of the patient, that is on subject's past, and on the mechanisms encompassing behavioral, cognitive, and emotional changes associated with the state of illness [30].

Many studies have shown that the stage of development is important, as it affected young people's perceptions of some aspects of life, especially attitude toward illness and treatment. Young people with a chronic illness, such as congestive heart failure, strove to overcome social, psychological, and physical difficulties to have a normal life. Peer relationships were important, but often their illness interfered with these relationships. Young people's determination for their lives to be normal appeared to increase as they developed through middle and late adolescence [31–33].

Therefore, the sentence, pointed out by Gullone and Cummins, "*when researchers study subjective well-being they implicitly make assumption of universality*," confirms the evidence that many variables are implicated in the determination of health status and well-being of subjects including also culture, age, wealth, and regional or national social organization [34]. This evidence of universality entails that the methods of evaluation of health and well-being cannot be fully inclusive of variables that influence significantly health and well-being; consequently, it is important a hierarchy of importance. Accordingly, there is a general consensus that emotion and cognition are the main domains to be considered in developing frameworks to assess HRQL. In addition, the universality of HRQL is also linked to the fact that variables interact and influence each other, and thus, according to the theory of complexity, the result of this integration is different from the simple sum of the effects of the single variables acting individually. That is, the higher the number of the variables, the higher the level of integration and complexity of the system. It is, therefore, not surprising that there is neither an agreed definition nor a standard form of measurement HRQL due to its complexity and universality.

16.3 Improving Adolescent Health Preventive Strategies

The last two decades have been marked by a substantial shift from health intervention to health promotion and prevention since the introduction of the concept of health as a continuum from that of absence of disease to a state of well-being. This shift in paradigm has changed the focus of health interventions from treating symptoms and deficits to identifying at-risk groups, with the aim of preventing the onset of illness. In addition, with the growing evidence that noncommunicable conditions are influencing adult health, adolescence is being increasingly recognized as an important period for health promotion, prevention, and intervention, because many of these behaviors emerge before adulthood [35, 36]. This led to an increase in school-based health promotion and prevention programs aimed at simultaneously promoting psychological well-being before the emergence of serious problems in mental and physical health, although has highlighted the relative lack of resources dedicated to adolescents [37].

In a study of school-aged children in 2009–2010, the WHO reinforces the viewpoint that social determinants are particularly important in well-being among youth aged 11–15 years [38]. There is a critical need to assist adolescents in learning about their health, so that they can make positive lifestyle choices to enhance their well-being. Growing evidence from education, public health, medicine, and psychology indicates that well-designed youth health education and development interventions support positive health outcomes.

Expanding the workforce of health professionals highly trained to understand the interplay between biological, psychological, behavioral, social, and environmental factors that influence the transformation from childhood into adulthood is pivotal to generating an effective, strategic, and interdisciplinary global response to adolescent health issues. According to this multidisciplinary perspective, one of the most important programs in the field of prevention and promotion of health in adolescence is the Health Behaviour in School-aged Children (HBSC) study. Since its inception, the HBSC has provided critical insight into the health and well-being of adolescents for a growing number of countries across Europe and North America. In addition, the use of a common protocol has enabled the collection of comparative cross-national data providing a platform for systematic data collection at the country level and a resource for national research capacity building. This has resulted in a coherent set of indicators that provide a valid representation of young people's health, well-being, and risk behaviors; as well as their developmental and social determinants [39]. The wideness of its topics and cross-national nature offer a snapshot into the factors that contribute to creating the best conditions for young people to grow up in different social contexts and how they fare against others. This opens up to the need to develop a personalized preventive strategy plan that requires knowledge on adolescents' age-related stage from a physical, mental, and social point of view, and of their socio-cultural environment, including their interests, concerns, and activities in their spare time. In this multiparametric perspective, it has been developed a personal well-being index which is mainly based on the subjective psychological assessment of mood happiness [40], in agreement with the key point

that psychological well-being is a strong indicator of health. The personal well-being index-school children (PWI-SC), validated in Portugal and Australia, is designed as a cross-cultural instrument to measure subjective well-being among high school-aged children [40].

To date, despite the presence of different health promotion and prevention programs in adolescents, preventive strategies are mainly directed toward adolescents with disease rather than the healthy ones. Evidences suggest that service-targeting adolescents are highly fragmented and poorly coordinated. Future studies should specifically be targeted toward to evaluate the effectiveness of adolescent health interventions in different social setting (e.g., family, school, and community). As adolescent health is still an evolving area, it would be important to carry out an exercise involving experts of adolescent health to prioritize research gaps and recommend immediate areas of action (Fig. 16.2).

Moreover, it would be important to recognize ideal delivery platforms that can augment the coverage of proven adolescent health-specific interventions and provide an opportunity to reach hard-to-reach and disadvantaged population groups. This requires a specific focus on modes and channels of delivering targeted interventions via specialized health services, school-based delivery, youth organizations, community-based delivery, information communication technology, and mass media.

Evidence is growing that some effective best practices are developing about both individual approaches and holistic approaches in health promotion, early screening, and healthcare interventions that may have some positive potential for prevention and intervention. Interdisciplinary and interprofessional stakeholders such as

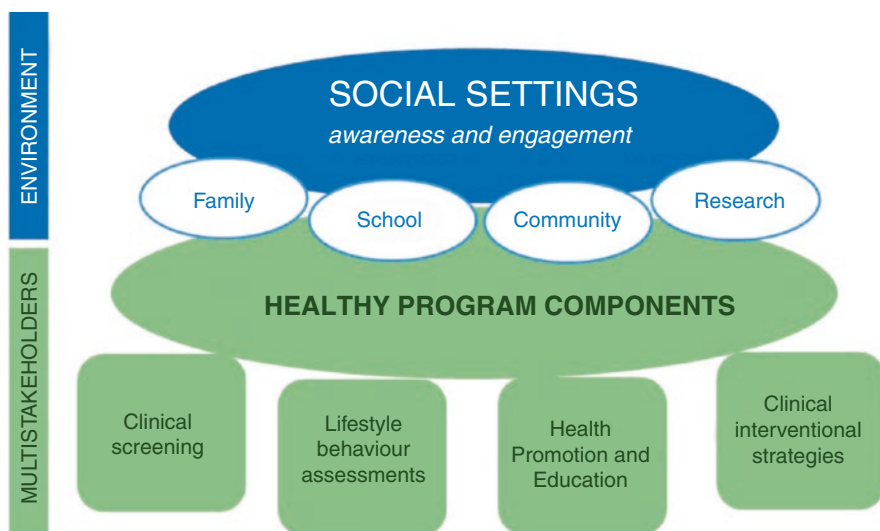


Fig. 16.2 A comprehensive model for health and well-being prevention strategies

researchers, clinicians, educators, parents, and care providers must work together on this health issue and inform each other of their outcomes.

16.4 The AVATAR Project

In line with the concept of complexity and universality of health, “A new purpose for promotion and eVALuation of healTh and well-being Among healthy teenag-eRs—AVATAR Project” began its work 3 years ago to advance our understanding of adolescents, according to the perspective that adolescent health is both shaped and constrained by factors stemming from the social spheres of family, peers, school, by the economic conditions in which they are growing up, and by emotional status. AVATAR network is an Italian alliance of researchers, teachers, parents, schools, and institutions that collaborate on the national survey of school students in order to change unhealthy behaviors and to potentiate those healthy through personalized interventions, addressed both to the community and to the individual, at-school and at-home.

The conceptual basis of the AVATAR project is that health and well-being are the result of an integrated network of factors belonging to different domains, including biological, social, emotional, and cognitive ones, in which interaction is mandatory to the maintenance of the psycho-physical homeostasis. According to this concept, AVATAR project adopted an integrated approach to define health profile of subjects, including several components of health and well-being already known to influence health status and well-being in adolescents [22, 41]. The true novelty of the AVATAR project is to consider all these variables in an interactive and integrated model providing us the opportunity to assess the weight of each variable in relation to the others for the definition of the individual health profile. Moreover, this framework that looks at the adolescent in a large perspective has the potential to personalize interventions in order to potentiate the strong points and change or improve the weak ones. The four main areas are the following: lifestyle habits, emotional status, social context, and cognitive abilities. Each area includes single variables listed in Fig. 16.3.

This study is focused on healthy adolescent subjects (age 9–14 years); in this period of life, epidemiological data show that behavioral risk factors might not affect health status in this period, but they can have crucial effects later in life, predisposing to chronic degenerative disease [42]. This highlights the importance to develop preventive approaches and strategies contributing to maintain or improve health status and therefore reducing predisposition to chronic degenerative diseases in adulthood [43]. Moreover, it is actually supported by healthy policies the need of preventive interventions in healthy adolescent population before it is too late [22]. In this context, strengthening self-esteem, resilience, and awareness of each adolescent can result in improvement in well-being that, in turn, has been related to high mental, physical health, and education attainment [43, 44]. Accordingly, prevention strategies, in particular the primordial prevention, have the goal not only to reduce

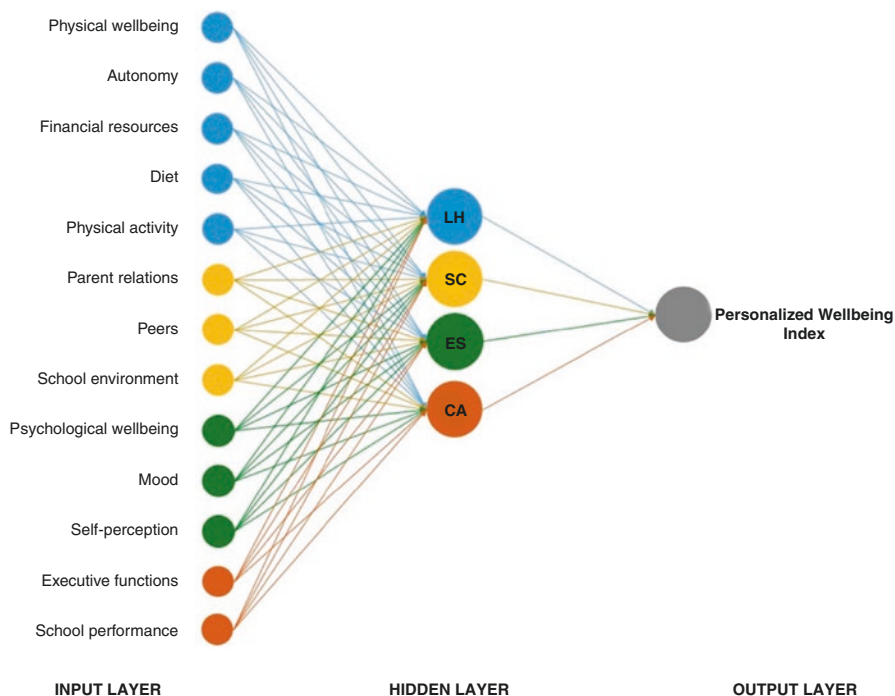


Fig. 16.3 A conceptual framework to define a personalized well-being index. *LH* lifestyle habits, *SC* social context, *ES* emotional status, *CA* cognitive abilities

lifestyle risk behaviors but also to improve sociability, which are all determinants of positive health status, and thus, higher quality of life [45].

Moreover, in the AVATAR project, there is a deep intersection between research and practical application of the results obtained. This is due to strict collaboration between research and scholastic institutions. To this goal, the schools that joined the projects are organized in a network, RETE ULISSE, *Scuole insieme per la ricerca scientifica e l'innovazione didattica*. Accordingly, the school offers a sustained and efficient place to contact adolescence; it can be considered the optimal setting to apply and develop programs to promote health and well-being for its safety, cost-effectiveness, and flexibility [46]. Furthermore, in the school, the continuous relationship between students and teachers guarantees both trust and accessibility toward the programs of health and well-being promotion [47]. School-based health and well-being programs can be shared into two main clusters, that is, the universal and targeted interventions. The universal interventions are oriented toward a scholastic general population, that is, all the students of a school join the educational program, whereas targeted interventions are designed for specific groups of students who have been identified to need specific support or treatment due to existing illness, vulnerability, or risk factors. Importantly, the targeted programs were mainly focused on aggressive, disruptive, and antisocial behaviors [48,

49]. In this context, the meta-analysis of Bonel et al. showed the effectiveness of targeted programs in reducing alcohol use and violence in the school environment [50]. However, regarding the results of the various proposed interventions, there are contrasting data in the literature. A recent meta-analysis of O'Connor et al., focused on the universal school-based intervention to promote health and well-being, showed positive effects on areas as coping skills, help-seeking skills, social skills, emotional regulation, and reduction of symptoms associated with low level of depression and anxiety [51]. Instead, a meta-analysis promoted by the World Health Organization's Health Promoting Schools (WHO-HPS) framework showed modest positive intervention effects on average in reducing body mass index, smoking and incidence of being bullied, and increasing physical activity, fitness, and fruit and vegetable intake [52]. It is very likely that the discordance of these data may depend on the large heterogeneity of the studies analyzed, in terms of type of intervention, duration of intervention, study population characteristics, and type of outcome considered. Furthermore, a clue issue is the skill and knowledge in the context of the health and well-being programs of the educational professionals and all other school staff. Accordingly, it is fundamental to have a multiagency working and an efficient link between education and healthcare professions in order to provide a greater chance of get efficient the health and well-being programs in the schools [52].

Moreover, the new era of computer technology, actually pervasive in healthcare and Web tools, highly flexible and adaptable in its potential applications, provides the opportunity to gather data in a fast, cheap, and low time-consuming way, favoring also the possibility to integrate the information with each other [53]. The development of AVATAR multimedia platform represents a powerful tool for the promotion of health and well-being in which a network of different stakeholders dedicated to the adolescence education may cooperate together to increase awareness, change behavior, and create environments that support good health practices also in a healthy adolescent population. This may favor the connections among all the institutional departments responsible for health and education that often operate in isolation from one another. The WHO-HPS framework explicitly suggests to break-down this institutional isolation, highlighting the need of the interinstitutional cooperation that could allow the educational health and well-being policy oriented to adolescents to achieve its potential.

16.5 AVATAR Aims

The general and main aim of the AVATAR project is to improve health status and well-being of adolescents through personalized interventions aimed to strengthen the power items and to change or improve the fragile items of adolescents defined in the personalized index of well-being. The improvement of health status and well-being has positive effects in the context of primordial prevention of the

chronic degenerative diseases. The American Heart Association statement on primordial prevention highlights the need to develop a framework for a comprehensive healthy strategy to prevent cardiovascular diseases that are the main causes, among the chronic degenerative diseases, of morbidity and mortality in the Western countries. This framework includes preventive intervention strategies to improve psychosocial and environmental conditions having potential health implications through the development of a network of different institutional, political, and social stakeholders of health [54, 55]. In this context, the object of the AVATAR project is to facilitate the development of a network among the institutional stakeholders of health to promote health preventive strategies and policies focused on the epidemiological and objective data on adolescent well-being and health.

16.6 AVATAR Methodology

At the base of the AVATAR project, there is the development of a web platform able (1) to collect data from the students, (2) to store these data, and (3) to provide automatically the results to the institutional stakeholders, teachers, and school directors, as well as to the parents. In addition, these data can be used for research studies, in the clinical and epidemiological fields, also in order to create preventive and personalized strategies [56].

The Web-tool platform offers:

- A framework for acquiring data over time;
- A multimodal data processing module, with dedicated algorithms which extract a number of variables correlated with health status;
- A data fusion and synthesis module, to define an integrated and personalized Well-being Index. The index of the health status and well-being of an adolescent will be traced over time, thus enabling users to relate the adolescent profile to their well-being; and
- A personalized user guidance module, which acts as a kind of well-being navigator to support users in the achievement and maintenance of a correct health status and well-being.

AVATAR Web-platform provides the collection of sociodemographic data on gender, age, schooling, family structure, and body mass index, according to WHO age group [57]. KIDSCREEN-52 questionnaire is used to assess health-related quality-of-life variables [58, 59]. The KIDSCREEN is a self-report questionnaire designed to address health-related quality of life, aimed to monitor and measure the personal experiences in children and adolescent about their perception of health status and well-being. The questionnaire, that describes physical, psychological, mental, social, and functional aspects of well-being, consists of 52 items

grouped in 10 dimensions [58, 59]. Also, physical activity and dietary intake food frequency per week (e.g., meat, vegetables, and fish) are considered. The cognitive processing is evaluated with the Stroop Color and Word Test Children's Version [60]. The school engagement is estimated through questions concerning the scholastic achievement in Language & Literature, Language acquisition, Science.

Two statistical methods are developed: (1) Cluster analysis, to classify a sample of adolescents (based on a set of measured variables) into a number of different groups; (2) Structural Equation Models (SEMs), to define a personalized well-being index (PWBI), and to determine how each of the variables considered (well-being determinants assessed by means of questionnaire) represents and contributes to the underlying latent construct of the index (Fig. 16.3). For each adolescent, the contribution (weight) of the single variable in the measurement of the underlying latent constructs (lifestyle habits: nutrition, physical activity, sleep, etc.) is calculated. The chance to identify the different behaviors in adolescents with the same score in the various latent variables (low, intermediate, and high level) provides to calibrate personalized interventions aimed to promote well-being.

16.7 AVATAR Innovation

The major innovations of this Web-tool well-being assessment and promotion are the simplicity and usability data acquisition that is as comprehensive in terms of both well-known and less-known well-being indicators, including psychosocial and behavioral dimensions. The use of this multifactorial approach allows the three levels of stakeholders (students, teachers, and parents) to automatically retrieve from the database data on adolescents' well-being. Teachers can directly visualize the groups (clusters) of students with similar profiles based on combined approach obtained from lifestyle habits, social context, mental skills, and emotional status data, and the integrated personalized index of well-being of each teenager in the class. Parents can visualize the integrated personalized index of well-being of own child. Also, adolescents can visualize directly the own integrated personalized index of well-being.

The Web-tool is highly flexible and adaptable in its potential applications. This helps teachers to select more appropriately personalized interventions and educational programs for individual students and for the students of a classroom and, thus, monitor their compliance and effectiveness, by producing graphical trends of single student or class over time. In addition, the platform can be considered a data repository tool for epidemiological studies to archive reliable and comparable data of adolescents' well-being determinants.

Finally, the development of the Web platform represents a powerful tool for the promotion of health and well-being in which a network of different stakeholders dedicated to the adolescence education may cooperate together to increase awareness, change behavior, and create environments that support good health practices (Fig. 16.4).

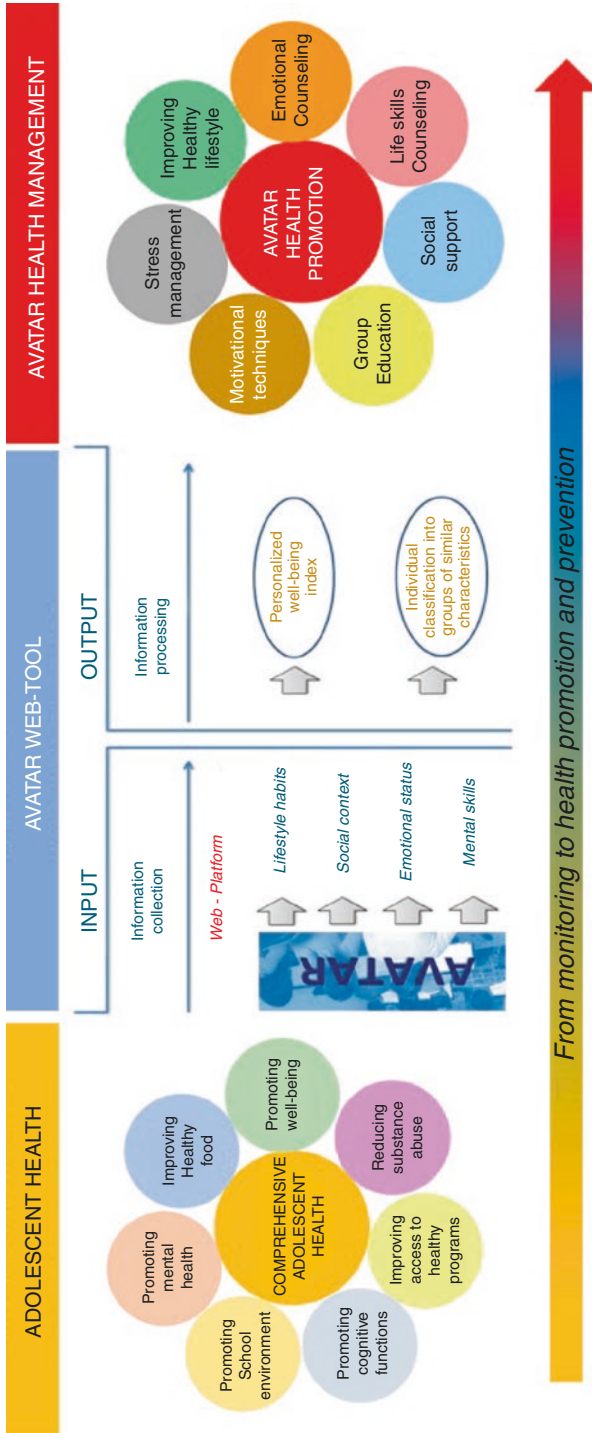


Fig. 16.4 AVATAR innovation

16.8 AVATAR Preliminary Results

In the pilot study, the AVATAR Web tool was found to be useful and user-friendly by the adolescents, teachers, and parents [56]. Interestingly, adolescents provided interest and attention in receiving follow-up information about their own health status and well-being, opportunities to define goals, and track well-being index during time. This suggests that adolescents may envision an active role in health and well-being behavior change, thanks to the possibility to self-regulate unhealthy behaviors.

Moreover, preliminary unpublished data gained from 756 adolescents showed that (1) among the variables of each domain (lifestyle habits, social context, emotional status, and cognitive abilities), autonomy, parental relation, mood, and scholastic achievement were the more relevant items; and (2) when we assessed the relationship among the main domains, the higher association was between lifestyle habits and social context and between social context and emotional status.

When we assessed gender differences, males perceived higher autonomy to create social and leisure time, whereas females had higher levels in school environment dimension. However, when we considered gender differences with respect to the menarche condition, psychosocial setting in males and females significantly changed, in line with previous results showing that the switch in emotional/mood responses usually emerge in this period of age [61]. Indeed, post-menarcheal females revealed more negative perception in psychological well-being, mood, and self-esteem as well as reduced school relationship in comparison to female without menarche. Therefore, post-menarcheal condition is associated to psychosocial and emotional changes, with possible multiple pathways to postpubertal mood symptoms.

16.9 Conclusion

Adolescence is a period of enormous changes in all settings of life, including physical, psychological, hormonal, cognitive, and emotional ones.

Adolescence is characterized by paradoxes. It is considered the healthiest period of the lifespan with respect to the most measurable parameters of physical health in which the healthy adolescent brain has a considerable capacity for resilience, based on its ability to respond to interventions designed to open “windows of plasticity” and redirect its function toward better health.

At the same time, it is recognized as a developmental period marked by surges in overall morbidity and mortality. Moreover, many types of behavioral and educational interventions appear to be relatively ineffective during adolescence, leading some to think that this is the worst period to try promotion and prevention strategies.

Adolescents' behaviors are influenced at the individual, peer, family, school, community, and societal levels, suggesting an increased focus on leveraging these

influences by use of positive youth development interventions that support adolescents to become healthy adults.

The educational programs should be focused to identify the strength and the fragile characteristics of each adolescent in order to potentiate the first ones and to change or improve the others. This needs the knowledge of the individual sides of the adolescent and how the single sides talk to each other. This provides the opportunity to create dedicated and personalized interventions that help adolescent increasing her/his awareness, resilience, and thus subjective well-being. Adolescent health promotion, according to WHO definition of health, is a key component of public health, school health programs, and preventive medicine in view of the primordial prevention to reduce chronic degenerative disease later in life. Although this commitment to the health of adolescents has achieved some progress, there remains a need for more innovative action.

In this context, the message may be to care well-being in adolescence to reduce incidence of chronic degenerative diseases in adulthood.

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