

Chapter 1

Why Obesity in Parents Matters

Mark Hanson

Abstract Promoting the best possible environment for early human development offers one of the greatest missed opportunities today for improving global health, human productivity and longevity. Overweight and obesity in parents and parents-to-be are not only associated with poorer health prospects for this section of the population in the future, but also pass the risk of overweight and obesity to their children. This calls for a new initiative to improve the health of current and prospective parents, commencing with adolescent girls and women of reproductive age, but also their partners.

Keywords Obesity • Parents • Generations • Public health • Education • Childhood • Diabetes • Cardiovascular

1.1 The Challenge

Non-communicable diseases (NCDs), including diabetes, cardiovascular and lung disease, some forms of cancer, mental illness, musculoskeletal disorders and some atopic and allergic conditions now account for almost two-thirds of deaths worldwide and a substantial burden of morbidity. WHO figures show that 38 million people die from NCDs each year, 28 million of these deaths occurring in low-middle income countries [1]. NCDs incur enormous costs in health care, which are challenging even in high-income countries. For example, the McKinsey Global Institute estimates that reversing the rising prevalence of the major NCD risk factor obesity in the UK could save the NHS \$1.2 billion/year [2]. The scale of the economic costs is unsustainable, especially in low-middle income countries. NCDs not only cause deaths and shorten lifespan but they can also impair neurocognitive development [3, 4] reducing productivity and well-being. Hence,

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apart from direct health-care costs, there will be significant economic benefits from reducing the burden of NCDs in all countries.

Until recently, it was widely believed that risk of NCDs in individuals was a combination of fixed inherited genetic risk factors and an unhealthy lifestyle in adulthood. However, genome-wide association studies have not found genetic variants which account for a substantial fraction of risk at the population level (e.g. [5]), and whilst overweight and obesity were estimated to produce 3.8 m deaths globally in 2010, there are as yet no successful national campaigns for tackling the problem [6]. The challenge is to find a new approach.

Overweight and obesity are important and very widely known risk factors for NCDs [1] and so emphasis on preventing them makes much sense. The problem is often thought to commence in childhood, as obesity in children has long-term effects on a wide range of organ systems [7]. The problem of childhood obesity in both high and low-middle income countries led to the establishment in 2014 of a Commission on Ending Childhood Obesity by Dr Margaret Chan, the Director-General of the World Health Organization [8], which will report in early 2016. Obese children have long been known to be more likely to become obese adults [9], and globally, 1.9 billion adults aged 18 years and older were overweight or obese in 2014 [10].

Turning to parental effects, in England in 2013 for example, 48 % of women of reproductive age were overweight or obese [11]. Being overweight or obese will affect their health and increase the risk of complications during pregnancy and delivery [12]. Even more important is the fact that obese women tend to have obese children and maternal obesity is a major factor in the preconceptional and fetal or infant origins of later risk of NCDs in the offspring [13]. This volume attests to the considerable concern about the effects of obesity in parents on their children, especially in mothers, but there is increasing evidence for an increased risk of obesity in children with two obese parents [14, 15] and there is accumulating experimental evidence for a role of paternal effects in transmission across generations [16].

Meeting the challenge posed by obesity in parents also has important social and equity implications, because it is particularly of concern in women with low educational attainment or socio-economic status [17], and in some ethnic and migrant groups [17, 18]. Obesity and the resulting increased risk of NCDs can perpetuate or even widen social inequalities in health [19] adding another level of urgency to finding a new solution to the problem.

The major focus of this chapter is on the biological rather than the social processes by which parental obesity affects the next generation. The distinction between the two is somewhat artificial and should not be taken to imply that aspects of parental behaviour, the family environment, etc., do not play a role in inducing obesity in children and adolescents, or are not areas where potential interventions could have major effects (see for example [20]). There have been some very hopeful initiatives in this respect such as the Family–Nurse Partnership [21] and the Abecedarian project [22] in which wider social considerations about family life and child education have been shown to improve long-term health outcomes including obesity.

1.2 New Insights into the Importance of Healthy Early Development

New research in the field of developmental origins of health and disease (DOHaD) has focused attention on the processes of developmental plasticity, operating during critical periods of early human life to affect growth and development of tissues, organs and physiological control systems [13, 23]. The critical periods of development commence in the early embryo [24], sometimes before the woman knows that she has conceived, and continue through pregnancy [25, 26], infancy and childhood and into adolescence [27]. During these periods the developing individual responds to aspects of their environment, via the mother and placenta before birth, and via breast milk and parental behaviours after birth. Signals relating to maternal nutrition, body composition, physical activity, stress, behaviour and exposure to chemicals and toxins can set the level of the developing individual's responses to later challenges such as living in today's highly obesogenic, increasingly urban, environment [28]. In this way, the effects of unhealthy lifestyle are passed from one generation to the next and can be amplified. This amplification is greater when there is a mismatch between the developmental and adult environments, as happens for example with nutritional and other lifestyle transitions in countries undergoing socio-economic transitions and in migrant groups [29]. These new concepts are fundamental to understanding the growing challenge of NCDs worldwide. They also offer opportunities for promoting future health for the current and future generations at several points in the human reproductive cycle (Fig. 1.1). However, once a critical period has passed intervention is much more difficult, becoming less effective and potentially more expensive. This is one of the reasons why current approaches to reducing the incidence of NCDs in adults may not be achieving the results needed. One of the most important phases in which to prevent and reduce overweight and obesity is during adolescence and the reproductive years, as this will not only promote the health of the woman but also that of her child(ren).

1.3 Obesity in Adolescents and Young People

Apart from the longer-term effects of obesity in increasing the risk of NCDs referred to above, there are a range of short- to medium-term implications which apply specifically to women of reproductive age and to a lesser extent to their partners. These are perhaps not sufficiently emphasised as they could help increase motivation to adopt healthier behaviours. Obesity in women is associated with reduced fertility rates and greater risk of early miscarriage [30] and to reduced sperm counts and morphological abnormalities [31]. The early embryos of obese mothers already show signs of abnormal development and metabolism [32]. Obesity in pregnancy is associated with increased risk of gestational diabetes [33] which, if poorly controlled, can result in the perinatal complications of fetal

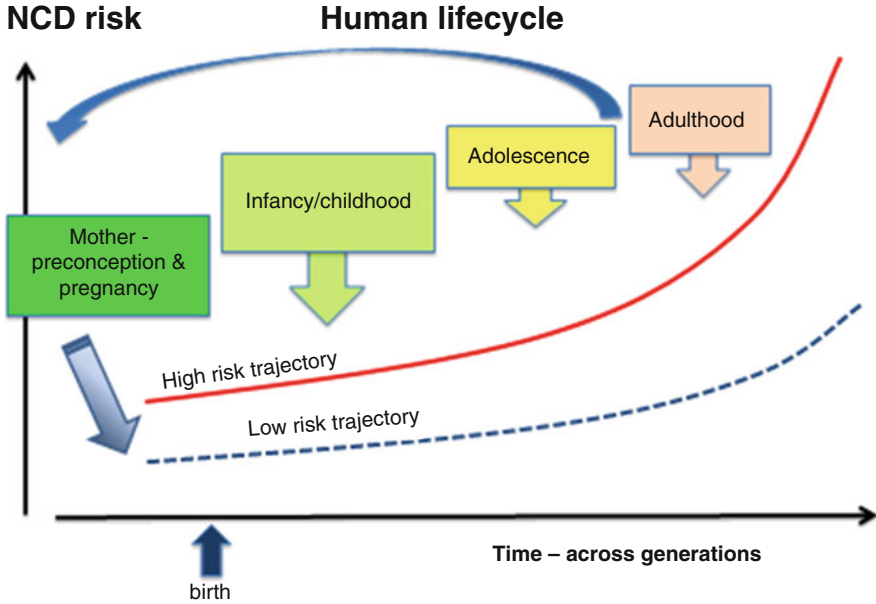


Fig. 1.1 Life-course view of NCD risk. Risk of NCDs increases in a non-linear way throughout life, starting before birth. The trajectory of risk can be affected by interventions at various times, although establishment of a low-risk trajectory must be early in the life course, especially preconception and in pregnancy (broad *blue arrow* on left). Risk reduction in adolescents or young adults can not only affect their later health but, as they are future parents, reduce inherited risk in their children (human life cycle *arrow*)

macrosomia, shoulder dystocia, obstructed labour and neonatal hyperinsulinaemic hypoglycaemia [34]. The specific role of pre-pregnancy weight and weight gain in pregnancy in these conditions [35], related to ethnicity [36], may offer new avenues for intervention. Maternal hyperglycaemia is also associated with higher incidence of a range of congenital abnormalities in the baby [37].

It is estimated that there are 1.8 billion people aged 10–24 years in the world today, comprising about one-quarter of the total global population. In some countries, especially in sub-Saharan Africa, they represent an even higher proportion of the population. Adolescence is a time in life when many behaviour patterns become established and is a time when interventions might reverse the effects of earlier poor development [38]. Many adolescent people are overweight or obese (e.g. for England see [39]) and have markers of cardiovascular risk, including elevated blood pressure and lipid or insulin/glucose levels [40]. A high proportion of adolescents and young women and men have an unhealthy lifestyle, with poor diet, low levels of physical activity, smoking, excessive alcohol consumption and use of recreational drugs [41–43]. These lifestyles will have adverse later health implications for the individuals, but will also have repercussions on the development and health of their future unborn children, giving the next generation a poor start to life. Access to health care is fragmentary in this section of the population,

even in high-income countries. Adolescents frequently defer, or discount, any action to improve their health until the future [44, 45] and for those adults with lower educational attainment and socio-economic status poor health can become self-fulfilling prophecy [46].

For those women who become pregnant, contact with health-care services often does not occur until late in the first trimester, by which time the pregnancy is well established and it is too late for modification of risk factors which affect embryonic development. In most high-income countries, prospective parents do not prepare for pregnancy [47]; this is even more true of many low-middle income countries. In the UK, however, it is suggested that more than two-thirds of pregnancies are in fact planned to some degree, at least in the sense that contraception has not been routinely used [48].

1.4 Meeting the Challenge

Most societies do not have in place coordinated schemes to promote the health of adolescents and young people, in particular before conception [49], as this is assumed to be part of routine public health primary care, which is not always the case [50]. This is an important missed opportunity to prepare for pregnancy, to promote healthy pregnancy and to ensure healthy outcomes [51, 52].

Formal educational programmes delivered through schools have only had small effects on, for example, levels of obesity and risky behaviours, and it appears that integration of such programmes more widely into the community and involving parents will improve success [53–55]. New integrated pedagogical approaches are necessary to promote health literacy, for example through linking schools and health researchers through out-of-classroom activities which incorporate continuing professional development for science teachers, hands-on exposure to research methods and ‘meet the scientist’ encounters for school age students [56].

There are three interrelated policy implications in addressing the challenge of parental obesity, which need to be considered simultaneously, both in terms of their implementation and their assessment (Fig. 1.2). While concern about the impact of parental obesity is a global issue, these components will have to be implemented at the level of national and local governments, in order to make them culturally specific. They are:

- (a) *Profile and priority.* Make the health of adolescents and young women and their partners a national priority, on a par with events and movements which promote an image of vital, active collective life, e.g. the Olympic Games. This requires establishment of national organisations with professional representation from health, education, communities and local governments, media, sport and the private sector.
- (b) *Create demand* by investing in health literacy promotion through education programmes in schools linked to community-based initiatives involving a range

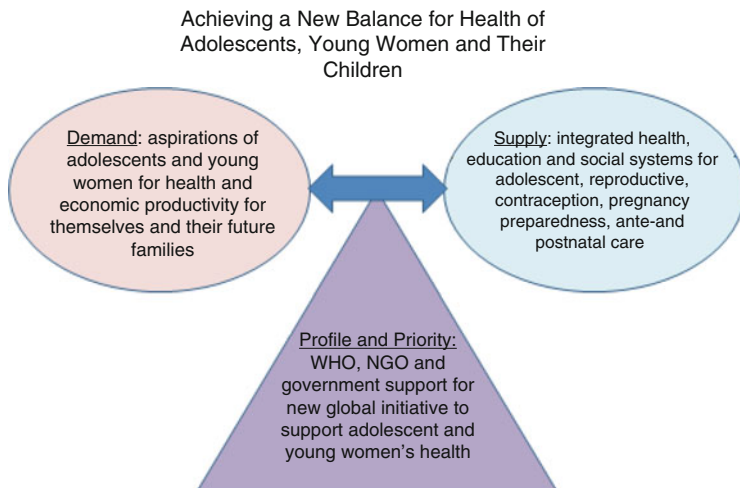


Fig. 1.2 Achieving a new balance for health of adolescents, young women and their children. Promoting health at this time in the life course requires a balance between the supply of health, education and social care services and the demand for such provision based on appreciation of their importance for health and prosperity. This balance needs to be supported through the profile and priority given to it by a range of government and other organisations

of organisations and sponsors. This investment is predicated on the projected return through reduced health care and other costs of reducing parental and childhood obesity, adverse pregnancy outcomes and early markers of NCD risk.

- (c) *Supply*. Establish integrated systems for the provision of health care to adolescents and women before conception, throughout pregnancy and delivery and after birth, linked to family planning and sexual health services, primary care and wider community organisations.

1.5 Conclusion

The challenge posed by parental obesity, and obesity in parents-to-be, requires urgent action, because such obesity does not augur well for the health of these adolescents and young adults in the future. As this section of the population have a substantial proportion of their lives ahead of them, the costs of NCDs in terms of their well-being, productivity and longevity as well as the direct health-care costs will be very hard to meet, even in high-income countries. Worse, such ill health passes the risk of overweight and obesity to their children by a range of mechanisms. There is a need to establish a new approach to meeting this challenge, in terms of raising the profile and priority accorded to the issue at the level of national and local governments and in conjunction with organisations such as WHO; creating awareness of the problem and a desire to address it among young people, especially adolescents; and providing an integrated health-care delivery system

linked to education and wider community initiatives to ensure that parents do not miss the opportunity for health promotion at a time in their lives which is critical for them and their children.

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References

1. Alwan A (2011) Global status report on noncommunicable diseases 2010. World Health Organization, Geneva
2. McKinsey Institute (2014) Overcoming obesity: an initial economic analysis. McKinsey Institute, Washington, DC
3. Barkin SL (2013) The relationship between executive function and obesity in children and adolescents: a systematic literature review. *J Obes* 2013
4. Yau PL et al (2012) Obesity and metabolic syndrome and functional and structural brain impairments in adolescence. *Pediatrics* 130:e856–e864
5. T2D Morris AP et al (2012) Large-scale association analysis provides insights into the genetic architecture and pathophysiology of type 2 diabetes. *Nat Genet* 44: 981
6. Ng M et al (2014). Global, regional, and national prevalence of overweight and obesity in children and adults during 1980–2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet* 384(9945): 766–781
7. Han JC, Lawlor DA, Kimm SYS (2010) Childhood obesity. *Lancet* 375(9727):1737–1748
8. <http://www.who.int/end-childhood-obesity/en/>
9. Serdula MK et al (1993) Do obese children become obese adults? A review of the literature. *Prev Med* 22(2):167–177
10. WHO (2014) Childhood overweight and obesity. <http://www.who.int/dietphysicalactivity/childhood/en/>
11. The Health and Social Care Information Centre (2013) Health survey for England 2013. <http://www.hscic.gov.uk/catalogue/PUB16076/HSE2013-Ch10-Adult-anth-meas.pdf>. Website last accessed 5 Jul 2016
12. Sebire NJ et al (2001) Maternal obesity and pregnancy outcome: a study of 287,213 pregnancies in London. *Int J Obes Relat Metab Disord* 25(8):1175–1182
13. Hanson M, Gluckman P (2011) Developmental origins of noncommunicable disease: population and public health implications. *Am J Clin Nutr* 94:1754S–1758S
14. Lake JK, Power C, Cole TJ (1997) Child to adult body mass index in the 1958 British birth cohort: associations with parental obesity. *Arch Dis Child* 77(5):376–380
15. Whitaker KL et al (2010) Comparing maternal and paternal intergenerational transmission of obesity risk in a large population-based sample. *Am J Clin Nutr* 91(6):1560–1567
16. Hughes V (2014) Epigenetics: the sins of the father. *Nature* 507:22–24
17. Nishino Y, Gilmour S, Shibuya K (2015) Inequality in diabetes-related hospital admissions in England by socioeconomic deprivation and ethnicity: facility-based cross-sectional analysis. *PLoS One* 10:e0116689
18. McLennan AK, Jayaweera H (2014) Non-communicable diseases and risk factors in migrants from South Asian countries. COMPAS, University of Oxford, Oxford
19. Di Cesare M et al (2013) Inequalities in non-communicable diseases and effective responses. *Lancet* 381:585–597
20. Faith MS et al (2012) Evaluating parents and adult caregivers as “agents of change” for treating obese children: evidence for parent behavior change strategies and research gaps a scientific statement from the American Heart Association. *Circulation* 125(9):1186–1207

21. Owen-Jones E et al (2013) The effectiveness and cost-effectiveness of the Family Nurse Partnership home visiting programme for first time teenage mothers in England: a protocol for the Building Blocks randomised controlled trial. *BMC Pediatr* 13:114
22. Campbell F et al (2014) Early childhood investments substantially boost adult health. *Science* 343(6178):1478–1485
23. Hanson MA, Gluckman PD (2014) Early developmental conditioning of later health and disease: physiology or pathophysiology? *Physiol Rev* 94(4):1027–1076
24. Fleming TP et al (2015) Do little embryos make big decisions? How maternal dietary protein restriction can permanently change an embryo's potential, affecting adult health. *Reprod Fertil Dev* 27(4):684–692
25. Kapur A (2015) Links between maternal health and NCDs. *Best Pract Res Clin Obstet Gynaecol* 29:32–42
26. Murray R, Godfrey KM, Lillycrop KA (2015) The early life origins of cardiovascular disease. *Curr Cardiovasc Risk Rep* 9:1–8
27. Todd AS et al (2015) Overweight and obese adolescent girls: the importance of promoting sensible eating and activity behaviors from the start of the adolescent period. *Int J Environ Res Public Health* 12(2):2306–2329
28. Gluckman PD, Hanson MA (2012) *Fat, fate and disease*. Oxford University Press, Oxford
29. Gluckman PD, Hanson MA (2006) *Mismatch—why our world no longer fits our bodies*. Oxford University Press, Oxford
30. Chappell LC et al (2013) Exploration and confirmation of factors associated with uncomplicated pregnancy in nulliparous women: prospective cohort study. *BMJ* 347:f6398
31. Sermondade N et al (2012) Obesity and increased risk for oligozoospermia and azoospermia. *Arch Intern Med* 172(5):440–442
32. Leary C, Leese HJ, Sturmev RG (2015) Human embryos from overweight and obese women display phenotypic and metabolic abnormalities. *Hum Reprod* 30:122–132
33. Wendland EM et al (2012) Gestational diabetes and pregnancy outcomes—a systematic review of the World Health Organization (WHO) and the International Association of Diabetes in Pregnancy Study Groups (IADPSG) diagnostic criteria. *BMC Pregnancy Childbirth* 12(1):23
34. Alberico S et al (2014) The role of gestational diabetes, pre-pregnancy body mass index and gestational weight gain on the risk of newborn macrosomia: results from a prospective multicentre study. *BMC Pregnancy Childbirth* 14(1):23
35. Black MH et al (2013) The relative contribution of pre-pregnancy overweight and obesity, gestational weight gain, and IADPSG-defined gestational diabetes mellitus to fetal overgrowth. *Diabetes Care* 36(1):56–62
36. Bowers K et al (2013) Gestational diabetes, pre-pregnancy obesity and pregnancy weight gain in relation to excess fetal growth: variations by race/ethnicity. *Diabetologia* 56(6):1263–1271
37. Ornoy A et al (2015) Effect of maternal diabetes on the embryo, fetus, and children: congenital anomalies, genetic and epigenetic changes and developmental outcomes. *Birth Defects Res C Embryo Today* 105(1):53–72
38. Dick B, Ferguson BJ (2015) Health for the world's adolescents: a second chance in the second decade. *J Adolesc Health* 56(1):3–6
39. HSCIC. Health survey for England—2013. Trend tables <http://www.hscic.gov.uk/catalogue/PUB16077>
40. Graves L et al (2014) Waist-to-height ratio and cardiometabolic risk factors in adolescence: findings from a prospective birth cohort. *Pediatr Obes* 9:327–3384
41. Leech RM, McNaughton SA, Timperio A (2014) The clustering of diet, physical activity and sedentary behavior in children and adolescents: a review. *Int J Behav Nutr Phys Act* 11:4
42. Monti PM, Colby SM, O'Leary TA (eds) (2012) *Adolescents, alcohol, and substance abuse: reaching teens through brief interventions*. Guilford Press, New York
43. Huang GC et al (2014). Peer influences: the impact of online and offline friendship networks on adolescent smoking and alcohol use. *J Adolesc Health* 54(5): 508–514

44. Brown SL, Teufel JA, Birch DA (2007) Early adolescents perceptions of health and health literacy. *J Sch Health* 77:7–15
45. Kulendran M et al (2013) Inhibitory control and perception of the future health in obese adolescents and normal weight adolescents. *Lancet* 382:S55
46. Pepper GV, Nettle D (2014) Perceived extrinsic mortality risk and reported effort in looking after health. *Hum Nat* 25(3):378–392
47. Inskip HM et al (2009) Women’s compliance with nutrition and lifestyle recommendations before pregnancy: general population cohort study. *BMJ* 338:b481
48. Stephenson J et al (2014) How do women prepare for pregnancy? Preconception experiences of women attending antenatal services and views of health professionals. *PLoS One* 9:e103085
49. Shawe J et al (2015) Preconception care policy, guidelines, recommendations and services across six European countries: Belgium (Flanders), Denmark, Italy, the Netherlands, Sweden and the United Kingdom. *Eur J Contracept Reprod Health Care* 20(2):77–87
50. Atrash HK et al (2006) Preconception care for improving perinatal outcomes: the time to act. *Matern Child Health J* 10(1):3–11
51. Jack BW, Culpepper L (1990) Preconception care: risk reduction and health promotion in preparation for pregnancy. *JAMA* 264(9):1147–1149
52. Johnson K et al (2006) Recommendations to improve preconception health and health care—United States. *Morb Mortal Wkly Rep* 55(4):1–23
53. Langford R et al (2015) Obesity prevention and the Health promoting Schools framework: essential components and barriers to success. *Int J Behav Nutr Phys Act* 12(1):15
54. Waters E et al (2014) Interventions for preventing obesity in children. *Sao Paulo Med J* 132(2):128–129
55. Agency for Healthcare Research and Quality (2013) Childhood obesity prevention programs: comparative effectiveness review and meta-analysis. *Comp Eff Rev* 115, publication no. 13-EHC081-EF
56. Grace M et al (2012) Developing teenagers’ views on their health and the health of their future children. *Health Educ* 112(6):543–559