

# Internet addiction, sleep and health-related life quality among obese individuals: a comparison study of the growing problems in adolescent health

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## Abstract

**Background** The rapid rise in the global prevalence of obesity suggests that environmental factors may be responsible. The increased use of technology is associated with increased rates of obesity due to declines in physical activity and significant sedentary life style. Internet addiction is also a growing health issue associated with diminished physical activity and poor sleep quality as well as various health problems. The purpose of this study was to determine associations between Internet addiction and adolescent obesity-related problems.

The original version of this article was revised: A sentence under the heading “Internet use” was incorrect, and the references 31 and 32 were wrongly swapped in the references list. These errors have been corrected.

This article is part of the topical collection on Sleep and Obesity.

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**Design and methods** In this case–control study, 71 adolescents with obesity were recruited from the outpatient clinic at Tepecik Teaching Hospital and Katip Celebi University Hospital, Department of Pediatric Endocrinology in Izmir, Turkey. The control group consisted of 64 non-obese adolescents that were matched with patients in the study group by age and gender. All subjects completed socio-demographic forms, an Internet addiction scale, the Pediatric Quality of Life Inventory, the Pittsburgh Sleep Quality Index, and the Epworth Sleepiness Scale.

**Results** Adolescents with obesity were significantly more likely to have Internet addiction ( $p = 0.002$ ), lower quality of life ( $p < 0.001$ ), and higher daytime sleepiness ( $p = 0.008$ ). Moreover, binary regression analysis showed that Internet addiction and less physical activity were associated with increased odds of obesity.

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**Conclusion** The results indicated a significant association between Internet addiction and obesity. Health practitioners should take possible Internet addiction, online activities, and physical activities into consideration in follow-up of obese adolescents. In addition to pharmacologic therapies and dietary interventions, providing behavioral therapy targeting healthy Internet use may be promising to reduce the effects of obesity in adolescence.

**Keywords** Obesity · Health-related quality of life · Physical activity · Sleepiness

## Introduction

Human beings have an inherent desire to connect with other people. We need direct social engagement to build emotional connectivity and empathize with others, which, in turn, lays the foundation for a fulfilling and balanced life [1]. In today's world, we are surrounded by electronic communication devices, which occupy much of the time that we might, otherwise, spend on individual communication activities that promote social empathy [2–5]. Indeed, many adolescents today tend to prefer social networking and games available on the Internet over direct interaction with others and activities that require physical activity [5–7]. The Internet is a practical source to get information and to communicate with others. However, excessive or uncontrolled use of the Internet may also have an adverse effect on our daily activities, emotional regulation, and communication abilities [8–10]. Loss of control over the use of the Internet has been termed excessive Internet use, pathological Internet use, and problematic Internet use [10–12]. Another term that is used to refer this condition is Internet addiction, with reference to similarities between this other behavioral addictions [13]. This is a clinical situation which is generally under identified, and yet can cause social and medical problems [14]. There are serious health problems associated with Internet addiction, the most extreme of which is sudden death as reported among individuals playing online games for multiple consecutive days [15]. A more common health concern is adoption of a sedentary lifestyle, which, in turn, increases the risk for obesity. Individuals with Internet addiction spend a large part of their time sitting at their computer or device in an immobile position. Therefore, it seems likely that impaired control of body weight and subsequent obesity could develop in these individuals over time [16–18]. Moreover, obese adolescents are at serious risk for social and psychological problems [19, 20].

Obesity among children and adolescents is a growing public health problem with an already high prevalence [21]. In addition, it has tripled in for adolescent ages during the past three decades [22, 23]. Obese and overweight

children may suffer not only during childhood and adolescence, but also throughout their adult lives. Obese individuals are more likely to be unhealthy, unhappy, and absent from school than their healthy-weight peers [24]. Given the wide recognition of the potential for Internet *misuse* and the worldwide obesity epidemic, a related question is whether Internet *addiction* is related to obesity. Short sleep duration and poor sleep continuity were associated with higher levels of eating behaviors shown to be associated with increased food intake [25]. An association between eveningness and addicted Internet use has been shown [26]. Excessive Internet use and extended period of screen time may cause sedentarism, which refers to decreased energy expenditure or, simply, physical inactivity [27–29]. However, current data about adolescent obesity have not been correlated with the increasing rates of Internet use by adolescents [29]. This study aims to:

1. characterize the Internet usage patterns of obese adolescents;
2. compare Internet addiction severity between obese adolescents and non-obese adolescents;
3. determine physical activities, physical and psychosocial health, sleep quality, and daytime sleepiness among obese adolescents;
4. assess the relationship between Internet use and addiction, and obesity among adolescents.

## Materials and methods

### Study design and population studied

In these cross-sectional and case–control studies, adolescents between the ages of 13 and 18 were recruited from a hospital-based specialty clinic and outpatient clinics in Izmir, Turkey. The case group consisted of adolescents who presented to the Pediatric Endocrinology Clinic with a chief complaint of obesity from April 2015 to January 2016. The control group consisted of adolescents who visited Pediatric Outpatient Clinics for routine well care. Participants with a chronic disease diagnosis (hypothyroidism, Cushing syndrome, growth hormone deficiency, etc.) were excluded from the study.

### Data collection instruments

#### Socio-demographic information, activities, and BMI

Data regarding the participants' age, sex, frequency of exercise, peer activities outside school, and self-reported household income were collected. The frequency of exercise was determined by reported frequency of at least 30 min of

daily exercise in the last 1-week period. BMI was calculated by dividing each individual's body weight by the square of his or her height ( $\text{kg}/\text{m}^2$ ). Patients with a BMI greater than the 95th percentile were categorized as obese [30].

### Internet use

Participants completed a survey which was developed for another study evaluating Internet access, device use, Internet and other media usage time, and Internet usage types [31].

#### *Internet access*

Participants were asked where they access the Internet, with options to choose any of the following: home, school, Internet cafe, smart phone, neighbor's Wi-Fi access, Internet connection from a friend's phone (i.e., "personal hotspot"), or free public Wi-Fi.

#### *Device use*

Participants were asked what devices they used to access the Internet, including computers, tablets, or smartphones.

#### *Internet usage time*

Participants were asked to quantify the amount of time spent using the Internet and watching TV on a typical weekday ("normal school day") and during weekend days. Usage hours for school days and weekends were weighted to calculate the number of daily average usage hours. The median response (5 h per day) was used to dichotomize the frequency of Internet into moderate internet use (<5 h daily) and heavier Internet use ( $\geq 5$  h daily) [32].

#### *Types of Internet usage*

Participants were asked to rate on a 6-point Likert-type scale the amount of time per week they used the Internet to do the following: listen to music, watch videos (including movies and shows), use social media (ex. Facebook, Instagram, Flickr, Foursquare), use instant messaging (ex. WhatsApp, Tango), read blogs, chat with other people, play online games, gamble, shop, download media (music/videos), do homework, read and send e-mail, and generally browse the Internet (12 items) [31]. Participants were also asked whether they made new friends online, and whether they had met these new friends in real life.

### Internet Addiction Scale (IAS)

The IAS was developed in Turkish by Gunuc and Kayri [33] and was evaluated in study of 752 Turkish adolescents

(Cronbach's  $\alpha = 0.94$ ). The scale consists of 35 5-point Likert scale questions, with responses from (1) strongly disagree to (5) strongly agree. The scale measures four subfactors: withdrawal, control difficulties, functional disruption, and social isolation. Total scores range from 35 to 175, with higher scores indicating greater problems associated with Internet usage, and with a cut-off value of 68.5 for Internet addiction.

### Pediatric Quality of Life Inventory for Children (PedsQL)

Measuring quality of life with various psychological tests is important for evaluating the efficacy of some medical interventions, and guiding health policies. The 23-item PedsQL Measurement Model uses a modular approach to measure health-related quality of life in children and adolescents with acute and chronic health conditions. Generic Core Scales measure the core dimensions of health as delineated by the World Health Organization, as well as role (school) functioning. The four multidimensional scales are Physical Functioning (8 items), Emotional Functioning (5 items), Social Functioning (5 items), and School Functioning (5 items). The three summary scores are: Total Scale Score (23 items), Physical Health Summary Score (8 items), and Psychosocial Health Summary Score (15 items). The reliability and validity of the Turkish version of PedsQL in adolescents have been studied by Memik et al. [34]. The internal consistency of this scale in our study was 0.82 using participants' self-report.

### Pittsburgh Sleep Quality Index (PSQI)

The PSQI is a self-reported psychometric and non-polysomnographic questionnaire, which assesses sleep quality and sleep disturbances over the prior month. It is composed of 19 items that are scored to determine seven component scores: sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleeping medication, and daytime dysfunction. The seven component scores are then summed to yield a global PSQI score, which has a range of 0–21; higher scores indicate worse sleep quality. A global score of 5 or higher indicates a "poor" sleeper [35]. The Turkish version of PSQI was developed by Agargun et al. [36], and the Cronbach's  $\alpha$  coefficient of the index was 0.80.

### Epworth Sleepiness Scale (ESS)

The ESS is a self-administered questionnaire with eight questions. It provides a measure of a person's general level of daytime sleepiness in daily life. It was adapted to Turkish by Izci et al. (Cronbach's  $\alpha = 0.86$ ) [37].

## Procedure

Adolescents were approached in the waiting rooms of the Pediatric Endocrinology and Pediatric Outpatient Clinics and invited to participate in the study. Informed consent was obtained from adolescents and parents before completing an anonymous, self-administered paper survey.

## Analysis

Statistical Package for Social Sciences Software (SPSS 21, Chicago, IL, USA) was used for the analysis. Chi-square tests were used to compare differences in gender, Internet usage time, Internet access, and device use measures between the groups. Independent sample Student's *t* test was used to compare the mean values of self-report test scores between groups. Statistical significance was regularly assigned to *p* values less than 0.05. However, since we had performed multiple orthogonal testing among Internet addiction test, PedsQL and PSQI, we needed to use Bonferroni correction when we interpret the test results. We calculated one total score and four subscale scores for Internet addiction test, one total score and six subscale scores for PedsQL, and one total score and six subscale scores for PSQI. To avoid any increase in type-I error, significance level was adjusted downward (in accordance with Bonferroni correction) to 0.05 divided by the number of multiple tests. Therefore, the significant levels for *p* values were set as  $0.05/5 = 0.01$  for Internet addiction test,  $0.05/7 = 0.007$  for PedsQL and  $0.05/7 = 0.007$  for PSQI. A binary logistic regression analysis was performed to determine the independent effect of Internet addiction, frequency of daily exercise, gender, ownership of a personal tablet, and sleepiness on obesity. Despite the insignificant result of gender in bivariate analysis, it was included due to the close examination of adolescent obesity studies, which reveal that gender differences are common, both before and during puberty [38, 39].

## Results

### Demographics

Seventy-one obese adolescents participated in the study, and sixty-four non-obese adolescents without any chronic medical diagnoses were enrolled as a control group. The members of both groups were predominantly from low income families, without significant income differences. Participants' age and gender were uniformly distributed (Table 1).

### Internet and media use

Most of the participants (87.7 %) had internet access at home. Obese adolescents had higher rates of excessive daily Internet use (57.7 % vs. 32.8 % among controls,  $p = 0.001$ ). There was no difference between the groups in hours of television watched ( $p = 0.656$ ). Obese adolescents were found to have higher usage of online games ( $p = 0.008$ ). There was no significant difference between the groups regarding other types of online activities. There was no difference between the groups with regard to having online friends ( $p = 0.054$ ). However, endorsement of meeting these online friends in person was significantly lower in the obese group ( $p < 0.001$ ). Obese adolescents were more likely to own a tablet device ( $p = 0.029$ ). However, there was no difference between the groups in ownership of other mobile devices.

### Internet addiction

In the obese group, 47.8 % ( $n = 34$ ) of participants met criteria for Internet addiction, compared to 21.8 % ( $n = 14$ ) of participants in the control group ( $p = 0.002$ ). Further details of these differences, including subfactors of the IAS, are shown in Table 1.

### Physical activity and life quality

Frequency of exercise in the week prior to the survey period was lower in the obese group compared to the controls (mean hours =  $1.05 \pm 0.93$  vs  $2.95 \pm 1.52$ ,  $p < 0.001$ ). In the evaluation of the health-related life quality subscales, physical, emotional, and school functionality scores were significantly lower among the obese adolescents. In addition to this, the three summary scores of quality of life (Physical Health Summary Score, Psychosocial Health Summary Score, and Total Scale Score) were lower in the study group (Table 1).

### Sleep

The total and subscale scores of PSQI were not significantly different in the obese group. In addition, daytime sleepiness scores from the ESS were higher in the obese group (Table 1). Regarding the specific items in the PSQI, we found that participants in the obese group were more likely to be late sleepers and to stay awake after midnight [ $n = 32$  (45 %),  $p = 0.021$ ].

Binary logistic regression analysis applied to the entire sample also showed that adolescents with Internet addiction were 3.295 times more likely to be obese compared to those without Internet addiction ( $p = 0.028$ ). Adolescents with Internet addiction as well as low exercise were 4.265

**Table 1** Socio-demographics, Internet addiction test, PedsQL, PSQI, and ESS scores of the participants

	Obese group ( <i>n</i> = 71)	Control group ( <i>n</i> = 64)	<i>p</i> value
<b>Socio-demographics</b>			
Age (mean years ± SD)	13.6 ± 1.8	13.9 ± 1.3	0.268**
<b>Gender</b>			
Girls ( <i>n</i> , %)	42 (59 %)	41 (64 %)	0.471*
Boys ( <i>n</i> , %)	29 (41 %)	23 (36 %)	
BMI, mean (SD)	31.2 ± 2.4	20.2 ± 1.1	<b>&lt;0.001**</b>
Household income	1394 ± 659.3 TL	1529 ± 605.3 TL	0.218**
Frequency of exercise/week	1.05 ± 0.93	2.95 ± 1.52	<b>&lt;0.001**</b>
Excessive Internet use	50 (57.7 %)	21 (32.8 %)	<b>0.001*</b>
Hours of television watched	4.11 ± 2.04	3.96 ± 1.62	0.656**
<b>Internet addiction test sub-factor scores</b>			
Withdrawal	28.23 ± 9.39	25.51 ± 11.22	0.127**
Controlling difficulty	23.18 ± 9.08	18.98 ± 9.53	<b>0.010**</b>
Disorder in functionality	15,86 ± 6,22	12,23 ± 5,38	<b>0.001**</b>
Social isolation	12.89 ± 6.20	11.34 ± 5.54	0.135**
Total score	72.58 ± 24.51	59.54 ± 22.11	<b>0.004**</b>
<b>PedsQL subscales</b>			
Physical functionality	12.43 ± 9.57	7.25 ± 3.92	<b>&lt;0.001**</b>
Emotional functionality	7.52 ± 6.34	4.62 ± 3.53	<b>0.002**</b>
Social functionality	3.86 ± 6.18	1.87 ± 3.08	0.022**
School functionality	8.53 ± 6.01	5.37 ± 3.10	<b>&lt;0.001**</b>
Physical health summary score	12.43 ± 9.57	7.25 ± 3.92	<b>&lt;0.001**</b>
Psychosocial health summary score	20.21 ± 17.82	11.87 ± 6.67	<b>0.001**</b>
Total PedsQL score	33.14 ± 26.85	18.67 ± 8.44	<b>&lt;0.001**</b>
<b>PSQI categories</b>			
Subjective sleep quality	1.07 ± 0.85	0.75 ± 0.42	0.036**
Sleep latency	2.11 ± 1.45	2.37 ± 1.39	0.313**
Sleep duration	1.07 ± 0.86	1.01 ± 0.93	0.720**
Habitual sleep efficiency	0.42 ± 0.32	0.37 ± 0.22	0.57**
Sleep disturbances	8.93 ± 4.42	8.25 ± 3.99	0.362**
Daytime dysfunction	1.80 ± 1.58	1.18 ± 0.92	0.018**
Global PSQI index	15.89 ± 6.90	14.5 ± 6.02	0.260**
Daytime sleepiness (ESS scores)	4.72 ± 3.39	3.22 ± 2.72	<b>0.021**</b>

The significant levels for *p* values were set as 0.05/5 = 0.01 for Internet addiction test, 0.05/7 = 0.007 for PedsQL and 0.05/7 = 0.007 for PSQI after Bonferroni correction

*PedsQL* Life Quality Inventory Scale, *PSQI* Pittsburgh Sleep Quality Index, *ESS* Epworth Sleepiness Scale

\* Chi square test, \*\* Independent sample *t* test, Significant *p* values were shown in bold

times more likely to be obese compared to those without Internet addiction ( $p < 0.001$ , respectively). No other measures were associated with increased likelihood of obesity (Table 2).

## Discussion

We found that obese adolescents have a higher rate of Internet addiction, poorer physical and psychosocial health, and more daytime sleepiness than non-obese adolescents.

In addition, binary logistic regression analysis highlighted that Internet addiction and low exercise were the only two factors to exert an independent effect on adolescent obesity. Most previous research studying the impact of the Internet on health is focused on comparing “addicted users” to “non-addicted users.” Our research provides further exploration of the factors associated with Internet addiction, including data about sleep and life quality specific to obese adolescents.

International studies have shown that, based on BMI tables, obesity is growing in prevalence among adolescents



**Table 2** Univariate and multivariate analysis: factors independently associated with obesity

	Univariate analysis				Multivariate analysis (all predictors entered) <sup>a</sup>				Multivariate analysis (predictors included using forward selection) <sup>b</sup>			
	Values	<i>p</i>	<i>B</i>	SE	Wald	<i>p</i>	OR (95 % CI)	<i>B</i>	SE	Wald	<i>p</i>	OR (95 % CI)
Doing exercise	8.64 <sup>a</sup>	<0.001**	-1.450	0.287	25.517	<0.001	0.234 (0.134–0.412)	-1.407	0.270	27.124	<0.001	0.245 (0.144–0.416)
Internet addiction	8.519 <sup>b</sup>	0.004*	1.192	0.543	4.826	0.028	3.295 (1.137–9.547)	1.354	0.524	6.690	0.010	3.874 (0.138–10.812)
Daytime sleepiness	-2.34 <sup>a</sup>	0.021**	0.135	0.090	2.255	0.133	1.145 (0.960–1.365)	-	-	-	-	-
Gender	0.520 <sup>b</sup>	0.471*	0.552	0.536	1.063	0.303	1.737 (0.608–4.962)	-	-	-	-	-
Having a personal tablet	4.797 <sup>b</sup>	0.029*	-0.603	0.623	0.937	0.333	0.547 (0.162–1.854)	-	-	-	-	-
Constant	-	-	2.788	0.710	15.427	<0.001	16.251	3.065	0.584	27.527	<0.001	21.434

<sup>a</sup> When all predictors included in binary logistic regression. Omnibus test:  $\chi^2 = 69.2$ ,  $p = <0.001$ , Hosmer and Lemeshow test:  $\chi^2 = 8.315$ ,  $p = 0.403$ , Coxand Snell R Square: 0.423 Nagelkerke R Square: 0.565, and Omnibus Tests of Model Coefficients: 78.6 % of the cases were correctly classified from the full model

<sup>b</sup> When using the predictors included by forward selection in binary logistic regression. Omnibus test:  $\chi^2 = 64.6$ ,  $p = <0.001$ , Hosmer and Lemeshow test:  $\chi^2 = 7.813$ ,  $p = 0.349$ , Cox and Snell R Square: 0.401, Nagelkerke R Square: 0.536, and Omnibus Tests of Model Coefficients: 77.8 % of the cases were correctly classified from the full model

\*  $\chi^2$  test, \*\*Independent sample *t* test, a: *t* value, b:  $\chi^2$  value

[40]. However, there is limited research regarding the association between Internet addiction and obesity in adolescents [29]. High rates of night-time use of the Internet, particularly video games, have been shown to predict higher BMIs in adolescents [41]. Studies conducted in China showed that excessive use of the Internet was associated with higher rates of binge eating behaviors and bulimia [42, 43]. In a previous study conducted in Turkey, 35 % of Internet addicted adolescents were found to be overweight and obese [44]. Finally, Internet addiction was found to be a predictor of the development of eating disorders with a larger association in females compared with males [45, 46]. In our study, obese adolescents were highly engaged with online gaming with 47.8 % having Internet addiction, thus complementing the heretofore sparse literature on the relationship between Internet addiction and obesity.

We found that obese adolescents were more likely to have Internet addiction compared with non-obese adolescents. One explanation for this association could be the overlapping neural systems that appear to be implicated in both obesity and addictive disorders. Previous neuroscience research has shown that these neural systems include particular reward dysfunction [47], impulsivity [48], and emotion dysregulation [49]. This neuroimaging research suggests that addictive-type mechanisms may contribute to obesity for some individuals. Another similarity that may exist between “food addiction” and Internet addiction is the presentation of withdrawal symptoms. Removing certain foods from the diet may be more likely to trigger psychological symptoms (i.e., anxiety) as in the psychological withdrawal symptoms of Internet addiction [50]. Therefore, exploring the larger science of addiction may be useful for developing new intervention methods for adolescents with obesity.

Most of the health-related life quality subscales and psychosocial health summary scores were significantly worse in the obese group compared with the non-obese group, and obese adolescents were more likely to have Internet addiction with worse emotional functioning, in addition to physical functioning. Past studies have shown that adolescent Internet addiction originates from negative emotions and psychological and behavioral problems, such as social anxiety and poor interpersonal relationships [6, 7, 11, 46, 51]. It may be that Internet addiction caused by poor emotional functioning contributes to obesity in several ways. First, as online activities increasingly displace physical activities among obese adolescents, the decrease in physical activity directly contributes to obesity. On the other hand, obesity has a negative impact on emotion regulation and peer relations. This may lead to further addictive Internet use with the aim of sensation seeking or escaping from the in-person realm into the online world, thus indirectly perpetuating obesity [52].

Adolescents with Internet addiction were found to engage in making new friends through the Internet and meeting these online friends in person [53]. Our study showed that the frequency of making new friends through the Internet was similar in both groups, but meeting these friends in person was less likely among obese adolescents. Obese adolescents often experience stigmatization and discrimination as well as pressure to be thin from the media and the people around them. In fact, inverse relationships have been found between self-esteem and weight status. The Internet provides the obese adolescents with low self-esteem a lifestyle, in which they can reduce in-person social interaction and feel more comfortable interacting with others online [54–56].

This study also adds to the current literature on adolescent Internet use habits. We found that obese adolescents tended to use the Internet more than 5 h in a day (weekdays and weekends), which is indicated in the prior literature to be pathological [32]. Furthermore, obese and non-obese adolescents did not differ in the places they accessed the Internet. Interestingly, ownership of a personal tablet was significantly higher in the obese group. However, it was not found to be significantly associated with obesity in binary logistic regression analysis. While a tablet is a tool which may improve access and variety of Internet applications for the Internet addicted adolescents, in this study, it was not an independent factor contributing to obesity.

Obese adolescents reported higher tendency to stay up late and more daytime sleepiness compared with non-obese adolescents, all of which may be due to excessive Internet usage time and video gaming. However, daytime sleepiness was not found to be associated with obesity as independent variables in binary logistic regression. Delay going to sleep and increased evening time activity generally increases daytime sleepiness [57]. We also found that participants in the obese group were more likely to be late sleepers and tend to stay awake after midnight. The consequent reduction in daytime activation and tendency toward ‘eveningness’ would have a negative impact on performance capability and disposition toward high-intensity exercise in the daytime [57]. Furthermore, prior research demonstrated that later sleep start and later bedtime are correlated with overeating [25]. Thus, further research is needed to determine the relative contributions of sleep behaviors to obesity.

This study has several limitations. Results were obtained from self-report questionnaires, which may be subject to bias and fall short of producing clinical diagnoses. Moreover, our relatively small sample size and the cross-sectional nature of the study prevent the ability to detect a direct causal relationship between the variables. However, the study found significant associations that should be

further explored in larger, multisite studies. We did not measure anxiety or depression, so it was not possible to determine the possible contributions of anxiety or depression to Internet addiction. We also did not assess eating behaviors; evaluation of eating disorders, particularly binge eating disorder, would be helpful in determining the nuances of the association between obesity and Internet addiction [42]. These measures should be the subject of further studies. Despite these shortcomings, our study has the methodological advantages of using standardized instruments for the assessment of life quality, sleep, and Internet addiction. Furthermore, we utilized novel tools to gather data about the location of Internet use, device use, and types of online activities to obtain a deeper picture of Internet use in this population.

## Conclusions

Our study is one of the few studies in the literature exploring specific online activities and Internet addiction, and associated problems in a clinical population. Based on our findings, we propose that there is a need for psychosocial assessment of obese adolescents to improve treatment efficacy and obesity-related outcomes. Our findings suggest that Internet addiction is an important independent risk factor for clinicians to assess in conjunction with obese adolescents’ physical activity and psychosocial problems. It is clear that increasing physical activity is critical for helping obese adolescents. Treatment of Internet addiction may be a successful intervention approach for some individuals with obesity, and in particular, those with Internet addiction and non-obese adolescents with Internet addiction in terms of life quality, sleep problems, and eating routines should be conducted in a further study.

Findings of this study imply that poor physical activity and Internet addiction have independent effect on adolescent obesity. Furthermore, parents, health practitioners, and policy makers should take Internet addiction and online activities into consideration in public health efforts to address obesity among adolescents through pharmacologic therapies and, dietary interventions, behavioral therapy, and psychoeducational programs on health education and healthy Internet use. This study provides a foundation for action toward addressing Internet addiction, which may help to reduce the prevalence and effects of obesity in adolescence.

## Compliance with ethical standards

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**Ethical approval** All procedures performed in this study which involves human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Permission for this study was granted by the Ethical Committee of Izmir Tepecik Teaching and Research Hospital (19.03.2015/6).

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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