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Association between smartphone addiction, physical activity, and overweight or obesity occurrence among Polish adolescents

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ABSTRACT

Introduction: Smartphone addiction (SA) is a growing problem among adolescents, and it may have adverse health outcomes. The aim of this study was to analyse the risk of SA according to the level of physical activity (PA), and the occurrence of overweight and obesity in a population of 460 adolescents – students of secondary schools in Poland.

Material and methods: The physical activity of adolescents was assessed using a short version of the International physical activity questionnaire. Smartphone addiction, as the independent variable, was measured by the mobile phone addiction assessment questionnaire. Overweight and obesity were identified by body mass index (BMI). Waist-to-hip ratio and body height were also measured.

Results: 284 (61.7%) respondents were not addicted to the smartphone, 148 (32.2%) were at risk of addiction, and 28 (6.1%) were addicted. It was found that in all respondents (n = 460) SA was associated with PA – low overall PA was associated with a higher level of SA (rho = –0.279; $p < 0.0001$). Moreover, the index of overall SA increased with sitting time (β = 0.113) and decreased with the general PA growth (β = –0.190). It was also shown that the increase of SA in overweight/obese adolescents was influenced by the reduction of general PA (rho = –0.343; $p < 0.05$), intense PA (rho = –0.268; $p < 0.05$), and walking (rho = –0.280; $p < 0.05$). Smartphone addicts were also students with higher BMI (24.77 kg/m^2; $p < 0.0001$) and higher BMI percentile (80.57; $p < 0.0001$).

Conclusions: Smartphone addiction is significantly associated with the PA of adolescents, and it is more common among those with an insufficient level of PA. Increased BMI is also an indicator of SA. Interventions for reducing SA should take into account both the context of PA and anthropometric indicators of schoolchildren.

KEY WORDS:

smartphones, smartphone addiction, physical activity, overweight, obesity, adolescents.

INTRODUCTION

Adolescence is a particularly important period in human growth and maturity. During this time young people undergo dynamic mental, physical, and emotional changes. It is also a time of shaping an individual value system. For this reason, the period of adolescence is crucial to develop good health habits for future behaviour. Today, representatives of the young generation are undisputed experts in the field of handling and using digital devices. They were born into a world where computers, tablets, game consoles, and mobile phones/smartphones are part of the existing order of things [1]. Young people treat their existence as something obvious, and they are able to use them in a completely natural, trusting, and intuitive way [2]. The average smartphone user makes

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about 2617 clicks a day. 82% of Polish users fall asleep with their phone, and 70% declare that they would always come back for it, even if they had to be late for an important meeting or school [3]. The use of new devices and communication technologies is more and more often recognised as a phenomenon that can be addictive and that may negatively affect the mental, physical, and emotional development of a user [1–3]. Research confirms the impact and relationship of mobile phone use on/with the quality and length of sleep. More than half of the respondents (55%) who showed symptoms of addiction have had poorer sleep quality [4]. The psychological consequences of excessive smartphone use also include a sense of loneliness, low self-esteem, information overload, anxiety, limitation of social contacts, and lack of interpersonal skills [5, 6]. The common physical symptoms of excessive smartphone use are thumb/wrist pain and degenerative changes of the spine [7, 8].

PHYSICAL ACTIVITY

Physical activity (PA) is the basic factor of human development, which aims to achieve the expected results, but also to maintain the already achieved fitness and health at a given level [9]. Even the smallest piece of PA gives the body many benefits [10]. It reduces the risk of depression and stress, as well as heart disease, respiratory disease, hypertension, and stroke. Physical activity helps to maintain appropriate values of total cholesterol in the blood serum and proper metabolism of carbohydrates [9, 10].

Lack of PA can lead to obesity, overweight, and diabetes. According to the World Health Organisation (WHO), physical inactivity is the fourth factor of mortality, causing an estimated 3.2 million deaths worldwide [11]. Insufficient PA level is one of the most important factors contributing to the emergence of non-communicable diseases, which can shorten life by an average of 3–5 years [9]. According to the Centre for Economics and Business Research, 4 out of 5 teenagers and 1 in 4 adults in Europe are not physically active enough. In addition, half a million Europeans die from diseases the main cause of which is insufficient PA [12].

OVERWEIGHT AND OBESITY AMONG CHILDREN AND ADOLESCENTS

The World Health Organisation defines overweight and obesity as abnormal or excessive accumulation of fat, which in turn can cause negative health effects, including cardiovascular diseases, certain cancers, diabetes, and skeletal muscle disorders [13]. The risk of developing these diseases increases with a higher body mass index (BMI) score, which is commonly used to classify overweight and obesity in adults. The body mass index is calculated by dividing a person's weight in kilograms by the square of their height in metres [13]. In childhood and adolescence, the primary cause of overweight and obesity is the energy imbalance between calories consumed and calories burned [9]. In addition, low awareness about a properly balanced diet, food processing, marketing, including advertising, and lack of PA may also contribute to the increase in overweight and obesity. These are environmental effects of overweight and obesity [13]. The number of overweight and obese infants and children aged 0–5 years worldwide has increased from 32 million in 1990 to 41 million in 2016 [14]. It is predicted that in 2025 there will be 91 million obese children and adolescents globally, and 177 million overweight aged 5–17 years [15]. In 2018, 10% of Polish boys and 4% of girls aged 10–19 years were obese [16].

The increasingly common problem of excessive body weight is related to the sedentary lifestyle and lack of PA [17, 18]. Therefore, the purpose of this study was to analyse the risk of smartphone addiction (SA) according to the level of PA, and the occurrence of overweight and obesity in a population of adolescents – students of Polish secondary schools.

MATERIAL AND METHODS

A total of 460 adolescents (225 girls and 235 boys) aged 16–19 years, students of secondary schools in the Podkarpackie Province in the South-East Poland, participated in the study. The average age of the respondents was 17.10 ±0.92 years. For more than half of the youths (*n* = 241, 52.4%), the place of education was a general secondary school.

The study was conducted using the self-reported questionnaire (which included 31 questions), the mobile phone addiction assessment questionnaire (KBUTK) by Potembska *et al.* [19], and the international physical activity questionnaire (IPAQ) in a short version. Each participant gave verbal consent to the measurement of body weight, body height, and waist and hip circumferences. Participation in the study was voluntary and anonymous, and all information obtained through the questionnaire was confidential. The study was approved by the Bioethics Committee of the University of Rzeszów – resolution No. 28/02/2019 of 14 February 2019. In addition, among the secondary schools participating in the project, the consent of the management was obtained.

The mobile phone addiction assessment questionnaire consists of 33 items developed for Polish conditions for adolescents aged 13–24 years, showing a reliability coefficient of 0.91 [19]. The questionnaire was divided into 4 subscales: *Need for acceptance and closeness* ($\alpha = 0.91$) – determining the level of seeking acceptance and closeness through phone conversations and text messages; *Addiction to mobile phone features* ($\alpha = 0.81$) – determining the level of addiction to such utilities as, e.g., smartphone camera; *Addiction to text messaging and voice calls* (α = 0.85) – determining the level of addiction to smartphone communication functions, and *Indirect communication* (α = 0.83) – determining the degree of preference for communication *via* smartphone through face-to-face meetings. Participants could obtain a maximum of 132 points. Respondents who scored 31–69 points were considered at risk of SA, and those who scored 70 or more points were considered addicted [19].

The short version of IPAQ was used to measure the PA of the participants. The physical activity questionnaire contains 7 questions regarding all types of PA, which lasted at least 10 minutes continuously. The respondent answered questions about PA performed in the last 7 days preceding the survey. The level of PA was expressed in MET units (moderate activity: 4.0 MET min/week, intensive activity: 8.0 MET min/week, or walking: 3.3 MET min/week). During the analysis, each type of PA was expressed in units of MET min/week by multiplying the coefficient assigned to this PA by the number of days it was performed *per* week and its duration in minutes *per* day. Then, the results from individual types of PA were added together to obtain the average PA units expressed in MET-min/week. Based on the results, PA was classified according to 3 levels: high, sufficient, and insufficient. To qualify for the high PA level, respondents had to achieve the result of 3 or more days of intensive PA, which in total resulted in at least 1500 MET-min/week, or 7 and more days of combination of PA exceeding 3000 MET-min/week. The sufficient level had to be achieved by 3 or more days of intensive PA not less than 20 minutes/day, or 5 or more days of moderate PA or walking, not less than 30 minutes *per* day, or 5 or more days of a combination of PA exceeding 600 MET-min/week. The insufficient level of PA was classified by respondent who did not meet the criteria for a sufficient or high level [20].

Body mass index was calculated based on the assessment of height and weight according to the formula: BMI = body weight [kg]/body height^2 [m]. In this study the BMI charts of boys and girls aged 3–18 years were used [21]. Waist circumference was measured after taking several natural breaths. The measurement site was precisely marked halfway between the highest point of the iliac crest and the lowest part of the costal arch. In addition, the circumference of the hips was measured. This measurement was made in the greatest convexity of the gluteal muscles, below the hip plates. For the measurement of the above parameters, the respondent wore underwear only. Moreover, the 2 parameters of waist and hip circumference were used to calculate the waist-to-hip ratio (WHR index) by dividing the waist circumference by the hip circumference. Both indicators were given in centimetres. Measurements were made in the school nurse's office in conditions of intimacy. Respondents were informed about the results immediately after the tests were performed.

Statistical analysis was performed with the IBM SPSS Statistics 20 program. The results of descriptive statistics were presented using numerical and percentage values, averages, standard deviations, and quartiles. When assessing the differences between the 2 nominal variables, the χ^2 test of independence was used, taking into account the Yates correction for continuity for 2 × 2 tables. The Kolmogorov-Smirnov test was applied to verify a normal distribution. The lack of normality in the distribution of variables suggested the use of non-parametric methods: the Mann-Whitney *U* test, Kruskal-Wallis test, and Spearman's rho correlation coefficient. The significance of selected correlates for the dependent variable "smartphone addiction" was assessed using logistic regression models with the input method or the progressive selection method, or linear regression modelling with the stepwise method. The significance level of $p < 0.05$ was assumed in this study.

RESULTS

ANTHROPOMETRIC DATA

It was shown that 77.8% of participants had a normal BMI (*n* = 358). 67 (14.6%) respondents were overweight and 13 (2.8%) were obese, and 22 (4.8%) were underweight. Because 91.5% of the study group consisted of respondents aged 16–18 years, it was decided to take into account the percentile values when assessing the BMI index. This made it possible to isolate a group of overweight/obese students. The cut-off value for overweight/obesity was ≥ 85%. Thanks to this approach, 90 (19.6%) adolescents with overweight/obesity were identified; 370 (80.4%) participants had a BMI below the 85%.

The average waist circumference was almost 79 cm, which, with the average hip circumference of around 88 cm, gave a WHR value of 0.90 ±0.06. The average BMI value was 22.81 ±3.08 kg/m^2. The results of the BMI index were compared to the percentile charts, which allowed us to conclude that the average BMI percentile was 62.10 ±23.89 (Table 1).

LEVELS OF SMARTPHONE ADDICTION (MOBILE PHONE ADDICTION ASSESSMENT QUESTIONNAIRE) AND PHYSICAL ACTIVITY (PHYSICAL ACTIVITY QUESTIONNAIRE)

Dividing the general results of the KBUTK scale according to the mean value and standard deviation, it was found that 61.7% of respondents (*n* = 284) were not addicted to their smartphone, and 32.2% of the respondents (*n* = 148) were at the risk of such addiction. High scores corresponding to SA were obtained by 6.1% of the respondents (*n* = 28).

It was shown that the lack of SA was more often related to respondents with a high level of PA (*n* = 182; 72.8%), less often to respondents with a sufficient level of PA (*n* = 56; 58.9%), and the least to students with

TABLE 1. Selected anthropometric indicators of the participants

Parameters	Body weight	Body height	Waist circumference	Hip circumference	WHR	BMI	BMI (%)
Mean	66.81	170.85	78.98	87.87	0.90	22.81	62.10
SD	11.88	9.36	13.46	12.77	0.06	3.08	23.89
Min	44	145	55	62	0.68	16.10	1
Max	120	198	130	139	0.99	34.38	99
Q1	58.00	164.00	68.00	78.00	0.86	20.81	48.00
Q2 (Me)	65.00	170.00	76.00	88.00	0.91	22.49	66.00
Q3	74.00	178.00	88.00	96.00	0.94	24.22	80.75

BMI – body mass index, WHR – waist-to-hip ratio

TABLE 2. The level of smartphone addiction (mobile phone addiction assessment questionnaire) and levels of physical activity by international physical activity questionnaire

Parameters	IPAQ			Total
	Insufficient	Sufficient	High	
KBUTK				
No addiction, *n* (%)	46 (40.0)	56 (58.9)	182 (72.8	284 (61.7)
Risk of addiction, *n* (%)	46 (40.0)	37 (38.9)	65 (26.0)	148 (32.2)
Addiction, *n* (%)	23 (20.0)	2 (2.1)	3 (1.2)	28 (6.1)
Total, *n* (%)	115 (100.0)	95 (100.0)	250 (100.0)	460 (100.0)

IPAQ – international physical activity questionnaire, KBUTK – mobile phone addiction assessment questionnaire
$\chi^2 = 69.237; p < 0.0001$

an insufficient level of PA (*n* = 46; 40.0%). Smartphone addiction was found much more often among adolescents with an insufficient level of PA (*n* = 23; 20.0%). The differences were statistically significant ($\chi^2 = 69.237$; $p < 0.0001$) (Table 2).

SMARTPHONE ADDICTION (MOBILE PHONE ADDICTION ASSESSMENT QUESTIONNAIRE), PHYSICAL ACTIVITY (PHYSICAL ACTIVITY QUESTIONNAIRE), AND THE OCCURRENCE OF OVERWEIGHT AND OBESITY AMONG THE RESPONDENTS

Our research showed that in all respondents (*n* = 460) addiction to the smartphone was associated with PA. It was found that adolescents with low overall PA had a higher level of SA (*rho* = –0.279; $p < 0.0001$). In particular, the negative relationship between general PA and SA was visible in relation to the scales: *need for acceptance and closeness* (*rho* = –0.231; $p < 0.0001$), *addiction to text messaging and voice calls* (*rho* = –0.275; $p < 0.0001$), and *indirect communication* (*rho* = –0.271; $p < 0.0001$). It was found that the level of PA did not significantly affect the device's features (*rho* = –0.049; $p = 0.2956$). The negative relationship between PA and SA was visible in individual aspects of PA (intense, moderate, and walking) as well as in the overall level of SA. It was also found that the longer the time of sitting during a day, the higher the dependency on the smartphone features (i.e. camera) (*rho* = 0.123; $p < 0.05$), and the higher the dependency on *indirect communication* (*rho* = 0.147; $p < 0.05$). In the case of participants without overweight/obesity, similarly to the study in general, higher PA corresponded to a lower rate of SA (*rho* = –0.272; $p < 0.0001$). Negative correlations of individual subscales of PA and SA were also found. In the group of overweight/obese students, the level of general PA had a negative impact on SA (*rho* = –0.343; $p < 0.05$). The relationship was therefore similar to the overall study, and among adolescents without overweight/obesity. It was also shown that the increase of the SA was influenced by the reduction of intense PA, the reduction of activity related to walking, but not by moderate PA (Table 3).

Then, a stepwise linear regression was used to measure the impact between subscales and overall level of SA (KBUTK) and PA by IPAQ. It was noticed that the index of overall SA increased with the amount of sitting time during a day (β = 0.113), and it decreased with the general PA growth (β = –0.190). In the case of the *need of acceptance and closeness* subscale, it was noticed that respondents with a higher general PA obtained lower results (β = –0.206). *Addiction to smartphone features* increased significantly with increasing sitting time during a day (β = 0.162). The higher the general PA of respondents, the lower the *addiction to text messaging and voice calls* (β = –0.222). In the case of the *indirect communication* subscale, higher scores were obtained by adolescents with a longer sitting time during the day (β = 0.168), and lower scores were obtained by participants with a higher general index of PA (*β* = –0.174) (Table 4).

THE IMPACT OF BODY MASS INDEX PERCENTILE ON THE LEVEL OF SMARTPHONE ADDICTION

The impact of BMI percentile on the level of SA was assessed similarly to the IPAQ scale. It was shown that both overall level of SA and dependence on the smartphone features increased significantly with BMI per-

TABLE 3. Smartphone addiction scale (mobile phone addiction assessment questionnaire) and levels of physical activity in all respondents due to overweight and obesity ($N = 460$)

KBUTK		IPAQ				
		Intense PA	Moderate PA	Walking	General PA	Sitting time *per* day
Need for acceptance and closeness	rho	–0.179**	–0.134**	–0.164**	–0.231***	0.037
Addiction to mobile phone features	rho	–0.086	–0.056	0.022	–0.049	0.123**
Addiction to text messaging and voice calls	rho	–0.150**	–0.164**	–0.246***	–0.275***	0.030
Indirect communication	rho	–0.224***	–0.122**	–0.157**	–0.271***	0.147**
Overall level of smartphone addiction	rho	–0.214***	–0.162**	–0.183***	–0.279***	0.065
Not overweight/obese ($n = 370$)						
Need for acceptance and closeness	rho	–0.163**	–0.141**	–0.120**	–0.211***	0.036
Addiction to mobile phone features	rho	–0.066	–0.023	0.068	–0.007	0.127**
Addiction to text messaging and voice calls	rho	–0.131**	–0.172**	–0.255***	–0.281***	0.032
Indirect communication	rho	–0.204**	–0.117**	–0.123**	–0.248***	0.134**
Overall level of smartphone addiction	rho	–0.206**	–0.168**	–0.155**	–0.272***	0.069
Overweight/obese ($n = 90$)						
Need for acceptance and closeness	rho	–0.244**	–0.136	–0.281**	–0.320**	0.059
Addiction to mobile phone features	rho	–0.123	–0.146	–0.112	–0.174	0.064
Addiction to text messaging and voice calls	rho	–0.235**	–0.148	–0.221**	–0.285**	0.053
Indirect communication	rho	–0.303**	–0.148	–0.274**	–0.382**	0.221
Overall level of smartphone addiction	rho	–0.268**	–0.172	–0.280**	–0.343**	0.086

IPAQ – international physical activity questionnaire, KBUTK – mobile phone addiction assessment questionnaire, PA – physical activity
**** $p < 0.001$; ** $p < 0.05$*

TABLE 4. A stepwise linear regression model for the mobile phone addiction assessment questionnaire and international physical activity questionnaire physical activity of adolescents

Parameters		WNS		WS	*t*	*p*
		B	SE	β		
Overall level of smartphone addiction						
General PA		–0.00003	0.00001	–0.190	–3.431	0.0007
Sitting *per* day		0.00026	0.00013	0.113	2.036	0.0426
Need for acceptance and closeness	General PA	–0.00005	0.00001	–0.206	–3.789	0.0002
Addiction to mobile phone features	Sitting *per* day	0.00041	0.00014	0.162	2.967	0.0032
Addiction to text messaging and voice calls	General PA	–0.00004	0.00001	–0.222	–4.105	0.0001
Indirect communication						
General PA		–0.00004	0.00001	–0.174	–3.170	0.0017
Sitting *per* day		0.00052	0.00017	0.168	3.058	0.0024

B – value of the unstandardized regression coefficient, β – value of the standardized regression coefficient, PA – physical activity, SE – standard error, WNS – unstandardized regression coefficient, WS – standardized regression coefficient

centile growth (β = 0.101; β = 0.188). The body mass index percentile value had also a significant impact on the *addiction to text messaging and voice calls* and *indirect communication* subscales. It was also found that participants with higher BMI percentiles had a higher level of *text messaging and voice calls* addiction (β = 0.155) and a higher *indirect communication* index (β = 0.105). No significant relationship was found between the *need for acceptance and closeness* subscale and the BMI percentile (Table 5). It was also shown that smartphone addicts had higher BMI (24.77 kg/m^2; $p < 0.0001$) and higher BMI percentile values (80.57; $p < 0.0001$) compared to non-addicted participants (Table 6).

DISCUSSION

Currently, people, especially adolescents, use their smartphones intensively and seem inseparable from

TABLE 5. A stepwise linear regression model for mobile phone addiction assessment questionnaire and anthropometric data of adolescents

Parameters		WNS		WS	*t*	*p*
		B	SE	β		
Overall level of smartphone addiction	BMI (%)	0.002	0.001	0.101	2.295	0.0222
Need for acceptance and closeness	BMI (%)	–0.013	0.228	0.147	–2.187	0.0741
Addiction to mobile phone features	BMI (%)	–2.201	0.539	0.188	–4.086	0.0001
Addiction to text messaging and voice calls	BMI (%)	0.004	0.001	0.155	3.487	0.0005
Indirect communication	BMI (%)	0.004	0.002	0.105	2.349	0.0193

B – value of the unstandardized regression coefficient, β – value of the standardized regression coefficient, BMI – body mass index, PA – physical activity, SE – standard error, WNS – unstandardized regression coefficient, WS – standardized regression coefficient

TABLE 6. Smartphone addiction and body mass index of adolescents

KBUTK	BMI (%)	BMI
No addiction		
Mean	61.27	22.78
SD	24.51	3.11
Risk of addiction		
Mean	60.20	22.50
SD	23.03	3.03
Addiction		
Mean	80.57	24.77
SD	11.53	2.25
Overall		
Mean	62.10	22.81
SD	23.89	3.08
p	< 0.0001	< 0.0001

BMI – body mass index, KBUTK – mobile phone addiction assessment questionnaire, SD – standard deviation

them. Previous studies have shown that the problematic use of mobile phones can lead to many health effects, i.e. sleep disorders [4, 22], reducing PA [23, 24] and leading to overweight and obesity [25]. However, the link between PA and obesity, and SA has not been fully clarified. The current study focused on the relationship between SA, PA, and the prevalence of overweight and obesity in adolescents aged 16–19 years.

According to the results of the KBUTK test used in this study, 6.1% of respondents were addicted to their smartphone. A large group of respondents (32.2%) were at risk of developing addiction. 61.7% of respondents showed no addiction to a mobile device. Similar results were obtained in research conducted using KBUTK on a group of 470 respondents from Silesian upper secondary schools aged 16–19 years [26]. 3.83% of the respondents were smartphone addicted, and 35% met the criteria of the risk of SA [26]. Comparing the current result with KBUTK original data collected in 2010 and 2011 in the group aged 13–14 years, a clear intensification of the observed phenomenon can be seen over the years [19].

The problematic use of smartphones by young people is growing both worldwide and in Poland. When comparing with the alarming statistics of adolescents' PA, a novel and noteworthy relationship is revealed. In the current study addiction to a smartphone was significantly associated with PA at every level: high, sufficient, or insufficient ($\chi^2 = 69.237$; $p < 0.0001$). According to the WHO, the optimal physical effort for children and adolescents that meets their development and health needs is 60 minutes of exercise and 11,000–12,000 steps *per* day [9]. According to Kim *et al.*, smartphone addiction negatively influences PA, such as walking steps, and results in an increase in fat mass and a decrease in muscle mass [23]. In our study these results have also been confirmed – adolescents who took fewer steps *per* day had a higher degree of SA. Interestingly, this relationship applied to both obese and non-obese adolescents. Our study showed that sitting time during the day was significantly associated with SA. Previous studies examining the relationship between the SA and PA of middle school students also found that the higher the SA, the lower the PA index [25–27].

Although it may be the result of abnormalities in the functioning of genes that control body weight, the influence of the environment and eating habits is probably the greatest cause of obesity in children [28, 29]. The correlates of obesity in adolescents are numerous and complex but have already been demonstrated to include a lack of PA and increased sedentary time, e.g. screen time [25, 26, 30]. The risk of overweight/obesity among adolescents was significantly positively associated with sedentary behaviour and negatively with PA [29]. It is also noticeable that the intensive use of smartphones is becoming another environmental problem. Teenagers appear to be most at risk for both substance and behavioural addictions due to their lack of self-control, and they are more susceptible than others to the adverse effects of smartphone use, which is a potential risk factor for obesity [19, 22]. In this study, we found that the overall level of SA increased with BMI percentile. The high frequency of using smartphones also significantly influenced the behaviour of the youths with overweight/obesity. We found that adolescents with higher BMI percentile values were more likely to use their phones to text or call their friends (a higher level of the *addiction to text messaging and voice calls* and *indirect communication* subscales). Similarly, Coban revealed the relationship between SA and being overweight among university students aged 22.38 ±3.15 years [26]. As a result of analysing the BMI and the degree of SA in previous studies, it was found that the higher the SA, the higher the BMI index [26, 28, 29], which is consistent with the results of our study. However, interestingly, some studies have shown the opposite result [31]. These results undoubtedly confirm that factors associated with the risk of developing SA have been described in detail in the literature, although this topic requires further research. Despite the benefits offered by smartphones, e.g. communication optimisation, quick and easy access to information, and access to applications, including health-related ones, problematic smartphone use is a serious global health problem and should not be ignored.

CONCLUSIONS

In general, our study examined the association between smartphone addiction, PA, and overweight/obesity in adolescents, revealing various significant associations in this dimensions. These results suggest that SA may be a new risk factor for insufficient PA of adolescents, and consequently lead to possible long-term health problems in adult life. Interventions for reducing SA should take into account both the context of PA and anthropometric indicators of schoolchildren.

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DISCLOSURE

The authors declare no conflict of interest.

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