

## **PHYSICAL ACTIVITY, BODY MASS INDEX, AND SMARTPHONE ADDICTION: A CROSS-SECTIONAL STUDY AMONG ADOLESCENTS**

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### **ABSTRACT**

Smartphone addiction has become a growing public health concern among adolescents. Excessive smartphone use has been associated with physical inactivity, mental health problems, and unhealthy lifestyle behaviors that may contribute to abnormal body mass index (BMI). This study aimed to examine the association between physical activity level, body mass index, and smartphone addiction among adolescents. A cross-sectional study was conducted among 102 adolescents, 15–17 years old in Surakarta, Indonesia. Data were collected using a structured questionnaire including demographic characteristics, the Smartphone Addiction Scale–Short Version (SAS-SV), and the International Physical Activity Questionnaire (IPAQ). BMI was calculated based on measured height and weight. The prevalence of smartphone addiction was 52.9%. Most participants had normal BMI (52.0%), while 28.4% were obese. Low physical activity levels were observed in 42.2% of respondents. Chi-square analysis indicated a borderline association between physical activity level and smartphone addiction ( $p = 0.054$ ), suggesting a tendency for lower physical activity to be associated with higher smartphone addiction. No significant association was found between BMI and smartphone addiction ( $p = 0.084$ ), nor between physical activity level and BMI ( $p = 0.359$ ). Smartphone addiction was highly prevalent among adolescents. Although physical activity showed a potential association with smartphone addiction, BMI was not significantly correlated to either smartphone addiction or physical activity. These findings showed that the importance of promoting regular physical activity as part of preventive strategies against smartphone addiction among adolescents.

Keywords: adolescent; addiction; BMI; physical activity; smartphone

### **INTRODUCTION**

Smartphone addiction has become a growing public health concern among adolescents. (Abi-Jaoude et al., 2020; Daryabeygi-Khotbehsara et al., 2021) . Prevalence of smartphone addiction among adolescents were 16.9% in Switzerland (Haug et al., 2015), 10% in United Kingdom (Lopez-Fernandez et al., 2014), 37,1% in Malaysia (Wei Lee et al., 2023), 35.6% in South Korea (Lee & Lee, 2017) and 33,1% in India (Soni et al., 2017). Excessive smartphone use has been associated with physical inactivity, mental health problems, and unhealthy lifestyle behaviors that may contribute to abnormal body mass index (BMI). (Daryabeygi-Khotbehsara et al., 2021; Ma et al., 2025; Nagata et al., 2023).

Particularly among adolescent, poor digital device use is acknowledged as a significant concern. (Guertler et al., 2024; Kuss & Griffiths, 2017) Global estimations show that nearly 25% of people suffer from smartphone addiction, 17.42% from social media addiction, and 14.22% from Internet addiction. (Meng et al., 2022) Excessive smartphone use can also disrupt physical activity. unctions such as calling, sending and receiving text messages, updating social networking sites, and browsing the Internet, have historically been defined as sedentary behaviors. (Lepp et al., 2013; Rosenberg et al., 2010)

Such inactive behavior correlates with various health problems including obesity or metabolic syndrome because it results in low levels of energy expenditure. (Das et al., 2024) Specifically, high Internet and computer use, considered as sedentary behaviors, are associated with higher body mass index and lower physical activity levels. (Godoy-Cumillaf et al., 2023; Yuniarti et al., 2024) High frequency users of smartphones can impede physical activity and promote sedentary behaviors, such as watching television and using computers, resulting in the reduction of cardiorespiratory fitness. (Lepp et al., 2013) However, the relationship between smartphone use and physical activity is obscure (Kumban et al., 2025; Nagata et al., 2023; Zhang et al., 2024)

Physical activity as an effective modality to reduce and mitigate the phenomenon of smartphone addiction. (Chen et al., 2022) Physical activity serves as a means for individuals to achieve fitness and health and improve physical and mental well-being. Physical activity improves physical fitness, enhances overall health, and maintains bodily functions . The World Health Organization (WHO) recommends a minimum of 150 minutes per week of moderate-to-vigorous physical activity to prevent chronic diseases. Furthermore, the WHO recommends engaging in 75 minutes of vigorous-intensity exercise weekly, as regular physical activity offers significant benefits for physical and mental health. (WHO, 2020) Existing studies have shown that exercise serves as an effective intervention for the treatment of smartphone addiction, with longer intervention durations yielding better outcomes. (Geng & Liu, 2025; Liu et al., 2022) Systematic physical activity (PA) can significantly reduce smartphone addiction. (Godoy-Cumillaf et al., 2023; Zhang et al., 2024) Recent research has shown that physical activity acts as an effective negative predictor of smartphone addiction, with self-control mediating the relationship between the two. (Guo et al., 2022) Regular physical activity is suggested as a viable strategy for preventing MPA, and moderate evidence supports its effectiveness in reducing addictive behaviors among college students.

## **METHOD**

One hundred and two adolescent in Surakarta were recruited as the subjects for this study. Participants (9 males and 93 females) aged 15 to 27 have been studying in SMK Farmasi Nasional. This study collected data through a structured questionnaire consisting of general characteristics. All questionnaires were in the self-report format. Lastly, smartphone addiction, body composition and physical activity were measured. Participants were excluded if they refused to participate in the study. The design of the study included a one month period, during which time spent using the smartphone was automatically registered from their smartphone device, and participants filled out questionnaires on screen use and physical activity.

### **Measure of Smartphone Addiction**

The SAS-SV is a well-validated specific questionnaire to identify the level of the smartphone addiction risk and to distinguish the high-risk group in adolescent. The questionnaire includes 10 questions describing daily-life disturbance, positive anticipation, withdrawal, cyberspace-oriented relationship, overuse and tolerance. For each item, participants expressed their opinion on a 6-point scale ranging from 1 (strongly disagree) to 6 (strongly agree). It identifies the different range for males and females. Males are addicted to scores higher than 31, with high risk of addiction with scores between 22 and 31 and females are addicted to scores higher than 33, with high risk of addiction on scores between 22 and 33.

### Measures of Physical Activity and Body Composition

The Indonesian version of the IPAQ was used to subjectively measure physical activity and sedentary behavior. (Dharmansyah & Budiana, 2021) The Indonesian version of the IPAQ has a satisfactory criterion validity. A total of 7 question items in the IPAQ were valid. The Kaiser-Meyer-Olkin value was 0.910, and Bartlett's test of sphericity was  $X^2 = 573,434$  ( $df=28$ ,  $p<0.000$ ). This validated questionnaire measures participation in vigorous- and moderate-intensity physical activity and sedentary behavior over the past seven days, and using published values, physical activity data from the questionnaire were transformed into energy expenditure estimates as metabolic equivalent tasks (METs). Outcome measures from the IPAQ were (1) total physical activity expressed as MET-minutes per day and minutes reported in (2) vigorous-intensity, (3) moderate-intensity activity, and (4) in sitting per day. To objectively measure the number of steps, the activity trackers in the participant's smartphone, described above, were used.

Body mass index (BMI) was used as an indicator of nutritional status and was calculated based on direct measurements of body weight and height. Body weight was measured using a calibrated digital scale, with participants wearing light clothing and no footwear. Height was measured using a stadiometer with participants standing in an upright position and barefoot. BMI was calculated by dividing body weight in kilograms by the square of height in meters ( $kg/m^2$ ). The resulting BMI values were then categorized according to standard classification criteria to determine underweight, normal weight, and obesity status. BMI was classified into underweight ( $<18.5 kg/m^2$ ), normal ( $18.5-22.9 kg/m^2$ ), overweight ( $23-24.9 kg/m^2$ ), and obese ( $\geq 25 kg/m^2$ ) (Madden & Smith, 2016)

## RESULT AND DISCUSSION

A total of 102 adolescents participated in this study. The mean Physical Activity Questionnaire (PAQ) score was  $2551.04 \pm 3671.57$ . The Smartphone Addiction Scale (SAS) score was  $33.40 \pm 10.34$ , suggesting heterogeneous patterns of smartphone use behavior within respondent.

Table 1.  
Respondent Characteristic

Variabel	Frequency	Percent
Gender		
Men	9	8.8
Women	93	91.2
Smartphone Addiction		
Yes	54	52.9
No	48	47.1
Physical Activity		
Low	43	42.2
Moderate	34	33.3
High	25	24.5
Body Mass Index		
Underweight	20	19.6
Normal	53	52.0
Obesity	29	28.4

The sample was predominantly female (91.2%), with male participants accounting for 8.8%. Regarding body mass index (BMI), more than half of the respondents were classified as having a normal BMI (52.0%), while 28.4% were categorized as obese and 19.6% as underweight. Based on physical activity categories, 42.2% of adolescents exhibited low physical activity levels, 33.3%

moderate levels, and only 24.5% high physical activity levels. Concerning smartphone addiction status, 52.9% of respondents were classified as having smartphone addiction. The findings of this study showed that adolescents reported an average smartphone use of approximately 8–10 hours per day, indicating daily engagement with digital devices. This level of smartphone use reflects extensive exposure across routine activities, including communication, learning, and entertainment, and illustrates a high intensity of screen-based behavior within respondent

Table 2.

Smartphone Addiction and Physical Activity Score

	PAQ	SAS SV
Mean		2551.04
Std. Deviation		3671.57

The Chi-square analysis showed a minimally significant correlation between high activity levels and smartphone addiction. The Pearson Chi-square test showed *p-value* was 0.054, which suggests that there may be 'direct correlation' between lower physical activity and higher smartphone use. The research showed that the correlation between body mass index and smartphone addiction, but found no significant that appears to be genuine. The Pearson Chi-square test showed *p-value* was 0.084. The Chi-square test that no significant the relationship between physical activity level and body mass index. The Pearson Chi-square was a *p-value* of 0.359. Overall, the results indicate that while physical activity may be a factor in smartphone addiction, there is no significant between body mass index and either behavior or exercise in this group.

The study showed that low physical activity and smartphone addiction were prevalent among adolescents, with more than half of participants reporting smartphone addiction and nearly half engaging in low levels of physical activity. This pattern reflects a growing public health concern, as adolescence is a critical developmental period during which lifestyle behaviors are formed and can persist into adulthood. The high proportion of adolescents with low levels of physical activity aligns with previous research showing that increased smartphone use is associated with sedentary behavior and reduced engagement in physical movement. (Nambirajan et al., 2025) Excessive smartphone use often displaces time that could otherwise be devoted to physical activity, thus contributing to lower energy expenditure. (Kim et al., 2015).

Furthermore, the distribution of BMI categories, with nearly one-third of participants classified as obese, underscores the potential role of a sedentary lifestyle in influencing weight-related outcomes among adolescents. Body mass index (BMI) serves not only as an indicator of nutritional status but also as a proxy for long-term behavioral patterns associated with physical inactivity and energy imbalance. (Tiruneh, n.d.) The low levels of physical activity and high BMI observed in this study showed that lifestyle behaviors associated with smartphone use may indirectly contribute to poor weight status.

The relatively high prevalence of smartphone addiction (52.9%) was consistent with previous studies reporting increased rates of problematic smartphone use among adolescents. Adolescents are particularly vulnerable to smartphone addiction due to ongoing neurodevelopmental processes, including immature impulse control and heightened sensitivity to reward-related stimuli. (Tymofiyeva et al., 2020) Excessive smartphone use can exacerbate sedentary behavior, disrupt daily routines, and reinforce unhealthy lifestyle habits. (Goyal & Rakhra, 2024; WHO, 2020; Wong et al., n.d.)

Overall, these findings highlight the interconnected nature of physical activity, BMI, and smartphone addiction among adolescents. Although the cross-sectional design of this study does not allow for causal conclusions, the observed patterns emphasize the need for integrated public health strategies that address digital behaviors alongside physical activity promotion and weight management. Interventions targeting smartphone addiction in adolescents may benefit from incorporating components that encourage active lifestyles and healthy behavioral routines. From a public health perspective, the results of this study provide important evidence from a developing country context, where rapid digitalization and lifestyle transitions are occurring. This study contributes to the limited literature examining the combined associations between physical activity, BMI, and smartphone addiction among adolescents and underscores the importance of a multidimensional approach to adolescent health promotion.

## CONCLUSION

This study showed smartphone addiction is prevalent among adolescents, with over half of the participants classified as smartphone addicts. Most adolescents also demonstrated low levels of physical activity, highlighting a concerning pattern of sedentary behavior in this population. The data indicate a potential association between physical activity levels and smartphone addiction, suggesting that lower physical activity may be associated with a higher likelihood of smartphone addiction. However, this association was not significant. Body mass index was not significantly associated with either smartphone addiction or physical activity levels in this study. These results suggest that smartphone addiction among adolescents may be more closely related to behavioral factors, such as physical activity, than simply weight status.

Overall, these findings underscore the importance of promoting an active lifestyle alongside healthy digital behaviors as part of adolescent health interventions. Further studies using larger samples and longitudinal designs are needed to further elucidate the complex relationships between physical activity, body mass index, and smartphone addiction, and to inform evidence-based public health strategies.

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