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The Association Between Gadget Use, Physical Activity, and Overnutrition Among Adolescents: A Cross-Sectional Study in Bekasi, Indonesia

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ABSTRACT

Background: Overnutrition among adolescents has become a growing public health concern in many urban regions of Indonesia. Lifestyle transitions, characterized by decreased physical activity and increased screen time due to gadget use, have contributed to this trend. Adolescents living in metropolitan areas, such as Bekasi, often face greater exposure to sedentary habits, which may elevate their risk of developing nutrition-related disorders.

Aims: This study aimed to examine the relationship between gadget use and physical activity with the incidence of overnutrition among adolescents in a junior high school setting in Bekasi, Indonesia.

Methods: A cross-sectional analytical observational design was employed with 100 students aged 12–15 years from SMP Negeri 33 Bekasi. Data on gadget usage were collected using a validated questionnaire developed by Khulwia (2018), while physical activity levels were assessed using the Physical Activity Questionnaire for Adolescents (PAQ-A). Nutritional status was determined through anthropometric measurements, with body mass index-for-age z-scores (BMI-for-age) as the reference indicator based on WHO standards. Data were analyzed using the Chi-square test to assess the associations between variables.

Results: The analysis showed that 59% of students had high gadget use and 45% engaged in low physical activity. A total of 31% of the respondents were classified as having overnutrition. The Chi-square test revealed no significant association between gadget use and overnutrition ($p = 0.452$), while a statistically significant relationship was found between physical activity and overnutrition ($p = 0.000$). Students with lower physical activity levels were more likely to be overnourished compared to those with higher activity levels.

Conclusion: The findings highlight that physical inactivity is significantly associated with overnutrition among adolescents, emphasizing the critical role of regular physical activity in maintaining a healthy nutritional status. Although no direct association was found between gadget use and overnutrition, high gadget use may indirectly contribute to a sedentary lifestyle, reinforcing the need for balanced screen time regulations. Public health interventions and school-based programs should prioritize increasing physical activity among adolescents to combat the rising trend of overnutrition in urban areas.

Keywords: Adolescents, Gadget Use, Physical Activity, Overnutrition, Urban Health

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INTRODUCTION

Overnutrition among adolescents is becoming an increasingly pressing health issue, particularly in urbanized regions of Southeast Asia. The growing prevalence of overweight and obesity in this age group contributes to long-term risks such as type 2 diabetes, cardiovascular disease, and poor psychosocial outcomes. Indonesia, like many developing countries, is facing a dual burden of malnutrition, where overnutrition coexists with undernutrition, especially in cities experiencing rapid urban growth. According to Liu et al. (2025) and Vrevic et al. (2024), urban adolescents are at a higher risk of becoming overweight due to lifestyle changes, including increased access to high-calorie foods and reduced opportunities for physical activity . These shifting patterns reflect global transitions in nutrition and behavior, often referred to as the "nutrition transition." As early-life obesity often persists into adulthood, identifying modifiable factors such as screen time and physical activity is essential. Tackling adolescent overnutrition is thus not only a medical concern but also a strategic public health priority. Without timely intervention, this trend could lead to a significant economic and healthcare burden in the future.

Technological advancement and digital lifestyle adoption among adolescents have drastically reshaped daily routines and behaviors. Prolonged use of gadgets such as smartphones, tablets, and gaming consoles has been linked to sedentary habits, lower physical activity, and increased caloric intake. Alosaimi et al. (2024) and Malheiros et al. (2021) highlighted that excessive screen time correlates strongly with reduced physical movement and greater likelihood of unhealthy snacking patterns among youth . This concern is especially relevant in urban settings, where digital devices are widely accessible and often used for both educational and recreational purposes. In areas like Bekasi, where urbanization and technological access are accelerating, adolescents are particularly vulnerable to these behavioral shifts. These environmental and behavioral factors interact to create a perfect storm for rising rates of overnutrition. Investigating how gadget use relates to physical activity and nutritional outcomes can provide critical insights for designing effective interventions. Understanding these links can help inform school-based and community-based programs to promote healthier behaviors among young people.

Despite the growing body of research on adolescent nutrition, studies that explore the triadic relationship between gadget use, physical activity, and overnutrition remain limited, particularly in the Indonesian context. Many previous investigations have treated these variables in isolation, overlooking their interdependent nature. Recognizing that screen time might displace time for physical activity, this study aims to fill a gap in current literature by examining their combined effects. As reported by Albarracín et al. (2024) and Hargreaves et al. (2022), interventions targeting adolescent health must consider both behavioral and environmental determinants to be effective . The urban adolescent population offers a unique lens through which to explore these patterns due to their increased exposure to digital technology and lifestyle shifts. Focusing on this demographic provides an opportunity to prevent chronic health conditions before they become entrenched in adulthood. This research is timely and relevant, offering evidence-based recommendations for health promotion strategies. By understanding the behavioral contributors to adolescent overnutrition, this study adds depth to ongoing discussions on youth health and digital lifestyle.

This study is motivated by the need to explore how two dominant lifestyle factors—gadget use and physical activity—interrelate and influence overnutrition in adolescents. While both have

been studied individually in various contexts, few studies have comprehensively analyzed their combined effects in urban Indonesian settings. Bekasi represents a typical urban area undergoing rapid digital and infrastructural development, making it an ideal context to study this phenomenon. Investigating this association is vital because early intervention during adolescence can prevent long-term health complications and reduce the future burden on the healthcare system. Moreover, the findings can serve as a foundation for evidence-based school health programs that promote active living and mindful gadget use. This research also contributes to the broader discourse on non-communicable disease prevention through behavioral modification in early life. By targeting modifiable lifestyle factors, this study aims to offer a practical approach to public health promotion in urban youth populations.

Recent studies have increasingly shown a complex relationship between gadget usage and various aspects of physical and mental health among children and adolescents. Dwi Syakirah et al. (2024) investigated the correlation between street food consumption, physical activity, and media exposure in elementary students, revealing a link between electronic media usage and increased obesity risk. Similarly, Liza et al. (2023) found a significant association between gadget addiction and cognitive function impairment in Bangladeshi schoolchildren, stressing the need for regulated screen time. Donthu et al. (2022) explored the relationship between screen time and both physical and mental health, concluding that excessive use negatively affects children's overall well-being. Sirajudeen et al. (2022) documented the prevalence of 'text neck' and smartphone addiction among university students in Saudi Arabia, underlining musculoskeletal implications due to poor posture. Rashid et al. (2021) conducted a cross-sectional study in Bangladeshi secondary schools and found that electronic gadget use was strongly associated with vision problems, sleep disorders, and reduced academic focus.

In addition, Alwhaibi et al. (2022) examined children with Down Syndrome and discovered a negative correlation between increased technology usage and physical activity levels, suggesting that the vulnerable population is at even higher risk. Behera et al. (2023) found that musculoskeletal pain among nursing students was significantly associated with prolonged gadget usage, further indicating broader impacts beyond the school age group. El-Gohary & Aljohani. (2023) demonstrated that habitual texting and writing behaviors impact hand-grip strength, indicating early signs of physical adaptation or strain due to frequent gadget use. Furthermore, Prakasam et al. (2024) compared stress levels and physical activity before, during, and after the COVID-19 lockdown, showing that excessive gadget use contributed to sedentary lifestyles and increased stress, especially in academic settings. Finally, Muange & Ngigi. (2021) highlighted how prolonged gadget exposure negatively affects dietary patterns, contributing to nutritional deficiencies and poor physical health.

These studies collectively reinforce the notion that excessive gadget use is not only a behavioral concern but also a public health issue. The findings emphasize the necessity of comprehensive approaches to mitigate health risks in school-age populations, particularly through school-based interventions and parental awareness programs that promote balanced gadget use, physical activity, and healthy lifestyle habits.

Although existing research highlights the individual impacts of gadget use and physical inactivity on adolescent health, few studies have examined the interplay of these two variables in the context of overnutrition, especially in urban Indonesian settings like Bekasi. Most literature is centered around general obesity trends without narrowing down to lifestyle-specific causes among

youth in secondary school environments. Additionally, previous studies have largely overlooked the role of school and community-based behavioral interventions tailored to urban adolescents. There is also limited data using standardized measurement tools for both gadget usage and physical activity, leading to inconsistencies in findings. Therefore, this study fills a critical gap by employing validated instruments to assess gadget usage and physical activity and by analyzing their combined effect on overnutrition in adolescents.

This study aims to determine the relationship between gadget use and physical activity with the nutritional status of adolescents. It investigates whether high gadget usage and low physical activity are significantly associated with an increased risk of overnutrition among junior high school students. By identifying behavioral factors that contribute to nutritional imbalances, this research intends to provide actionable recommendations for health promotion programs targeting urban youth. The findings are expected to support the development of preventive strategies and health policies in schools, particularly those in digitally advanced cities like Bekasi. Moreover, the study aims to promote awareness among educators, parents, and policymakers regarding the health implications of sedentary lifestyles. Understanding these associations will also help prioritize physical activity as a protective behavior in adolescent health. Ultimately, this research contributes to the broader public health discourse on addressing modifiable risk factors for non-communicable diseases from an early age.

METHOD

Research Design

This study employed a quantitative observational approach using a cross-sectional design to examine the relationship between gadget use, physical activity, and overnutrition among adolescents. A cross-sectional design is suitable for identifying patterns and associations within a population at a specific time point. It provides an efficient framework for health behavior studies among adolescents, especially when dealing with lifestyle and nutrition variables. This design allows researchers to analyze multiple variables simultaneously without manipulating study conditions. The study was conducted from September to November 2023 in a junior high school located in Bekasi, West Java, Indonesia. Cross-sectional approaches are commonly used in adolescent health studies to monitor emerging public health risks (Berg et al. 2022 and Taba et al. 2022). The design supports rapid data collection and provides a snapshot of behavioral trends affecting nutritional outcomes. Ethical approval was obtained from the institutional review board before the study commenced.

Participants

The target population consisted of students aged 12–15 years enrolled in SMP Negeri 33 Bekasi. A total of 100 students were selected using stratified random sampling to ensure balanced representation across grades. Inclusion criteria required participants to be free from chronic illness and able to independently complete the questionnaires. Adolescents with known metabolic disorders, physical disabilities, or those undergoing weight treatment were excluded. The sample size was determined using a prevalence-based formula with a 95% confidence level and 10% margin of error. This method is consistent with previous nutritional surveillance studies in Southeast Asia (Chua et al. 2021). Written consent was obtained from participants and their guardians prior to data collection. The study ensured confidentiality and anonymity through secure data handling protocols.

Instruments

Three major instruments were utilized: a gadget usage questionnaire, the PAQ-A to assess physical activity, and anthropometric measurements for nutritional status. Gadget usage was measured using a modified version of Mazeas et al. (2022) questionnaire that evaluates daily duration and frequency of device use. Physical activity was assessed with the Physical Activity Questionnaire for Adolescents (PAQ-A), a standardized instrument known for its high reliability in diverse adolescent populations. Anthropometric data, including height and weight, were collected using calibrated instruments following WHO protocols. Nutritional status was categorized using BMI-for-age z-scores based on WHO growth standards. Participants with z-scores above +1 SD were classified as overnourished. All tools were pre-tested with 10 students to ensure clarity and internal consistency. Data collection was supported by trained personnel from the school's health unit.

Data Analysis Plan

Data analysis was conducted using SPSS version 25.0. Descriptive statistics were used to summarize demographic characteristics, gadget usage, physical activity scores, and nutritional status. The association between gadget use and overnutrition, as well as between physical activity and overnutrition, was tested using the Chi-square test. This statistical test is widely used in health studies for categorical data comparisons and epidemiological risk assessments (Yu et al. 2022). A significance level of $p < 0.05$ was considered statistically meaningful. The independent variables (gadget use and physical activity) were categorized into high/low groups based on established scoring criteria. Cross-tabulations were performed to observe distribution patterns between variables. Results were interpreted in reference to theoretical models of sedentary behavior and youth health outcomes.

RESULTS AND DISCUSSION

Results

A total of 100 adolescents aged 12–15 years participated in this study. Among them, 59% were classified as having high gadget usage (more than 4 hours per day), while 41% reported low gadget usage. In terms of physical activity, 55% of students fell into the active category, and 45% were classified as having low activity based on PAQ-A scores. Nutritional status assessment showed that 31% of the respondents were categorized as overnourished (BMI-for-age > +1 SD), while the rest had normal or underweight status. The Chi-square test was used to determine the statistical relationship between independent variables and nutritional status. Table 1 presents the association between gadget use and overnutrition, and Table 2 shows the relationship between physical activity and overnutrition. Based on these analyses, gadget usage did not show a statistically significant association with overnutrition ($p > 0.05$), whereas physical activity demonstrated a significant relationship ($p < 0.001$). These findings suggest that physical activity plays a more decisive role in influencing adolescent nutritional outcomes than gadget use alone.

Table 1. Association between Gadget Usage and Overnutrition

Gadget Usage	Overnourished	Not Overnourished	Total
High Usage	18	41	59
Low Usage	13	28	41
Total	31	69	100

p-value: 0.452 (Chi-square Test)

Table 1 shows that among adolescents with high gadget usage, 18 (30.5%) were overnourished. Among those with low gadget usage, 13 (31.7%) were overnourished. The Chi-square test indicates no significant relationship between gadget usage and overnutrition (p = 0.452), suggesting that gadget use alone may not directly influence nutritional status in this population.

Table 2. Association between Physical Activity and Overnutrition

Physical Activity	Overnourished	Not Overnourished	Total
Low Activity	24	21	45
High Activity	7	48	55
Total	31	69	100

p-value: 0.000 (Chi-square Test)

Table 2 reveals that 24 out of 45 students with low physical activity were overnourished, compared to only 7 out of 55 students who had high physical activity. The Chi-square result (p = 0.000) shows a significant association between physical activity and overnutrition. This finding supports the hypothesis that low physical activity is a major contributor to overnutrition in adolescents.

Discussion

The study found a strong and statistically significant association between low physical activity and overnutrition among adolescents, aligning with findings from similar studies globally. Adolescents with low activity levels were more likely to be overnourished, which reflects broader concerns about sedentary lifestyles in urban environments. This supports the argument that regular physical activity is a key factor in maintaining a healthy weight among adolescents (Wintle. 2022). The absence of a significant relationship between gadget usage and overnutrition suggests that while screen time may be high, it is the reduced physical movement associated with it that exerts a greater impact (Verma et al. 2025). Other studies have echoed that physical activity plays a stronger mediating role in the relationship between digital behavior and BMI than screen time alone (Shi et al. 2024).

Furthermore, urban adolescents are especially vulnerable due to lifestyle changes driven by modernization and digital access. A study by (Sarmiento et al. 2021) emphasized that interventions targeting increased physical activity in schools significantly reduce obesity rates in urban youth. While gadget use may not directly cause overnutrition, it can displace active time and reduce energy expenditure, which cumulatively contributes to weight gain (Aguas. 2024). In this context, policies should not only aim to limit screen time but also actively promote physical education programs and extracurricular sports (Haug. 2025). Given the growing dependence on gadgets for education and entertainment, a more integrative approach combining awareness and structured physical activity is warranted. Schools, parents, and health authorities must collaborate to design sustainable interventions that prioritize adolescent health holistically.

Implications

The findings from this study underscore the critical importance of promoting physical activity to combat overnutrition in adolescents. School-based health promotion programs must be reinforced to encourage daily exercise routines and limit sedentary behavior. Public health campaigns should also address the indirect impact of high gadget use by fostering awareness on active screen engagement. Policymakers can use these insights to develop national guidelines that integrate

physical activity into daily curricula. In urban areas like Bekasi, where digital penetration is high, efforts to balance technology use and physical health are urgent. Teachers and parents play a vital role in shaping lifestyle habits early in adolescence. Furthermore, the study adds value to existing literature by focusing on the combined influence of digital behavior and physical activity. This holistic view can inform future interventions and contribute to the long-term prevention of adolescent obesity.

Limitations

Despite its valuable findings, this study has several limitations. First, its cross-sectional nature prevents the establishment of causal relationships between variables. Second, the sample was limited to a single school in an urban area, which may affect the generalizability of the results. Third, the use of self-reported questionnaires may introduce recall bias or socially desirable responses. Fourth, the categorization of physical activity and gadget use relied on cutoff points that may vary in other cultural settings. Additionally, unmeasured factors such as dietary intake, parental influence, and socioeconomic status were not included in the analysis. Future research should consider incorporating longitudinal designs and a wider demographic to validate these findings. Including qualitative methods may also enrich understanding of adolescent behavior regarding screen time and exercise.

Suggestions

Future studies should explore longitudinal relationships between gadget use, physical activity, and nutrition to better understand causal pathways. Expanding the research to multiple schools in both urban and rural settings can improve the representativeness of the data. Researchers are encouraged to include dietary patterns, psychosocial factors, and family dynamics in future models. Interventions aimed at adolescents should involve collaborative strategies between schools, healthcare providers, and families. Technological tools such as fitness apps or gamified activity trackers may serve as innovative solutions to enhance physical activity. Educational modules can also be integrated into school curricula to promote digital health literacy. Finally, policy-level initiatives should focus on building environments conducive to adolescent well-being, including safe recreational spaces and accessible sports facilities.

CONCLUSIONS

This study concludes that physical activity has a significant association with overnutrition among adolescents, whereas gadget usage alone does not exhibit a direct statistical relationship. Adolescents with low physical activity levels were found to have a higher risk of being overnourished, emphasizing the critical role of active lifestyles in maintaining optimal nutritional status. Although high gadget use is often blamed for sedentary behavior, its impact may be indirect and moderated by the level of physical movement. These findings suggest that interventions should prioritize promoting physical activity rather than solely focusing on reducing screen time. Public health strategies must be tailored to address behavioral patterns in urban adolescent populations, particularly in digitally saturated environments like Bekasi. Integrating structured physical education programs within school systems can serve as an effective preventive measure. The results contribute valuable evidence to the discourse on adolescent health and offer practical insights for education and health policy development. Future research should further investigate the combined influence of digital behavior, physical activity, and dietary patterns on long-term health outcomes.

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