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Correlates of physical activity, screen time, and engagement in sports extracurricular activities and clubs among urban Indonesian adolescents

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Abstract

Introduction. While the correlates of physical activity and screen media use have been widely studied in high-income countries, there is limited evidence from middle-income settings such as Indonesia. **Aim of Study.** This study investigated the correlates of physical activity, screen time, and sports participation among adolescents in urban Yogyakarta, Indonesia. **Material and Methods.** A cross-sectional study was conducted with 1,068 junior high school students (mean age = 14.1 years, SD = 0.95) from three public schools. Data were collected using online questionnaires assessing sociodemographic characteristics, physical activity (measured via the Indonesian version of the Physical Activity Questionnaire for Adolescents – PAQ-A), and daily screen time across various domains. Physical activity was categorized into low, moderate, and high levels. Multinomial logistic regression was used to examine correlates of physical activity, while binary logistic and multiple linear regression analyses explored predictors of sports participation and total screen time. **Results.** The majority of participants (80.7%) had low physical activity levels. Average screen time was 7.8 hours on weekdays and 10.3 hours on weekends. Two-thirds of students did not participate in sports extracurriculars. Physical activity levels were significantly associated with school grade, parental education, sex, body mass index (BMI), sports participation, and screen-based behaviors (p < 0.05), explaining 37.7% of the variance. Sports extracurricular participation was more likely among boys, students in lower grades, those with normal BMI, and adolescents with higher physical activity levels and lower weekend screen time. Male students and those with more highly educated fathers were more likely to report lower screen time. **Conclusions.** This study highlights alarmingly low physical activity, high screen use, and limited sports participation among adolescents in a middle-income urban context. Future research should explore longitudinal and mixed-method approaches to better understand behavioral patterns over time and guide culturally tailored interventions to improve adolescent health.

KEYWORDS: physical activity, adolescents, sedentary behavior, Indonesia, urban, screen time.

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Introduction

Research has confirmed that physical activity contributes to adolescents' health significantly, preventing obesity, enhancing physical fitness, increasing bone and mental health, as well as cognitive function [1-3]. For this reason, the World Health Organization recommends that adolescents engage in regular physical activity throughout the week, with a duration of at least an average of 60 minutes of moderate-to-vigorous physical activity per day [1]. Unfortunately, many young people fail to comply with the guidelines [4]. Literature also showed that physical activity levels tend to decrease during adolescence [5].

The trend of the decline in physical activity among adolescents was influenced by multiple factors, including sociodemographic, social support, lifestyle choices, and environmental factors [6].

In Indonesia, the increase in technology use, especially screen-based media, seemed prevalent [7, 8]. This trend may have affected adolescents' lifestyles significantly, including the decrease in physical activity levels. While screen-based activities can offer educational, social, and recreational benefits, excessive screen time for non-academic or leisure purposes has been linked to adverse health outcomes, including poorer body composition, reduced social interaction, lower fitness levels and academic achievement [9, 10].

Numerous studies have identified a range of sociodemographic, behavioral, and environmental factors associated with physical activity among children and adolescents. These correlates include age, sex, body mass index (BMI), parental support, access to recreational facilities, screen time, and participation in organized sports [11-13]. However, the vast majority of these studies have been conducted in high-income countries, where the contextual factors influencing youth activity patterns – such as urban design, school infrastructure, and cultural norms – may differ significantly from those in low- and middle-income countries (LMICs).

This geographic imbalance limits the generalizability of existing evidence and highlights the need for context-specific investigations. In this regard, studies conducted in middle-income countries like Indonesia are essential to identify locally relevant correlates of physical activity and inform more targeted health promotion strategies. This study addresses this gap by exploring the correlates of physical activity, screen time, and sports extracurricular/club engagement among adolescents in urban areas in Yogyakarta. The objective of this study is to identify key sociodemographic and behavioral factors associated with these outcomes. Results from this research may inform future interventions aiming to promote healthier lifestyles among Indonesian youth.

Material and Methods

Participants

We recruited junior high school students from three public schools in the Yogyakarta City region to participate in this study, using quota and incidental sampling techniques. A quota of 12 classes per school was selected to ensure a diverse and adequate representation of students across Grades 7 to 9, while also taking into account the varying number of classes available in each grade at different schools. This approach allowed for proportional sampling based on class availability and helped maintain a manageable scope for data collection. Prior to data collection, written informed consent was obtained from the students' parents or legal guardians via an online form. Students were informed that participation was voluntary and that they could decline to complete the questionnaire without any consequences. While formal written assent was not required, verbal assent was implied by each student's decision to proceed with the online survey. After removing duplicate entries and excluding incomplete responses, a total of 1,068 complete responses were retained for analysis.

Study design

This study employed a cross-sectional design, with data collection conducted in Yogyakarta in March 2024. Ethical approval was obtained from the Research Ethics Committee of Universitas Negeri Yogyakarta (Approval Number: T/6.35/UN34.9/KP.06.07/2024).

Measures

Sociodemographic questionnaire

We asked participants and their parents to report demographic characteristics, such as grade, education level, salary, and age, using an online form. The questionnaire was distributed to parents via an online link so that they could review its contents and assist their child if needed. Although students were the ones completing the survey, they were instructed to consult with their parents when answering questions that required parental information, such as parental education, occupation, and household income.

Anthropometry

Participants self-reported their weight (kg) and height (cm) using an online form. We used the data to assess BMI.

Physical activity

For assessing physical activity levels, we collected data by using the Indonesian version of the Physical Activity Questionnaire for Adolescents (PAQ-A) [14], originally developed by Kowalski et al. [15], delivered through an online form. The item validity of the Indonesian version of PAQ-A ranged between 0.338 and 0.737, while the reliability was acceptable ($\alpha = 0.740$) [14].

Screen time

To assess screen time, participants were asked to report the average number of hours per day over the past

seven days spent on screen-based sedentary activities, including watching TV and videos, using social media, and playing screen-based games. These items were adapted from the Adolescent Sedentary Activity Questionnaire (ASAQ) [16] and administered via an online form.

Data collection
We collected data through a secured online Google Form. The research team explained the data collection procedure to the physical education teachers, and then the teachers explained it to their students. Depending on the available facilities, students accessed and completed the online questionnaire either using their personal smartphones or through school-provided computers in the computer laboratory. The collected data were compiled using a Google spreadsheet and then imported into Microsoft Excel for further analysis.

Data analysis
Descriptive analyses were conducted using Microsoft Excel and IBM SPSS Statistics version 23. In Excel, duplicates were cross-checked by scanning for identical entries in name and response patterns. In cases where multiple identical entries were found for a single participant, only the first complete submission was retained, and any subsequent or incomplete responses were removed. Duplicate responses were also identified using the 'Identify Duplicate Cases' function in SPSS, based on matching values across key variables (e.g., name, class, and demographic information). We presented physical activity level and demographic data in frequency (n), percentage (%), mean (average), and standard deviation (SD).
Furthermore, we excluded participants who accumulated a total screen time for more than 15 hours per day. This threshold was chosen considering that adolescents typically allocate significant portions of their day to school activities and sleep, making screen time exceeding 15 hours per day implausible for most. Implementing this cap allowed us to retain the majority of our data while minimizing the impact of potentially inaccurate responses.
To identify the correlates of physical activity levels, we used multinomial logistic regression, with physical activity treated as a categorical outcome consisting of three levels: low, moderate, and high. The physical activity variable was originally classified into five categories (very low, low, moderate, high, very high) based on standard scoring of the Indonesian version

of PAQ-A [14]. However, due to an extremely small number of respondents in the very low (n = 15) and very high (n = 0) categories, the distribution was highly skewed. To improve the stability and interpretability of the model, these five categories were collapsed into three. This approach also helped address estimation problems such as singularities and extreme standard errors. The adjusted effects of the independent variables on physical activity levels were presented as odds ratios with 95% confidence intervals.
The independent variables included in the regression model were grade, father's education, mother's education, total parental income, sex, BMI, participation in sports extracurricular activities/clubs, and weekday/weekend screen-based behaviors (TV, video, social media, and screen-based gaming). Age was excluded from the final model because it caused estimation issues and multicollinearity within the multinomial logistic regression model.
To identify factors associated with sports extracurricular participation (Yes/No), binary logistic regression was performed, with grade, sex, parental education, parental income, BMI, physical activity level, and screen-based behaviors as predictor variables. Meanwhile, multiple linear regression was used to examine factors associated with total weekday and weekend screen time (in hours). The predictors included grade, sex, father's and mother's education, total parental income, BMI, physical activity level, and sports extracurricular participation.

Results

Sample characteristics
A total of 1,068 out of 1,239 eligible students completed the survey, yielding an actual response rate of 86.2%. Participants were enrolled in Grades 7 through 9, with 321 students (30.1%) from Grade 7, 367 (34.4%) from Grade 8, and 380 (35.6%) from Grade 9. In terms of gender distribution, 588 participants (55.1%) were female and 479 (44.9%) were male. The mean age of participants was 14.1 years (SD = 0.95). Among fathers, the most common educational attainment was senior high school (39.2%), followed closely by bachelor's degree (38.7%). Among mothers, the two most frequently reported education levels were senior high school and bachelor's degree, both at 42.2%. Overall, 33.8 % of students reported participating in sports extracurricular activities or clubs (boys = 39.5%, girls = 29.2%). Further demographic and background details are presented in Table 1.

Table 1. Characteristics of participants (n = 1,068)

Variable	Frequency	Percentage (%)
Sex		
female	588	55.1
male	479	44.9
age (years), mean (SD)	14.1 (0.95)	
Body Mass Index		
very underweight	273	25.6
underweight	229	21.4
normal weight	461	43.2
overweight	66	6.2
obese	39	3.7
Grade		
7	321	30.1
8	367	34.4
9	380	35.6
Father's education		
not relevant (passed away)	33	3.1
primary school	23	2.2
junior high school	57	5.3
senior high school	419	39.2
bachelor's degree	413	38.7
master's degree	99	9.3
doctoral degree	24	2.2
Mother's education		
not relevant (passed away)	5	0.5
primary school	23	2.2
junior high school	45	4.2
senior high school	451	42.2
bachelor's degree	451	42.2
master's degree	71	6.6
doctoral degree	22	2.1
Parents' salary		
very low (>IDR 1,000,000)	71	6.6
low (IDR 1,000,000-2,500,000)	232	21.7
moderate (IDR 2,500,000-4,000,000)	449	42.0
high (IDR 4,000,000-5,500,000)	103	9.6
very high (<IDR 5,500,000)	213	19.9
Attending sports extracurricular/club (yes/no)	361/707	33.8/66.2
female (yes/no)	172/417	29.2/70.8
male (yes/no)	189/290	39.5/60.5

Note: SD – standard deviation, IDR – Indonesian rupiah

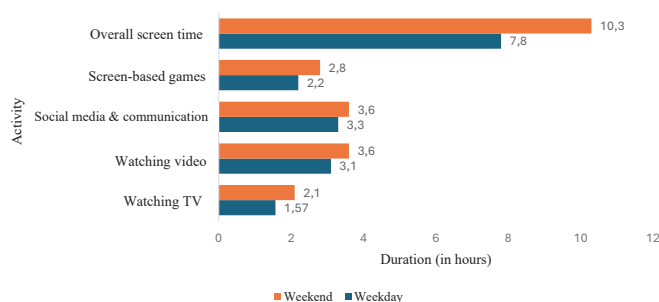*Physical activity level and screen time*
We found that the majority of the participants reported insufficient physical activity (low = 80.7%, very low = 1.4%), with a higher number of girls reporting insufficient physical activity than boys (47% vs 35%). Participants were most active during physical education lessons (mean = 3.7, SD = 0.9). The average total screen time during weekdays was 7.8 hours (SD = 3.3), while on the weekend was 10.3 hours (SD = 4.2). Details can be seen in Table 2 and Figure 1.

Table 2. Participants' physical activity and screen time (n = 1,068)

Variable	Frequency	Percent
Physical activity level		
very low	15	1.4
low	862	80.7
moderate	176	16.5
high	15	1.4
very high	0	0.0
Physical activity by sex		
female (sufficient/insufficient)	86/503	14.6/85.4
male (sufficient/insufficient)	105/374	21.9/78.1
PAQ-A	Mean	Standard deviation
Question 1 (leisure PA)	1.1	0.3
Question 2 (PA during PE)	3.7	0.9
Question 3 (PA during lunch time)	1.8	1.3
Question 4 (PA after school)	1.8	0.9
Question 5 (PA late afternoon)	1.6	0.8
Question 6 (PA during weekend)	2.3	0.8
Question 7 (overall PA past week)	1.6	0.9
Question 8 (daily PA past week)	2.7	0.7
Screen time	Mean (hours)	Standard deviation
watching TV weekday	1.57	0.9
watching TV weekend	2.1	1.2

watching video weekday	3.1	1.4
watching video weekend	3.6	1.4
social media & communication weekday	3.3	1.3
social media & communication weekend	3.6	1.3
screen-based games weekday	2.2	1.2
screen-based games weekend	2.8	1.5
Overall screen time		
weekday: male/female (mean ± SD)	7.8 (8.2 ± 3.2 / 7.6 ± 3.3)	3.3
weekend: male/female (mean±SD)	10.3 (10.8 ± 4.1 / 9.8 ± 4.2)	4.2

Note: PAQ-A– physical activity questionnaire for adolescents, PA – physical activity, PE – physical education, SD – standard deviation

Figure 1. Duration of screen time during weekday and weekend (in hours)

Correlates of physical activity
Multinomial logistic regression was conducted to examine the correlates of physical activity levels among adolescents (low, moderate, high). The model was statistically significant (χ^2 = 297.67, df = 112, p < 0.001) with good fit indicators (Pearson χ^2 = 1041.74, p = 1.000, deviance = 807.81, p = 1.000). The model explained 37.7% of the variance (Nagelkerke R^2 = 0.377) and correctly classified 83.1% of cases. Significant predictors of physical activity level included grade (p < 0.001), father's education (p < 0.001), mother's education (p < 0.001), sex (p < 0.001), BMI category (p < 0.001), participation in sports extracurricular activities (p < 0.001), weekday TV viewing (p < 0.001), weekday social media use (p < 0.001), and both weekday and weekend screen-based gaming (p < 0.001) (Table 3).
Compared to Grade 9 students, those in Grade 7 were 1.95 times more likely (OR = 1.95, 95% CI: 1.11-3.43, p = 0.02) and those in Grade 8 were 6.49 times more likely (OR = 6.49, 95% CI: 4.03-10.44, p < 0.001)

to report moderate physical activity levels. Students whose parents had very low income were significantly less likely to be moderately active (OR = 0.20, 95% CI: 0.06-0.74, p = 0.015) compared to those with very high income. Male students had 2.5 times greater odds of being moderately active than females (OR = 2.52, 95% CI: 1.62-3.92, p < 0.001). Interestingly, students not participating in sports extracurriculars had higher odds of reporting moderate physical activity than those who did (OR = 1.67, 95% CI: 1.09-2.55, p = 0.017). Lastly, playing screen-based games for more than 2 hours on weekends was associated with increased odds of being in the moderate physical activity category (OR = 2.40, 95% CI: 1.02-5.64, p = 0.044) (Table 4).

Table 3. Correlates of physical activity

Effect	Likelihood ratio tests		
	chi-square	df	sig.
Grade	136.611	4	0.000
Father's education	62.678	12	0.000
Mother's education	78.164	12	0.000
Parents' salary	11.662	8	0.167
Sex	17.221	2	0.000
Body mass index (BMI)	52.982	8	0.000
Sport extracurricular/clubs	73.042	2	0.000
Watching TV weekday	57.982	8	0.000
Watching TV weekend	2.217	8	0.974
Watching video weekday	2.083	8	0.978
Watching video weekend	2.731	8	0.950
Using social media weekday	59.419	8	0.000
Using social media weekend	4.368	8	0.822
Playing screen-based games weekday	66.097	8	0.000
Playing screen-based games weekend	67.647	8	0.000

Correlates of participation in sports extracurricular/ clubs
Binary logistic regression analysis revealed several significant predictors of sports extracurricular participation among adolescents (Table S1, Supplementary Materials). Students in Grade 7 (OR = 9.08, 95% CI: 5.87-14.03, p < 0.001) and Grade 8 (OR = 5.91, 95% CI: 3.86-9.03, p < 0.001) were significantly more likely to participate than those in Grade 9. Male students had 1.7 times greater odds of

Table 4. Significant odds ratios – moderate vs low physical activity

Predictor comparison	PA level compared to low	Exp(B) (odds ratio)	95% CI lower bound	95% CI upper bound	p-value	Interpretation
Grade 7 vs Grade 9	moderate	1.950	1.109	3.430	0.02	Grade 7 students are 1.95 × more likely to be in moderate PA than Grade 9
Grade 8 vs Grade 9	moderate	6.487	4.032	10.436	0.000	Grade 8 students are 6.49 × more likely to be in moderate PA than Grade 9
Parents' salary very low vs very high	moderate	0.204	0.056	0.737	0.015	Students whose parents had very low income were 4.9 times less likely to be in moderate PA compared to those whose parents had very high income
Sex = male vs female	moderate	2.522	1.620	3.924	0.000	Male students are 2.5 × more likely to be in moderate PA than females
Sport extracurricular = no vs yes	moderate	1.669	1.094	2.545	0.017	Students not in extracurricular sports are 1.7 × more likely to be in moderate PA than those who participate
Games weekend <2 hours vs >4 hours	moderate	2.400	1.022	5.636	0.044	Gaming <2 hours on weekends increases likelihood of moderate PA compared to <4 hours

Note: PA – physical activity

participating compared to female students (OR = 1.69, 95% CI: 1.18-2.43, p = 0.005). Compared to students with obese BMI, those with normal BMI (OR = 4.15, p = 0.002) had significantly higher odds of participation. Physical activity level was a strong predictor, with students in the high physical activity category having nearly 58 times greater odds of participating compared to those in the low physical activity category (OR = 57.70, 95% CI: 6.53-509.81, p < 0.001). Overall, the model demonstrated a good fit (Hosmer–Lemeshow p = 0.877) and correctly classified 75.9% of cases.

Correlates of total weekday and weekend screen time
Table S2 (Supplementary Materials) describes the comparison between the independent t-test and multiple linear regression results for screen time. We found that the models met assumptions of normality, linearity, and homoscedasticity, with no indication of multicollinearity (all VIFs < 1.4) and acceptable residual independence. Independent t-tests revealed that male students reported significantly higher total screen time than female students on both weekdays (M = 8.18 hours vs 7.58 hours, p = 0.003) and weekends (M = 10.85 hours vs 9.85 hours, p < 0.001). However, in the multiple linear regression analysis that adjusted for covariates including grade level, parental education, parental income, BMI, physical activity level, and sports extracurricular participation, sex was significantly associated with

lower screen time: being male was associated with reduced screen time during both weekdays (B = –0.607, p = 0.003) and weekends (B = –0.995, p < 0.001). This indicates that the direction of association changes after accounting for other influencing factors.

Discussion
This study is among the first to investigate the correlates of physical activity, screen time, and sports extracurricular/club engagement among adolescents in urban Yogyakarta, Indonesia. This study contributes to the growing but still limited body of research on the correlates of adolescent physical activity in LMICs, particularly within the Southeast Asian context. By focusing on urban Indonesian youth, the findings provide regionally relevant insights that are often underrepresented in the global literature dominated by studies from high-income settings.
Regarding physical activity level, we observed that the majority of participants reported low physical activity levels (80.7%), with a higher number of girls reporting insufficient physical activity than boys (85.4% vs 78.1%). Sports participation was also relatively low, which was shown by the fact that around 70% of girls and 60% of boys did not join sports extracurricular activities/clubs. These findings are consistent with global patterns. In a research involving 146 countries worldwide, Guthold et al. [4] found similar results – 81% of adolescents

reported insufficient physical activity, the prevalence in girls was higher compared to boys (84.7% vs 77.6%). In a study including data from 105 low- to high-income countries, Marques et al. [17] found that more than 80% of adolescents did not perform daily physical activity, with girls reporting a lower prevalence of daily physical activity compared to boys (19.4% vs 28.2%). Other studies also reported that boys were more likely to engage in more physical activity than girls [17-20]. Findings from the present study implied that future interventions aiming to improve physical activity in adolescents are urgently warranted for both girls and boys, with some emphasis on girls who have a higher prevalence of physical inactivity.

Our analysis revealed that girls reported significantly lower physical activity levels than boys, a pattern that appears to be closely linked to their lower participation in sports extracurricular activities. This finding is consistent with the study by Telford et al. [20], which identified reduced support from schools and families, as well as limited engagement in structured sports programs, as key contributors to lower activity levels among girls. These results highlight the important role of school-based extracurricular opportunities in promoting adolescent physical activity. To reduce gender disparities, it is essential to foster inclusive and supportive environments that address girls' social and structural barriers to participation.

Beyond structural access, psychosocial factors such as body image may also play a role in limiting girls' physical activity. Kantanista et al. [18] found that body image was positively associated with physical activity, and that girls were more likely than boys to report negative body image. This suggests that poor body image may discourage girls from engaging in physical activity, especially in group or public settings. Furthermore, other studies have shown that girls perceive greater barriers to being physically active compared to boys, particularly in terms of lack of energy and willpower [21]. These insights highlight the need for future interventions targeting adolescent girls to incorporate strategies that improve self-confidence, body image, and motivation, in addition to increasing accessibility. Tailoring programs to align with girls' preferences – such as offering fun, non-competitive, and peer-supported activities – may enhance participation. Moreover, support from parents (e.g., through transportation or financial assistance) and schools (e.g., by offering a variety of engaging extracurricular options) can play an essential role in increasing girls' overall activity levels.

Our analysis revealed that school grade significantly influenced adolescents' physical activity levels and participation in sports extracurricular. Students in Grades 7 and 8 are more likely to report higher levels of physical activity and participation in sports extracurricular, indicating a decline in involvement as students progress to higher educational levels. While some previous studies reported no significant association between age and physical activity levels [22, 23], our results align with other research demonstrating declines in physical activity as students advance to higher grades or age [24-26]. Previous studies in Switzerland and China also found similar results that adolescents' participation in sports extracurriculars declined over time [27, 28]. These reductions might be attributed to increased academic demands, reduced leisure time, and fewer structured opportunities for physical activity in older adolescents. Future research should explore the specific reasons behind this trend to better inform targeted physical activity interventions. A previous study reported that adolescents having lower sports skills were also less likely to join in sports activity [28]. Future interventions aiming to increase sports participation in adolescents need to design programs that are inclusive for adolescents irrespective of their sports skills.

For clarification, although age data were initially collected, we excluded age from our final analysis due to issues with estimation and multicollinearity in the regression models. Age and grade were highly correlated; however, grade was retained over age because it provides greater contextual relevance in the school setting. Specifically, grade level directly reflects students' academic progression, social environment, and opportunities for structured physical activities such as curriculum-based physical education. Additionally, grade categories have clearer implications for policy interventions.

Our analysis also revealed notable associations between adolescents' physical activity levels and participation in sports extracurricular activities. Interestingly, students who did not participate in sports extracurricular activities showed higher odds of reporting moderate physical activity levels compared to those who participated. Although counterintuitive, this result may reflect that students who are formally registered for sports extracurricular activities might not consistently attend or actively engage in the programs. Several factors might influence this limited participation, such as competing academic demands, scheduling conflicts, lack of interest, or insufficient social support.

Additionally, informal or unstructured physical activities outside formal extracurricular programs could significantly contribute to adolescents' overall moderate activity levels. Future research should explore attendance patterns and engagement intensity within extracurricular sports programs, as well as adolescents' informal physical activity behaviors, to inform more effective strategies for increasing overall physical activity.

Our findings on parental education differed somewhat from previous research. While prior studies have often found higher parental education to be positively associated with greater adolescent physical activity [29, 30], our analysis indicated a more complex relationship, with parental education significantly contributing to the overall model, yet without clear directional odds ratios distinguishing between education levels. It is possible that cultural or contextual differences within the Indonesian setting may explain this complexity. Further investigation into how parental educational background affects adolescent physical activity behaviors in different cultural contexts would provide valuable insights.

Although the overall likelihood ratio test indicated that parental income was not a significant predictor across all physical activity categories collectively, specific comparisons revealed notable differences. For example, adolescents from households with very low parental income showed significantly lower odds of engaging in moderate physical activity compared to their peers from higher-income households. This indicates that parental income may play a specific, context-dependent role in determining physical activity, particularly when distinguishing between certain levels of activity. Thus, interpreting individual odds ratios alongside overall model tests provides a nuanced understanding of how socioeconomic factors may influence adolescent behaviors.

Further analysis revealed other important correlates of sports extracurricular participation among adolescents. BMI status influenced participation, with students categorized as obese less likely to engage in sports activities, potentially due to physical discomfort, body image concerns, lower perceived physical competence, or fear of social judgment [31, 32]. As expected, adolescents with higher physical activity levels were more likely to participate in sports, suggesting a supporting relationship between habitual activity patterns and structured sport engagement. Additionally, screen-based behaviors such as excessive weekend TV watching and gaming were inversely associated with sports participation, supporting existing literature that

excessive screen time may displace opportunities for physical activity [33].

The current study found a high duration of daily screen time in adolescents during weekdays, and even much higher on the weekend. This situation is alarming due to the adverse effects that can be caused by excessive screen time. Previous studies showed that longer sedentary behaviour was positively correlated with adverse health outcomes [1], including poorer fitness and body mass index profile, higher cardiometabolic risks, as well as poorer sleep quality and psychosocial health [3, 9, 10, 34]. Marques et al. [35] reported that excessive screen-based sedentary behaviour in girls was associated with more physical and mental problems, including headaches, more anxiety, short temper and feeling inferior to others. Meanwhile, in boys, more screen time was correlated with short temper [35].

Moreover, our findings indicated that adolescents who reported playing screen-based games for less than 2 hours (<2 hours) on weekends had higher odds of being moderately physically active compared to those who played for more than 4 hours (>4 hours). This result provides new insight, namely that moderate gaming on weekends may not necessarily displace physical activity opportunities and could reflect healthier time-management patterns. Similarly, existing literature comparing nonactive and active gamers found that the latter spent longer time on moderate to vigorous physical activity [36]. However, it is important to note that excessive gaming durations appear to be associated with lower physical activity levels, potentially due to reduced available time for physical activities. Future interventions aimed at promoting physical activity should emphasize balanced recreational gaming practices, encouraging adolescents to maintain moderate gaming durations, especially during weekends.

It is also important to acknowledge that not all screen time is inherently harmful. Screen-based devices are increasingly used for educational purposes, especially in digitally integrated learning environments. The context and content of screen use play a crucial role in determining its impact. While recreational screen time has been consistently linked to negative health outcomes, educational screen use can support cognitive development and academic achievement [37]. Future studies should aim to differentiate between types and purposes of screen time to more accurately evaluate their effects on adolescent health and behavior.

The contrasting results between the bivariate and multivariate analyses for correlates of screen time provide insight into the complex relationships between

sex and screen time. Although boys initially appeared to spend more time on screens than girls, this association reversed in the regression models after adjusting for other covariates. This suggests that the higher raw screen time observed among boys may be influenced by other factors, such as grade level or BMI, which are themselves associated with screen behaviors. When these are controlled for, fesmale students demonstrated a stronger tendency toward higher screen use, particularly for social or passive media [7, 38]. This finding showed the importance of using multivariable analysis to uncover more accurate associations and avoid misleading conclusions based on unadjusted comparisons.

This study has several strengths. First, it utilized a large and diverse sample. Second, it explored a comprehensive set of variables, including sociodemographic factors, physical activity levels, screen time behaviors, and sports extracurricular participation. The use of the validated Indonesian version of the PAQ-A questionnaire also strengthens the reliability of the physical activity measurement. Importantly, the study was conducted in a middle-income setting, which remains underrepresented in the literature. The findings are especially relevant to Indonesia, where rapid technological adoption and urbanization are shaping adolescent behaviors and health outcomes. Although the cross-sectional design limits the ability to infer causality or determine temporal sequences, it remains a valuable methodological approach in this context. Cross-sectional studies allow for the identification of associations between key behavioral and contextual variables across large populations at a single time point. This makes them cost-effective and efficient for public health surveillance, particularly in school-based settings. In this study, the cross-sectional approach provided crucial baseline data on correlates of physical activity, screen time, and sports participation, which can guide future longitudinal studies and targeted interventions. Nonetheless, several limitations should be acknowledged. The use of self-reported measures may cause recall bias or inaccuracies. Additionally, relevant contextual factors such as dietary habits, mental health status, or environmental influences (e.g., availability of recreational facilities or safe play spaces) were not assessed. Including these variables in future studies may provide a more holistic understanding of adolescent health behaviors.

Conclusions

This study highlights the complex and interconnected correlates of physical activity, screen time, and sports extracurricular participation among adolescents in urban Yogyakarta, Indonesia. The findings point to alarmingly low physical activity levels, excessive screen time, and low sports participation, with significant disparities based on sex and school grade. Targeted interventions aimed at reducing screen time and increasing opportunities for active engagement are crucial – especially among girls, older students, and adolescents with high screen use. To support healthier adolescent lifestyles, schools and families must play a proactive role by providing inclusive access to sports programs, offering a diverse range of physical activity options, and modelling balanced digital media use. Addressing the specific barriers to participation, including social, cultural, and structural factors, will be key to closing gaps in physical activity equity. Future research should employ longitudinal and mixed-method approaches to track behavior changes over time and to inform the development of culturally relevant and scalable interventions tailored to the Indonesian context.

Conflict of Interest
The authors declare no conflict of interest.

Supplementary Materials
Supplementary data to this article can be found online at: https://tss.awf.poznan.pl/SuppFile/204207/1/

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