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The Impact of Screen Time, Content, and Context on Physical Activity, Sleep, and Behavioral Problems among International School Students

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Abstract: This study aimed to examine the associations between screen exposure, including usage duration, content characteristics, and viewing context, and adolescents' physical activity, sleep quality, and behavioral problems. A cross-sectional study was conducted among 16 eighth-grade students from an international school in Beijing. Screen usage was assessed using a self-administered questionnaire, while physical activity level, sleep quality, and behavioral problems were measured with the Physical Activity Questionnaire for Adolescents (PAQ-A), the Pittsburgh Sleep Quality Index (PSQI), and the Strengths and Difficulties Questionnaire (SDQ), respectively. Kendall's tau-b correlation analysis was used for statistical testing. The results showed that weekday screen time was significantly positively correlated with sleep problems ($\tau = 0.47$, $p < 0.05$) and hyperactivity problems ($r = 0.50$, $p < 0.05$), while weekend screen time was significantly negatively correlated with physical activity level ($r = -0.41$, $p < 0.05$) and prosocial behavior ($r = -0.45$, $p < 0.05$). In addition, exposure to violent content was significantly positively correlated with peer relationship problems ($r = 0.51$, $p < 0.05$), whereas no significant correlations were found for co-viewing frequency. These findings suggest that different dimensions of screen exposure may have distinct effects on adolescent health: weekday screen time is mainly associated with sleep and hyperactivity problems, weekend screen time may influence physical activity and prosocial behavior through a "time displacement" effect, and violent content may exacerbate peer relationship problems through social learning pathways. Overall, the study provides empirical support for targeted interventions based on the "screen time – content – context" triad model.

1. Introduction

In contemporary research on adolescent development, the interplay between digital media use and physical and mental health has emerged as a central topic. As internet penetration in China continue to rise, screen time among adolescents has increased remarkably. According to the Fifth National Report on Minors' Internet Usage, jointly released by the Youth League Central Committee's Department for the Protection of Adolescents' Rights and Interests and the China Internet Network

Information Center (CNNIC) on December 23, 2023, the number of minor internet users in China has reached 193 million. Notably, junior high school students spend an average of over 2.5 hours per day on screens, with this figure surging to more than 4.2 hours on weekends. Such pervasive screen exposure significantly impacts adolescent development, necessitating a thorough examination of its complex links to health indicators. In this study, "screen exposure" is conceptualized across three core dimensions: duration of use (differentiated by between weekdays and weekends), content characteristics (with a specific focus on exposure to violent content), and contextual factors (such as co-viewing with parents). Furthermore, drawing on the theoretical framework proposed by Goodman (1997) [1], problem behaviors were assessed using the Strengths and Difficulties Questionnaire (SDQ). This instrument evaluates five dimensions: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. These behaviors not only impair current social functioning but also serve as significant predictors of future mental health risks.

Several theoretical frameworks provide critical insights into the interplay between screen use and adolescent development. Bandura's (1986) Social Cognitive Theory highlights the pivotal role of observational learning in shaping behavior [2]. Meanwhile, the Displacement Hypothesis posited by Kraut et al. (1998) suggests that screen time reduces opportunities for physical activity and face-to-face social interaction [3]. Additionally, biological rhythm theories explain how nighttime screen use disrupts physiological sleep mechanisms [4]. Empirical studies have established strong associations between screen use and adolescent well-being. For instance, a large-scale study by Twenge and Campbell (2018) found that adolescents spending over three hours per day on screens faced a 35% higher risk of depressive symptoms [5]. A systematic review by Hale and Guan (2015) confirmed a dose-response relationship between screen use and both shortened sleep duration and sleep latency [6]. Furthermore, a meta-analysis by Bushman and Huesmann (2014) demonstrated a moderate positive correlation (r=0.30) between exposure to violent media content and aggressive behavior [7].

Despite these insights, existing literature still has notable limitations. Most studies focus solely on screen time duration, overlooking the moderating effects of content characteristics and usage contexts. Research specifically targeting students in international schools—a distinct demographic—is relatively scarce. Moreover, there is a lack of integrative research that simultaneously examines the interplay of screen exposure, physical activity, sleep quality, and problem behaviors. To address these gaps, this study employs a cross-sectional design involving eighth-grade students from international schools in Beijing. It systematically explores the relationships between various dimensions of screen exposure and physical activity, sleep quality, and problem behaviors. The aim is to provide empirical evidence for developing targeted intervention strategies and to fill the research gap regarding this specific population.

2. Methods

2.1 Participants

This study employed a cross-sectional design with data collected in May and June 2025. Participants were recruited via convenience sampling from an international school in downtown Beijing. A total of 24 questionnaires were distributed, and 16 valid responses were recovered, corresponding to an effective response rate of 66.7% . The final sample consisted entirely of eighth-grade students, comprising 7 boys (44%) and 9 girls (56%).

2.2 Measures

2.2.1 Self-designed Demographic Questionnaire

A self-designed demographic questionnaire was utilized to collect participants' basic information, including gender, age, grade, primary caregiver status, and parents' educational backgrounds and occupations. Additionally, the survey assessed subjective socioeconomic status (SES), with the specific question being "What is your current household financial situation?" Participants responded to this question on a 5-point scale, where the options ranged from "having a significant surplus" to "being severely deficient".

2.2.2 Physical Activity

Physical activity levels were assessed using the Chinese version of the Physical Activity Questionnaire for Adolescents (PAQ-A) [8], originally developed by Kowalski et al. (2004). This 20-item instrument includes specific items (Items 13 and 20) designed to evaluate overall physical activity intensity and participation frequency over the past week. Responses are rated on a 5-point scale, where 1 indicates "almost never" and 5 indicates "5 or more times per week."

2.2.3 Sleep Quality

Sleep patterns were evaluated using the adolescent version of the Pittsburgh Sleep Quality Index (PSQI) [9]. This instrument combines quantity and quality metrics to assess sleep over the past month. The scale consists of 19 self-rated items and 5 items rated by a bed partner or roommate; however, the 19th self-rated item and the 5 other-rated items are excluded from scoring. The scorable items are grouped into seven components, including sleep quality, sleep latency, sleep duration, and sleep efficiency. Each component is scored on a scale of 0 to 3. These component scores are summed to produce a global PSQI score (ranging from 0 to 21), with higher scores indicating poorer sleep quality.

2.2.4 Problem Behaviors

Problem behaviors were measured using the student version of the Strengths and Difficulties Questionnaire (SDQ) [1]. This 25-item questionnaire is categorized into five dimensions, with five items per dimension: emotional symptoms, conduct problems, hyperactivity/inattention, peer relationship problems, and prosocial behavior. Each dimension contains five items rated on a 3-point scale (0–2). Higher total scores reflect greater difficulties. Notably, the prosocial behavior dimension is reverse-scored.

2.2.5 Screen Exposure

A self-designed questionnaire was used to assess screen exposure across three domains: daily screen time (differentiated by weekdays and weekends), exposure to violent content, and the frequency of co-viewing with parents. Screen time was recorded in hours, while violent content exposure and co-viewing frequency were measured using a 3-point Likert scale.

2.3 Procedure

Following ethical approval from the school, the *Physical Activity and Mental Health Questionnaire* was uploaded to the Wenjuanxing online platform. We enabled skip logic and mandatory response validation, and set the restrictions of one response per mobile phone/computer and anonymous submission mode. To ensure anonymity, no personally identifiable information was

collected. Homeroom teachers distributed an encrypted survey link and QR code via class WeChat groups, accompanied by standardized instructions explaining the study's purpose, the principle of voluntary participation, and the right to withdraw at any time.

Students completed the self-administered survey independently after class. The system automatically recorded metadata, including IP addresses, response duration, and completion status. To maximize response rates, the research team asked homeroom teachers to remind non-respondents to complete the survey one week later, while monitoring the response rate through the platform's backend system. Upon completion, data were automatically stored on the cloud server. The research team exported the raw data in Excel format and anonymized it for analysis, strictly adhering to confidentiality protocols and ethical standards to protect participant privacy.

2.4 Statistical Analysis:

Data analysis was performed using SPSS Statistics 29.0. Statistical significance level was set at a two-tailed level alpha = 0.05. First, we calculated descriptive statistics to summarize the sample characteristics. Frequencies and percentages were reported for categorical variables, including gender, primary caregiver type, and subjective family economic status; continuous variables, such as scores on the five SDQ dimensions, were presented as means and standard deviations (M ± SD). Second, we examined group differences in problem behaviors. Independent sample t-tests were used to compare scores between male and female students, while one-way analysis of variance was used to assess differences related to primary caregiver type and subjective family economic status. Finally, we conducted Pearson, Spearman, and Kendall correlation analyses to test the linear relationships between screen exposure variables (screen duration, violent content exposure, parent-child co-viewing), PAQ-A, PSQI, and the SDQ dimensions.

3. Results

3.1 Prevalence of Adolescent Problem Behaviors

The analysis revealed distinct patterns of risk distribution across the SDQ dimensions. (1) For emotional symptoms, 70.6% of students fell within the normal range, while 17.6% were classified as borderline and 11.8% as abnormal. This indicates that nearly 30% of students experience some degree of emotional distress. (2) In contrast, conduct problems and hyperactivity levels were generally low. The prevalence of normal scores was high for both conduct problems (94.2% normal, 5.8% abnormal) and hyperactivity (92.9% normal, 7.1% abnormal). (3) Peer relationship problems presented a moderate risk; 58.9% scored in the normal range, but 23.5% were borderline and 17.6% were abnormal, suggesting that over 40% of students face difficulties in peer interactions. (4) The findings for prosocial behavior were particularly concerning: only 52.9% scored in the normal range, with 23.5% borderline and a substantial 23.6% classified as abnormal. Overall, emotional symptoms and prosocial behavior appear to be the primary psychological risks in this cohort and should be prioritized in future interventions.

3.2 Demographic Characteristics of Problem Behaviors

To examine the effect of gender on adolescent problem behaviors, independent sample t-tests were conducted to systematically compare scores across the SDQ dimensions between male and female students, with results presented in Table 1. The sample consisted of 7 boys (43.8%) and 9 girls (56.2%), indicating a balanced gender distribution.

The specific findings were as follows: (1) Emotional symptoms: Significant differences were

observed. Girls (M=4.2±2.3) scored significantly higher than boys (M=1.9±1.8; t=-2.28, p=0.037). (2) Conduct problems: Girls (M=2.4±2.2) scored higher than boys (M=1.3±1.1), but the difference did not reach statistical significance, indicating that the effect of gender on conduct problems is limited. (3) Hyperactivity: Girls (M=4.7±2.2) also scored higher than boys (M=3.6±2.6), but the difference was not statistically significant. (4) Peer relationship problems: Girls (M=4.9±1.9) scored higher than boys (M=2.9±2.2), but this difference was not statistically significant. (5) Prosocial behavior: Girls (M=6.2±2.8) scored slightly higher than boys (M=5.7±4.3); this difference was not statistically significant, indicating no significant main effect of gender on prosocial behavior. In summary, girls exhibited higher levels of distress in the emotional symptoms dimension, whereas no statistical differences were found for conduct performance, hyperactivity, peer relationships, or prosocial behavior. This suggests that gender should be considered an important control variable in future interventions and longitudinal studies.

Additionally, one-way analysis of variance was performed to compare differences based on primary caregiver type and subjective economic development level.

First, primary caregiver type showed a significant main effect on SDQ conduct problems (F=18.62, p<0.001), while differences in emotional symptoms, hyperactivity, peer relationships, and prosocial behavior were not statistically significant (p>0.05). This suggests that caregiver status is closely related only to adolescent conduct performance.

Second, subjective economic development level showed a significant main effect on SDQ conduct problems (F=9.53, p=0.001), while differences in emotional symptoms, hyperactivity, peer relationships, and prosocial behavior were not statistically significant (p>0.05). This indicates that subjective economic status is significantly associated only with adolescent conduct performance.

Table 1. Demographic Characteristics of Problem Behaviors

Variables	Gender		**p**
	Male	Female	
Sample Size (%)	7(43.8%)	9(56.2%)	
Problem Behavior Scores (M±SD)			
Emotional Symptoms	1.9(**±1.8**)	4.2(**±2.3**)	<0.05
Conduct Problems	1.3(**±1.1**)	2.4(**±2.2**)	>0.05
Hyperactivity	3.6(**±2.6**)	4.7(**±2.2**)	>0.05
Peer Relationship Problems	2.9(**±2.2**)	4.9(**±1.9**)	>0.05
Prosocial Behavior	5.7(**±4.3**)	6.2(**±2.8**)	>0.05

3.3 Correlations between Screen Exposure, Sleep, and Problem Behaviors

In this study, Kendall's tau-b was used to conduct two-tailed correlation tests among screen exposure, physical activity, sleep quality, and the SDQ dimensions. The results are presented in Table 2. (1) Screen Time Duration: Weekday screen duration was significantly positively correlated with PSQI scores (r=0.47, p<0.05), indicating that longer screen time during school days is associated with more severe sleep problems. Weekend screen duration was significantly negatively correlated with physical activity levels (r=-0.45, p<0.05) and prosocial behavior (r=-0.45, p<0.05), suggesting that excessive screen use on holidays significantly reduces prosocial tendencies and physical activity. (2) Content and Co-viewing: Exposure to violent content was positively correlated with peer relationship problems (r=0.51, p<0.05), whereas the frequency of parent-child co-viewing showed no significant correlation with any of the variables measured in this study. In summary, weekday and weekend screen duration, as well as exposure to violent content, are key risk factors for sleep disturbances,

hyperactivity, peer relationship problems, and issues with prosocial behavior. These findings provide empirical evidence for subsequent targeted interventions.

Table 2. Correlations between Screen Usage Duration, Sleep, and Problem Behaviors

	Weekday Daily Screen Duration	Weekend Daily Screen Duration	Violent Content Exposure	Frequency of Interaction with Parents/Others during Electronic Device Use
PAQ-A	-0.389	-0.41*	-0.26	0.08
PSQI	0.47*	-0.19	0.41	0.09
SDQ Emotional Symptoms	0.17	-0.09	-0.05	-0.03
SDQ Conduct Problems	0.40	-0.36	0.10	-0.02
SDQ Hyperactivity	0.50*	-0.05	0.24	-0.11
SDQ Peer Relationship Problems	0.32	-0.04	0.51*	-0.21
SDQ Prosocial Behavior	-0.15	-0.45*	0.07	0.24

Note. P < 0.05 indicates statistical significance. * indicates P < 0.05; ** indicates P < 0.01; *** indicates P < 0.001.

4. Discussion

Based on Kendall's rank correlation analysis, this study systematically examined the associations between screen exposure (duration, content characteristics, and parent-child co-viewing contexts) and adolescent physical activity, sleep quality, and the various dimensions of the SDQ. The results showed that weekday screen duration was significantly and positively correlated with sleep problems and hyperactivity. Conversely, weekend screen duration was significantly and negatively correlated with physical activity and prosocial behavior, while exposure to violent content was significantly and positively correlated with peer relationship problems. These findings not only validate the theoretical assumptions of the "Time-Content-Context" tripartite model but also provide a pathway for developing targeted interventions.

First, the concurrent negative correlations between weekend screen duration and both physical activity ($r=-0.41$, $p<0.05$) and prosocial behavior ($r=-0.45$, $p<0.05$) validate the "Time Displacement Hypothesis" [10]. During weekends/holidays, the absence of school supervision and the increase in discretionary time enable high screen exposure to displace opportunities for outdoor exercise and face-to-face interactions with peers, directly reducing MVPA levels. Furthermore, the instant gratification provided by online entertainment diminishes sensitivity to the delayed rewards associated with prosocial activities, leading to a decline in the frequency of altruistic behaviors. Previous longitudinal studies have similarly shown that each additional hour of weekend screen time is associated with a 0.25-hour reduction in MVPA and an 8% decrease in the incidence of prosocial behaviors [11]. Therefore, interventions should target the "weekend digital window." By establishing home-school collaboration to set "screen curfews" and creating checklists for alternative outdoor tasks, screen time can be effectively substituted with more productive activities.

Second, the significant positive correlation between violent content exposure and peer relationship problems ($r=0.51$, $p<0.05$) supports the social learning pathway [12]. The rapid editing, intense sound effects, and aggressive modeling found in violent games can repeatedly activate the sympathetic nervous system and reduce the prefrontal cortex's inhibitory control over the basal ganglia. Simultaneously, the internalization of violent scripts may predispose individuals to use aggressive strategies during real-life peer interactions, resulting in increased social conflict. At the intervention level, parents could enable the "Teen Mode" on digital platforms to reduce the algorithmic weighting of violent content recommendations. Meanwhile, school counseling programs should focus on delayed gratification and conflict resolution training for students with high exposure to break the

"media-cognition-behavior" transmission chain.

It is worth noting that while weekday screen duration was significantly positively correlated with PSQI (τ=0.47, $p<0.05$) and hyperactivity (r=0.50, $p<0.05$), weekend duration showed no significant association with sleep. This suggests that the disruptive effect of "school-day digital exposure" on sleep is more pronounced. Excessive device use after evening study sessions can suppress melatonin secretion due to blue light exposure and delay bedtime, thereby increasing the risk of sleep disturbances. In contrast, students are often able to engage in "catch-up sleep" on weekends, which buffers the immediate impact of screens on sleep. Interventions should therefore focus on the "post-study-to-bedtime window." Schools could implement a "pre-sleep digital detox" policy, mandating the unified collection of electronic devices to improve student sleep quality.

In summary, based on Kendall's correlation method, this study revealed significant or directional associations between weekend screen duration and physical activity/prosocial behavior, violent content and hyperactivity/peer relationships, and parent-child co-viewing and prosocial behavior. These findings provide empirical support for the "Time-Content-Context" tripartite intervention framework. Limitations of this study include the small sample size and the cross-sectional design, which precludes causal inferences. Future research should combine EMA with randomized controlled trials to further verify the temporal sequence and modifiability of these pathways.

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