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Parental Control and Children's Short Sleep Duration and Difficulties as Predictors of Screen Time: The Japanese Context

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Parental Control and Children's Short Sleep Duration and Difficulties as Predictors of Screen Time: The Japanese Context

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Abstract: Children's screen time may affect their growth and development. However, different aspects of children and their parents that affect children's screen time has not been investigated in the Japanese context. This study aimed to explore the relationship between relevant factors affecting children's screen time based on their sleep, difficulties, and parental control, among Japanese elementary and junior high school students. A cross-sectional survey was conducted among parents in Japan. Data on screen time duration, parent-child background, strengths and difficulties, sleep variables, and parental control types were collected from 225 households. Path analysis revealed that high Strengths and Difficulties Questionnaire (SDQ) scores ($\beta = 0.167$, $p = 0.007$), sleep duration ($\beta = -0.282$, $p < 0.001$), and parental control ($\beta = -0.205$, $p < 0.001$) were significantly related to children's screen time. Additionally, late parental bedtime negatively correlated with children's sleep duration ($\beta = -0.326$, $p < 0.001$). The findings suggest that children's difficulties, sleep duration, and parental control are associated with children's screen time. This study, together with previous research, provides comprehensive insights to design interventions to decrease screen time in children in the Japanese context.

Keywords: screen time; SDQ; sleep; parental control

1. Introduction

The relationship between prolonged exposure to screen media (television, video games, smartphones, tablet devices, etc.) and child growth and development is a significant concern for parents, schoolteachers, researchers, and practitioners. The Japanese Pediatric Society recommends limiting screen time to two hours or less per day for children aged two years and above [1]. This recommendation is based on previous research indicating the risks of excessive screen time, such as obesity [2], sleep disorders [3], emotional and behavioral problems [4], impaired vision [5], and academic underachievement [6]. From a public health perspective, limiting screen time is may be beneficial for preventing development of cardiovascular diseases, diabetes, and mental disorders. Some Japanese elementary and junior high schools have implemented initiatives to restrict screen time for their students. These efforts involve collaboration between schools and parents, and continue for 10 days to manage students' screen time. However, relying solely on these measures may not be sufficient to ensure long-term reduction in screen time. Overseas studies have suggested that in addition to such interventions, education on the health consequences of screen time for teachers and children and frequent distribution of newsletters to parents can be effective in reducing screen time [7,8]. In recent years, the widespread use of Information and Communication Technology (ICT) in Japanese schools is predicted to increase children's exposure to screen media. In this context, efforts to reduce screen time are urgently needed. Factors that contribute to excessive screen time include child difficulties such as hyperactivity/inattention, emotional symptoms, and conduct problems [9] and short sleep duration [10]. In addition, parental control of screen time is partially mediated by

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parental self-efficacy, which contributes to reduced screen time [11]. However, research on the relationship between screen time and these factors for Japanese elementary and junior high school students is limited. Thus, an immediate investigation is needed.

Based on prior evidence, we developed the following hypotheses:

1. Children's difficulties, sleep duration, and parental control are directly linked to screen time.
2. Considering the connection between children's problematic temperament and maternal authoritative control [12], their difficulties directly affect parental control.
3. Considering the weak negative correlation between Strengths and Difficulties Questionnaire (SDQ) scores and sleep duration [13], children's difficulties directly affect sleep durations.
4. Based on the evidence of a relationship between parental late bedtime and child's sleep problems [14], parental late bedtime directly affects sleep duration in children.

This study validated the hypothetical model using path analysis, with a particular focus on the relationship between children's difficulties and short sleep duration with screen media time and the effect of parental control on screen time.

2. Materials and Methods

2.1. Ethics statement

The study protocol was approved by the institutional review board of Shinshu University (approval number: 5926). The study was conducted by a school nurse who obtained permission from the principals of the participating schools. The questionnaire was administered to the parents of the students. Shinshu University collected the data ensuring privacy and confidentiality of the participants' personal information. Then, the university conducted statistical analyses using the de-identified data. These measures were taken to protect the privacy and confidentiality of the participants' data in accordance with ethical guidelines.

2.2. Study design and participants

This multi-center cross-sectional survey was conducted from 17–26 June, 2023, and targeted 438 households in Nagano Prefecture, Japan. The survey was administered using *Google Forms*, and the primary caregiver of one elementary or junior high school student from each household was requested to complete the questionnaire. A total of 225 (51.4%) households participated in the survey.

2.3. Procedures and measures

The background information was collected from the questionnaire survey, which included the students' school year, sex, number of siblings, age, and sex of the primary caregiver. For the assessment of screen time, participants were requested to report children's average daily usage time (excluding the usage to study), including weekends, over the past week. The durations of screen time were recorded in 30-minute increments, ranging from 0 to 300 minutes. Regarding sleep-related variables, students' habitual bedtime and wake-up time, as well as their parents' bedtime and wake-up time on weekdays were investigated. Based on these variables, the time in bed (TIB) was calculated. Additionally, the parents were administered the SDQ [15] to assess the child's difficulties. The total and specific sub-domain scores were calculated. Regarding parental control of screen time, the survey was conducted using the following: 1. No rules, 2. Promise without compliance, 3. Verbal promise with compliance, 4. Automated time limiting.

2.4. Statistical analysis

The model illustrated in Figure 1 was created to test the hypotheses. In descriptive statistics, continuous variables were summarized using means and standard deviations, while categorical variables were presented as frequencies and proportions. To analyze the relationships between main model variables, appropriate statistical methods such as the Kruskal-Wallis's test and Spearman's correlation analysis were employed. The significance level for the Kruskal-Wallis's test was adjusted

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to a two-tailed $P < 0.05$. The relationships between model variables were analyzed as follows. The mean screen time for each group based on the SDQ scores (low need: 0-13, some need: 14-16, high need: 17-40) was compared using the Kruskal-Wallis's test. A principal component analysis for sleep variables was performed due to potential correlations between school year and sleep variables (TIB and bedtime). The extracted principal component, referred to as "sleep duration," was evaluated for its correlation with screen time using Spearman's correlation analysis. Correlation between parental and child bedtime was investigated using Spearman's correlation analysis. Screen time between parental control sub-groups were compared by categorizing parental control into three levels based on the survey results: "No control" = No rules or Promise without compliance," "Verbal promise" = Verbal promise with compliance, and "Automated time limiting."

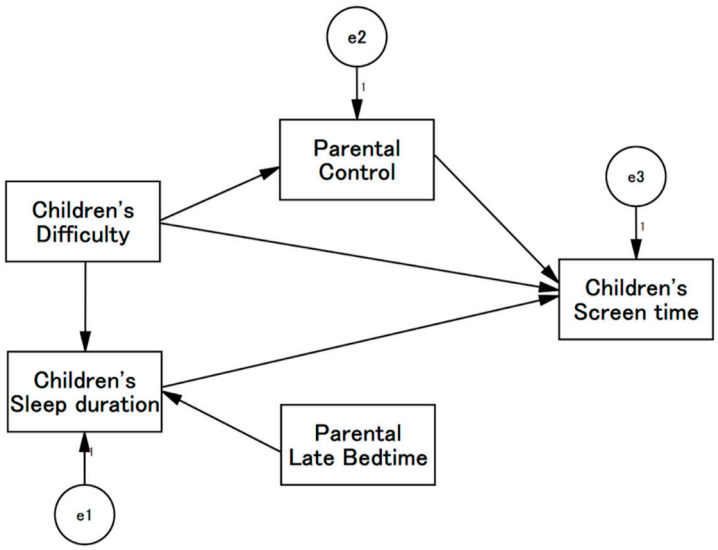

Figure 1. Hypothesized model of screen time in Japanese young children. Abbreviations: e = error.

Next, path analysis was conducted to investigate the relationships between the model variables. Model fit was assessed using the following fit measures: $\chi 2$, comparative fit index (CFI), and root mean square error of approximation (RMSEA). The model fitting criteria were set at CFI ≥ 0.95 and RMSEA ≤ 0.06. Bootstrapping with a total of 1000 bootstrap samples was performed to assess the reliability of the estimates.

Path analysis was performed using the Statistical Package for the Social Sciences Amos version 29 (SPSS; IBM Corp., Armonk, NY, USA), while other analyses were conducted using SPSS Statistics version 29 (IBM Corp., Armonk, NY, USA).

3. Results

3.1. Demographic and clinical characteristics

Table 1 presents the demographic and clinical characteristics of the children and care givers. The mean (standard deviation, SD) screen time of the children was 133.6 (67.37) minutes. The average grade of the surveyed participants was 6.16 (2.52), and 82.7% were above fourth grade. The average bedtime and wake-up time for the children were 22:03 (56 minutes) and 6:29 (31 minutes), respectively. For students in grades 4–6, the average bedtime and wake-up time were 21:42 (31 minutes) and 6:32 (22 minutes), respectively; for junior high school students, they were 22:30 (53 minutes) and 6:32 (36 minutes), respectively. Students in grade 4–6 and junior high school showed a tendency for earlier bedtimes and wake-up times compared to the times mentioned in the Children and Youth White Paper for the fiscal year 2015 [16]. The average TIB for the primary caregivers was 6 hours 54 minutes, equivalent to the average TIB of 6 hours 53 minutes for women in their 40s

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according to the National Living Time Survey [17]. The average total score of the SDQ was 9.71 (5.21). Among the children, 26 (11.7%) met the criteria for "High need," while 23 (10.2%), for "Some need."

Table 1. Demographic and clinical characteristics.

N= 225	
Background	Mean (SD or %)
School year	6.16 (2.52)
Sex male	110 (48.9%)
Siblings	2.08 (0.76)
Age (primary caregiver)	44.0 (6.13)
Sex male (primary caregiver)	26 (11.6%)
Screen time	Mean (SD)
All students (N=225)	133.60 (67.7)
School year 1-3 (N=39)	120.00 (57.6)
School year 4-6 (N=56)	131.25 (63.9)
School year 7-9 (N=130)	138.69 (71.9)
Bedtime / wakeup time	Mean (SD)
All students (N=225)	22:03 (56 min) / 6:29 (31 min)
School year 1-3 (N=39)	21:08 (40 min) / 6:20 (25 min)
School year 4-6 (N=56)	21:42 (31 min) / 6:32 (22 min)
School year 7-9 (N=130)	22:30 (53 min) / 6:32 (36 min)
Primary caregiver (N=225)	22:49 (65 min) / 5:43 (55 min)
SDQ	Mean (SD)
Total difficulties score	9.71 (5.21)
Conduct problem	1.58 (2.03)
Hyperactivity/inattention	2.97 (2.09)
Emotional symptoms	2.48 (2.35)
Peer problems	1.98 (1.74)
Prosocial behavior	6.56 (2.04)

Continuous variables are presented as mean (SD); categorical variables are presented as n (%). Abbreviations: min = minutes; SDQ = Strengths and Difficulties Questionnaire; SD = standard deviation.

3.2. Association between screen time and SDQ, sleep variables, and parental control

The mean screen time for the three groups based on SDQ scores was compared (Figure 2) using the Kruskal-Wallis's test. Significant differences were found between the high need and some need groups (high need – some need [standard error]: 58.42 [18.40], P = 0.004), as well as between the high need and low need groups (high need – low need [standard error]: 35.76 [13.50], P = 0.024).

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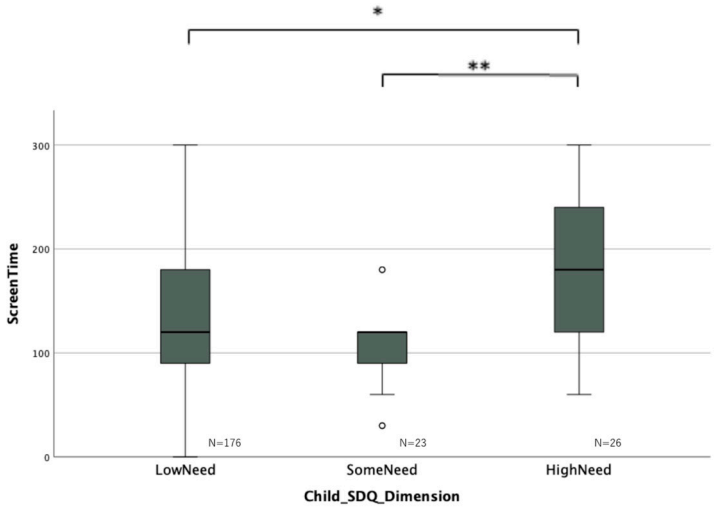

Figure 2. Association between screen time and SDQ score. *P < 0.05, ** P < 0.001. There were significant variations in screen time between the three groups, with the high-need group showing higher screen time compared to the some-need and low-need groups. Abbreviations: SDQ = Strengths and Difficulties Questionnaire.

Factor analysis of sleep variables was conducted to adjust for each sleep variable and school year. The sample adequacy measure (Kaiser-Meyer-Olkin) was found to be 0.693, indicating sufficient suitability for the analysis. The factor matrix revealed that the first principal component was strongly correlated with TIB (correlation coefficient of 0.919) and was named the "sleep duration" factor. There was a weak negative correlation between "sleep duration" and screen time, with a Spearman's rank correlation coefficient of -0.225 (95% confidence interval, CI: -0.349 to -0.093, p < 0.001). Additionally, the correlation coefficient between parental and children's bedtimes was 0.368 (95% CI = 0.246 - 0.479, p < 0.001).

Figure 3 presents the results of the Kruskal-Wallis's test which was conducted to assess the differences in average screen time among the three sub-groups based on parental control levels. The findings indicated that both "Automated time limiting" and "Verbal promise" groups had significantly shorter screen time compared to the "No control" group. Specifically, the screen time was significantly shorter in the "Automated time limiting" group compared to that in the "No control" group (Automated time limiting – No control [standard error]: - 35.52 minutes [12.30], P = 0.012). Similarly, the screen time was significantly shorter in the "Verbal promise" group compared to the "No control" group (Verbal promise – No control [standard error]: -34.00 minutes [9.43], P = 0.001).

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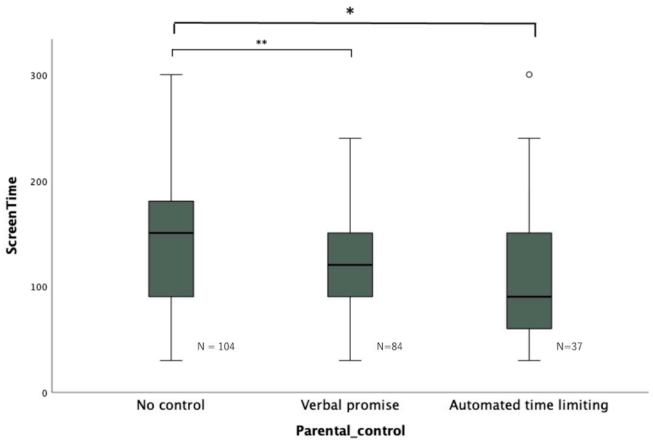

Figure 3. Association between screen time and parental control level. *P < 0.05, **P < 0.01. There was a significant difference in screen time between groups, with "Automated time limiting" and "Verbal promise" having shorter screen time than "No control".

3.3. Path analyses

Path analysis indicated that among the variables related to children, difficulty (β = 0.167, SD = 0.800, P = 0.007) and sleep duration (β = -0.282, SD = 4.359, P < 0.001) directly influenced screen time (Figure 4). Additionally, parental control showed a significant negative correlation with screen time (β = -0.205, SD = 5.674, P < 0.001). These findings supported the first hypothesis. However, contrary to the second and third hypotheses, the correlations between children's difficulty and parental control (β = -0.062, SD = 0.009, P = 0.352) and between children's difficulty and sleep duration (β = 0.059, SD = 0.012, P = 0.346) were not significant.

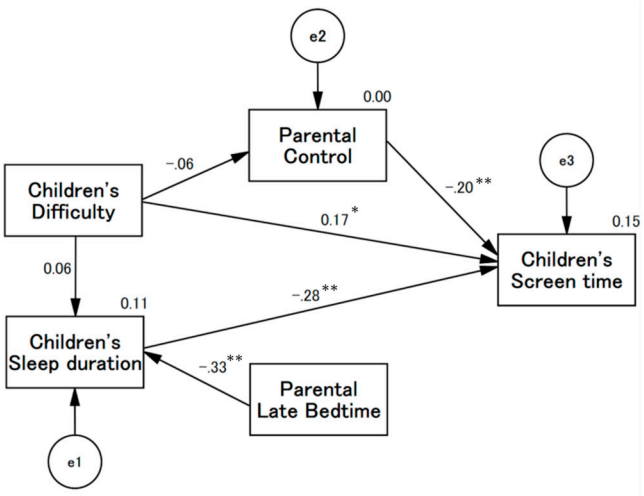

Figure 4. Final model with standardized regression estimates corresponding to significant pathways of influence. School year, considered a covariate to the sleep variable, was adjusted for "Children's Sleep duration" in the factor analysis. *p < 0.05, **p < 0.001 Abbreviations: e = error.

As mentioned in the fourth hypothesis, late parental bedtime significantly negative correlated with sleep duration in children (β = -0.326, SD = 0.055, P < 0.001). Overall, the research hypotheses were partially supported. All models fit the data well: $\chi 2$ (degree of freedom = 4) = 2.777, p = 0.596; CFI = 1.000; RMSEA (95% CI) = 0.000 (0.000 - 0.085).

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Table S1 presents the 95% confidence intervals and probability of significance for Bootstrapping (with a total of 1000 bootstrap samples) for assessing the reliability of the estimates.

4. Discussion

The study found that among Japanese elementary and junior high school students, high difficulties assessed by SDQ and short sleep duration are associated with increased screen time. These findings are consistent with those of previous research [18–26] and may be generalizable in the Japanese context. Furthermore, the findings indicated that parental control is related to reduced screen time among elementary and junior high school students in Japan. These results are significant considering the limited research on the effectiveness of parental control in the Japanese context. Specifically, "Automated time limiting" and "Verbal promise" were highly related to the reduction of screen time. The path analysis did not indicate a significant negative influence of children's difficulties on parental control. This suggests that interventions, particularly those using automated time limiting, may be effective regardless of children's difficulties. However, the classification and level of parental control are expected to be more complex in real-life situations, warranting a more detailed classification in future studies.

Because the squared multiple correlation coefficient of 0.148 for the path analysis of screen time indicates a weak to moderate effect, it is important to consider other factors that may influence screen time. Previous research have suggested that having a television in the bedroom [27], insufficient physical activity [28], the number of devices owned by children [29], parental screen time [29], and lack of parental involvement with their children [30] are associated with increased screen time. Developing and validating a hypothetical model including these factors is necessary.

This research explored the methods to reduce screen time through collaborative programs between parents, schools, and mental health professionals. According to previous research, educating children about screen time at school, providing regular newsletters to parents, educating teachers, and implementing a screen media time reduction challenge period of around 10 days were effective in reducing children's screen time [7,8]. Considering the results of this study, specific education and interventions for parents and children, such as visualizing the usage of automated time limiting for specific device through newsletters or suggesting methods to advance bedtime, could be beneficial. Especially for children with difficulties, screening and collaboration between mental health professionals and schools may be crucial.

The study had some limitations. Its applicability to a broader context may be limited due to its focus on specific regions within Japan. Furthermore, data were collected exclusively through surveys, introducing the possibility of parental subjectivity and memory biases. This underscores the need for large-scale and objective research in the future. Finally, it is essential to highlight that no definitive causal relationship was established in this study. Moreover, the enduring consequences of heightened parental control remain uncertain.

5. Conclusions

The study revealed that children's difficulties and shorter sleep duration are associated with increased screen time, while more parental control is related to reduced screen time in the Japanese context. To strengthen the validity of these results, it is crucial to conduct large-scale and objective research, as well as to explore factors that were not investigated in this study. Thus, we can gain a more comprehensive understanding of the complex factors influencing screen time in Japanese elementary and junior high school students.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Shinshu university (protocol code: 5926 and date of approval: August 9, 2023).

Informed Consent Statement: Informed consent was obtained through an opt-out option promoted on the school's website.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. Because no informed consent was given by the participants for open data sharing, not all data are freely accessible. However, the individual data are available upon reasonable request.

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Conflicts of Interest: The authors declare no conflict of interest.

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