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Cognitive Effects of Daily Screen Time Habits among Early Adolescents

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ABSTRACT

Background: Screen time has become a normal part of daily life for early adolescents. Many young students switch between schoolwork, videos, gaming, and social media throughout the day. Some of this use is helpful and even necessary, especially for learning. However, long hours on screens are concerning and affect attention, memory, and overall thinking skills. Sleep disturbance caused by late-night screen use may also influence how well students perform in school. **Objective:** To explore how daily screen-time habits relate to basic cognitive functions in early adolescents aged 11 to 14 years. The focus was on attention, working memory, processing speed, and sleep quality. **Methodology:** This study used a cross-sectional design to examine associations between screen-time habits and cognitive functioning in early adolescents. We recruited 100 students, aged 12 to 14 years, from four different schools. Schools were selected through convenience sampling within the local region; within each school, students were approached randomly during regular school hours after obtaining permission from school authorities and parental consent. Students with known neurological, developmental, or serious health conditions were excluded to avoid confounding. Each participant completed a self-administered questionnaire capturing their daily screen-time habits. Participants completed a short sleep-quality scale, adapted from existing sleep questionnaires, to report usual bedtime, wake-up time, sleep disturbances, and subjective sleep quality. Cognitive assessment of participants was carried out using standardized short tasks. Pearson correlation analyses were conducted to explore linear relationships and multiple linear regression models were constructed to test the predictive value. **Results:** Students who spent more than three hours a day on recreational screens, especially at night, showed lower attention and weaker working-memory scores. Their reaction times were slower, and many reported disturbed sleep. On the other hand, moderate academic screen use did not show major negative effects and, in some cases, showed slightly better performance. **Conclusion:** Our findings suggest that parents and teachers should guide early adolescents toward healthy and balanced screen habits. It is important to limit recreational or entertainment screen time, especially during the evening, as this can affect sleep and overall brain function. Encouraging good sleep routines can help protect attention, memory, and processing skills.

Keywords: Attention, Cognitive functioning, Screen time habits, Sleep disturbance, Working memory

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INTRODUCTION

Screen exposure has become ubiquitous in the daily lives of early adolescents. With the proliferation of smartphones, tablets, laptops, and other digital devices, students frequently engage in a variety of screen-based activities, including academic work, video streaming, gaming, and social media interactions. While digital tools offer educational and cognitive benefits, concerns have emerged regarding their potential impact on attention, memory, and overall cognitive development in this age group. Excessive screen use, particularly late at night, can disrupt sleep patterns, which may further influence cognitive performance and academic achievement.

Early adolescence, defined approximately between 12 and 14 years of age, represents a critical period for cognitive development. During this stage, attention, working memory, and processing speed undergo substantial maturation. There is growing evidence that high levels of recreational screen exposure may negatively affect these cognitive domains. In particular, excessive gaming or social media use has been associated with reduced attention span, weaker working memory, and slower information processing. Additionally, late-night screen exposure can suppress melatonin production and disrupt circadian rhythms, resulting in poorer sleep quality and reduced daytime cognitive efficiency.[1]

Recent empirical studies have highlighted both the risks and potential benefits of screen use. A large-scale U.S. study reported that adolescents with high recreational screen time exhibited greater cognitive difficulties, especially in attention and executive functioning.[2] Conversely, studies have shown that structured or educational screen use, such as interactive learning applications, may support working memory and problem-solving skills.[3] These findings indicate that the effects of screen exposure are not solely dependent on duration, but also on the nature and purpose of the activity.

Comprehensive reviews of the literature suggest a consistent association between excessive screen time and adverse outcomes, including diminished executive functioning, poorer academic performance, and emotional or behavioral disturbances.[4,5] The COVID-19 pandemic further amplified screen use among adolescents, intensifying concerns regarding attention, sleep quality, and overall cognitive health.[6] Nevertheless, studies demonstrate heterogeneity in outcomes, suggesting that moderate, purposeful, or supervised screen use may not produce significant cognitive deficits and can, in some contexts, enhance learning.[7]

Despite the growing body of evidence, research on early adolescents remains limited, particularly studies examining the combined effects of total screen time, type of activity, and sleep quality on core cognitive functions. Understanding these relationships is essential, given the prevalence of screen use in this age group and its potential implications for academic performance and mental health. Therefore, the present study aims to investigate the relationship between daily screen-time habits and cognitive functions in early adolescents aged 12 to 14 years. It aims to examine how different screen activities, including academic, recreational, and social media use, are associated with attention, working memory, processing speed, and sleep quality.

METHODOLOGY

This study used a cross-sectional design to examine associations between screen-time habits and cognitive functioning in early adolescents. We recruited 100 students, aged 12 to 14 years, from four different schools. Schools were selected through convenience sampling within the local region; within each school, students were approached randomly during regular school hours after obtaining permission from school authorities and parental consent. Students with known neurological, developmental, or serious health conditions were excluded to avoid confounding.

Each participant completed a self-administered questionnaire capturing their daily screen-time habits. The questionnaire asked about several domains: time spent on screens for academic purposes (online classes, homework, research), recreational video watching or streaming, gaming, and social media or messaging use. Respondents also recorded the average daily hours spent on each category, and the timing of use (daytime vs. late evening/night). In addition, participants completed a short sleep-quality scale, adapted from existing sleep questionnaires, to report usual bedtime, wake-up time, sleep disturbances, and subjective sleep quality. Cognitive assessment of participants was carried out using standardized short tasks. To assess attention, a continuous

performance type test was used, measuring the accuracy and reaction time to visual stimuli, with a brief practice period followed by a main trial session. For working memory, a digit span task (forward and backward) was administered, requiring participants to recall sequences of numbers. To measure processing speed, a simple visual reaction time test was given: participants had to press a key as quickly as possible when a stimulus appeared on screen. All tests were administered in a quiet room at school, under supervision.

Collected data, including screen-time responses, sleep-quality scores, and cognitive-task results, were entered into SPSS version 23 for analysis. First, descriptive statistics (means, standard deviations, frequencies) described the sample's demographic characteristics, screen use distribution, sleep quality, and cognitive scores. Next, Pearson correlation analyses were conducted to explore linear relationships between total and domain-specific screen time (academic, recreational, social media), sleep quality, and cognitive outcomes (attention accuracy, working-memory score, reaction time). Finally, multiple linear regression models were constructed to test the predictive value of different types of screen use on cognitive performance and sleep quality, controlling for age and gender. A significance threshold was set at $p<0.05$.

To strengthen interpretability and reduce bias, data collection occurred within a single academic term to avoid seasonal influences (e.g., exam stress, holiday disruption). Cognitive tests and questionnaires were administered on school days only, avoiding weekend variations. Participation was voluntary, and anonymity was maintained. Each student received a code number; no personal identifiers were recorded in the dataset. This methodological approach allowed us to combine self-reported behavioral data (screen habits, sleep patterns) with objective cognitive measures. Given limitations of cross-sectional design, this study does not establish causality but aims to highlight associations that may inform further longitudinal research

RESULTS

A total of 100 early adolescents aged 12–14 years participated in the study. Among them, 54 % were girls and 46 % boys. The mean total daily screen time was 3.9±1.5 hours, with academic screen use averaging 1.3±0.7 hours/day and recreational/social media use averaging 2.6±1.3 hours/day. Nearly 40 % of students reported using screens after 10:00 pm on at least four nights per week. These findings suggest that while students spend a substantial portion of their screen time on recreational activities, a significant subset is engaging in late-night screen use that could affect sleep quality and cognitive performance. Table 1 presents participants' demographic details and overall screen-time patterns. The table highlights that girls and boys were almost equally represented, with a slightly higher proportion of girls. Total screen use exceeded three hours on average, mainly due to recreational activities. Late-night screen use was common, indicating potential risk for disrupted sleep.

Sleep quality analysis indicated that almost half of the participants (47%) reported poor sleep quality. Interestingly, the majority of students who engaged in late-night screen use fell into this poor-sleep category, emphasizing a potential link between evening screen use and disrupted sleep. Table 2 provides the details regarding the distribution of sleep quality among the participants. The cognitive performance of participants was assessed across three domains: attention, working memory, and processing speed. Overall, mean attention accuracy was 83.0±9.5 %, mean working-memory score was 14.5±3.2, and

Table 1: Demographics of participants and screen-time habits

Variables		Mean ± SD
Age (years)	-	13.3 ± 0.9
Female	54	54%
Total Screen Time (hr/day)	100	3.9 ± 1.5
Academic Screen Time (hr/day)	100	1.3 ± 0.7
Recreational Screen Time (hr/day)	100	2.6 ± 1.3
Late-night Screen Use (>10 pm, ≥4 nights/week)	40	40%
Good sleep quality	53	53 %
Poor sleep quality	47	47 %

average reaction time was 380±45 ms. When participants were categorized by recreational screen time, a clear pattern emerged. Students with ≤2 hours/day of recreational screen use performed the best across all cognitive domains. Those with >3 hours/day recreational use had the lowest scores and slower reaction times. The intermediate group (2–3 h/day) scored between the extremes. These trends are summarized in Table 3, demonstrating that higher recreational screen time is associated with poorer cognitive outcomes.

Pearson correlation analyses further explored relationships between screen-time habits, sleep quality, and cognitive performance. As shown in Table 4, total screen time and recreational screen time were negatively associated with attention and working memory and positively associated with slower reaction times. Academic screen time did not significantly correlate with cognitive outcomes. Sleep quality was also inversely related to recreational screen use, indicating that more screen time is linked to poorer sleep, which may in turn affect cognition.

Figure 1 presents cognitive differences across recreational screen-time groups, showing that higher daily screen time is linked to poorer cognitive performance. The ≤2 hours/day group had the highest attention (89) and working memory (16.2) scores and the fastest reaction time (350 ms). Scores declined and reaction times slowed as screen time increased, with the >3 hours per day group showing the lowest attention (78.4), working memory (13.2), and slowest reaction time (402 ms). Standard deviations also increased with screen time, indicating more variability in performance.

Regression analyses, controlling for age and gender, confirmed that recreational screen time significantly predicted lower attention (β= −0.39, p<0.001), weaker working memory (β= −0.27, p=0.003), and slower reaction time (β=0.25, p=0.005). Sleep quality partially mediated these relationships. Academic screen time remained non-significant. These results suggest that excessive recreational screen use, particularly at night, negatively impacts sleep and cognitive performance. Academic screen use appears safe. This highlights the importance of moderating recreational screen time and encouraging healthy sleep habits in early adolescents.

DISCUSSION

In this study of 100 adolescents aged 12–14, we found that higher recreational screen time, especially when used late at night, was linked with poorer cognitive performance (lower attention, weaker working memory, slower processing speed) and poorer sleep. These results add to growing concerns that too much screen use may interfere with adolescent cognitive health. Our findings match what some recent research shows. A study by Dong et al (2025) found that

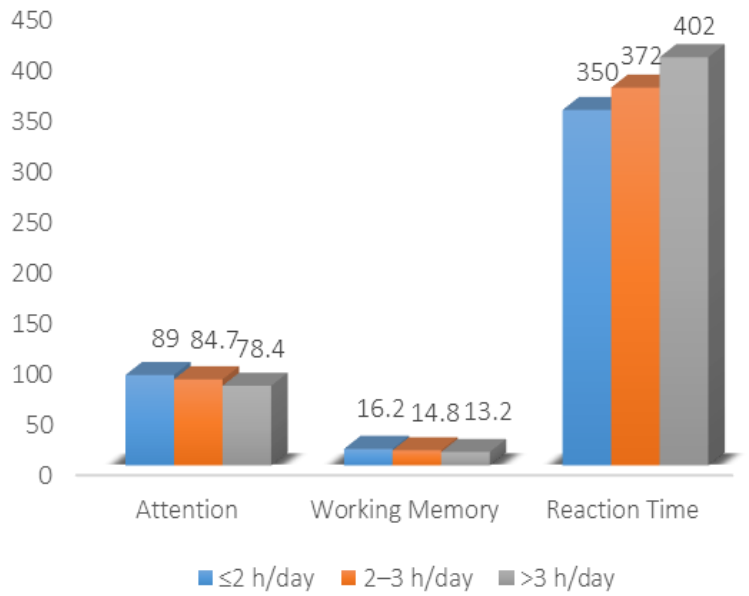
Table 2: Cognitive performance by recreational screen-time group

Recreational Screen Time	Attention	Working Memory (Digit Span)	Reaction Time (ms)
≤2 hr/day (n = 22)	89.0 ± 5.8	16.2 ± 2.7	350 ± 30
2–3 hr/day (n = 30)	84.7 ± 7.2	14.8 ± 3.0	372 ± 38
>3 hr/day (n = 48)	78.4 ± 8.9	13.2 ± 3.4	402 ± 45

Table 3: Pearson correlation (screen time, sleep quality, and cognition)

Variables	Attention	Working Memory	Reaction Time	Sleep Quality
Total Screen Time	−0.43**	−0.30**	0.28**	0.39**
Recreational Screen Time	−0.47**	−0.35**	0.32**	0.36**
Academic Screen Time	−0.05	−0.03	0.04	0.02

Figure 1: Cognitive performance by recreational screen-time groups



adolescents with high screen exposure tended to report more cognitive difficulties, such as trouble concentrating or remembering, compared with peers with lower screen use.[11] Another study by Muppalla et al. (2023) noted that excessive passive screen watching (videos, social media) was associated with slower development of attention and inhibitory control over time.[12]

Also, a recent research in Brunei with adolescents aged 13–19 showed that heavy screen use correlated with reduced sleep quality.[13] In our data, almost half the students reported poor sleep, and a good portion of them were late-night screen users. That aligns with findings that more screen time, especially before bed, can disturb sleep, delay bedtime, and increase sleep onset latency.[14] Poor sleep itself has been linked to impaired attention and working memory in adolescents, so sleep disturbance may be a key mediator.[12] However, not all screen use seems harmful. In a cross-sectional study of adolescents that compared short-term social media use vs face-to-face interaction, researchers did not find significant differences in working memory or inhibitory control for brief social media exposure under recommended daily limits.[15]

As technology is now a central part of children's lives, it influences cognitive, language, physical, and socio-emotional development. While screen time can offer benefits, it also poses risks, so monitoring is essential.[16] This suggests that it is not just screen time quantity, but also quality, timing, and content that influence outcomes. In our study, academic screen time did not show negative effects; only recreational and late-night use did.[17] That supports the idea that structured, purposeful screen activities may pose less risk, whereas unstructured, recreational use may be harmful, particularly when it cuts into sleep. Our study has limitations. As this is a cross-sectional therefore, we cannot say screen time causes poor cognition or poor sleep, only that they are associated.[18] Furthermore, the screen-time and sleep quality data are self-reported; so recall bias or social desirability bias may have misrepresented sleep patterns.[19] Our study sample size is relatively small. Larger samples could give more stable estimates. Finally, we did not measure other lifestyle factors (physical activity, diet, family environment) that might influence cognition along with screen time.[20]

CONCLUSION

Our findings suggest that parents and teachers should guide early adolescents toward healthy and balanced screen habits. It is important to limit recreational or entertainment screen time, especially during the evening, as this can affect sleep and overall brain function. Encouraging good sleep routines can help protect attention, memory, and processing skills, which are essential for learning, problem-solving, and daily activities. Using screens for schoolwork or structured learning is generally acceptable, but the amount of time spent and the context should still be monitored to ensure it supports healthy development and does not interfere with rest or other important activities.

DECLARATIONS

Consent to participate: Written consent had been

obtained from patients. All methods were performed following the relevant guidelines and regulations.

Availability of Data and Materials: Data will be made available upon request. The corresponding author will submit all dataset files.

Competing interests: None

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Authors' contributions: All authors had read and approved the final manuscript.

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