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ORIGINAL RESEARCH

Night Screen Time is Associated with Cognitive Function in Healthy Young Adults: A Cross-Sectional Study

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Background: In recent years, a significant shift toward remote work, virtual education, and social distancing measures was witnessed, thereby leading people to increasingly depend on digital devices for communication, work, and entertainment. This increased exposure to screens has raised concerns regarding its potential impact on cognitive function.

Purpose: This study investigated the relationship between screen time and cognitive function among healthy young adults.

Methods: One hundred forty-five healthy individuals (mean age 21.55 ± 2.84 years) participated in this cross-sectional study. Sociodemographic information including age, sex, height, weight, and level of education were obtained. Participants reported screen time using a screen time questionnaire. Cognitive function tests including, Paced Auditory Serial Addition Task (PASAT), Montreal Cognitive Assessment (MoCA) and Symbol Digit Modalities Test (SDMT) were conducted. Multilinear regression analyses were used to examine the associations between age, sex, level of education, screen time, and cognitive function.

Results: One hundred thirty-nine participants (76 women) completed the study. Increased night screen time, bachelor's educational level, and women were associated with lower PASAT scores (R2=0.258; p≤0.047). Moreover, increased night screen time was associated with lower MoCA scores (R2=0.029; p=0.035). However, no associations were found between night screen time and SDMT scores.

Conclusion: Participants who had higher night screen exposure had lower cognitive scores in the information speed processing, working memory, calculation, and attention domains. Considering these findings, this study emphasizes on the importance of setting a future recommended screen time guidelines for young adults as well as to promote healthy cognitive habits in order to preserve cognitive function and reduce the risk of developing neurodegenerative disease in the future. Future prospective cohort studies involving a more diverse age range is needed.

Keywords: cognition, young adults, screen time

Introduction

Cognitive function plays a crucial role in an individual's overall development, encompassing fundamental brain processes including attention, memory, learning, language, and executive function.[1] These skills play a pivotal role in maintaining independence and an optimal quality of life across all age groups.[1] Consequently, cognitive functions are essential to facilitate the function required to thrive in environmental and social settings.[1–3] Previous studies have shown that cognitive function can be influenced by various factors, including genetic and environmental factors.[4,5] Numerous studies have consistently identified age, education, sex,[6] health habits such as drinking and smoking,[7] depression,[8] sleep issues,[9] social factors (activity level and occupation),[9] and body mass index (BMI)[10] as factors affecting cognitive

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function among young adults. Identifying factors associated with cognitive decline might help in enhancing cognitive function through appropriate measures.

Recently, the use of electronic devices has led to a significant global shift, influencing the widespread employment of remote work and virtual education, integrating themselves more deeply into our daily routine, expanding their ability to complement or replace certain mental functions.[11] These electronic devices have advanced features as phonebooks, appointment calendars, internet gateways and media, tip calculators, navigation aids, music players, gaming consoles, and many other tasks.[11] Having these devices enables individuals to establish real-time connections at any hour, either through video calls or via short message services.[12–14]

While screen time plays a crucial role in our lives, the cumulative effect of prolonged screen exposure may lead to cognitive impairments.[1–3] Ultimately contributing to a reduced cognitive reserve, which in turn, increases the susceptibility to early signs of neurodegenerative conditions such as mild cognitive impairment, Alzheimer's Disease and Related Dementias.[15] In recent years, there has been a growing emphasis on exploring the relationship between screen time and cognitive performance.[1] where numerous studies have targeted screen time, particularly focusing on the impact of electronic devices, which have become widespread in modern society.[1] Electronic devices have firmly taken part into the lives of youngsters, as demonstrated by the fact that nearly all-American adolescents (97%) acknowledge having at least one electronic media device in their bedrooms.[16,17] Moreover, in a study conducted by Early Childhood Authority (ECA) (https://eca.gov.ae/) it was found that children in the middle east, aged eight and below, exhibited an increase in screen time from two hours to three hours per day. However, there is a lack of prior literature on screen time in young adults, thus further studies should be conducted to investigate this aspect.

Screen time have the potential to influence a wide array of cognitive function domains, from attention and memory to speed processing and problem-solving.[18] However, it is noteworthy that empirical research regarding the effect of screen time on cognitive function in young adults is limited. Despite the growing interest in this field, the findings thus far are marked by contradictions and inconclusive outcomes.[18] Two studies involving older adults revealed that smartphone usage and interaction with social media platforms enhanced cognitive functions[19] and life satisfaction.[20] Conversely, multiple studies focusing on children and adolescents indicated a negative correlation between screen exposure and cognitive functions.[21–23] Interestingly, a study conducted by Zhang et al found no significant associations between screen exposure and cognitive function among children.[3] Furthermore, there is an evident lack of research investigating the association between overall and nocturnal screen time considering different screen types and multiple cognitive domains particularly in the young adult population.[11,24,25]

Most existing literature has been directed towards the time spent on screens and understanding of overall screen time (mobile phones, media browsing or gaming) on cognitive function in children and adolescents.[18,25] The reviewed literature has shown that adolescents spend around 9 hours every day consuming some type of entertainment media, which includes watching television, browsing the Internet (including those of cellular phones and computers), and playing video games (≥40 hours per week).[26] Particularly, ever since the lockdowns were enforced due to the COVID-19 pandemic, work nature, and activities had impacted the way people spend their day. A systematic review and meta-analysis reported an increase in the overall time spent on screens across all age groups.[27] The age group that showed the most significant increase is primary school-aged children (6–10 years), followed by adults (>18 years), adolescents (11–17 years), and young children (0–5 years). A similar pattern has been observed in leisure screen time, with primary-aged children experiencing the most substantial increase, followed by adults, young children, and adolescents.[27]

Young adults, in contrast to children and adolescents, undergo a transformative period marked by significant lifestyle changes. This includes transitions into higher education, entry into the workforce, and the establishment of independent living arrangements. Within this context, screen time, encompassing the use of digital devices and technology, emerges as a pivotal lifestyle factor. The pervasive influence of screens on communication, leisure, and work among young adults underscores the need to explore its potential impact on cognitive outcomes. More comprehensive research is needed to investigate if there is an association between screen time and cognitive function among young adults. Therefore, the aim of this study was to investigate the association between screen time (day and night) and cognitive function, considering age, sex, and the educational level of healthy young adults. It was hypothesized that there would be an association between the independent and dependent variables. The findings of this study will provide valuable insights for the future.

Materials and Methods

Study Design and Setting

This cross-sectional study was carried out at the College of health sciences, University of Sharjah, United Arab Emirates (January 2023 to July 2023). Ethical approval was obtained from the Research Ethics Committee, University of Sharjah, United Arab Emirates (REC-23-01-23-01-S). The study was conducted in accordance with the principles of the declaration of Helsinki.

Participants

The study recruited 145 healthy young adults aged between 18 and 35 years, using a convenient sampling method. Participants were excluded from the study if they have had any history of visual problems (cataracts), neurological and mental (Schizophrenia, bipolar or clinical depression) disorders, systemic diseases, managed with or without medications, that might impact the overall cognitive function. The participants that were included in this study were able to communicate and understand simple English terms. Participants were recruited through word of mouth, posting adverts on social media as well as on university notice boards.

Procedure

All participants received a verbal explanation and an information sheet about the study aims, procedures, and instructions to be followed. A written informed consent was obtained from all participants before data collection. Participants self-reported age, sex, height, weight, nationality, level of education, medical history, and other characteristics on a sociodemographic form. Then participants filled the screen time questionnaire.[28] The cognitive function tests were then conducted in a quiet room without any interruptions. The Paced Auditory Serial Addition Task (PASAT), the oral version of the Symbol Digit Modalities Test (SDMT), and the Montreal Cognitive Assessment (MoCA) were used. All tests were explained in detail for the participant to understand. All data were collected by a qualified physiotherapist trained in conducting cognitive tests.

Variables

The independent variables were age, sex, educational level, day screen time and night screen time. Participants' scores in cognitive measures including PASAT, MoCA, and SDMT were the dependent variables.

Outcome Measures

Screen Time Assessment

The screen time questionnaire used in the study includes 18-items addressing screen time based on the electronic devices of five different categories (1- TV, 2- TV-connected devices such as: streaming devices, video game consoles, 3- laptop/ computer, 4- smartphone, and 5- tablet) commonly used by the American population.[28] The participants were instructed to estimate the total time spent in hours and minutes using each device (eg, 1 h and 30 min = 90 min). The questionnaire includes reporting of screen use during an average weekday, an average weeknight, and an average weekend day separately. This questionnaire has shown fair to excellent relative reliability (ICCs = 0.50–0.90; all < 0.000) in adult population.[28]

Cognitive Function Assessments

A cognitive test battery was used to assess key cognitive abilities including attention, concentration, calculation ability, information speed processing, working memory, visuo-spatial skills, and executive function. The following tests were specifically used to assess cognitive function.

The PASAT

The Paced Auditory Serial Addition Task (PASAT) is a software program used to assess the speed of auditory information processing.[29] It is also a valid[30,31] and highly reliable measure to assess attention and working memory updating processes.[32,33] The test randomly selects 61 numbers between 1 and 9 at 3 second intervals.[34] The participants were required to answer with the sum of the two consecutive numbers as fast as possible. The accuracy score was calculated by the total sum of all the correct answers as well as by using the percentages of correct responses of the PASAT 3 second interval. Scores below 35 for those with over 12 years of education served as an indicator of cognitive impairment.[34,35]

The MoCA

The Montreal Cognitive Assessment (MoCA) is a simple 10 min paper and pencil test, with accepted test-retest reliability and moderate validity,[36,37] that was developed to detect mild cognitive impairment.[35] The test assesses multiple cognitive domains including memory, language, executive functions, visuospatial skills, calculation, verbal abstraction, attention, concentration, and orientation to time and space. The clinical cut-off score of 26 is recommended.[38] The test and instructions are freely available on the MoCA official website at www.mocatest.org.

The SDMT

The Symbol Digit Modalities Test (SDMT) is used to assess divided attention, visual scanning, tracking and motor speed. The SDMT presents a series of nine symbols, each paired with a single digit in a key at the top of the sheet. The participants were asked to pair specific numbers with given geometric figures within 90s using a reference key (SDMT-correct). The participants responded by voicing the digit associated with each symbol as quickly as possible.[39] The overall test time taken to conduct the entire test was recorded (SDMT-Time).

Risk Bias Management

The cognitive function tests were administered in a random order to overcome the influence of fatigue and order effects bias.

Sample Size

The G*Power 3.1.9.7 software was used for sample size computation. For an effect size (f^2) of 0.10, an alpha value of 0.05, a power of 0.80 and five independent variables included for the multiple linear regression analysis, the minimum sample size required was 134.

Statistical Analyses

All data analyses were performed using the IBM SPSS Statistics version 26. The normality of (unstandardized and standardized) residuals for the variables of interest were checked using the Kolmogorov–Smirnov test. All residuals were normally distributed ($p>0.05$). Descriptive statistics were presented as mean and standard deviation (SD), median and interquartile range (IQR) or frequencies and percentage. Association between independent and dependent variables was identified by conducting multiple linear regression analysis. All data were analyzed with a predetermined significance level of 0.05. The degree of Multicollinearity of the independent variables was assessed by Variation Inflation Factors (VIF). The VIF for all variables included in the model was <3. Cook's distance was used to identify multivariate outliers, and all values that exceeded >1 were removed.[35]

Results

Among 145 Participants who volunteered for the study, only 139 participants (women=54.7%) were included in data analyses. Participants who had invalid data (n=3), chose to withdraw from the study (n=1), or were identified as outliers based on Cook's distance (n=2) were excluded from the study. The mean age of participants is 21.55 ± 2.84 years. Most of the participants (86.3%) were studying a bachelor's degree while the rest were pursuing a master's degree. Moreover, the collected sample comprised 5% Emiratis, 6.5% Asians and Africans, and 82% (non-Emirati) Arab individuals. (Table 1)

As presented in Table 2, the most used screen device among the participants during the daytime was the laptop/computer (510.8 minutes), followed by the smartphone (274.9 minutes), tablet (231 minutes), TV-connected devices (101.8 minutes), and television (99.3 minutes). However, during the night, the smartphone was the most used device

Table 1 Sociodemographic Information of the Participants (n=139)

Variables	Mean ± SD
Age (years)	21.55 ± 2.84
Height (cm)	168.15 ± 9.63
Weight (Kg)	71.63 ± 18.52
BMI (Kg/m^2)	25.08 ± 4.93
Sex	**Frequency**
Men	63
Women	76
Educational level	**Frequency**
Bachelor's level	120
Master's level	19
Nationality	**Frequency**
Arabs (non-Emiratis)	114
Emirate	7
Asians	9
Africans	9

Abbreviation: BMI, Body Mass Index.

Table 2 Total Day and Night Screen Time Utilizing Different Types of Screens

Variables	Day Screen Time (Mean ± SD)	Night Screen Time (Mean ± SD)
T.V (minutes)	36.6 ± 62.7	28.5 ± 53.2
T.V-connected devices (minutes)	28.4 ± 73.4	23.0 ± 72.0
Laptop/ computer (minutes)	265.7 ± 245.1	147.5 ± 156.4
Smartphone (minutes)	91.0 ± 183.9	223.5 ± 125.3
Tablet (minutes)	78.9 ± 152.1	42.2 ± 86.2
Total	506.7 ± 319.2	464.6 ± 256.1

Abbreviations: SD, standard deviation; T.V, television.

(348.7 minutes), followed by the use of laptop/computer (303.9 minutes), tablet (128.4 minutes), TV-connected devices (95.0 minutes), and television (81.7 minutes).

From Table 3, it is evident that men scored higher in the PASAT test (calculation and speed processing domain) than women. Moreover, slight difference was noted between men and women scores in the SDMT test, where women correct scores were higher than men (speed processing domain). In addition, women completed the SDMT test in a shorter time span compared to men. Both men and women scored approximately near to the cut-off point (26) in the total MoCA test.

Table 3 A Summary of Cognitive Function Test Scores

Variables	Men (Mean Rank)	Women (Mean Rank)	Total (Mean ± SD)
PASAT	(42.94)	(37.87)	40.2 ± 9.56
MoCA - Total	(26.11)	(26.28)	26.20 ± 2.14
SDMT-Correct	(56.37)	(59.43)	58.04 ± 10.08
SDMT- Time	(2.89)	(2.62)	2.74 ± 0.83

Abbreviation: SD, standard deviation.

Furthermore, Table 4 showed minimal difference in scores among men and women in the "MoCA-Attention" sub-category, with men demonstrating slightly better performance in the attention domain compared to women.

Table 5 shows that night screen time and sex were negatively associated with PASAT scores. Every one-minute increase in night screen time was associated with a decrease in PASAT score by (−0.016). Overall women PASAT score was (3.631) less compared to men. On the contrary, educational level was positively associated with PASAT scores. Where master's degree pursuers had higher PASAT score by (4.662) compared to undergraduate students.

Table 4 The Subcategories of MoCA Cognitive Function Tested in Men and Women

Variables	Men (Mean Rank)	Women (Mean Rank)	Total (Mean ± SD)
MoCA- Visuospatial /Executive function	4.67	4.89	4.79 ± 0.53
MoCA- Naming	3.00	2.97	2.99 ± 0.24
MoCA- Attention	5.06	4.82	4.93 ± 1.02
MoCA- language	1.27	1.59	1.45 ± 1.05
MoCA- Abstraction	1.71	1.79	1.76 ± 0.43
MoCA- Delayed recall	4.43	4.24	4.32 ± 0.97
MoCA- Orientation	5.97	5.97	5.97 ± 0.17

Abbreviation: SD, standard deviation.

Table 5 Variables Associated with PASAT

Variable	β Coefficient	95% CI	p-value	Multicollinearity Tests (VIF)	R^2	Adjusted R^2
Constant	42.28	(28.32, 54.76)	**<0.001**		0.29%	0.26%
Age	0.082	(−0.473, 0.638)	0.770	1.301		
Sex	−3.631	(−6.523, −0.739)	**0.014**	1.086		
Education	4.662	(0.068, 9.256)	**0.047**	1.305		
NST	−0.016	(−0.022, −0.010)	**<0.001**	1.259		
DST	0.000	(−0.005, 0.005)	0.929	1.237		

Notes: Values in bold indicate significant difference.
Abbreviations: DST, screen time day; NST, night screen time; VIF, variation inflation factors.

A negative association was evident between night screen and MoCA total scores (Table 6). Every one-minute increase in night screen time was associated with a decrease in MoCA score by −0.002. Moreover, MoCA-Attention score was

Table 6 Variables Associated with MoCA-Total

Variable	β Coefficient	95% CI	p-value	Multicollinearity Tests (VIF)	R^2	Adjusted R^2
Constant	27.285	(24.338, 30.232)	**<0.001**		0.064%	0.29%
Age	−0.077	(−0.219, 0.065)	0.287	1.301		
Sex	0.216	(−0.525, 0.957)	0.566	1.086		
Education	1.014	(−0.163, 2.191)	0.091	1.305		
NST	−0.002	(−0.003, 0.000)	**0.035**	1.259		
DST	0.000	(−0.001, 0.001)	0.787	1.237		

Notes: Values in bold indicate significant difference.
Abbreviations: DST, Screen Time Day; NST, Night Screen Time; VIF, variation inflation factors.

negatively associated with night screen time, where every one-minute increase in night screen time was associated with a decrease of −0.001 in MoCA-Attention score. (Table 7)

No significant associations were found between night screen time and SDMT- correct responses within 90 seconds (Table 8). Moreover, sex was not significantly associated with SDMT-correct scores.

Table 7 Variables Associated with MoCA-Attention

Variable	β Coefficient	95% CI	p-value	Multicollinearity Tests (VIF)	R^2	Adjusted R^2
Constant	5.846	(4.449, 7.242)	<0.001		0.072%	0.037%
Age	−0.039	(−0.106, 0.029)	0.260	1.301		
Sex	−0.227	(−0.578, 0.125)	0.204	1.086		
Education	0.394	(−0.163, 0.952)	0.164	1.305		
NST	−0.001	(−0.001, 0.000)	0.061	1.259		
DST	0.000	(−0.001, 0.000)	0.586	1.237		

Abbreviations: DST, Screen Time Day; NST, Night Screen Time; VIF, variation inflation factors.

Table 8 Variables Associated with SDMT

Variable	β Coefficient	95% CI	p-value	Multicollinearity Tests (VIF)	R^2	Adjusted R^2
Constant	60.613	(46.619, 74.606)	<0.001		0.048%	0.012%
Age	−0.192	(−0.868, 0.485)	0.576	1.301		
Sex	3.257	(−0.262, 6.776)	0.069	1.086		
Education	2.349	(−3.240, 7.939)	0.407	1.305		
NST	−0.004	(−.012, 0.003)	0.263	1.259		
DST	−0.002	(−0.008, 0.004)	0.532	1.237		

Abbreviations: DST, Screen Time Day; NST, Night Screen Time; VIF, variation inflation factors.

Discussion

To the best of our knowledge, this is the first cross-sectional study that investigated the association between screen time (during day and night) and different cognitive domains among healthy young adults. Previous studies have explored this association across different populations, using various methodological strategies, yielding conflicting results. However, it is still novel how screen time might impact cognitive functions in young adults' population. Therefore, by employing standardized cognitive assessment tools, the findings obtained from the current study contribute to the growing body of literature by resolving conflicting findings and revealing that night screen time is negatively associated with various cognitive domains: attention, calculation ability, information speed processing, and working memory.

These domains were assessed by PASAT due to its recognized sensitivity.[40] Moreover, a negative association was found between night screen time only and overall cognitive function, which was evaluated by the MoCA test. This study has also taken age, sex, and education level into consideration, where findings revealed that women and undergraduate students were negatively associated with the previously mentioned cognitive domains. However, no associations were found between night screentime and visual speed information processing domain, which was assessed by the SDMT cognitive test. Interestingly, the current study found no correlation between day screen time and cognitive performance in all above-mentioned domains.

The findings from this study align with previous cross-sectional studies that identified a negative association between screen exposure and attentiveness in young adults.[41,42] The findings of the current study correspond with those of a study that examined the effect of screen exposure on attention among internet addicted young adults and matched healthy young adults (aged 20 to 28 years).[42] The results Showed that Internet addicted young adults had attention deficit compared to healthy young adults.[42]

Similarly, a study involving young adults aged between 21 to 32 years supports the findings of the current research, indicating that heavy smartphone users exhibited compromised attention and lower calculation ability, potentially linked to impaired activity in the intraparietal sulcus.[41] In addition, Hadar et al (2017) proposed that excessive reliance on devices for numerical calculations, without engaging in arithmetic calculations independently, could lead to a decline in this mental capacity, aligning with the concept of "Use It or Lose It".[42] This is in concordance with neuroplasticity principle which states that if neural circuits remain inactive in task performance for a prolonged period, they will start to deteriorate.[43] Though the previous study lacks sufficient data to support the explanation for diminished calculation ability, certain therapy approaches have been designed based on 'Use It or Lose It' neuroplasticity principle.

Contrary to current findings, one study exploring the effects of nighttime mobile phone use on adolescents' perceived health and cognitive functions found no association between memory, concentration, and nighttime mobile phone usage.[24] It's important to note that this latter study evaluated night screen time by documenting instances of mobile phone shutdown and frequency of awakenings caused by either their own or roommates' mobile phones per month. We believe that the lack of an association between memory, concentration, and nocturnal mobile phone use in the previously mentioned study might be attributed by several factors, including the limited sensitivity of the chosen cognitive test,[24] selection bias and the small sample size.[24]

The findings of the current study for working memory align with prior neuroscientific research, indicating adverse associations between screen time and anatomical alterations in the prefrontal cortex, critical brain region responsible for executive functions such as attention, and working memory.[3,44] Additionally, previous research has shown that extended screen time correlates with alterations in white matter properties, which is linked to processing speed.[45,46]

Throughout an individual's life, cognitive status can fluctuate due to factors influencing either positive or negative neuroplasticity.[47] Positive neuroplasticity involves the brain's physiological ability to form and strengthen dendritic connections, make beneficial changes, and enhance cognitive reserve. Engaging in physical exercise, education and intellectual pursuits support positive neuroplasticity.[47]

Numerous investigations have consistently demonstrated an inverse relationship between screen time and engagement in physical activities.[48–50] A systematic review and meta-analysis conducted on both children and adults revealed that high total screen time and leisure screen time were found positively associated with sedentary behavior.[51] Moreover, low physical activity levels, coupled with prolonged screen viewing in mid-adulthood, were linked to poor cognitive function performance in processing speed and executive function domains.[52] The lack of association between day screen time and cognitive performance in the current study could be due to the lifestyle of young adults and the type of screen content.[53] In this study we have found that the night screen time only impacted the cognitive function. Almost all the participants in the study were undergraduates or postgraduates pursuing their master's degree, thus the electronic devices were used for educational purposes during the daytime and leisure screen time at night. This speculation is supported by a longitudinal study that revealed a positive correlation between a child's reading speed and understanding when engaged in educational programs.[53] Conversely, a negative correlation was noted between a child's viewing of entertainment programs and their reading speed and understanding.[54]

However, night-time screen exposure was found to impact cognitive function, possibly due to its interference with sleep quality and quantity,[24] which are essential for learning, attention and memory consolidation processes.[55–59] As previously mentioned, the current study also observed sex differences in cognitive functions (speed information processing, attention, calculation ability, and working memory domains) when examined by PASAT. These findings could be clarified by a study which revealed men generally had better sleep quality and cognitive performance, though women slept longer[60]

Another influencing factor that the study considered is the education level. The findings observed cognitive function variations among different educational level attainment. The findings of the current study correspond with positive neuroplasticity concept and cognitive reserve.[47] A recent study that aligns with the current study findings, showed a positive correlation between higher levels of educational attainment and cognitive performance.[61]

The current study found no direct association between sex, screen time pattern and visual speed processing, when examined by SDMT. This finding was different from another study where women exhibited better visual speed processing comparing to men.[62] The absence of associations between age, sex, education level, and cognitive performance regarding screen time patterns may be attributed to the study's age restricted population and the limitations of previous normative data.[62]

Strength and Limitations of the Study

Despite extensive research on the relationship between screen exposure and cognitive functions, there's a notable gap in understanding the impact on information processing speed. The current study addresses this gap by examining total screen time across various devices during both day and night. While most previous studies focused on children and adolescents[3], this study expands the evidence base by including young adults.[3]

Nevertheless, this study has some limitations. The screen time was measured using subjective self-reported questionnaire. Though almost all the smartphone screen time use was reported according to objective recorded data screen time on the individuals' mobile phones in this study, other screen time data could be susceptible to recall bias from the self-reported questionnaire. Though objective recorded data are not susceptible to reporting bias in contrast to self-reported information, the screen time questionnaire has shown fair to excellent reliability.[28]

Although the findings of the current study were based on cut-off points due to the absence of normative data for the study population characteristics, the current study used standardized sensitive cognitive outcome measures to test specified domains. Adding to that, the current study took the influencing factors (age, sex, and education level) into consideration.

Some might argue that the results presented in this study has small effect size and maybe dismissed as statistically unimportant. However, this should be viewed differently as the argument on the importance of small effects is beyond the scope of this response, it is crucial to acknowledge that top scholars argue that statistically small effects can have substantial practical implications when the outcomes are important, and a large population is affected, both of which are applicable in this context.[63–65] Moreover, we did a post-hoc power analysis using G*Power 3.1.9.7. Considering the R^2 value (PASAT = 0.29, MoCA = 0.064, and SDMT = 0.072) for multiple linear regression analysis for the dependent variables of interest, we calculated the respective f^2 values (0.63 for the PASAT, 0.26 for the MOCA, and 0.22 for the SDMT). By entering the effect size (f^2) values, a level of significance of 0.05, a total sample size of 139, and the number of independent variables as 5, it resulted in a power of 0.99 to 1.00. Hence, 139 participants included in the final analysis were deemed sufficient for the study. The study employed valid and reliable measurement tools, both of which are integral components for ensuring generalizability. Nevertheless, future research necessitates a broader age range to extend the generalizability of findings across a wider spectrum of ages.

Conclusion

The study concluded that young adults with an increased exposure to screens at night exhibited lower cognitive scores in the domains speed information processing, working memory, calculation, and attention. Moreover, Women in comparison to men had lower cognitive scores. Postgraduate students had higher cognitive scores compared to undergraduate students. Furthermore, future studies should include prospective cohort research with a broader age range, in addition to longitudinal studies focusing on specified cognitive domains to obtain normative data.

Future Recommendations

Considering the current study findings, the study emphasizes the significance of establishing future guidelines for recommended screen time among young adults and advocates for increased awareness about responsible screen usage to prevent future neurodegenerative diseases.

Data Sharing Statement

The datasets used in the study are available from the corresponding author on reasonable request.

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The authors declare that there are no conflicts of interests.

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