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RESEARCH ARTICLE

The Silent Strains and Blurred Minds: A Study of Digital Screen Time, Mental Fatigue and Brain Fog among University Students

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Abstract: This study aim to study the digital screen time on mental fatigue and brain fog among the university students. A sample of 1000 participants was taken using convenience sampling technique from Bachelor students in private and government universities of Pakistan. The students digital screen time was recorded in the demographic section of survey which was followed by the completion of the Mental Fatigue and Brain Fog Scales. The correlation and regression was done using SPSS-24. Results of Correlation analysis showed that there is relationship between the digital screen time, mental fatigue and brain fog. A weak but significant positive correlation was found between digital screen time and mental fatigue ($r = .153$, $p < .001$), as well as the digital screen time and brain fog ($r = .198$, $p < .001$). The strongest relationship was observed between mental fatigue and brain fog ($r = .493$, $p < .001$), which shows that as the mental fatigue increases so does the brain fog. All are statistically significant at the 0.01 level. The study showed the significant relationship between digital screen time, mental fatigue and brain fog. However, linear regression analysis showed that the digital screen time was a statistically significant predictor of mental fatigue. Furthermore, digital screen time significantly predicts of Brain fog. The results show the digital screen time significantly predict mental fatigue and brain fog. The Findings highlighted that promoting awareness of brain fog and balanced digital screen use is vital for students' cognitive health and improved academic performance.

Keywords: University Students, Mental Fatigue, Brain Fog, Digital Screen Use, Cognitive Functioning

Introduction

Digital device usage in the recent couple of years has become the part of the fabric of everyday life for every individual. In this era of technology there is no envision of lives without such technologies and various devices. As the digital screen time refers to the time that is spend by people of different ages on virtual and digital screens which include smart phones, smart watches, television, computers, laptops and various devices (Lissak, 2018). As the online world emerged in education the quintessential increase in the digital screen time enlarged. It also resulted in transmuted use of technologies and many smart devices in people's life. The 67.5 percent of the total world's population which makes 5.52 billion people was using the digital devices at the start of the October 2024. The known numbers of the social media users around the world in the last 12 months grew by 256 million (Datareportal, 2024).

Globally, people all around the word has an average screen time of 6 hours and 40 minutes per day from the recent studies. According to recent uncovering's the daily screen time has increased by over 30 minutes per day since 2013.Average Americans spends about 7 hours and 3 minutes per day. Average screen time of Africans is 9 hours and 24 minutes per day. Almost half (49 %) of 0–2-year-olds interact with various sort of technological devices. Average Generation z spends arounds 9 hours of screen time per day. A just

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out research states that the average screen time per day of individuals devices that were connected to the internet 24 hours a day were 6 hours and 40 minutes. (Howarth,2024). The average screen time in Pakistan is around 7-9 hours per day (Niazi et al., 2022).

Due to the COVID-19 global pandemic there was substantial increase in the digital screen time among diverse demographics. The COVID-19 pandemic has significantly increased digital screen time across various demographics. There is a cohort study which included 228 children whose age vary from 4 -12 years so when the global pandemic started the reported daily screen time among such individuals were reported as 1.75 hours, screen time and for educational purposes the screen time increased by 0.93 hours and recreational screen time increased by 0.89 hours (Hedderson et al., 2023).

Additionally, there is also research that indicates that the addiction of using the screen for many hours can also results in various psychoneurological effects, such as individual may start having addictive and craving behaviors such as that are similar to the substance craving and dependence and reduction in the social coping skills. Those individuals who have shown an addictive behavior regarding the screen usage have change in their brain structure especially regarding to the emotional regulation and cognitive and intellectual control (Ding et al., 2023). At the same time the usage of the screen time also increased and most commonly among the students especially the university students.

One of the crucial and critical issue that is associated with the increased digital screen time is the mental fatigue. Mental fatigue is defined as such state of the mind that results because of the long and intense mental work that makes a person tired and have lesser energy (Rozand et al., 2016). The recent studies investigated the link between the digital screen time and mental fatigue. A study showed that the extended cognitive effort, which is result of the lingering screen related tasks, which stems in the major reduction in the mental performance and alertness (Marcora et al., 2009). Mental fatigue or mental exhaustion can be explained as when brain gets acquainted with a lot of fosters and foment stimulations like if it is being repeatedly pricked or the brain is involved in the ardent and extreme level of the activity without taking any rests in between (Kunasegaran et al., 2023).

The tasks that require a lot of the cognitive efforts may results in reduce functioning of the brain networks and the various executive functions. This efficiency mostly manifests because there is reduced and diminished connection between the various important key regions in the brain, which ultimately results in the increasing of the fatigue and effecting the cognitive performance. Prolonged cognitive tasks can lead to reduced efficiency in brain networks responsible for attention and executive functions. This inefficiency manifests as decreased connectivity between key brain regions, impairing cognitive performance and increasing the perception of fatigue (Qi et al., 2019). There was one study that was done to investigate the impact of mental fatigue on the activity of the brain. To understand how the brain activity is done during when individuals are in resting state or in a state of performing a task with the help of an electroencephalogram. A sample of 20 healthy male were intentionally mentally fatigued by consecutive mental arithmetic tasks. An electroencephalogram was used to collect the data before and after each task. The result of the findings indicated that indeed there was mental fatigued induced in the twenty male participants with the mental arithmetic. The absolute power index was more sensitive and better in detecting the relative power in the terms of mental fatigue mostly in the resting state. When the alpha frequency was divided into alpha 1, and alpha 2 and in the fatigue related studies the sub bands were much better in providing physiological insights and better statistical differentiation. The appropriate importance of selecting a fitted condition for getting an EEG data and analysis in the research shows how the brain activity is different during the performing task or resting task (Cheng et al., 2011). The study by the Neophyto and colleagues (2019) reviewed observational and the conceptual proof for the relationship between the long screen time and the sensory overstimulation with the neurodevelopment, learning, memory, mental health and substance use disorders, and the occurring of neurodegeneration. Overall, it was discovered that the increase in the

screen time was linked to the low self-esteem, mental health issues, substance issues, untimely decline of the cognition, acuteness of the mental health issues. The study further emphasized that the overindulgent with the smart phone may result in the various acute cognitive, behavioral, emotional disorders among the adolescents and young adults. There are also the various dimensions of the mental fatigue that consist of the motivational and emotional dimensions. When there is chronic use of the cognitive efforts it may be one of the leading causes of depletion of the motivation which could result in the lack of the cognitive control, lack of motivation to engage in the tasks and affecting the decision-making skills, increased distraction and lessen functioning in the task.

Another important factor understudy was digital screen time role in brain fog. Brain fog which is also sometimes referred as mental fog. Brian fog can be interpreted as wide range of symptoms of intellectual impairment which may most probably result in the wrong judgment, confusion, and many issues related to learning and retention of information (Migala, 2023). Individuals experiencing brain fog may scuffle with the multitasking and may have problem with the avaricious concepts or in a state of ecstasy and may get bewildered and engrossed by any sort of diversions. Individuals who experience brain fog may face the intellectual lassitude and tardiness and may also complain about apathy and torpor (Higuera, 2017). Brain fog is one of the newest concepts where a lot of the studies and exploration is needed to be done. But the current stats on the brain fog is that there is work being done on understanding and familiarity with the concept of the brain fog. There are many digital applications that were developed to combat and banish the brain fog among the individuals including the individuals suffering from the chronic patients as well as COVID-19 survivors. The applications are Daylio, structured, Me+, Mood banks, The packing pack etc (University College London Hospitals NHS Foundation Trust., n.d.). There is no known evidence of the brain fog being an actual medical or know to be a scientific term, The term brain fog is usually used by the individuals when experienced that thinking has been quite lazy or slowed down (Budson, 2021). A study investigated about the relationship between the smartphone addiction and emerging signs of the brain fog among the adults.

A cross-sectional survey on 321 university students from the city of Rawalpindi and Islamabad. The age of the sample ranged from the year of 18 to 29 years. The correlation analysis provided the significant positive correlation between the smart phone addiction and brain fog symptoms which includes the cognitive, physiological and the various psychological aspects of the brain fog. The findings also provides that there was higher smartphone addiction among the married individuals as compared to the unmarried individuals. On the physiological symptoms of the brain fog the unemployed participants scored more on the physiological symptoms as compared to the employed individuals. Any of the participants who have experienced trauma in the last 6 months scored much higher on the brain fog across all the three domain symptoms. Findings also provided that the increased use of the smartphone results in the cognitive overload, attention impairment which are the proponents of the brain fog. The study suggested for the sensible use of the smartphones to reduce its negative effect on the cognitive health. The study highlights about the relationship between the smartphone addiction and impairment in the cognition mostly the brain fog. This study supports the hypothesis that increased exposure to the screen contributes to the mental fatigue as well as the brain fog (Ijaz & Imran, 2024).

Recent research has put forward the prevalence as well as the impact of the high digital screen with having excessive screen time with more than 8+ hours/day which was ultimately directly linked with the reduced mental well-being and poor academic performance. (Kaewpradit, Ngamchaliew, & Buathong, 2025). Many studies show the relationship between the increase digital device use and the experience of the brain fog. A study revealed that the prolonged screen usage was linked to the decline cognitive performance (Cain et al., 2010).

Finally, at the end a study investigating the difficulties experienced by the individuals with the chronic fatigue syndrome which mostly focused on the brain fog. It describes how the brain fog could occur as the subjective experience of the mental fatigue which affects the overall cognitive performance. The study also shows that brain fog is not just a sensation or feeling that goes away instead it is a real problem that cannot be measured directly and studied. Mostly it occurs because of issues in the brain and are mostly common in people with the chronic fatigue syndrome. The study states that as the fatigue increases the brain fog also increases. The research proves that as mental fatigue increases, brain fog also gets worse. It also states that it is especially common in the long-term health condition which are the chronic fatigue syndrome the mental exhaustion and brain fog are fairly connected (Ocon, 2013).

This current study indents to find out whether the increased use of digital screen time could act as a predictor of mental fatigue and brain fog among university students. As well as how this study assumes to offer the practical efforts for the digital literacy of the people, creating awareness of brain fog among students as well as general population.

Hypothesis

1. Higher the digital screen time, the higher will be the mental fatigue and brain fog among students
2. Digital screen time will be a significant predictor of mental fatigue
3. Digital screen time will be significant predictor of brain fog

Methodology

The present study employed the quantitative correlational study about the role the digital screen time on mental fatigue and brain fog among university students. A sample of 1000 bachelor students from private and government universities through the convenience sampling. The data was collected from University of Gujrat Hafiz Hayat Campus Gujrat, Zamindar College, Gujrat institute of Management Sciences, Arid Agriculture University RWP, and University of Central Punjab, Gujrat Campus.

The digital screen time was asked in demographic sheet. The Mental Fatigue Scale (MFS) developed by the Johansson and collogues (2009) that measures the brain exhaustion, burn out, fatigability, impaired attention, and sensory sensitivity whereas Brain Fog Scale (BFS) another tool that was developed by Debowska and collogues (2024) was employed to measure the mental confusion. There was demonstrated acceptable reliability of all scales which was confirmed through the Cronbach's alpha.

In order to collect the data from the selected sample there was informed consent, socio demographic sheet and two standardized questionnaires were used. In the informed consent respondents were invited to participate in the study and the topic was explained. The consent of the participant was taken, and they had the authority to leave the participation in the research anytime they want. The demographic sheet was followed after the informed consent. The basic questions about the age, gender, university, academic program, where they live, digital screen time, what social media is used, how often it is used and which time of the day it is used were ask. Questionnaire were distributed in person, respondents' anonymity and confidentiality were ensured. All the respondents were approached in professional and respectable manner in their respected institutions. All the collection of data collection was done with the permission from the authorities. Before the surveys were given to the respondents the clarification was given to them about how to understand it and keeping them in confidence that their information would be kept confidential. The statistical package for social sciences version 24 (SPSS-24) was used to understand, analyse, interpret and present the data. The correlation and regression were used to justify the predictability of the relationship between the variables mentioned.

Results

The obtained findings provide overview of the statistical analysis used in the study. This provides the statistical viewpoint on the relationship between the digital screen time, mental fatigue and brain fog. The software that was used to run the statistical analysis was the Statistical Package for the social sciences (SPSS) version 24. The screening of the data was conducted. The screening is mostly done to look for the outliers, missing value and any errors in the data before the analysis is conducted.

Correlation Analysis

Table 1

Correlation between the digital screen time, mental fatigue, and brain fog among university students (N=1000)

Variables	1	2	3
1. Digital screen time	-		
2. MFS	.153**	-	
3. BFS	.198**	.493**	-

The table gives us the value of correlation between the variables. The table gives the Pearson correlation values among digital screen time, mental fatigue, and brain fog. A weak but significant positive correlation was found between digital screen time and mental fatigue ($r = .153$, $p < .001$), as well as the digital screen time and brain fog ($r = .198$, $p < .001$). The strongest relationship was observed between mental fatigue and brain fog ($r = .493$, $p < .001$), which shows that as the mental fatigue increases so does the brain fog. All are statistically significant at the 0.01 level.

Regression Analysis Table

Digital Screen Time Predicting Mental Fatigue

Table 2

Regression Coefficients and Model Summary

Variables	B	SE	β	t	p	95% CI for B
(Constant)	13.19	0.51	—	26.09	< .001	[12.200, 14.18]
Digital Screen Time Daily	0.37	0.08	0.153	4.90	< .001	[.222, .518]

Note. B = Unstandardized coefficient; SE = Standard Error; β = Standardized coefficient; CI = Confidence Interval (not provided here, but can be computed if needed); R^2 = proportion of variance explained.

A simple linear regression was conducted to examine whether digital screen time predicted the mental fatigue. The regression coefficient for digital screen time was B = 0.37, SE = 0.08, and this effect was statistically significant, $t(998) = 4.90$, $p < .001$, with a standardized beta coefficient of $\beta = .153$, suggesting a small positive relationship. This means that for each additional unit increase in screen time, mental fatigue increases by approximately 0.37 units. There was a 95% confidence interval for the unstandardized coefficient ranging from 0.222 to 0.518.

Table 3

Model	R	R^2	Adjusted R^2	F	p	SE Estimate
Model 1	.153	.023	.023	24.00	< .001	6.95

The model explained 2.3% of the variance in MFS scores ($R^2 = .023$, Adjusted $R^2 = .023$), and the standard error of the estimate was 6.95, indicating a modest overall model fit. The model was statistically significant, $F(1, 998) = 24.00$, $p < .001$, indicating that digital screen time is a significant predictor of mental fatigue.

Digital Screen Time Predicting Brain fog

Table 4

Regression Coefficients and Model Summary

Variables	B	SE	β	t	p	95% CI for B
(Constant)	33.90	0.98	—	34.77	< .001	[31.98, 35.81]
Digital Screen Time	0.93	0.15	0.198	6.40	< .001	[0.65, 1.22]

A simple linear regression was conducted to examine whether daily digital screen time predicted brain fog scores (BFS). The results indicated that digital screen time was a significant positive predictor of BFS, B = 0.93, SE = 0.15, β = .198, t(998) = 6.40, p < .001, with a 95% confidence interval for the unstandardized coefficient ranging from 0.65 to 1.22.

Table 5

Model	R	R^2	Adjusted R^2	F	p	SE Estimate
Model 1	.198	.039	.038	40.92	< .001	13.40

Note. R = correlation coefficient; R^2 = proportion of variance explained; SE Estimate = standard error of the estimate.

Table shows the model fit statistics for a linear regression predicting brain fog score (BFS) from daily digital screen time. The model was statistically significant, F(1, 998) = 40.92, p < .001, indicating that digital screen time contributes significantly to the prediction of brain fog symptoms. The correlation coefficient, R = .198, indicates a small but positive relationship between screen time and BFS. The model explains approximately 3.9% of the variance in brain fog scores (R^2 = .039, Adjusted R^2 = .038), suggesting that individuals who spend more time on digital screens tend to report higher brain fog, although the effect size is small.

Discussion

The current research was done with the motive of exploring the relationship between the variables such as digital screen time, mental fatigue and brain fog among university students that would be a greater addition to the present body of literature review. The quantitative correlational design was used that was in relevance to our research as it is easy to find the relationship among the variables. The predictor in the mentioned research was the digital screen time and mental fatigue and brain fog are the dependent variables. Much research has investigated effect of the digital screen on either mental fatigue or brain fog, but these phenomena have not been studied concurrently.

As the primary goal of the study was to find the relationship between the digital screen time, mental fatigue and brain fog among the university students. The results showed that digital screen time and mental fatigue were linked significantly with correlation of 0.153. Digital screen time and brain fog show significant positive correlation of 0.198 and finally correlation between the mental fatigue and brain fog was positive and significant with a value of 0.493. Same significant predictive relationship existed between digital screen time and mental fatigue and brain fog.

As the Digital screen time refers to the time that is spend by people of different ages on virtual and digital screens which include smart phones, smart watches, Television, computers, Laptops and various devices (Qi, Yan, & Yin, 2023). The digital screen time also influences the dietary habits of the individual as well. There is a direct correlation between the alarming risk of obesity with the many cardiometabolic risk factors, unhealthy eating habits and eating disorders among the children and adolescents (Priftis & Panagiotakos, 2023).

The recent studies investigated the link between the digital screen time and mental fatigue. A study showed that the extended cognitive effort, which is result of the lingering screen related tasks, which stems in the major reduction in the mental performance and alertness (Marcora et al., 2009). As the research

indicated the increase in the digital screen time is linked with the mental fatigue and the adversely affect the brain functions which may involve control of the cognition, and information processing (Zhang et al., 2020). There are many adverse side effects of mental fatigue on the physical and the cognitive functioning of the individuals. There are various countermeasures that can be applied to combat the mental fatigue by the behavioral, physiological and psychological approaches. In the psychological interventions there are various outdoor tasks and the intake of the caffeine before the tasks that require intense mental efforts. Behavioral interventions include listening to the various music while doing tasks to keep one active and as well as enhancing and improving the extrinsic motivation also resulted in better results. It also had it drawbacks as there were less of the evaluation of the various neurophysiological markers in the present studies (Meijer et al., 2022).

Further, the current study also look into the role of digital screen in brain fog which is also sometimes referred as mental fog. Brian fog is intellectual impairment resulted in the incorrect judgment, misperception, and many problems related to learning and retaining information (Migala, 2023). People all around the world experience mental fatigue when they are involved in the academic or intellectual activities for longer period of time without taking any lapse of time between there sessions or when they are under the acute burden of the responsibilities of their life. Individuals living with the diagnosed or under diagnosed mental health or individuals involved and engaged in the over thinking, worries and stresses of the live may experience the mental exhaustion (Kunasegaran et al., 2023). A study shows how the exposure to various screen devices lead to the cognitive overload resulting in the mental exhaustion and reduced attention. (Firth et al., 2019). Moreover, a study investigated about the relationship between the smartphone addiction and emerging signs of the brain fog among the adults. The research clearly shows increase in the screen time is resulted in the brain fog (Ijaz & Imran., 2024). The large-scale study for the subjective characterization of the brain fog claimed that the brain fog is a subjective cognitive impairment which is directly linked with the difficulties in the daily life function. The results show the complicated nature of the brain fog and shows the need to do further research to find the targeted solutions. This shows how the cognitive arrears linked with the brain fog which supports the hypothesis that increase in the screen time contribute to the mental fatigue and cognitive impairments (Alim-Marvasti et al., 2024). The results of the current study were consistent with the literature.

Limitations

Despite special and essential information given by this study, some limitations need to addressed so that it can be acknowledged in future studies. First of all, the study was limited to the undergraduate students of a specific geographic region and cultural context, which may obstruct the generalizability of the findings to the other populations of different social cultural backgrounds. Secondly, the self-report questionnaires were used that may introduce the biasness in the response because of the social desirability or unable to truly recall the events. The research would be more effective if longitudinal or the mixed methods designs would be considered with the larger and much more diverse sample rather than just a specific geographic region.

Conclusion

The proposed study investigated the role of digital screen time on mental fatigue and brain fog among the university students, added to the current body of scientific literature. By using the quantitative research design, it was found that there was positive correlation between digital screen time on mental fatigue and brain fog and positive correlation between mental fatigue and brain fog. Further, digital screen time was the significant predictor of mental fatigue and brain fog.

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