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Does screen time and duration of exercise impact cognition levels during COVID-19 lockdown: An observational study

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Abstract

Coronavirus Disease is a novel disease that was first detected in China. There has been a surge in the number of coronavirus cases globally with India having the second-highest number of cases. Due to the prevailing problems, the colleges around the country are closed and education is being imparted through online mode. The use of the online mode of education led to an addition in the screen time of college students. Social restrictions like lockdown led the individuals to confine to their homes thereby causing a reduction of physical activity and exercise duration. Hence, we conducted this study to evaluate the impact of screen time and physical activity on the level of cognitive failure in college students in India. We conducted this explanatory, cross-sectional, online survey with 500 college students from India, and data collection was completed following informed consent. We found that the highest percentage of college students (43%) had a screen time of more than six hours. Subjects having a higher screen time also demonstrated a higher cognitive failure questionnaire score (56.19+20.07). Subjects who performed exercises for more than 29 minutes per day were found to have the lowest cognitive failure score (44.31+22.34). We should take into concern the cognitive failures of college students who are consistently being using digital devices and not doing exercises for an optimal duration. Higher screen time and lower exercise duration might serve as a factor to increase cognitive failure in college students in India.

Keywords: Cognition, mobile phone, technology, COVID-19, Mental health, SARS-CoV-2 coronavirus, Risk factors

Introduction

As the second wave of novel coronavirus has hit India like a storm, a sedentary lifestyle and extensive screen exposure have become a pandemic of its variety. India is a densely populated country with a population of 1.3 billion people spread across diverse states. India has wide economic and social disparities, health inequalities, and distinct cultures that possess great challenge in this phase of the COVID-19 pandemic and makes it extremely difficult to contain the virus in time [1]. Because of its rampant spread, students are confined to their homes and spend most of their time on screen. According to the American Academy of Child Adolescent Psychiatry, the recommended maximum screen time is less than or equal to two hours per day [2]. However, the average screen time during the pandemic was found to be more than five hours a day [3]. The increase in screen time has a great impact on their physical and mental well-being [4, 5].

The time spent by an individual on television, games, mobile phones, computers and laptops is referred to as "screen time". India has seen a rise in the use of media devices in the recent past [6]. An increase in COVID-19 cases led to an additional increase in screen time owing to the components of online classes in colleges. This increase in screen time leads to a decline in mental health that is compounded by the impact of mandatory social distancing norms that restricts the time students spend with their peers [6, 7]. In a recent review, children were found to have a 76.5% increase in their screen times with a 58.6% decline in their physical activity during COVID-19 [8]. Although increased screen time had been associated with the disruption in cognitive abilities even before the pandemic also [6] but it succumbed to a doomed road in this pandemic [9]. It has been previously been reported that the left side of the brain controls

language and cognitive behavior but the present scenario of screen learning decreases these connections ultimately leading to cognitive decline [10]. More than two hours of screen time has been shown to produce major behavioral problems in youth like irritability, forgetfulness, and an increased tendency to make unnecessary mistakes [11].

On the other hand, physical activity has been shown to increase cognitive ability [12]. The improvement in cognitive ability following physical activity has been attributed to the increased activation of brain-derived neurotrophic factor (BDNF). This in turn enhances synaptic plasticity, learning, memory, and an increase in the synapsin I activity [13, 14]. Increased physical activity also enhances neuronal recruitment in the brain [15]. A study done on physiotherapy students during the COVID-19 showed that their mental well-being declined as a result of increased screen time due to mandatory online classes. However, an increase in physical exercises led to betterment in mental health [16]. Physical activity can essentially increase the quality of life and decrease the unnecessary screen time on television and tablets because people start to enjoy the positive effects of physical exercise more than spending time on “leisure watching” [17]. However, in this pandemic, the students cannot avoid the extended screen times owing to online classes. Thereby, we conducted this cross-sectional study to analyze the impact of screen time and exercise level on the cognitive failures in college students. Previous recommendations suggest that exercises should be done at a moderate intensity and higher frequency to attain better outcomes in the cognitive abilities of healthy individuals [18].

Previous literature has highlighted the role of sleep disturbance in school-going children but not much work has been done in college students for their screen usage. This study becomes more important in this phase of COVID-19 because decreasing screen time is not a viable solution right now. This is the first study where we aimed to assess the relationship between screen time and exercise duration in terms of cognition failure in college students.

Materials and Methods

This is a cross-sectional, explanatory, online survey study conducted following the methodological guidelines of Lau *et al.* [19]. It involved multiple cohorts of respondent groups (N = 500) varying in characteristic features including age, gender, exercise duration, and screen time.

An online form was generated using Google forms and circulated on a social media platform (WhatsApp). The survey form, primarily in English, aimed at collecting inputs from Indian college students. We developed the form in such a way that it could be filled only once using one device. The data was collected by circulating the link using the non-discriminative, exponential snowball method, and the

participants were requested to share the form link with other college students from April 21 to 25, 2021. The form comprised of several open-ended and close-ended questions and consist of the following components: a) In the introduction section, we introduced the theme and goal of the study with a consent form for participants to express their willingness to participate and data to be published. b) questions about the basic patient characteristics sheet included data about the subject’s age, weight, height, gender, city, screen time, and daily exercise duration c) a self-reported questionnaire evaluating the failures in motor function, memory, and perception. The questions in the survey were adapted from Cognitive Failure Questionnaires (CFQ) [20].

Chronic failure questionnaire

It is a 25-item self-reported questionnaire that includes questions about memory, motor function, perception, and absent-mindedness of participants (Table 1). Each question is scored on an ordinal score of 0 to 4 (Never, very rarely, occasionally, quite often, and very often). We determined a final score by summing up the individual scores to all 25 questions. Out of 100, a higher score denoted more failures in the various domains. This questionnaire was used to assess the cognitive failures.

Exercise duration

We devised 4 categories to determine the duration spent by the participants on exercises per day. The categories included duration of fewer than 10 minutes, 10 to 19 minutes, 19 to 29 minutes, and more than 29 minutes of exercise per day respectively. Subjects were made to choose one option out of these categories.

Screen time

Screen time is comprised of the total amount of time spent using a mobile phone, laptop, iPad, television, and desktop. The duration of time spent watching a screen was divided into 4 categories namely less than one hour, one to three hours, three to six hours, and more than six hours.

Statistical analysis

Data was collected and analyzed for the descriptive characteristics to evaluate the impact of screen time and exercise duration on the cognitive failure components. An independent sample t-test was used to compare the mean age, weight, and height of male and female participants. An independent sample t-test was used to compare the various screen time and exercise duration categories in terms of the CFQ score. A pairwise analysis was also conducted for multiple combinations of exercise duration and screen time using Tukey’s honest significance test. P-value of <0.05 was considered as a statistically significant difference.

Table 1: Cognitive failure questionnaire responses

	Cognitive failure questionnaire items	0	1	2	3	4
1	Do you read something and find you haven’t been thinking about it and must read it again?	29	87	134	151	101
2	Do you find you forget why you went from one part of the house to the other?	69	126	120	108	77
3	Do you fail to notice signposts on the road?	123	116	92	100	69
4	Do you find you confuse right and left when giving directions?	136	86	101	91	85
5	Do you bump into people?	156	136	86	54	68
6	Do you find you forget whether you’ve turned off a light or a fire or locked the door?	83	108	94	103	112
7	Do you fail to listen to people’s names when you are meeting them?	116	107	101	97	79
8	Do you say something and realize afterwards that it might be taken as insulting?	44	129	111	112	104
9	Do you fail to hear people speaking to you when you are doing something else?	66	107	109	116	102
10	Do you lose your temper and regret it?	47	88	96	134	135

11	Do you leave important letters unanswered for days?	109	107	101	92	91
12	Do you find you forget which way to turn on a road you know well but rarely use?	120	111	91	111	67
13	Do you fail to see what you want in a supermarket (although it's there)?	94	129	100	100	77
14	Do you find yourself suddenly wondering whether you've used a word correctly?	51	117	102	117	113
15	Do you have trouble making up your mind?	51	105	123	105	116
16	Do you find you forget appointments?	112	117	99	103	69
17	Do you forget where you put something like a newspaper or a book?	71	110	109	106	104
18	Do you find you accidentally throw away the thing you want and keep what you meant to throw away - as in the example of throwing away the matchbox and putting the used match in your pocket?	122	107	94	100	77
19	Do you daydream when you ought to be listening to something?	62	86	108	117	127
20	Do you find you forget people's names?	92	113	109	108	78
21	Do you start doing one thing at home and get distracted into doing something else (unintentionally)?	58	99	97	121	125
22	Do you find you can't quite remember something although it's 'on the tip of your tongue'?	46	109	120	124	101
23	Do you find you forget what you came to the shops to buy?	105	123	83	104	85
24	Do you drop things?	113	165	91	64	67
25	Do you find you can't think of anything to say?	51	90	110	117	132

Number of responses for 25 questions in each score category on a scale of 0 to 4 (never, very rarely, occasionally, quite often, very often) to assess the frequency of cognitive failure.

Results

We obtained a total of 500 responses out of which 260 were males and 240 were females. The mean and standard deviation age of male participants was 22.5 + 2.35 and that of females was 22.13 + 2.26 (Table 2). The mean weight for the

participants was 65 kg and the mean height was 167.5 cm. 43% of the subjects were found to have a screen time of more than six hours with only 9.6% presenting with a screen time of less than one hour. Among the responders, 29.4% performed the exercises for more than 29 minutes per day.

Table 2: Gender-specific demographic profile

	Male (N = 260)		Female (N = 240)	
	Mean + SD	Range	Mean + SD	Range
Age (Yr)	22.5 + 2.35	18-30	22.13 + 2.26	16-28
Weight (kg)	69.47 + 10.61	26-99	57.34 + 11.69	29-87
Height (cm)	170.51 + 7.26	145-186	161.79 + 8.93	125-183

Impact of screen time on CFQ scores

Out of all the responders, the maximum number of participants (33.6%) were having screen time from three to six hours (Table 3). The subjects having a screen time of more than six hours had a mean CFQ score of 56.19 + 20.07. The subjects who were using the devices for 1-3 hours had the lowest mean CFQ scores of 43.06 + 18.68. This was followed by subjects in the less than one hour and three to six hours

category (Figure 1a). Tukey's honest significance test and analysis of variance for comparative pairwise analysis of the various categories of screen time showed a statistically significant difference in the following a) <1 hour vs.. >6 hours, b) 1-3 hours vs.. 3-6 hours c) 1-3 hours vs.. >6 hours d) 3-6 hours vs.. >6 hours (Figure 2a). The results of the comparison are summarized in Table 4.

Table 3: Background patient data

Patient characteristics	N = 500
Age (yr) a	22 (21, 24)
Weight (kg) a	65 (55, 73)
Height (cm) a	167.5 (159, 172.8)
Screen time b	
<1 hour	9.6
1-3 hours	13.8
3-6 hours	33.6
>6 hours	43
Exercise time b	
<10 minutes	25.6
10-19 minutes	19.4
19-29 minutes	25.6
>29 minutes	29.4

^aData presented as median (1st quartile, 3rd quartile). ^bData presented as a percentage.

Impacts of exercise duration on CFQ scores

Subjects who performed exercises for more than 29 minutes per day had the lowest CFQ score (57.05 + 17.88) followed by less than 10 minutes, 19 to 29 minutes, and 10 to 19 minutes, respectively (Figure 1b). Pairwise comparisons (Table 4) of the various exercise categories revealed statistically significant results in the following: a) <10 minutes vs. 10-19 minutes, b) <10 minutes vs. >29 minutes,

c) 10-19 minutes vs.. >29 minutes and d) 19-29 minutes vs.. >29 minutes respectively as shown in Figure 2b.

Discussion

Countrywide lockdown due to COVID-19 is a major contributor to an increase in screen exposure time and reduced physical activity because of the increased dependence on mobile phones, laptops, and tablets for study as well as

leisure purposes [21]. Cognitive function encompasses a plethora of processes such as attention, memory, perception, language comprehension, and decision-making [22]. To date, this is the first study that evaluates the impact of screen time and physical activity duration on the cognitive failures observed in the daily routines of collegiate students. Previous

literature has shown a negative association of screen time and cognition in children and elderly individuals but none of those discussed the effects of screen time and exercise on collegiate students during online classroom scenarios amidst this COVID-19 pandemic.

Table 4: Impact of screen time and exercise duration on CFQ values

Parameters	T-test (95% CI)	p value
Screen time		
<1 hour vs. 1-3 hours	0.39 (-5.42 to 8.05)	0.699
<1 hour vs. 3-6 hours	-1.42 (-10.18 to 1.69)	0.159
<1 hour vs. >6 hours	-4.09 (-17.57 to -6.05)	<0.001*
1-3 hours vs. 3-6 hours	-2.03 (-10.97 to -0.15)	0.044*
1-3 hours vs. >6 hours	-4.99 (-18.34 to -7.92)	<0.001*
3-6 hours vs. >6 hours	-3.65 (-11.65 to -3.49)	<0.001*
Exercise time		
<10 minutes vs. 10-19 minutes	-2.19 (-10.39 to -0.54)	0.029*
<10 minutes vs. 19-29 minutes	-0.31 (-5.43 to 3.94)	0.755
<10 minutes vs. >29 minutes	2.89 (2.31 to 12.24)	0.004*
10-19 minutes vs. 19-29 minutes	1.93 (-0.09 to 9.55)	0.055
10-19 minutes vs. >29 minutes	4.93 (7.64 to 17.83)	<0.001*
19-29 minutes vs. >29 minutes	3.25 (3.16 to 12.87)	0.001*

*Significance level set at $P < 0.05$.

In our study, students with a higher screen time had an increased CFQ score thereby indicating more chances of cognitive failure. The highest CFQ score was observed in individuals who had a screen time of more than 6 hours whereas the lowest CFQ score was recorded in subjects with a screen time of one to three hours. One of the previous studies reported a cognitive delay in pre-school children because of an increase in screen time during the pandemic. However,

applying parental screen-time control helped in decreasing the negative effects of screen exposure [6]. Augmented screen exposure time has been associated with cognition, vigilance, arousal, and motivation in school-going children as well. The results of this study are well in coherence with our results as we also found that one to three hours of screen time leads to the least cognitive failures [7].

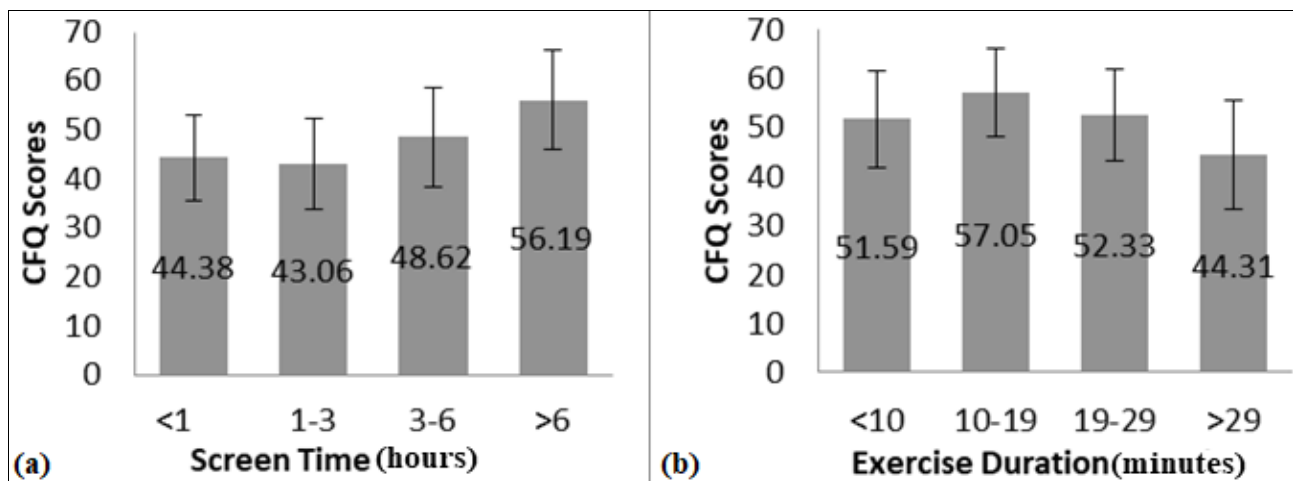


Fig 1: (a) Relationship between screen time and CFQ scores (b) Relationship between exercise duration and CFQ scores

The harmful effects of screen time on cognition are a direct consequence of blue light (wavelength = 415 and 455 nm) emitted from the electronic devices [23]. Although therapeutic blue light used in previous studies has been shown to improve cognition, the light source used by those researchers had a higher wavelength than the light emitted by the electronic devices [24].

On the contrary, exercise duration was found to be directly correlated with a reduction in cognitive failure. The people who used to perform exercises for more than 29 minutes had the lowest CFQ scores thereby indicating a reduced risk of cognitive failure. However, it was seen that subjects performing exercises for less than 10 minutes exhibited lower CFQ scores when compared to 10 to 19 or 19 to 29 minutes of

exercises. Physical activity is indeed responsible for increasing cognitive skills and decreasing cognitive delay in youth. A previous study supports our results as it suggests that a minimum of 10 minutes of physical activity might be needed to improve cognition in young adults [18]. Carlson *et al.* also found that monitoring the screen time and increasing the physical activity time of youth can help in improving cognition [25]. The increase in cognition following exercises might be attributed to an increase in BDNF activity and expression in the hippocampus of the brain. The BDNF protein had previously been shown to play a role in improving memory and cognitive performance in the short term along with causing neuroplasticity following an extended-expression [13, 14].

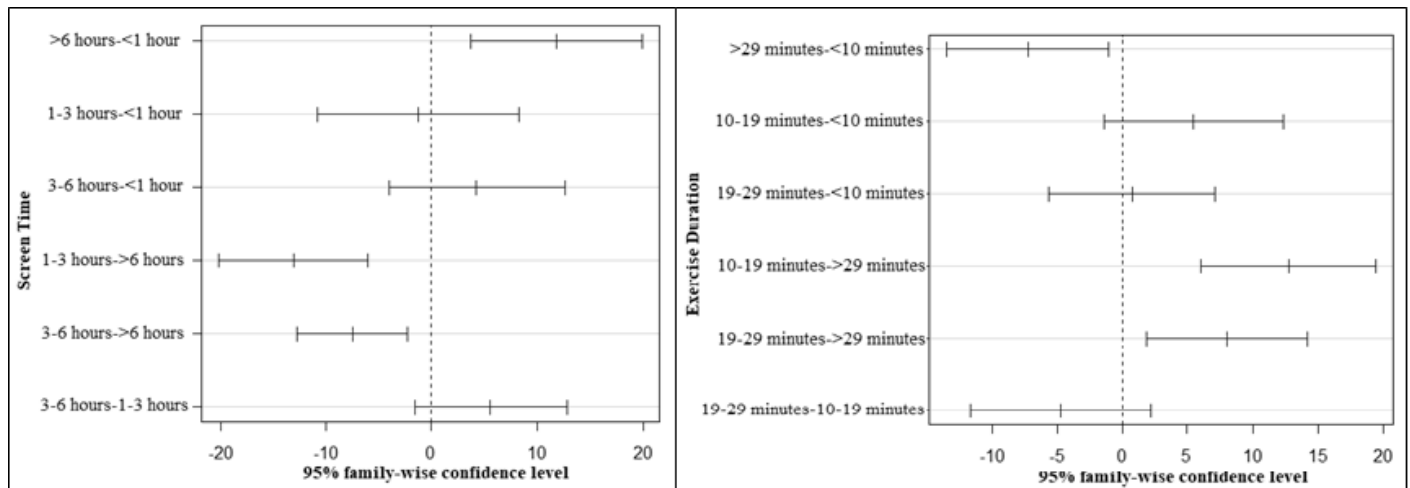


Fig 2: The pairwise confidence level for (a) Screen time (b) Exercise duration

Our study has certain limitations that should be noted. This study is limited to the Indian collegiate population only and the results might not be generalized to the western college students because of differences in the availability of resources and work habits. Secondly, we used an English language survey thereby restricting the applicability of results to the population who can understand the English language. Further developments in this field of cognition and mental health are required to bring forth effective strategies to counter the effects of increasing screen time. Future research should focus on conducting semi-structured interviews and focus group interviews to emphasize the individual factors responsible for cognitive impairments.

Conclusion

COVID-19 lockdown led to a reduction in social interactions and the guidelines for its prevention need to be followed properly. This contributed to an increased reliance on online classes leading to extended screen time in college students in India. A decrease in physical activity also accompanies the increased screen usage thereby impacting the mental health of college students leading to cognitive failure. Screen time should be monitored and regulated along with the introduction to the benefits of exercise routines to promote better mental well-being in college students.

Abbreviations

CFQ: Cognitive failure questionnaire
 BDNF: Brain-derived neurotrophic factor
 SARS-COV2: Severe acute respiratory syndrome coronavirus-2
 yr: Year
 kg: Kilogram
 cm: Centimeter
 nm: Nanometer

References

- Brooks SK, Webster RK, Smith LE, Woodland L, Wessely S, Greenberg N *et al.* The psychological impact of quarantine and how to reduce it: rapid review of the evidence [Internet]. *The Lancet*. Lancet Publishing Group 2020;395:912-20. [https://doi.org/10.1016/S0140-6736\(20\)30460-8](https://doi.org/10.1016/S0140-6736(20)30460-8).
- Bar-On ME, Broughton DD, Buttross S, Corrigan S, Gedissman A, González De Rivas MR *et al.* Children, adolescents, and television [Internet]. *Pediatrics*. Pediatrics 2001;107:423-6.
- Biswas S, Biswas A. Anxiety level among students of different college and universities in India during lock down in connection to the COVID-19 pandemic. *J Public Heal* 2021;7:1-7. <https://doi.org/10.1007/s10389-020-01431-8>.
- Chen Q, Liang M, Li Y, Guo J, Fei D, Wang L *et al.* Mental health care for medical staff in China during the COVID-19 outbreak. *The Lancet Psychiatry* 2020;7(4):e15-6. [https://doi.org/10.1016/S2215-0366\(20\)30078-X](https://doi.org/10.1016/S2215-0366(20)30078-X).
- Yang Y, Li W, Zhang Q, Zhang L, Cheung T, Xiang YT. Mental health services for older adults in China during the COVID-19 outbreak. *The Lancet Psychiatry* 2020;7(4):e19. [https://doi.org/10.1016/S2215-0366\(20\)30079-1](https://doi.org/10.1016/S2215-0366(20)30079-1).
- John JJ, Joseph R, David A, Bejoy A, George KV, George L. Association of screen time with parent-reported cognitive delay in preschool children of Kerala, India. *BMC Pediatr* 2021;21(1):1-8. <https://doi.org/10.1186/s12887-021-02545-y>.
- Dutta K, Mukherjee R, Das R, Chowdhury A, Sen D, Sahu S. Scheduled optimal sleep duration and screen exposure time promotes cognitive performance and healthy BMI: a study among rural school children of India. *Biol Rhythm Res* 2019, 1-3. 10.1080/09291016.2019.1646505.
- Guo YF, Liao MQ, Cai WL, Yu XX, Li SN, Ke XY *et al.* Physical activity, screen exposure and sleep among students during the pandemic of COVID-19. *Sci Rep [Internet]* 2021;11(1):8529. <https://doi.org/10.1038/s41598-021-88071-4>.
- Gupta T, Nebhinani N. Impact of COVID-19 pandemic on child and adolescent mental health. *J Indian Assoc Child Adolesc Ment Health* 2020;16(3):1-6.
- Horowitz-Kraus T, Hutton JS. Brain connectivity in children is increased by the time they spend reading books and decreased by the length of exposure to screen-based media. *Acta Paediatr Int J Paediatr* 2018;107(4):685-93. <https://doi.org/10.1111/apa.14176>.
- Parent J, Sanders W, Forehand R. Youth screen time and behavioral health problems: The role of sleep duration and disturbances. *J Dev Behav Pediatr* 2016;37(4):277. 10.1097/DBP.0000000000000272.
- Cabanas-Sánchez V, Martínez-Gómez D, Esteban-Cornejo I, Pérez-Bey A, Castro Piñero J, Veiga OL. Associations of total sedentary time, screen time and non-

- screen sedentary time with adiposity and physical fitness in youth: the mediating effect of physical activity. *J Sports Sci* 2019;37(8):839-49. <https://doi.org/10.1080/02640414.2018.1530058>.
13. Piepmeier AT, Etnier JL. Brain-derived neurotrophic factor (BDNF) as a potential mechanism of the effects of acute exercise on cognitive performance. *J Sport Health Sci* 2015;4(1):14-23. <https://doi.org/10.1016/j.jshs.2014.11.001>.
 14. Vaynman S, Ying Z, Gomez-Pinilla F. Hippocampal BDNF mediates the efficacy of exercise on synaptic plasticity and cognition. *Eur J Neurosci* 2004;20(10):2580-90. <https://doi.org/10.1111/j.1460-9568.2004.03720.x>.
 15. Chirles TJ, Reiter K, Weiss LR, Alfini AJ, Nielson KA, Smith JC. Exercise Training and Functional Connectivity Changes in Mild Cognitive Impairment and Healthy Elders. *J Alzheimer's Dis* 2017;57(3):845-56. <https://doi.org/10.3233/JAD-161151>.
 16. Akulwar IS, Chheda KU. Immediate Effect of Mental Practice on Performance of a Neurodynamic Skill in Physiotherapy Students: A Randomized Control Trial. *Adv Image Video Process* 2021;9(1).
 17. Dong X, Ding M, Chen W, Liu Z, Yi X. Relationship between smoking, physical activity, screen time, and quality of life among adolescents. *Int J Environ Res Public Health* 2020;17(21):8043. <https://doi.org/10.3390/ijerph17218043>.
 18. Nakagawa T, Koan I, Chen C, Matsubara T, Hagiwara K, Lei H *et al*. Regular moderate- to vigorous-intensity physical activity rather than walking is associated with enhanced cognitive functions and mental health in young adults. *Int J Environ Res Public Health* 2020;17(2):614. <https://doi.org/10.3390/ijerph17020614>.
 19. Lau F. Chapter 13 Methods for Survey Studies 2017. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK481602/>
 20. Broadbent DE, Cooper PF, FitzGerald P, Parkes KR. The cognitive failures questionnaire (CFQ) and its correlates. *Br J Clin Psychol* 1982;21(1).
 21. Majumdar P, Biswas A, Sahu S. COVID-19 pandemic and lockdown: cause of sleep disruption, depression, somatic pain, and increased screen exposure of office workers and students of India. *Chronobiol Int*. 2020;37(8):1191-1200. [10.1080/07420528.2020.1786107](https://doi.org/10.1080/07420528.2020.1786107).
 22. Nouchi R, Kawashima R. Improving Cognitive Function from Children to Old Age: A Systematic Review of Recent Smart Ageing Intervention Studies. *Adv Neurosci* 2014;11. [10.1155/2014/235479](https://doi.org/10.1155/2014/235479)
 23. Zhao ZC, Zhou Y, Tan G, Li J. Research progress about the effect and prevention of blue light on eyes. *Int J Ophthalmol* 2018;11(12):1999. [10.18240/ijo.2018.12.20](https://doi.org/10.18240/ijo.2018.12.20).
 24. Keis O, Helbig H, Streb J, Hille K. Influence of blue-enriched classroom lighting on students' cognitive performance. *Trends Neurosci Educ* 2014;3(3-4):86-92. <https://doi.org/10.1016/j.tine.2014.09.001>.
 25. Carlson SA, Fulton JE, Lee SM, Foley JT, Heitzler C, Huhman M. Influence of limit-setting and participation in physical activity on youth screen time. *Pediatrics* 2010;126(1):e89-96. [10.1542/peds.2009-3374](https://doi.org/10.1542/peds.2009-3374).