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Relationship between Addiction to Online Video Games and Cognitive Function in Adolescents

Dian Maharani Putri[1], Yudhisman Imran[2*]

[1] *Department of Medicine, Universitas Trisakti, Indonesia*
[2] *Department of Neurology, Faculty of Medicine, Universitas Trisakti, Indonesia*

***Corresponding Author**: Yudhisman Imran, E-mail: yudhisman.imran@trisakti.ac.id

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ABSTRACT

Introduction: Adolescent is a particular transition phase especially in their development of cognitive function. Cognitive interpreted as an activity of brain which has a function to its external environment. In Pasific Asia, the prevalence of people with decreased cognitive function is 6,7%. One of the factors contributes to this problem is playing online video game. Many previous researches have analyzed the correlation between online video games and cognitive function but there is still pros and cons about this. The aim of this study is to assess the relationship between addiction to online video games and cognitive function in adolescents.
Method: The method used in this study is a cross-sectional design of 56 adolescents who were selected using consecutive non-random sampling and met the inclusion criteria. Online video game addiction data is obtained from game addiction scale (GAS) questionnaire and Montreal Cognitive Assessment (MOCA-INA) is used to assess cognitive function. The relationship between two variables were analyzed using the Fisher's Exact.
Results: From 56 respondents, 44,6% experienced a decrease in their cognitive function. Data shows the lowest score of domain are attention (64.3%) and memory (55.4%). The respondents who are addicted to online video games are 16.1%.
Conclusion: In this study, there is no relationship between addiction to online video games and cognitive function in adolescents.

Keywords

Addiction, Online video game, Cognitive function, Adolescents

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INTRODUCTION

Adolescents population all over the world is approximately at 1.2 billion or 18% of the total human population.[1] Among them, Indonesian adolescents are approximately at 46 million people or 17% of the total global adolescents population, where most of them are male.[2] According to World Health Organization (WHO), adolescents are ranged between 10 to 19 years old.[3] Adolescent is a unique transition period, specifically on cognitive ability improvement, because during the period adolescents experience neurons plasticity and behavioral changes. Cognitive function development occurs until a person reaches the final part of their adolescent periods or when they are entering their adulthood period.[4] Cognitive function is a complex term involving aspects of memory, executive, attention, perception, language, and psychomotor functions. It is also defined as the procedure of processing sensory input in the form of tactile, visual, and auditory to be changed, processed, stored, and then used for perfect interneuron connection as well as sensory output. Cognitive function has aspects commonly known as the cognitive domain, namely attention, memory, language, visuospatial ability, and executive function.[5] Cognitive function can be declined caused by various independent predictor factors. [6] The prevalence of cognitive function degradation according to the Centers for Disease Control (CDC) is currently at 11.1% or 1 out of 9 people. However, the number reaches 6.7% in

Asia-Pacific regions.[7] One of the strategies for preventing cognitive disturbances is by preventing the modifiable risk factors.[8]

Factors that drives cognitive function degradation are known to be aging, vascular disease (hypertension), metabolic disease (diabetes mellitus), and lifestyle such as less physical activities, unhealthy food, and smoking habit.[9-11] Brain injury such as stroke, brain tumor, and head injury can also lower cognitive function.[12-14] Besides that, brain infection caused by viruses can also affect cognitive function.[15] Video games played by adolescent during their spare times, are known to be able to lower cognitive function and attention.[16] Cortex orbitofrontal and cortex cingulate anterior are parts of brain that involved in reward mechanism and decision making, are known to be affected by playing video games.[17]

According to Dworak, et al. a person who plays video games before going to bed has the chance to lose 20% of their verbal memory cognitive function.[18] According to Hisam, et al. gamers possess better cognitive functions that are related to analogy, responsiveness, reasoning and mathematics. Long term gamers are also known to have improved cognitive abilities.[19] However, according to Sala, et al. there is no evidence that playing video games is related to improved cognitive function.[20] Based on the results of previous studies, it is evident that there is a lack of research on the effect of video games towards cognitive function quality. This background has driven authors to conduct a study on the influence of game addiction on cognitive function degradation on adolescent.

METHOD

This study is an observational analytic study with a cross sectional design. The population of the study subject consists of adolescent in the 2022 class of Faculty of Public Health of Syarif Hidayatullah State University who are will to be involved as study subjects. If the subject experienced brain injury in form of stroke, brain tumor, head injury, brain infection, possesses history of hypertension, diabetes mellitus and smoking habit, the subject will be excluded from the study. Subjects will be selected by using consecutive non-random sampling with total respondents of 56 people. Data of both variables in this study are obtained by using Gaming Addiction Scale (GAS) questionnaire to measure addiction and Montreal Cognitive Assessment Indonesia (MOCA-INA) to measure cognitive function. Analysis of both study variables are conducted by using Fisher's Exact hypothesis in SPSS 25 software.

RESULTS

Table 1. Respondents Characteristics

Variables	n	%
Sex		
Female	52	92.9
Male	4	7.1
Online video game addiction		
Addicted	9	16.1
Not addicted	47	83.9
Cognitive function		
Normal	31	55.4
Abnormal	25	44.6
Online video game playing duration		
Addicted	1	1.8
Not addicted	55	98.2

Data collected from 56 students dominated by female (92.9%) shows no addiction on online video game playing (83.9%) and most of them possess normal cognitive function (55.4%). The average playing time on each student every day is less than one hour (0.85±1.30) which is categorized as not addicted based on the playing duration (98.2%).

Table 2. MOCA-INA Results

Fields	n	%
Visuospatial		
Normal	35	62.
Decreased	21	37.5
Naming		
Normal	55	98.2
Decreased	1	1.8
Attention		
Normal	20	35.7
Decreased	36	64.3
Language		
Normal	28	50.0
Decreased	28	50.0
Abstraction		
Normal	33	58.9
Decreased	23	41.1
Delayed recall		
Normal	25	44.6
Decreased	31	55.4
Orientation		
Normal	39	69.6
Decreased	17	30.4

Based on MOCA INA results on 56 students, most of them experience degradation of attention (64.3%) and memory (55.4%). Meanwhile the rest of the students delivered normal answers. For language field, 50% of these students provided the right answers.

Table 3. Relationship between online video game addiction and cognitive function quality

Variables	Cognitive Function					p Value
	Normal		Abnormal		Total	
	n	%	n	%	n	
Online video game addiction						
Addicted	6	66,7	3	33,3	9	0,716*
Not Addicted	25	53,2	22	46,8	47	

* Fisher's Exact test, p>0,05

Based on data presented in Table 3, we can see that the students that experience online video game addiction with abnormal cognitive function is only at 33.3%, meanwhile the rest of them has normal cognitive function. On the other hand, students that are not addicted to online video game with decreased cognitive function is at 46.8% and normal cognitive function is at 53.2%. Based on Fisher's exact statistical calculation, the p value was obtained at 0.716 or p value > 0.05. Based on the results, we can state that statistically there is no significant relationship between online video game addiction and cognitive function quality.

DISCUSSION

The subject in this study is dominated by female because out of 109 students in Faculty of Public Health Science in Islamic State University of Syarif Hidayatullah class 2022, there is 101 female students. Studies revealed that online video game players are dominated by male with significant percentage. In China 6.3% of them are male and 2.4% of them are female. In Korea, 3.6% are male and 1.9% are female. In The United States, where 4.9% of Its population are estimated to be gamers, 5.8% of male gamers and 3% of female gamers are indicated to be potential problematic gamers.[21-23]

According to Dong, et al. in responding the clues in online video games, male subject tends to express lower response on left prefrontal dorsolateral cortex than female. The low response activity is followed by the willing to keep on playing (addiction symptom). The situation underlines the reason behind addiction tendencies on male gamers.[24] The left prefrontal dorsolateral cortex itself is a part of executive function

utilized to modulate semantic process to obtain accurate understanding (ability to find solution of complex verbal problem).[25] On the other hand, female tend to possess better executive control ability.[24]

Apart from the left prefrontal dorsolateral cortex, there is another regio of the brain that experience alteration after playing online video game, which is the caudate nucleus. Within the regio, male gamers tend to show higher activation than female gamers, which help defend male gamers from becoming addicted gamers.[24] Caudate nucleus is divided into two segments namely the head and tail segments. The head segment is important in cognition and emotional processes, meanwhile the body or tail segment responsible in behavioral and perceptive abilities.[26]

This study reveals that there is no significant relationship between online video game addiction and cognitive function on adolescent. However, most subjects show attention and memory functions decrease. The results is similar to study results published by Setyaningsih, et al. which revealed that out of 142 participants, 71 participants are categorized as individuals who suffer from IGD (Internet Gaming Disorder). The study result revealed that gamers who are not categorized as IGD sufferer are not experiencing cognitive function degradation, even though there are indication of low scoring on three cognitive function valuations namely attention, memory, and language.[27] Supported by Collins, et al. it was concluded that there is no significant difference between problematic gamers and non-gamers regarding their cognitive functions. In the study mentioned that the average online game playing time of problematic gamers and non-gamers are not so different. This result is one of indicators that problematic gamers have the tendency to be un-problematic gamers with playing duration of 6.92 hours per week (low). Even so, the finding is considered controversial because studies show that addiction cannot only be viewed solely based on playing time, but also other unseparable problems that cannot be measured only by time factors.[28]

The result is not similar with a study by Ozcetin, et al. which mentioned that there is a significant relationship between online video game addiction and cognitive function quality. The study was implemented on 46 samples consist of 42 male adolescent (91.3%).[29] On another study by Antonius, et al. it was revealed that male adolescent tend to spend more time playing online video game (60%) than female adolescent.[30] Similarly, study by Grusser, et al and Gentile revealed that male adolescent between the age of 10 and 19 tend to spend more time playing online video game which leads to more addiction potential than female adolescent.[31,32] Meanwhile in this study, the majority of the subjects are female adolescent (92.9%).

This study also shows no connection between online video game playing and cognitive quality because the average playing time spent by the subjects are less than 1 hour (0.86±1.30). Based solely on the playing duration, this study identified no addiction because playing time is considered to be addiction when reaches more than 4 hours.[33] This result is different than the ones revealed by Yadav where the average playing time of the subjects are four hours per day (4.13±5.94), which resulted on adolescent with difficulties to name colors, lack of concentration, attention degradation, and signs of withdrawals.[34] Similarly, study by Hyun, et al. revealed that addicted subjects tend to play at least 5 hours of online video game per day (5.9±2.5).[33] Based on study by Yuan, et al. there is also a symptom of the left precentral cortex, precuneus, frontal medial cortex, inferior temporal, and medial orbitofrontal which connected to the duration of online video game playing with the average playing time of 8 to 15 hours per day as pathophysiological of online video game addiction.[35]

Study of Liu, et al. revealed that addicted online video gamers experience cognitive function degradation, namely attention. Based on the MRI results, they are exposed to distraction. The players will experience difficulties to activate dorsolateral prefrontal cortex which leads to response inhibition that resulted on attention difficulties.[36] Based on study by Wolfe, et al. it was discovered that continuous overnight online video gaming will lead to difficulties to control attention in the next morning.[37] Even though this study does not show connection between online video game addiction and cognitive function, the majority of the subjects experience lowered attention (36 students or 64.3%) with average 4.95±1.09. Besides that, there is also 55.4% of subjects that experience cognitive function degradation on other field namely memory with average 3.91±1.23. The results are similar to a study by Goodman, et al. where long-term online video game playing

will decrease dopamine D2 receptor in dorsal striatum which leads to neuroanatomical shift from hippocampus or striatum dorsomedial into striatum dorsolateralal.[38] Hippocampus plays an important role on declarative memory, which is the ability of a person to remember a fact or daily events, where information recurrence, recall, recombination, and reutilization are implemented.[39] Increased activity and volume on striatum will be followed by lowered activity and volume on hippocampus. This is why, online vide gamers usually have larger striatum.[40]

CONCLUSION

Based on this study, it is revealed that online video game addiction occurs on 16.1 subjects and 44.6% experience cognitive function decrease. Based on the results, it can be concluded that there is no significant relationship between online video game addiction and cognitive function quality on the subjects. Further study should be conducted by involving gamer population and neurological and physiological examination, along with neuroimaging support to eliminate subjects with brain injury history. After that, it is expected that other ambiguous factors such as consumption pattern and physical activities can be excluded. Population of further studies should also be taken by paying attention to sex type to obtain more significant results.

DECLARATIONS

This study was approved by Ethical Committee.

CONSENT FOR PUBLICATION

The Authors agree to publication in Journal of Society Medicine.

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COMPETING INTERESTS

The authors declare that there is no conflict of interest in this report.

AUTHORS' CONTRIBUTIONS

DMP contributed to the preparation of the manuscript. YI gave guidance in this study.

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REFERENCE

1. Jasny E, Amor H, Baali A. Mothers' knowledge and intentions of breastfeeding in Marrakech, Morocco. Vol. 26, Archives de Pediatrie. 2019: 285–9.
2. UNICEF. Profil Remaja 2021. 2021; 917 (2016): 1–2.
3. Diananda A. Psikologi remaja dan permasalahannya. J ISTIGHNA. 2019; 1 (1): 116–33.
4. Lee D, Kwak S, Chey J. Parallel changes in cognitive function and gray matter volume after multi-component training of cognitive control (MTCC) in adolescents. Front Hum Neurosci. 2019; 13: 1-14.
5. Putri A, Imran Y. Review of the Effect of Sedentary Behaviour and BMI on Cognitive Decline in Young Adults. Atlantis Press.2022; Proceedings of the 3rd Borobudur International Symposium on Humanities and Social Science 2021 (BIS-HSS 2021): 931-936.
6. Mulia Rahmansyah, Nany Hairunisa, Yudhisman Imran et al. Ketebalan Tunika Intima Media Karotis dan Fungsi Kognitif pada Wanita Menopause. Majalah Kedokteran Neuro Sains Perhimpunan Dokter Spesialis Saraf Indonesia. 2022; 39 (2): 91-94.

7. Directors NC for CD. Subjective cognitive decline - a public health issue. US Dep Heal Hum Serv. 2018; 10 (6): 844-52.
8. Adriani D, Imran Y, Mawi M, Amani P, Ilyas EI. Effect of Brain Gym ® exercises on cognitive function and brain-derived neurotrophic factor plasma level in elderly: a randomized controlled trial. Universa Medicina. 2020; 39(1): 34-41.
9. Sui SX, Williams LJ, Holloway-Kew KL, Hyde NK, Pasco JA. Skeletal muscle health and cognitive function: A narrative review. Int J Mol Sci. 2021; 22 (1): 1–21.
10. García-Hermoso A, Ramírez-Vélez R, Ramírez-Campillo R, Izquierdo M. Prevalence of Ideal Cardiovascular Health and Its Association with Cognitive Function in Older Adults: The Chilean National Health Survey (2009-2010). Rejuvenation Res. 2018;21(4):333–40.
11. Anto EJ, Siagian LO, Siahaan JM, Silitonga HA, Nugraha SE. The relationship between hypertension and cognitive function impairment in the elderly. Open Access Maced J Med Sci. 2019;7(9):1440–5.
12. Gorelick PB, Nyenhuis D. Stroke and Cognitive Decline. JAMA. 2015;314(1):29–30.
13. Chao S, Wei-min B, Bo-jie Y, Xiao-yun C, Shi-hai L, Ying M. Cognitive deficits in patients with brain tumor. Chin Med J. 2012;125(14):2610–7.
14. McInnes K, Friesen CL, MacKenzie DE, Westwood DA, Boe SG. Mild Traumatic Brain Injury (mTBI) and chronic cognitive impairment. PLoS One. 2017;12(4):1
15. Damiano RF, Guedes BF, de Rocca CC, de Pádua Serafim A, Castro LHM, Munhoz CD, et al. Cognitive decline following acute viral infections: literature review and projections for post-COVID-19. Eur Arch Psychiatry Clin Neurosci. 2022;272(1):139–54.
16. Farchakh Y, Haddad C, Sacre H, Obeid S, Salameh P, Hallit S. Video gaming addiction and its association with memory, attention and learning skills in Lebanese children. Child Adolesc Psychiatry Ment Health. 2020;14(1):1–12.
17. Lee D, Park J, Namkoong K, Kim IY, Jung YC. Gray matter differences in the anterior cingulate and orbitofrontal cortex of young adults with Internet gaming disorder: Surface-based morphometry. J Behav Addict. 2018;7(1):21–30.
18. Dworak M, Schierl T, Bruns T, Strü der HK. Impact of Singular Excessive Computer Game and Television Exposure on Sleep Patterns and Memory Performance of School-aged Children. Pediatrics. 2007;120(5):978–85.
19. Hisam A, Mashhadi SF, Faheem M, Sohail M, Ikhlaq B, Iqbal I. Does playing video games effect cognitive abilities in Pakistani children? Pakistan J Med Sci. 2018;34(6):1507–11.
20. Sala G, Tatlidil KS, Gobet F. Video game training does not enhance cognitive ability: A comprehensive meta-analytic investigation. Vol. 144, Psychological Bulletin. Sala, Giovanni: Graduate School of Human Sciences, Department of Clinical Thanatology and Geriatric Behavioral Science, Osaka University, Japan. 2018: 111–39.
21. Ling L, Yu Q, Zhang L, Jin S. The gender difference on Internet addictive among adolescent: The mediation effect of the differentiation of social and psychological situation in school. Chinese J Clin Psychol. 2015;23(6):1044–8.
22. Ha YM, Hwang WJ. Gender differences in internet addiction associated with psychological health indicators among adolescents using a national web-based survey. Int J Ment Health Addict. 2014;12(5):660–9.
23. Desai R, Krishnan-sharin S, Potenza M. Video gaming among high school students: Health correlates, gender differences, and problematic gaming. Pediatrics. 2010;126(6):1414–24.
24. Dong G, Zheng H, Liu X, Wang Y, Du X, Potenza MN. Gender-related differences in cue-elicited cravings in Internet gaming disorder: The effects of deprivation. J Behav Addict. 2018;7(4):953–64.
25. Metuki N, Sela T, Lavidor M. Enhancing cognitive control components of insight problems solving by anodal tDCS of the left dorsolateral prefrontal cortex. Brain Stimul. 2012;5(2):110–5.

26. Robinson JL, Laird AR, Glahn DC, Blangero J, Sanghera MK, Pessoa L, et al. The functional connectivity of the human caudate: An application of meta-analytic connectivity modeling with behavioral filtering. Neuroimage. 2012;60(1):117–29.
27. Setyaningsih I, Leksono ABB, Muhrodji P, Edyanto AS, Vidyanti A. Adolescents with internet gaming disorder are more likely to have lower score of cognitive function: A cross-sectional study among junior high school students in Yogyakarta, Indonesia. Open Access Maced J Med Sci. 2021;9(B):1111–6.
28. Collins E, Freeman J. Video game use and cognitive performance: Does it vary with the presence of problematic video game use? Cyberpsychology, Behav Soc Netw. 2014;17(3):153–9.
29. Özçetin M, Gümüstas F, Çag Y, Gökbay IZ, Gökbay A. The relationships between video game experience and cognitive abilities in adolescents. Neuropsychiatr Dis Treat. 2019; 15:1171–80.
30. Van Rooij AJ, Kuss DJ, Griffiths MD, Shorter GW, Schoenmakers TM, Van De Mheen D. The (co-) ccurrence of problematic video gaming, substance use, and psychosocial problems in adolescents. J Behav Addict. 2014;3(3):157–65.
31. Gentile D. Pathological video-game use among youth ages 8 to 18: A national study: Research article. Psychol Sci. 2009;20(5):594–602.
32. Grüsser SM, Thalemann R, Griffiths MD. Excessive computer game playing: Evidence for addiction and aggression? Cyberpsychology Behav. 2007;10(2):290–2.
33. Hyun GJ, Han DH, Lee YS, Kang KD, Yoo SK, Chung US, et al. Risk factors associated with online game addiction: A hierarchical model. Comput Human Behav. 2015; 48:706–13.
34. Yadav N. Relationship between cognitive functions and online game addiction. Int J Indian Psychol. 2018;9(4).
35. Yuan K, Cheng P, Dong T, Bi Y, Xing L, Yu D, et al. Cortical Thickness Abnormalities in Late Adolescence with Online Gaming Addiction. PLoS One. 2013;8(1).
36. Liu GC, Yen JY, Chen CY, Yen CF, Chen CS, Lin WC, et al. Brain activation for response inhibition under gaming cue distraction in internet gaming disorder. Kaohsiung J Med Sci. 2014;30(1):43-51.
37. Wolfe J, Kar K, Perry A, Reynolds C, Gradisar M, Short MA. Single night video-game use leads to sleep loss and attention deficits in older adolescents. J Adolesc. 2014;37(7):1003–9.
38. Goodman J, Packard MG. Memory systems and the addicted brain. Front Psychiatry. 2016;7(FEB):1–9.
39. Eichenbaum H, Cohen NJ. Can We Reconcile the Declarative Memory and Spatial Navigation Views on Hippocampal Function? Neuron. 2014;83(4):764–70.
40. West GL, Drisdelle BL, Konishi K, Jackson J, Jolicoeur P, Bohbot VD. Habitual action video game playing is associated with caudate nucleus dependent navigational strategies. Proc R Soc B Biol Sci. 2015;282(1808).