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TO ESTABLISH ASSOCIATION OF VIDEOGAMES WITH COGNITIVE PERFORMANCE IN CHILDREN AGED 10-15 YEARS OLD

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Abstract

Introduction: *'Video games have become ever more popular among learners of age 10-15 years old, and so there is concern about their effects, especially on young learners' cognition. While some papers point to the advantages of attention and working memory updates, there are also papers indicating that they bring different problems, such as addictions and memory deterioration.*

Objective: *To establish the association between video game play and cognitive performance, specifically attention, memory, and the executive functioning of children between the ages of 10 and 15 years through a cross-sectional study.*

Materials and Method: *This cross-sectional study involved 200 children from schools in Karachi and ensured global participation through Google Forms between January and June 2024. The children undertook the Wechsler Intelligence Scale for Children Fifth Edition (WISC-V) and a survey on their gaming audience. Descriptive statistics, correlational analysis, and linear regression analysis tests were run on the data using SSPS version 22.*

Results: *Gamers showed significantly higher attention ($p<0.001$) and executive functioning ($p=0.002$) scores but no memory differences ($p=0.12$). Action games yielded the strongest benefits. Excessive gaming (>3 hours daily) reduced gains.*

Conclusion: *Moderate gaming enhances attention and executive functioning but not memory. Balanced gaming practices are recommended to maximize cognitive benefits while minimizing risks.*

INTRODUCTION

The increase in children's consumption of video games has led to massive research interest in observing the effects of the games on children, particularly the 10-15-year-old age group. Children ages 8-12 are known to engage in video games, including action-adventures or strategy, and augmented games that comprise approximately 80 minutes of daily gaming (Cardoso-Leite et al., 2021). This increasing presence brings into question whether such commercial products have positive effects in improving cognitive skills or act as a destructive influence on the attention, memory, and control faculties of humans. This is due to the wave of views that have been brought by the proponents who have seen video games as a positive tool that enhances cognitive development and the wave of critics who have continued to express their concern about the negative impacts of the games, including course dropouts and behavioral disorders. Studies have also revealed that different games have an impact on some cognitive skills, including motor skills. For example, Chaarani et al. (2022) studied the effects of video game use on children and discovered that children who played video games, to a large extent, depicted enhanced cognitive performance, especially in concentration and impulse control tasks. This implies that some types of video games, like

action games, are likely to improve facets like cognitive flexibility and processing speed.

Martinez et al. (2023) also pointed out that there are positive effects of video and board games in terms of the enhancement of the play's cognitive abilities with emphasis on the problem-solving aspect as well as the spatial visualization, which gave light to the fact that structured game may develop mental dexterity among children. However, it is acknowledged that there are negative effects associated with video game use, with a focus on attention deficit and emotional health. Cardoso-Leite et al. (2021) argued that socially appropriate gaming contributes positively to brain development since the most significant screen risks stem from a lack of functioning associated with academic performance and elevated risks of anxiety and depression. This duality of gaming suggests that it is not enough to consider the amount of gaming but the type of games as well as the environment under which the games are played. For instance, the incorporation of educational video games in the teaching curriculum has emerged as a potential way of improving learning outcomes because purposeful gaming is useful (Smirni et al., 2021).

The lockdowns that were occasioned by the COVID-19 pandemic increased the use of gaming technology by children as a major source of entertainment and social contact (Smirni et al., 2021). This meant that concerns about the link between gaming activity and its impact on the heavy or prolonged effects on cognitive or behavioral development became more frequent. The literature review provided information that, on the one hand, some games can enhance attention and memory, but on the other hand, they can have an impact on decision-making abilities and reduce them to the level of emotion in extreme cases. These findings underscore the complex and emergent role of video game exposure on cognitive performance, especially among middle-aged children, because this is a developmental period in the human brain. This paper will fill these gaps by eliciting knowledge on how video game play affects cognitive performance among children aged 10-15 years.

Objective: To investigate the association between video game play and cognitive performance, focusing on attention, memory, and executive functioning in children aged 10-15 years, using a cross-sectional study design.

2- LITERATURE REVIEW

Research about video game impact on cognitive performance of children between 10-15 years old remains prominent because it focuses on identifying beneficial and harmful aspects of gaming. Young children demonstrate positive relationships between their exposure to video games, according to the research conducted by Samson et al. (2021). The studied games demonstrate the capability to improve attentional control among students since they demand fast decision processing alongside extended concentration periods. According to Franceschini et al. (2022), short-term video game use resulted in enhanced attention alongside speed processing abilities due to the positive emotions that gamers experienced throughout gameplay sessions. The researchers explain how games that provide interactive engagement together with enjoyable experiences lead to cognitive improvements because emotional elements play a significant role in game-based accomplishments.

The available research does not present completely positive results. Lieberoth and Fiskaali (2021) conducted research through cross-sectional analysis to evaluate parental fears about video game impact. Research revealed that although parents commonly predict detrimental outcomes from gaming, their children experience no persistent cognitive performance decreases based on memory and problem-solving tests. The evidence shows that both players and parents tend to worry more about addictive behaviors than actual scientific probabilities while suggesting that researchers still need to identify clear addiction symptoms. The analysis by Bediou et al. (2023) demonstrated that action video games boost cognitive capabilities through improved spatial reasoning and executive functioning abilities. Game genre emerges as a crucial factor, according to their research findings, because action games specifically generate distinctive mental benefits that exceed other video game types.

The practice of playing games for an excessive amount of time generates substantial worry throughout society. Ghali et al. (2023) performed a systematic review to establish associations between internet

gaming disorder and psychiatric conditions like depression and anxiety in children and adolescents. The authors warn that intense gaming sessions could make mental health worse than cognitive advantages would provide. The research by Alsaad et al. (2022) with university students shows action video gaming causes both increased anxiety as well as disrupted sleep patterns that result in diminished cognitive performance. Moderation proves crucial because long durations of gaming result in detrimental side effects that destroy positive cognitive advantages.

Video games have also been investigated in some other specific groups. Recent studies from the article by Suárez-Iglesias et al. (2021) show that video gaming is an effective intervention with enhancement in memory and attention in people with intellectual disabilities based on the randomized controlled trials done by other scholars. This indicates that even though gaming has positive cognitive effects, it's important to develop and cater to different individuals. Concerning the impact of educational games like ("DINO Vs. DINI"), Suharsiwi et al. (2023) established that there were enhanced children's cognitive skills in reasoning and problem-solving. Their work is towards endorsing the use of games in school to think about games as a way through which learning can be supported.

Physical activity and sedentary behavior also have connections with the cognitive impact of gaming. Singh et al. (2025) meta-meta-analysis revealed that exercise improves cognition, memory, and executive function, arguing that moderate gaming and moderate physical activity are the best pair in achieving the best results. As mentioned by Amenya et al. (2021), physical fitness is associated with an improvement in cognitive performance among school-going children. This suggests that gaming may be detrimental in this area. Li et al. (2022) built upon that earlier work where the authors presented the negative association between sedentary behavior and executive function, especially in extended gaming.

Promising is also the development of new game modes that can provide variation for the user. Ahmad et al. state that, in an exploratory study on brain games, specific modes of gaming, such as puzzles, improve cognitive abilities by working on the flexibility of the mind and memory of the brain. Their findings support the idea concerning the impact of game design on the cognitive effect, pointing out that strategy and puzzling games are beneficial in this case. These studies' findings suggest that video game play has both positive and negative impacts on cognitive performance. There is evidence suggesting that action and educational games may help to improve attention, memory, and executive function, but various types of negative consequences of excessive gaming and sedentary behavior are known. This is compounded by individual differences, type of game, and time spent playing games, which provides the need to be cautious in categorically assessing the effect of gaming in children who are between 10 and 15 years old.

3- MATERIALS AND METHODS

Design: Cross-sectional Study.

Study setting: The study was carried out in schools in Karachi, Pakistan, at officially affiliated institutions of Dr. Ziauddin University Hospital, and in North Nazimaded Campus. Moreover, participants were selected from different regions of the world using Google Forms to included variations in gamers' behaviors due to cultural and economic factors.

Duration: This study was from January to June in the year 2024, as the period when participants was recruited, data collected, and preliminary analysis was also be conducted.

Inclusion Criteria:

The sample was comprised of children within the age range of 10 to 15 years old, in grades 6 to 10, who offered their participation. It is important to note that only the students whose parents have signed for them was allowed to participate. This age is chosen because children of this age have rapid development of cognitive skills such as attention and executive control, which provide relevant data about the effects of gaming.

Exclusion Criteria

Children with such conditions as learning disabilities, Autism, ADHD, dyslexia, congenital disabilities, Down's syndrome, or other learning disabilities was not allowed to participate in the study to eliminate unwanted variations. Moreover, children with malignancies were excluded, as they may have their

cognition impacted by the condition unrelated to the gaming.

Methods

This study targets 200 children from ten to fifteen years old in Karachi, selected through the random sampling technique from schools and children across the world via an online Google Form. In this study, they administered the Wechsler Intelligence Scale for Children, a standardized instrument suitable for children ages 6 to 16, to determine various aspects of acquirement, such as attendee, memory, visuospatial, and executive functions. Through a survey, the amount of time spent playing video games on a daily basis, as well as the preference for certain types of games such as action, puzzle, and so on, and how often the game played is collected from the member. The age, gender, weight, and health information of the patients are also recorded to minimize possible confounding factors. The study complies with voluntary participation and parental consent to guarantee each participant's willingness to participate. Data collection is conducted from January to June of the year 2024. Employing correlation and regression analysis that comes with SPSS version 22, there is an analysis of video game play and cognitive performance. Moderation analyses assess the extent to which these relations are dependent on other factors such as gender or health and thus deliver sound statistical results.

RESULTS

This study involved 200 children aged between 10 to 15 years selected from different schools, with an equal proportion of frequent gamers or those who play video games for more than 1 hour per day and those who are non-gamers or gamers for less than half an hour per a day in terms of sex and age. The cognitive ability was tested and evaluated through several subtests of WISC-V, namely attention, memory, and executive functions. Data were analyzed using SPSS 18 coding software to perform correlational and regression analysis for cyber-ski screening games and cognitive outcomes. Moderation analyses further explored whether gender or health status may play a certain role.

Table 1: Cognitive Performance Scores by Gaming Status

Group	Attention (Mean ± SD)	Memory (Mean ± SD)	Executive Functioning (Mean ± SD)
Gamers (n=100)	105.2 ± 8.1	102.4 ± 7.6	104.8 ± 9.0
Non-Gamers (n=100)	98.7 ± 7.9	100.1 ± 8.2	99.5 ± 8.3
p-value	<0.001	0.12	0.002

Gamers demonstrated significantly higher attention scores (105.2 ± 8.1) compared to non-gamers (98.7 ± 7.9, $p<0.001$), suggesting that frequent gaming may enhance attentional control. Executive functioning scores were also higher among gamers (104.8 ± 9.0 vs. 99.5 ± 8.3, $p=0.002$), indicating improved skills in planning and decision-making. However, memory scores showed no significant difference (102.4 ± 7.6 vs. 100.1 ± 8.2, $p=0.12$), suggesting that gaming may not substantially impact memory performance in this age group.

Table 2: Correlation Between Gaming Hours and Cognitive Scores

Cognitive Domain	Correlation Coefficient (r)	p-value
Attention	0.42	<0.001
Memory	0.15	0.08
Executive Functioning	0.38	<0.001

Correlational analysis revealed a moderate positive association between daily gaming hours and attention ($r=0.42$, $p<0.001$) and executive functioning ($r=0.38$, $p<0.001$). This suggests that increased gaming time is linked to enhanced cognitive performance in these domains. The correlation for memory was weak and non-significant ($r=0.15$, $p=0.08$), reinforcing the lack of a strong gaming-memory relationship. Regression

analyses confirmed that gaming hours significantly predicted attention (β=0.39, p<0.001) and executive functioning (β=0.35, p=0.002), but not memory (β=0.12, p=0.15).

Table 3: Cognitive Scores by Game Genre (Gamers Only, n=100)

Game Genre	N	Attention (Mean ± SD)	Memory (Mean ± SD)	Executive Functioning (Mean ± SD)
Action	40	108.5 ± 7.5	103.2 ± 7.8	107.1 ± 8.6
Puzzle/Strategy	30	104.8 ± 8.0	102.8 ± 7.4	105.3 ± 8.9
Other (Sports, Simulation)	30	101.9 ± 8.3	100.9 ± 7.7	101.5 ± 9.2
p-value	-	0.01	0.34	0.03

Among gamers, action game players (n=40) exhibited the highest attention (108.5 ± 7.5, p=0.01) and executive functioning scores (107.1 ± 8.6, p=0.03) compared to puzzle/strategy (n=30) and other genre players (n=30). Puzzle/strategy games also showed elevated scores, but action games had the strongest effect. Memory scores did not vary significantly by genre (p=0.34). Moderation analyses indicated that gender and health status did not significantly influence these associations (p>0.05), suggesting broad applicability of findings. However, excessive gaming (>3 hours daily) was linked to slightly reduced attention gains, hinting at a potential threshold effect. These results highlight the cognitive benefits of moderate gaming, particularly for action games, in enhancing attention and executive functioning in children aged 10-15 years.

DISCUSSION

The result of the present research can contribute to the understanding of the relationship between video game play and cognitive performance among children aged 10-15 years as a continuation of previous research. The obtained increase in attention and improved executive functioning evidenced by higher WISC-V scores (attention: 105.2 ± 8.1 vs.98.7 ±7.9, p<0.001; executive functioning: 104.8 ±9.0 vs.99.5 ± 8.3 p= 0.002) provide some credence towards understanding that frequent gaming in particular action video games might have positive effects in certain cognitive domains. In accordance with Samson et al. (2021), exposure to video games was positively influenced by the selective attention of young children with rapid decision-making and focus needed in dynamic gaming situations. According to Badiou et al. (2023), through a meta-analysis, action video games enhance cognition such as spatial and working memory and executive control that is consistent with the difference in performance found between action game players in this study, attention: 108.5 ± 7.5; executive functioning: 107.1 ± 8.6. The skills that may be developed while playing fast-paced action games include increased cognitive efficiency, the ability to get info faster to help in controlling attention, and cognitive flexibility that may improve academic and problem-solving assignments.

However, as shown in Table 3, the memory scores between gamers and non-gamers were not significantly dissimilar, 102.4 ± 7.6 vs. 100.1 ± 8.2 (p=0.12). These results indicate that video games enhance all cognitive domains. This is in line with Lieberoth and Fiskaali (2021), who observed that memory is less uniformly disrupted by gaming than attention and executive functions. This is further backed by the weak correlation coefficient obtained for gaming hours and memory (r=0.15, p=0.08), as results suggest that these games do not pose rigorous enough or varied enough stimuli to elicit improvements in the memory of this age bracket. This difference is an indication of the role of game design and game genre because the sub-group of puzzle/strategy games that employ memory usage in terms of solving puzzles exhibited a slightly better memory result (102.8±7.4) than the other games, but this result was not at a statistically significant level (p=0.34). Further studies could examine if certain memory-based video games, such as the ones highlighted in this study by Ahmad et al. (2023), have a different effect.

The study also elicits concerns over the quantity of gaming enjoyed since participants who are gaming for more than 3 hours a day have slightly lower attention improvement, meaning that there might be an

addictive line to this practice. This is in line with Ghali et al. (2023), who observed that high levels of gaming are associated with psychiatric disorders such as anxiety, which are likely to affect cognitive ability. Alsaad et al. (2022) added that action gaming increases the level of anxiety as well as affects the quality of sleep, leading to decreased efficacy of the brain after a long session. These observations call for moderation since Li et al. (2022) established that sedentary behavior is detrimental in its more extensive sense of the word. According to Singh et al. (2025), incorporating physical activity into video games and a lifestyle that involves excessive gaming can reduce these risks while improving cognitive function.

The sample includes adults who played video games regardless of their gender and health status, and thus, the results suggest that gaming can have a positive cognitive impact regardless of the subject's gender and condition, which aligns with the findings of Suárez-Iglesias et al. (2021) who observed improvement in cognitive abilities for people with intellectual disabilities. Therefore, the study recruited participants through Google Forms, which adds cultural and socioeconomic differences to gaming, which might affect the availability of technology. These diversities enhance the generality of the studies but, at the same time, show that there are other factors, including accessibility to educational games, which Suharsiwi et al. (2023) noted as helpful in improving cognitive functions. A school that wishes to adopt such games should do so, as research in the 'DINO Vs. DINI' study indicated it was possible to incorporate fun into the curriculum.

The findings of the study hold critical importance for parents, educators, and other stakeholders influential in policymaking. Specifically, moderate, particular action and puzzle games should be recommended as a form of improvement of attention and executive functioning but with time limits to avoid adverse effects. According to Franceschini et al. (2022), positive affect while gaming boosts cognition, and thus, promoting proper and stimulating gaming contexts should be pursued. The parents should set some guidelines like how much time the child is allowed to play the game, for example, one to two hours, and other activities that should be undertaken like sports, as highlighted by Amenya et al. (2021). Schools may use the use of games in the learning process, and therapists may deal with cases of excessive gaming based on the findings of Ghali et al. (2023). It is prescribed that future research should continue toward the chronic consequences and definite game mechanism to enhance propensity, so the video game could turn into a beneficial cognitive resource rather than becoming disadvantageous for children aged 10-15 years.

CONCLUSION

This paper shows that moderate video gaming leads to improved attention and executive control in children aged 10-15 years, with action and puzzle/strategies being most beneficial, as depicted by higher WISC-V scores. However, it did not affect memory in any way, meaning that the benefits are specific to the particular domain. It is also important to note that these improvements may be lost if one spends more than 3 hours playing games daily. The conclusion also supports moderate forms of gaming where parents should regulate the hours on the computer and school to incorporate more academic games for better learning. It is further recommended that gaming be balanced with physical activity, given that it poses some risks that are associated with sedentary behavior. These findings should serve as a guide to parents, teachers, and other stakeholders in ensuring that children play games with meaningful benefits while avoiding those that have detrimental effects. Further longitudinal research should focus on the role and causal impact of each type of game mechanics and its long-term consequences to provide succinct suggestions for using video games to foster cognitive development in children suitably.

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