

# Research of effects of video games on sleep health and cognitive ability

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**Abstract.** As a new wave of innovative entertainment and media, video games are particularly well-liked among teenagers and young adults, and recent trends show a sharp rise in the amount of time spent playing them. In the modern digital era, video games' pervasive reach has prompted a growing interest in understanding their significant impacts when used continuously. The present paper further delves into the intricate effects of video games on sleep performance, cognitive abilities, and physical well-being, offering a comprehensive exploration of the multifaceted and complex relationship between video games and human health. Specifically, it explores video games' consequences on bodily health, sleeping, and cognitive function through explorations of different research papers and studies conducted. It's found that video games can result in decreased time spent in REM sleep and changes in circadian rhythm. Along with this, prolonged exposure can result in sleep deprivation which can lead to long-term physiological effects on the human body. Video games can both harm and benefit the human physique, as use can aid in increasing fitness in children but chronic use may result in muscle injury and correlate with higher body fat. Many studies found that video game emotional intelligence, behavior, and executive functions in active users.

**Keywords:** Video Games, Sleep, Sleep Quality, Physiology, Cognitive Ability.

## 1. Introduction

In the modern digital age, the pervasive influence of video games has sparked growing interest in understanding their impact on an essential physiological and cognitive function: sleep. Sleep plays a crucial role in our daily functioning, and its integrity can be influenced by a range of activities, including engagement in video games. If these games are played before sleep, they could potentially cause major modifications in the structure of sleep and diminish its effectiveness. According to the Entertainment Software Association (ESA), over 215 million people in the United States play video games. Due to the expanding popularity of video games and the industry's notable accomplishments, the study of video game-playing habits has emerged as a viable and compelling field of research and the findings have prompted researchers to inquire about the consequences of extended and consistent exposure to such influences.

Epidemiological studies have indicated that engaging in computer games during the night can result in delayed bedtime and reduced sleep duration [1], while the precise impacts on sleep structure and quality have yet to be definitively established. Moreover, in accordance with theories pertaining to targeted repercussions, sleep deprivation disturbs the functioning of specific brain regions, consequently

undermining cognitive performance but the specific correlation between video game usage before sleep and sleep deprivation is unclear [2]. Multiple longitudinal experiments have been conducted to look at sleep cycles, heart rate, and cognitive ability after excessive usage of video games before bed. Other studies utilized surveys to investigate the intellectual effects that can be created from video game usage.

Within the field of empirical study, the examination of the relationship between video game play and sleep has great significance. This is a result of video games becoming an increasingly common form of leisure time entertainment, especially among adolescents and young adults. It is crucial to comprehend how playing video games could affect one's ability to sleep because this activity is crucial for both cognitive and physical recovery. Numerous studies have shown that poor sleep quality or quantity can have a significant negative impact on a variety of cognitive processes, including attention, memory, decision-making, and general cognitive performance [3]. Understanding how video games and sleep interact intricately is essential for determining how much modern leisure activities may affect basic physiological functions and the results on cognition. In order to inform future research projects and public health interventions, it is important to fully understand the potential effects of digital recreational activities on sleep health and cognitive functioning.

## 2. Analysis of the effect on sleep performance

Sleep is a remarkably intricate physiological process that allows the body to properly and effectively function, comprising a multitude of crucial components that collectively orchestrate the overall effectiveness and quality of rest within the human body. Among these integral elements, two distinct and fascinating stages, known as Non-rapid Eye Movement (NREM) and Rapid Eye Movement (REM) sleep, play pivotal in shaping the trajectory of a typical sleep cycle during a night's sleep.

These multifaceted stages, NREM and REM sleep, hold the key to unveiling essential insights into the dynamic nature of sleep and its profound influence on a myriad of cognitive and physiological functions that impact our waking lives. These functions encompass the critical domains of memory consolidation, emotional regulation, and the holistic restoration of our physical well-being. Investigating into the intricate interplay between NREM and REM sleep unveils new, important knowledge and offers valuable insights for optimizing sleep patterns and promoting overall well-being. By comprehending the nuanced dance between these sleep stages, we can better navigate the complex landscape of restorative sleep, enhancing our ability to harness its rejuvenating power for a more fulfilling and healthier life.

Multiple studies have conducted experiments to compare the effects of a night's sleep with video game exposure before bedtime to a control group with no exposure to video games. These studies have consistently shown a decrease in REM (Rapid Eye Movement) sleep after playing video games before sleep [4]. One specific study found that the average duration of REM sleep was 45.6 minutes when participants were exposed to video games before bedtime, whereas it increased to 56.4 minutes in the absence of video game exposure [5]. These findings indicate a notable decline in the duration of REM sleep when individuals engage in video gaming prior to bedtime.

**Table 1.** Mean sleep efficiency [5].

	Mean sleep efficiency%	Mean sleep latency(minutes)	Mean REM(minutes)
Video games	85.76	11.40	45.60
Without Video games	87.69	23.00	56.40
P	0.507	0.19	0.30

Engagement in computer games led to notable reductions in the duration of slow-wave sleep. LED screens found in computers and phones emit a specific type of blue light known to disrupt circadian rhythms. Research has demonstrated that using LED screens, as opposed to non-LED screens, can lead to alterations in melatonin levels and sleep quality, ultimately resulting in reduced cognitive performance [6]. Additionally, prolonged time to fall asleep and an increased presence of stage 2 sleep were observed

subsequent to computer game involvement [7]. A study investigated the impact of engaging in computer games and utilizing a bright display on nighttime sleep within a controlled laboratory setting. Findings revealed a notable decrease in subjective sleepiness and relative theta power in electroencephalograms (EEG) following gameplay compared to control conditions. Moreover, there was a significantly extended period of time taken to initiate sleep after playing games compared to the control conditions. Additionally, the duration of REM sleep was notably reduced following gameplay in contrast to the control conditions.

### **3. Analysis of the effect of cognitive ability**

Recent scientific findings suggest that regular engagement with digital technology exerts a substantial influence, encompassing both adverse and beneficial aspects, on brain functioning and behavioral patterns. Detrimental outcomes stemming from prolonged screen exposure and extensive technology utilization encompass increased attention-deficit symptoms, compromised emotional and social acumen, susceptibility to technology addiction, social seclusion, hampered brain maturation, and disturbances in sleep patterns [8].

To assess the effects video games can have on the human mind, multiple studies investigated young adolescents to see how they directly affect the main consumers. One study systematically examined the effects of video game engagement on cognitive functions and behavioral outcomes among children during a period of lockdown. The research investigates the influence of video games on cognitive processes and behavioral tendencies in the pediatric population. The research concluded that the specific impacts may include alterations in attention, memory, and executive functions [9]. The cumulative findings of this research have provided evidence of potential alterations in attention, memory, and executive functions as notable outcomes, thereby emphasizing the need for continued examination of the intricate relationship between video game exposure and cognitive-behavioral dynamics in the pediatric population.

Extensive research has been conducted over the past few decades to examine the impact of video games on the emotional intelligence of children, specifically focusing on the duration of gameplay and the consequences of occasionally engaging with violent and highly realistic video games. Recent scientific findings suggest that regular engagement with digital technology can exert a substantial influence, both detrimental and beneficial, on brain function and behavior [10]. The potential adverse consequences of prolonged screen time and extensive technology usage include increased attention-deficit symptoms, compromised emotional and social intelligence, the risk of technology addiction, social detachment, hindered brain development, and disrupted sleep patterns. Several investigations have established a connection between computer usage and prolonged screen exposure, which includes activities like playing video games, with symptoms related to attention-deficit hyperactivity disorder (ADHD). A meta-analysis conducted in 2014 revealed a correlation between media consumption and attention-related issues [11].

Nonetheless, it's worth noting that certain applications, video games, and online tools have the potential to offer cognitive benefits and contribute to brain health. In certain studies, individuals exposed to video games had been seen to have an increase in multitasking skills. The complexity of specific video games creates an opportunity for multitasking training and therefore creates a new strength in the skill. Multitasking has become prevalent due to the widespread adoption of technology, and numerous studies have highlighted its adverse effects on cognitive performance [12]. A certain research study observed the effects of video game training on cognitive control in older individuals. Researchers would collect data on various cognitive measures, such as attention span, working memory, and response inhibition, both before and after the video game training intervention. By comparing these pre-and post-training assessments, the researchers assessed that those exposed to the multitasking video game had improved their strength in those areas [13].

#### 4. Analysis of the effect on the physical body

Video games have garnered increasing attention for their potential effects on the physical well-being of individuals. Some video games, particularly those that are fast-paced or competitive, can lead to increased heart rate and stress responses. While this can be normal during gameplay, excessive stress from gaming can have negative health effects if it becomes chronic. The findings of a certain study indicated that heart rate exhibited a notable increase following game playing compared to the control conditions, and it was also observed to be notably higher following the use of a bright display compared to a dark display [14].

Prolonged engagement with video games can lead to repetitive stress injuries, which stem from repetitive muscle and tendon use to the extent that it causes pain and inflammation. When left untreated, these injuries may advance, leading to sensations of numbness, weakness, and the potential for lasting harm. Among gamers, overuse injuries in the hands and arms are a prevalent concern. The prevalent injuries among video gamers primarily involve overuse conditions affecting the hands, which encompass ailments like carpal tunnel syndrome, tendonitis, and synovitis. Carpal tunnel syndrome specifically entails the constriction of the carpal tunnel—a vital pathway through which nerves extend from the arm to the hand—resulting in symptoms such as pain, weakness, and restricted hand and wrist mobility [15].

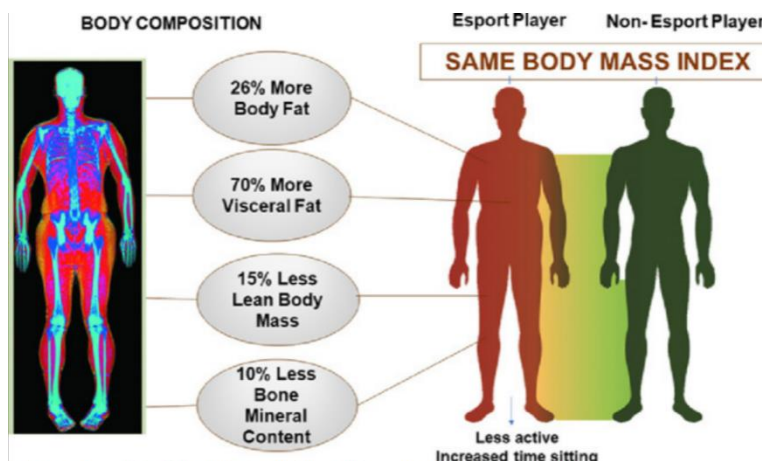


Figure 1: Averaged data from sample Esport Players' and Non-Esport Players' physiques [16]

**Figure 1.** Averaged data from sample Esport Player's and Non-Esport Players' physiques [16].

Continuous video game usage has been observed to correlate with a higher body fat percentage, often accompanied by reductions in lean body mass and bone mineral density [16]. Nevertheless, it is essential to recognize that video game usage is not entirely detrimental to physical health. In fact, certain video games, especially those designed for physical activity, such as motion-controlled or virtual reality games, have the potential to contribute positively to physical fitness.

One notable study focused on overweight or obese children, dividing them into two groups: one with active video game use and the other serving as a control group. Surprisingly, the group engaging in active video game use displayed promising outcomes in terms of enhanced muscle fitness, improved motor skills, and increased levels of physical activity in children [17]. This suggests that well-designed video games can serve as a tool to promote physical activity and potentially counteract some of the negative health effects associated with excessive video game usage.

While continuous video game usage has been linked to adverse effects on body composition and bone health, it's important to acknowledge that video games, particularly those designed for physical engagement, can have a positive impact on physical fitness, especially in younger populations. Therefore, when used mindfully and in moderation, video games can be a part of a balanced approach to promoting both leisure and physical well-being.

## 5. Conclusion

The impact of video games on sleep, cognition, and physical well-being is a multifaceted and intricate subject that warrants ongoing exploration. The dynamic interplay between video games and these fundamental aspects of human life has, in some previous research endeavors, yielded results that are not entirely conclusive or unequivocal.

The research conducted in this paper not only highlights the crucial importance of comprehending the intricate effects of video games on our health and cognitive abilities but also underscores the multifaceted nature of this phenomenon. Video games have seamlessly woven themselves into the very fabric of modern leisure, wielding a profound and pervasive influence on our overall well-being that extends far beyond the realm of mere entertainment.

As technology continues its relentless evolution, the role of gaming in recreation is growing more prominent by the day. It is becoming increasingly imperative to persevere in our investigative endeavors, delving deeper into the multifarious ways in which video games intersect with our lives. This ongoing pursuit of knowledge serves a dual purpose: it empowers individuals to make informed choices regarding their gaming habits while also furnishing the essential guidance needed for the formulation of effective public health policies and strategic interventions

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