

Sleeping Away Success: The Toll of Sleep Deprivation on Cognitive Function in Adolescents

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Abstract

This research study aimed to investigate the effects of consistent versus inconsistent sleep schedules on cognitive function in adolescents. Relevant research articles were accessed through PubMed using specific inclusion criteria, including keywords such that relate towards the importance of sleep. In addition, articles that were only published recently were selected.

The results revealed that maintaining a consistent sleep schedule is crucial for optimal cognitive function in adolescents. Inconsistent sleep schedules negatively impacted attention, processing speed, and working memory. These findings emphasize the significance of promoting healthy sleep habits among adolescents and implementing interventions to improve sleep consistency. Future actions may involve the development of sleep education programs and interventions targeting sleep schedules in educational settings. Healthcare providers can also play a role in assessing and addressing sleep issues in adolescents.

Introduction

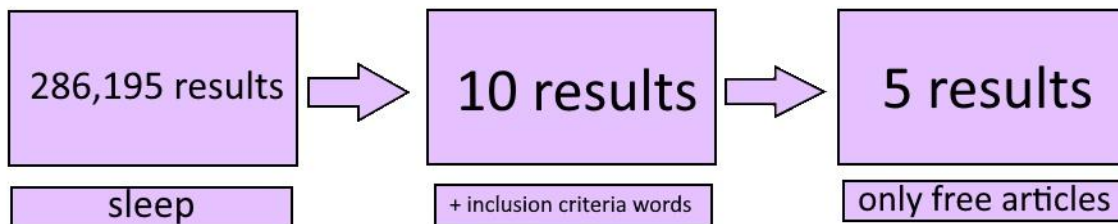
Everyone needs sleep. Sleeping is a human necessity that refreshes the human body and helps us function. However, this basic human necessity is restricted constantly among adolescents. A study found that the average high school student slept for 6.6 hours [1]. Ultimately, this contradicts the recommended 8-10 hours that most healthcare specialists recommend. In addition, 30% of boys and 49% of girls reported experiencing sleeping difficulties and 36% of 15-year-olds reported not having enough sleep to be able to concentrate on school work [2]. Researchers say that there are various reasons for adolescents not receiving enough sleep. One prevalent issue that researchers have found is that because of the competitive nature of school and college admissions, students are constantly required to sacrifice their sleep in order to have an advantage over their peers. These habits of getting less sleep to try and gain a competitive advantage over their peers might seem like a clever idea, but it ultimately could have the risk of impacting their cognitive function negatively.

Despite the acknowledged importance of sleep in adolescents, there is still a significant gap in our understanding of the relationships between sleep and cognitive abilities in adolescents. Extensive studies have gained increasing knowledge regarding the wide-ranging influence of sleep on cognitive function. However, there remains a lot of room for exploration concerning the intricate mechanism. Prior research has underscored the adverse outcomes arising from sleep deprivation, encompassing attention, memory, problem-solving, and decision-making [3]. The

consequences of inadequate sleep have been associated with diminished academic achievements, compromised learning capacities, and heightened vulnerability to mental health challenges among young individuals [4]. Overall, this paper will strive to find the true consequences behind varied sleep and show that adolescents who exhibit higher variability in sleep duration will demonstrate poorer cognitive functioning and experience higher levels of mental health difficulties compared to those with more consistent sleep duration patterns.

Materials

PubMed was utilized to access relevant research articles related to the study topic. The search was performed using specific keywords that include "adolescents", "cognitive function", "importance of sleep", "sleep" and filters to identify relevant publications.



Methods

Inclusion and Exclusion Criteria

To ensure the selection of relevant literature, specific inclusion and exclusion criteria were established. The inclusion criteria were as follows:

Participants: Adolescents aged between 10 and 19 years, as the studies used primarily focused on this age group.

Outcome of Interest: Cognitive function, as the research aimed to investigate its relationship with sleep.

Time Frame: Publications within the last 10 years (2013-2023) were considered to include the most recent and updated information.

The exclusion criteria were as follows:

Participants: Studies involving adults or children younger than 10 years of age were excluded from the analysis.

Outcome of Interest: Publications primarily focusing on physical effects such as eye strain or leg cramping were excluded.

Data Analysis: The analysis of the collected literature was qualitative. Key findings and information related to the impact of sleep on cognitive function in adolescents were identified and therefore used. A systematic review was used to explore patterns and relationships within the literature.

Results

A total of five articles were found and utilized. The findings indicate that sleep restriction and total sleep deprivation have detrimental effects on cognitive function, attention, mood, and memory formation in adolescents and young adults. Additionally, the studies highlight the importance of length of sleep in relation to emotional regulation, cognitive function, academic achievement, sleep quality, physical activity levels, and depressive symptoms in children and adolescents. Shorter sleep duration is associated with a higher risk of depressive symptoms, while those who had a longer sleep duration were able to perform greater cognitive functions such as greater math abilities.

Table 1.

Author Name, reference number	Country	Study Type	Results	References
Lo JC, et al.	Singapore	Randomized Control led	The sleep-restricted group showed deterioration in sustained attention, working memory, and executive function, increased subjective sleepiness, and decreased positive mood compared to the control group. Even after two recovery nights, subjective sleepiness and sustained attention did not return to baseline levels.	[3]
Lo JC, et al.	Multiple Countries	Experimental Study	Total sleep deprivation (TSD) led to a higher misinformation consistent response rate compared to the control group, indicating an increase in false memory formation. Partial sleep deprivation (PSD) did not reach statistical significance when compared to the control group. Ancova analyses suggested that the higher misinformation consistent response rate in the TSD group could not be solely attributed to impaired sustained attention or subjective alertness.	[4]

Tarokh L, et al.	United States and China	Literature Study	The sleep EEG amplitude and power decrease during adolescence, which is associated with reductions in cortical grey matter volume. Sleep deprivation impairs memory formation and consolidation in adults, but verbal memory in adolescents appears relatively unaffected. This suggests the presence of neural compensation or the sufficiency of conserved sleep in supporting cognitive performance.	[5]
Dutil C, et al.	Canada	Systematic Review	Later sleep timing was associated with poorer emotional regulation, lower cognitive function/academic achievement, shorter sleep duration/poorer sleep quality, poorer eating behaviors, lower physical activity levels, and more sedentary behaviors in children and adolescents. Limited associations were found between sleep timing and adiposity, quality of life/well-being, accidents/injuries, and biomarkers of cardiometabolic risk.	[6]
Zhou T, et al.	China	Cross-Sectional Study	Chinese adolescents with shorter sleep duration (<6 hours/night) had a higher risk of depressive symptoms. Higher mathematics scores were associated with a lower risk of depressive symptoms. Cognitive function mediated the effect of sleep duration on depressive symptoms.	[7]

Discussion

The study by Lo et al. investigated the effects of consistent versus inconsistent sleep schedules on cognitive function in adolescents [3]. Participants were randomized into a sleep restriction (SR) group and a control group, with the results showing that a more consistent sleep schedule led to better cognitive function. The SR group, with 5 hours of sleep per night, performed significantly worse on cognitive tasks compared to the control group with 9 hours of sleep.

Similarly, another study by Lo et al. investigated the effects of consistent versus inconsistent sleep schedules on cognitive function in undergraduate students [4]. Participants were divided into control, sleep restriction (PSD), and total sleep deprivation (TSD) groups. Cognitive performance was assessed using reliable measures such as the misinformation paradigm, psychomotor vigilance task (PVT), and Karolinska Sleepiness Scale (KSS). The results showed that both PSD and TSD groups exhibited impaired cognitive performance compared to the control group. Specifically, the TSD group demonstrated a higher susceptibility to incorporating false information into their memory. Although the difference between the PSD

and control groups was not statistically significant, there was a medium impact on cognitive performance.

Tarokh et al. also performed a study aimed to investigate the effects of consistent and inconsistent sleep schedules on cognitive function in adolescents [5]. Participants were randomly assigned to different sleep pattern groups, and the results showed that maintaining a consistent sleep schedule led to increased bilateral hippocampal grey matter volume. Like the studies performed by Lo et al., Tarokh et al. agreed that maintaining a consistent sleep schedule is crucial for optimal cognitive function such as memory testing abilities in adolescents. Inconsistent sleep schedules, characterized by sleep restriction, negatively impacted attention and an increase in memory under cognitive testing conditions. These findings highlight the importance of promoting healthy sleep habits and implementing interventions to improve sleep consistency. Factors such as circadian rhythm and sleep duration likely influenced the outcomes observed. One way to mitigate these factors is deploying programs such as sleep education programs in schools and involving healthcare providers in assessing and addressing sleep issues. Future research should aim to include more diverse populations and explore underlying mechanisms to develop targeted interventions and strategies for promoting healthy sleep habits and optimizing cognitive outcomes.

Although length of sleep is important, sleep timing should be considered in shaping various health outcomes and support the implementation of interventions to support optimal cognitive development and emotional well-being in children and adolescents. Dutil authored a systematic review aimed to examine the effects of sleep timing on health outcomes in children and adolescents [6]. The review included 37 articles and found that consistent sleep timing was associated with better emotional regulation, cognitive function, academic achievement, quality of life, and well-being. Conversely, irregular sleep timing was linked to negative outcomes such as anxiety, depressive symptoms, stress, mood disturbances, hyperactivity, and impulsivity. The review also identified associations between sleep timing and accidents and injuries, biomarkers of cardiometabolic risk, eating behavior, sleep duration and quality, and physical activity and sedentary behavior. The findings support the hypothesis that a more consistent sleep schedule leads to better cognitive function and academic achievement in children and adolescents. The review provides an up-to-date and comprehensive overview of the literature on sleep timing and health outcomes, considering both observational and experimental studies. However, it is important to acknowledge potential biases in the included articles and limitations such as recall bias and the predominance of cross-sectional designs. The generalizability of the findings should also be considered. Future research should aim to include diverse populations to enhance the external validity of the findings. Based on the results, future actions can be taken to promote regular sleep patterns and optimize cognitive function in children and adolescents. Educational campaigns can raise awareness about the importance of consistent sleep schedules and provide strategies for establishing healthy sleep habits. Healthcare professionals can play a role in

assessing and addressing sleep issues, offering guidance on sleep hygiene practices and monitoring sleep patterns.

In addition to cognition, sleep may also have consequential effects on mental health. The present study written by Zhou et al. examined the relationship between sleep duration, cognitive function, and depressive symptoms in Chinese adolescents [7]. The findings showed that shorter sleep duration was associated with a higher risk of depressive symptoms, while a longer sleep duration was linked to better mental health. Cognitive function mediated the relationship between sleep duration and depressive symptoms. These results support the hypothesis that consistent sleep schedules, indicated by adequate sleep duration, are associated with a decreased likelihood of experiencing depressive symptoms in Chinese adolescents. The study contributes valuable insights within the context of the Chinese adolescent population. It is important to consider potential biases in the study, such as reliance on self-reported data and the cross-sectional design, which limits establishing causality. Future research should employ longitudinal designs and comprehensive assessments of sleep patterns and quality to further explore the mechanisms underlying these associations and develop targeted interventions for promoting mental health and well-being in adolescents.

The overall consensus emerges on the pivotal role of maintaining consistent sleep schedules for optimal cognitive function among adolescents and young adults. While studies by Lo, Tarokh, and others underscore this agreement, nuances arise regarding sleep's influence on mental health, with an emphasis on depression. Lo's findings hint at the protective potential of adequate sleep duration against depressive symptoms, while Tong Zhou's research introduces the intricate interplay between sleep duration, cognitive function, and depression in Chinese adolescents. Limitations, like reliance on self-reporting and small sample sizes, echo across these studies and our synthesis, underscoring the need for robust methodologies and broader participant representation. Amidst these findings and constraints, these studies propel understanding of sleep's impact on cognitive and emotional well-being, advocating for proactive measures such as sleep education programs. Yet, unanswered questions persist about underlying mechanisms and individual variations. Moving forward, this collective research points to promising interventions for cognitive enhancement and mental health mitigation, necessitating rigorous studies to unravel sleep's intricate effects comprehensively and guide holistic adolescent flourishing.

Reference List:

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