

Influence of Sleep Duration and Timing Stability on Executive Control and Academic Performance in Adolescents across Cross-National School Settings

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DESCRIPTION

Sleep behavior among secondary school learners has become an increasingly relevant area of investigation in cognitive psychology due to its consistent association with attention regulation, memory consolidation, and classroom performance outcomes [1]. Adolescents experience substantial biological and social changes that influence circadian rhythms, often resulting in irregular sleep timing, reduced total sleep duration, and inconsistent sleep quality across school days and weekends. This article presents findings from a cross-national investigation conducted in Spain and Ghana involving students aged fourteen to eighteen years, focusing on how variations in nightly rest relate to executive functioning skills measured in academic contexts [2].

The study involved structured monitoring of sleep duration and sleep consistency over a six-week period using self-reported sleep diaries combined with actigraphy-based recordings. Participants were assessed on cognitive flexibility, inhibitory control, and task-switching efficiency using standardized computerized tasks and paper-based academic exercises aligned with secondary school curricula. In addition, classroom performance indicators such as assignment completion rate, accuracy in problem-solving tasks, and response latency during oral questioning were recorded to establish behavioral correlations with sleep patterns [3].

Results indicated a clear association between reduced sleep duration and diminished performance in tasks requiring sustained mental control. Students who consistently slept fewer than six hours per night demonstrated slower response times and higher error rates in tasks requiring rapid alternation between instructions. These individuals also exhibited reduced accuracy in multi-step mathematical problems and reading comprehension exercises that required integration of information across sentences. In contrast, students maintaining stable sleep schedules averaging seven to nine hours displayed more consistent cognitive performance across varied task

demands, particularly in activities requiring concentration over extended periods [4].

The investigation further analyzed working memory capacity using digit sequencing and visual pattern recall tasks. Students with reduced sleep duration exhibited weaker performance in maintaining and manipulating information over short intervals, particularly when tasks involved distractions or dual processing demands. This limitation was more pronounced in morning testing sessions, indicating that sleep-related fatigue effects may be strongest during early academic hours. By contrast, afternoon assessments showed partial improvement in some participants, though overall performance gaps between sleep groups remained evident [5].

A notable observation emerged in relation to inhibitory control tasks, where participants were required to suppress automatic responses in favor of rule-based decision-making. Students with insufficient sleep demonstrated increased impulsive responses and reduced accuracy in tasks requiring delayed judgment. This behavior was especially evident in timed assessments, suggesting that sleep deprivation affects not only cognitive capacity but also the regulation of response speed and decision thresholds. The data implies that insufficient rest may reduce the efficiency of neural systems involved in behavioral regulation, leading to premature or unfiltered responses [6].

Qualitative feedback collected from students revealed that those with shorter or irregular sleep patterns often experienced difficulty maintaining concentration during morning lessons. Many reported feelings of mental sluggishness during early hours, followed by partial recovery later in the day. Some students indicated reliance on caffeine-containing beverages or extended screen exposure during late evening hours, both of which were associated with further disruption of sleep timing consistency. Teachers noted that these students were more likely to exhibit inconsistent participation patterns, alternating between alert engagement and periods of disengagement within the same class session [7].

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Statistical evaluation using multivariate regression models indicated that sleep duration, sleep regularity, and evening screen exposure collectively accounted for a significant proportion of variance in cognitive performance outcomes. Among these variables, sleep regularity emerged as a particularly strong predictor of sustained attention and task accuracy. Even when controlling for academic background and socioeconomic status, students with stable sleep schedules consistently outperformed those with irregular patterns in tasks requiring continuous mental effort [8].

Further analysis of delayed recall tasks revealed that sleep quality had a measurable effect on memory retention after twenty-four hours. Students with adequate and stable sleep demonstrated higher retention of previously learned material compared to those with restricted or inconsistent sleep patterns. This effect was especially pronounced in language-based tasks involving vocabulary retention and reading comprehension passages. The findings support the interpretation that sleep contributes not only to immediate cognitive efficiency but also to the stabilization of newly acquired information over time.

The study also explored gender-related differences in sleep patterns and cognitive outcomes, although these differences were less pronounced than those associated with sleep duration and regularity [9]. Minor variations suggested that female students reported slightly higher sleep consistency, while male students showed marginally higher variability in bedtime schedules. However, both groups demonstrated similar cognitive sensitivity to sleep deprivation conditions, indicating that sleep effects on executive functioning are broadly consistent across demographic categories within adolescent populations [10].

CONCLUSION

The findings highlight the importance of considering sleep behavior as an integral factor influencing adolescent cognitive

development and academic functioning. Educational strategies that encourage stable sleep routines and reduce late-night cognitive stimulation may support improved attention regulation and memory performance. While external demands on students vary across cultural and household contexts, the consistency of observed relationships across countries suggests that sleep remains a central determinant of cognitive efficiency in school environments..

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