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THE INFLUENCE OF SLEEP QUALITY ON ATHLETIC AND COGNITIVE PERFORMANCE IN CHESS

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Abstract: *This study explores the link between sleep quality and cognitive performance in adolescent chess players. Over five months, ten athletes aged 13–18 from clubs in Odorheiu Secuiesc and Târgu Mureș were assessed using the Pittsburgh Sleep Quality Index (PSQI) and chess problem-solving tests. Results showed a moderate sleep quality (mean PSQI = 4.4); competitive players, despite slightly poorer sleep, achieved better cognitive and sport performance. The Spearman coefficient (r_s = 0.649) indicated a positive trend between good sleep and higher efficiency in focus and decision-making. Findings highlight the role of adequate sleep and sleep hygiene education in supporting mental performance and resilience in young chess players.*

Keywords: *sleep quality, sport performance, chess, adolescents, cognitive performance*

1. Introduction

Over the past two decades, sleep has been recognized as an essential determinant of athletic, cognitive, and psychological performance. Adequate sleep ensures the recovery of the central nervous and muscular systems, regulates hormonal secretion, maintains metabolic balance, and optimizes executive functions [2], [15]. These processes are fundamental in sports performance, as they influence resistance to fatigue, concentration capacity, and the precision of technical execution [6], [7].

Beyond its physiological effects, sleep plays a crucial role in memory consolidation and brain plasticity, facilitating the integration and stabilization of information acquired during training [5],[13]. Thus, high-quality sleep not only supports physical recovery but also directly contributes to improving cognitive performance, motor learning, and psychological adaptation to competitive demands.

While most studies have focused on physical sports—endurance, strength, or team-based disciplines—interest has recently increased in examining sleep effects within cognitive sports, where anticipation, attention, decision-making, and emotional control play a decisive role [8],[9]. Among these, chess holds a special

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place, being considered a "mind sport" in which performance directly depends on higher cognitive functions such as working memory, pattern recognition, mental flexibility, and processing speed [11].

Recent research conducted on Norwegian chess players [11] revealed significant differences in objectively measured sleep patterns between athletes with positive versus negative performance trajectories. Those showing progress in the FIDE ranking exhibited a higher proportion of deep sleep (NREM), lower respiratory rates, and better heart rate variability, suggesting a relationship between sleep quality and the development of cognitive and strategic performance.

From an epidemiological perspective, elite athletes often experience sleep deficits, characterized by average durations of less than eight hours per night and reduced sleep efficiency, which negatively affects recovery and increases the risk of injuries [4],[6]. Among adolescents, this condition is further influenced by biological and behavioral factors—delayed circadian phase, academic pressure, and prolonged screen exposure—that collectively contribute to chronic sleep restriction [1]. Additionally, competitive stress and pre-competition anxiety may reduce sleep efficiency and alter mood states, compromising cognitive output [8].

Partial or total sleep deprivation has been shown to decrease reaction speed, decision-making accuracy, and memory capacity [10],[12],[14]. In cognitive sports, such impairments can compromise strategic performance and the ability to anticipate the opponent's moves. Conversely, sleep-enhancing interventions, such as extending sleep duration or introducing daytime naps, have demonstrated significant improvements in both physical and cognitive performance [3].

Although the relationship between sleep and performance is well documented in physical sports, the literature concerning cognitive sports remains limited. In this context, the present study aims to analyze the relationship between sleep quality and sport performance among adolescent chess players, providing a complementary perspective on the role of psychophysiological factors in optimizing cognitive and strategic performance.

The present study aims to investigate the relationship between sleep quality and sport performance among adolescent chess players. Specifically, it seeks to determine the extent to which sleep-related variables—duration, efficiency, and subjective quality—influence cognitive performance and competitive outcomes.

By addressing this topic, the research intends to contribute to the existing body of literature which, although it emphasizes the role of sleep in physical performance [2], [6], [7], has insufficiently explored its impact on cognitive sports, such as chess [11].

To achieve the proposed aim, the following specific objectives were established:

1. To evaluate sleep quality among adolescent chess players using the *Pittsburgh Sleep Quality Index (PSQI)* and a complementary questionnaire addressing sleep habits and the subjective perception of rest;
2. To analyze chess performance through competitive indicators (FIDE coefficient, Elo score evolution, and frequency of participation) and through coaches' qualitative

observations regarding players' concentration capacity and cognitive resilience;

3. To determine correlations between sleep quality and the level of cognitive performance in chess competitions;
4. To identify potential differences between players with good-quality sleep and those with poor-quality sleep regarding performance outcomes and perceived well-being.

Research Hypothesis

It is hypothesized that there is a significant positive relationship between sleep quality and sport performance among adolescent chess players, such that athletes who report more restful and adequately long sleep achieve higher performance levels, both in official competitions and in cognitive parameters specific to chess.

This hypothesis is grounded in previous findings indicating that adequate sleep supports executive functions, memory, and information processing [5], [6], whereas sleep deprivation leads to a decline in cognitive performance and decision-making efficiency [12], [14].

2. Materials and Methods

2.1. Participants and research context

This study is based on a longitudinal experimental design conducted on a sample of ten participants—students enrolled in grades VIII to XII—registered with the chess sections of the School Sports Clubs of Odorheiu Secuiesc and Târgu Mureș. Of the total participants, five were affiliated with the Odorheiu Secuiesc School Sports Club and five with the Târgu Mureș School Sports Club.

In Odorheiu Secuiesc, the players were directly observed by one of the researchers, who also served as their teacher and coach. In Târgu Mureș, the training and observation process was coordinated by experienced teachers with extensive expertise in developing competitive athletes.

Because the study included several students from final grades preparing for graduation exams, part of the data was collected online, with those participants completing the questionnaires remotely. Their participation in chess competitions during the study period was limited; however, their previous performance records were included in the overall data analysis.

The experimental process began on December 10, 2021, coinciding with the National Rapid and Blitz Chess Championships – Senior Category, where the first data were collected, and concluded on May 15, 2022, at the National School Chess Championships. The total duration of the research was five months, during which systematic monitoring of sleep quality and chess performance was carried out. Each participant was observed both during training sessions and throughout official competitions.

2.2. Instruments and analyzed variables

To evaluate sleep quality, the Pittsburgh Sleep Quality Index (PSQI) was employed, a standardized and internationally recognized instrument for assessing perceived sleep quality. The questionnaire was administered once per month, each application referring to a four-week period. Scores were interpreted according to the original protocol, where values above 5 points indicate poor sleep quality.

In addition to the PSQI, a short custom-

designed questionnaire developed by the authors was administered approximately twice per week, prior to training sessions. This instrument included a few brief questions regarding the previous night's sleep and the participant's perceived level of rest at the time of testing. The internal validity of the questionnaire was verified using the Cronbach's Alpha coefficient, which reached a value of 0.854, indicating good internal consistency.

Chess performance was assessed through two complementary approaches:

1. Cognitive testing during training sessions, involving the resolution of standardized chess problems with progressively increasing difficulty;
2. Official competitive performance, measured by the FIDE (Elo) rating and by the results obtained in official tournaments during the study period.

On each day of competition, prior to the beginning of the matches, the athletes completed the short sleep questionnaire. Subsequently, their behavior was systematically observed and recorded—both during and outside the matches—in order to capture aspects such as concentration capacity, emotional stability, and stress management.

2.3. Observation and data collection procedure instruments and analyzed variables

Direct observation was conducted for the athletes from Odorheiu Secuiesc, where one of the researchers was directly involved in the training process. For the Târgu Mureș group, data were collected in collaboration with the respective coaches. Each participant completed the PSQI questionnaire monthly and took part twice a week in both chess performance tests and the short sleep questionnaire.

During official competitions, athletes' behavior was observed according to a standardized observation protocol, focusing on cognitive and emotional parameters. Particular attention was paid to the fact that adolescence is a period of emotional and physiological vulnerability, which influenced the participants' availability for testing and competition depending on their individual circumstances.

All collected data were centralized into an electronic database and subsequently checked for consistency and completeness prior to analysis.

2.4. Data analysis

The collected data were processed using descriptive and correlational statistical methods.

For each participant, the following parameters were calculated:

- The mean PSQI score across the five-month observation period;
- The average performance score obtained in chess problem-solving tests;
- The evolution of the FIDE (Elo) rating between the initial and final measurement points.

Correlations between sleep quality and chess performance were analyzed using the Pearson correlation coefficient (r), and the interpretation of the results was conducted in relation to existing literature on the effects of sleep deprivation on cognitive performance [5],[11],[14].

3. Results

The research sample consisted of ten

adolescent chess players, of whom seven actively participated in official competitions, while three were involved exclusively in training activities and the corresponding cognitive tests. This distribution allowed for a comparative analysis between athletes exposed to competitive stress and those who practiced chess in a controlled, non-competitive environment. All participants completed the questionnaires assessing sleep quality and were periodically evaluated through standardized chess problem-solving tests, providing a comprehensive view of the relationship between perceived sleep quality, cognitive performance, and competitive efficiency.

3.1. Results obtained from competitive players

The analysis of data collected from the seven athletes involved in official competitions revealed a moderate level of sleep quality (mean PSQI = 4.4), associated with high cognitive and competitive performance (mean chess test score = 32.4 points; mean ELO = 1740). Individual values are summarized in Table 1.

Table 1

Results of Competitive Players (n = 7)

Subject code	No. of competitions	Mean PSQI	Mini-questionnaire	Chess Test (Mean)	Mean ELO	General Interpretation
P1	9	5.1	1.7	31.9	1769	Moderate sleep; stable performance, slight decrease with higher PSQI
P2	4	5.7	2.0	19.8	1258	Poor sleep; fluctuating performance, moderate fatigue
P6	4	3.5	1.0	51.1	2053	Good sleep; excellent cognitive and sport performance
P7	9	5.0	1.6	42.0	2015	Stable sleep; consistent performance, cognitive balance
P8	1	2.7	1.7	28.1	1267	Excellent sleep; good performance, limited competition exposure
P9	4	3.2	1.4	35.1	1639	Good sleep; high cognitive performance, stable competition results
P10	1	5.6	2.0	18.8	2181	Poor sleep; lower cognitive performance but high ELO rating

Subject code	No. of com-petitions	Mean PSQI	Mini-questi-onnaire	Chess Test (Mean)	Mean ELO	General Interpretation
Group Means	-	4.4	1.6	32.4	1740	Average sleep quality, influenced by competition-related stress

It was observed that athletes with PSQI scores ≤ 4, indicating good sleep quality (e.g., P6 and P9), achieved high cognitive performance and competitive stability. In contrast, participants with PSQI scores > 5 (e.g., P2 and P10) showed lower performance in chess tests, although one of them (P10) had a high ELO rating, suggesting that experience may partially compensate for the negative effects of poor sleep.

Overall, the competitive group displayed an inverse correlation between PSQI scores and cognitive performance, indicating that better sleep favors mental efficiency in the strategic and anticipatory tasks specific to chess. This trend confirms previous findings showing that sleep quality supports executive functions and attentional control in high-performance athletes [1],[6]. It also aligns with the observations of Moen et al. (2020), who reported a positive relationship between deep sleep (NREM) and performance progression among Norwegian chess players [9].

3.2. Results of non-competitive players

For the three athletes who did not participate in official competitions during the study period, the obtained values are presented in Table 2.

Table 2

Results of Non-Competitive Players (n = 3)

Subject Code	Mean PSQI	Mini-Questionnaire	Chess Test (Mean)	General Interpretation
P3	3.8	1.1	28.5	Good sleep; stable cognitive performance
P4	5.4	1.7	24.0	Moderate to poor sleep; fluctuating performance
P5	4.6	1.3	26.5	Satisfactory sleep; consistent performance
Group Means	4.6	1.4	26.3	Slightly better sleep quality, but lower cognitive performance

As shown by the data presented in Table 2, for the three athletes who did not participate in official competitions during the study period, the mean PSQI score was 4.6, indicating a slightly better sleep quality compared to the competitive group. However, their performance in the chess tests was lower (mean = 26.3 points).

This difference suggests that the absence of competitive pressure contributes to more restful sleep but reduces cognitive stimulation and motivation for performance. The lack of

exposure to competitive situations appears to maintain greater emotional stability, yet without the same level of cognitive activation. These results support the hypothesis that a moderate level of stress (eustress) can have beneficial effects on cognitive functions, particularly in strategic sports such as chess [9].

3.3. Comparative analysis between groups

A comparison between the two groups reveals a clear difference in their profiles:
• Competitive athletes: moderate PSQI, but high cognitive and ELO performance;
• Non-competitive athletes: slightly better PSQI, but lower cognitive performance (Table 3).

Table 3

Comparative Summary of Competitive and Non-Competitive Groups

Group	Mean PSQI	Mean Chess Test	Summary Observations
Competitive (P1, P2, P6–P10)	4.4	32.4	Average sleep quality; higher cognitive performance, but fluctuating during competitive stress periods
Non-Competitive (P3–P5)	4.6	26.3	Slightly better sleep; lower but more stable and consistent performance

This relationship suggests the existence of a trade-off between competitive stress and sleep quality — while stress tends to impair rest, it simultaneously enhances cognitive capacity and mental resilience. The result is consistent with the findings of Walsh et al. (2020), who reported that athletes involved in intensive training may exhibit fluctuating sleep quality but maintain superior overall performance due to neurocognitive adaptations [15].

Furthermore, these observations support the conclusions of Carskadon (2011) and Hoshikawa et al. (2018), indicating that adolescent athletes often show moderate sleep quality, influenced by delayed circadian rhythm, academic demands, and competitive pressure [1], [8].

At the same time, the present study aligns with the results of Cunha et al. (2023), which suggest that sleep-targeted interventions can significantly improve athletic performance, emphasizing the need to implement sleep hygiene programs specifically adapted for young chess players [3].

3.4. Correlation between sleep quality and cognitive performance (spearman test)

To evaluate the relationship between sleep quality and cognitive performance, the Spearman rank correlation test (r_s) was applied based on the individual mean scores obtained from the PSQI and the chess performance tests.

The results indicated a correlation coefficient of $r_s = 0.649$, calculated for $N = 10$ participants ($\Sigma D^2 = 58$). This value highlights a moderate positive correlation between sleep quality and cognitive performance: athletes who reported better sleep generally achieved higher results in the chess problem-solving tests.

Although the calculated coefficient was

slightly below the threshold of statistical significance (critical r = 0.684, $p < 0.05$), the direction of the relationship supports the research hypothesis that efficient sleep enhances mental and decision-making performance in chess. This finding is consistent with the results reported by Moen et al. (2020) and Charest & Grandner (2020), who emphasized the central role of sleep in maintaining executive functions and cognitive performance among elite athletes [2], [11].

4. Discussion

The results obtained provide a clear picture of how sleep quality influences cognitive and sport performance in adolescent chess players. Competitive athletes, although showing slightly lower sleep quality, achieved better performance, which suggests the existence of adaptation mechanisms to competitive stress and high mental workload. This observation is consistent with the findings of Walsh et al. (2020) and Hamlin et al. (2021), which show that athletes can maintain a high level of performance even under fluctuating sleep conditions, due to neurocognitive training and intrinsic motivation [7], [15].

In contrast, the non-competitive group, although benefiting from better rest, recorded lower cognitive performance, a finding that confirms the hypothesis that moderate competitive pressure can act as a mental stimulation factor. In the specialized literature, this effect is explained by the concept of "eustress," in which an optimal level of stress activates cognitive processes such as focus and anticipation without leading to exhaustion [6].

The results of the Spearman correlation test (r = 0.649) support this trend, indicating a moderate positive association between sleep quality and cognitive performance. Although the value obtained is slightly below the threshold of statistical significance (critical r = 0.684, $p < 0.05$), the direction of the correlation is clear: athletes who sleep better tend to demonstrate greater cognitive efficiency and higher concentration capacity. This result is consistent with the conclusions of Moen et al. (2020) and Cunha et al. (2023), which show that sleep hygiene interventions can improve both sport and cognitive performance, especially in sports where rapid decision-making and anticipation play a central role [3], [11].

It should also be noted that adolescence represents a vulnerable period for sleep quality, due to physiological changes, academic workload, and increased exposure to disruptive factors [1]. Nevertheless, the results indicate that regular sport routines and systematic training help maintain a relatively stable sleep structure, even under competitive stress conditions.

In conclusion, the data obtained support the research hypothesis: good-quality sleep is a significant determinant of cognitive performance in chess, while insufficient or disturbed sleep is associated with reduced mental efficiency and lower stability of competitive performance.

5. Conclusions and Recommendations

The results obtained in this study highlight the importance of sleep as a key element of both athletic and cognitive performance among adolescent chess players. It was found that higher sleep quality is associated with greater concentration capacity, more efficient

strategic thinking, and enhanced emotional stability during competitive situations. The Spearman correlation coefficient (r = 0.649) confirms the tendency of a positive relationship between sleep quality and cognitive performance, even though it does not reach the statistical significance threshold. Nevertheless, it suggests a consistent interdependence between the two dimensions.

At the same time, the findings show that competitive athletes, although sometimes presenting slightly lower sleep quality, are able to maintain high performance levels through adaptive mechanisms and strong intrinsic motivation. These findings underline the complex role of sleep in balancing effort, recovery, and mental output.

Based on these observations, it is recommended to integrate sleep hygiene education into sports training programs, along with the periodic monitoring of rest quality and the adjustment of training plans according to perceived fatigue levels. Establishing regular sleep routines, reducing evening screen exposure, and maintaining balance between academic and athletic activities can significantly contribute to optimizing performance and preventing mental exhaustion.

Overall, the results of this research confirm that sleep is not merely a passive phase of recovery, but an active process fundamental to learning, adaptation, and performance in cognitive sports. Promoting a culture of conscious rest among young athletes may serve as a valuable tool in shaping a generation of balanced, resilient competitors capable of achieving excellence through the harmony between body and mind.

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