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Analysis of the Correlation between Sleep Quality and Interoception in Physical Education Majors

Hu Sijiao *

Henan Polytechnic University, Jiaozuo, China
**Corresponding author:13783603794@163.com*

Abstract: *The research adopted the methods of literature review, questionnaire survey, experimental test and mathematical statistics. Data collection was conducted using the MAIA multidimensional assessment Scale, the Pittsburgh Sleep Quality Index Scale and the polo table. By analyzing the characteristics and interrelationships between sleep quality and endosensory perception, the correlation between the two can be more clearly defined, providing a reference basis for physical education students to improve sleep quality, promote endosensory perception levels, and enhance the health level of the body. The research results showed that the total score and accuracy of sleep quality were P=0.003 (P < 0.01), and the accuracy of endosensory perception and daytime dysfunction were P=0.000 (P < 0.01). There was no correlation between the other six components of sleep quality and accuracy (P > 0.05). Sensory sensitivity was divided into 8 factors. Among them, only the factor (attention) had a relatively weak negative correlation with the total score of sleep quality (P=0.042). There is no close connection among the three components of internal perception. The three can exist independently and the accuracy of internal perception can represent an individual's overall internal perception. Therefore, it can be concluded that the overall sleep quality of students majoring in physical education is good, while that of a small number is low. The overall level of interoception is relatively high, but some students have impaired daytime functions, showing poor accuracy of interoception. Among the endosensory sensivities, only the "attention" factor is related to sleep quality, suggesting that the body initiates a compensatory attention mechanism when sleep is poor, but the effect is limited and other conclusions.*

Keywords: *Internal perception; Sleep quality; Students majoring in sports; Correlation; Sports health management; Physical and mental health*

1. Introduction

Statistics show that humans spend approximately one-third of their lives sleeping. As a fundamental requirement of human life activities, sleep quality is directly linked to physical development, mental health, and cognitive function. Sleep deprivation can severely impair emotional regulation and lead to numerous health issues, such as various chronic diseases[1]. The issuance of the Ministry of Education's "Sleep Order" and the establishment of "World Sleep Day" highlight modern society's heightened focus on sleep health. Research indicates that individuals with mental health issues exhibit disordered interoception [2]. As a form of self-perception, interoception reflects the sensation of internal bodily states and changes, playing a crucial bridging role in an individual's awareness of their internal state and subjective experience of bodily information. It is highly significant in the relationship between body and mind [3]. Using the body as a medium, it influences an individual's behavior and cognition through body image and schemas [4]. It is also intricately connected to emotions, sleep, physical health, and work efficiency.

Long-term high-intensity training and competitive pressure cause the sleep quality of sports students to decline, which is often manifested as insomnia caused by overtraining or nervous anxiety before the game, dissatisfaction with the game performance and other bad emotions caused by the decline of sleep quality, etc., and severe sleep disorders will cause various psychological diseases to lead to the decline of the body's internal perceptual ability. Current research mostly focuses on the association between sleep and intrinsic sensation in the general population.There are few systematic studies on this special group of sports students.

Numerous studies have documented and confirmed that individuals with psychological disorders, such as emotional disturbances, often experience sleep disorders, indicating a mutual influence between

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emotions and sleep quality. Interoception is also closely related to an individual's emotions and psychological state, interacting with them. However, most existing research separately explores the relationship between sleep quality and emotions, as well as the relationship between interoception and emotions. A few studies have examined the connection between the two, suggesting that sleep may influence interoceptive abilities. Some research has concluded that there is a small but significant relationship between sleep quality and interoceptive abilities in young people[5],and that sleep disorders may impair interoceptive skills, or vice versa. Donna L. Ewing further pointed out that poor sleep quality is associated with poor interoception, and lower interoceptive accuracy may indeed lead to poorer sleep quality. Her data suggest that sleep quality directly affects interoceptive processing, with mechanisms possibly related to the negative impact of sleep on attention and cognitive processes [6]. Based on this, this paper combines the sleep quality and interoception of student-athletes to explore their correlation. The aims are to (1) reveal the current state and group characteristics of sleep quality and interoception among student-athletes, (2) verify whether sleep deprivation reduces interoceptive accuracy by depleting cognitive resources, and (3) provide a scientific basis for sleep health management and interoceptive training for student-athletes. Additionally, this study expands the research scope of the "sleep-interoception" interaction in sports psychology, fills the theoretical gap for the student-athlete population, and applies the findings to optimize training programs for student-athletes, enhancing athletic performance and physical and mental health through sleep interventions and interoceptive training.

2. Current Status and Characteristics of Sleep Quality Among Student-Athletes

According to the questionnaire data, it can be seen from Figure 1 that only 26% of the students survived in sleep disorders, and the other 74% did not have sleep disorders.

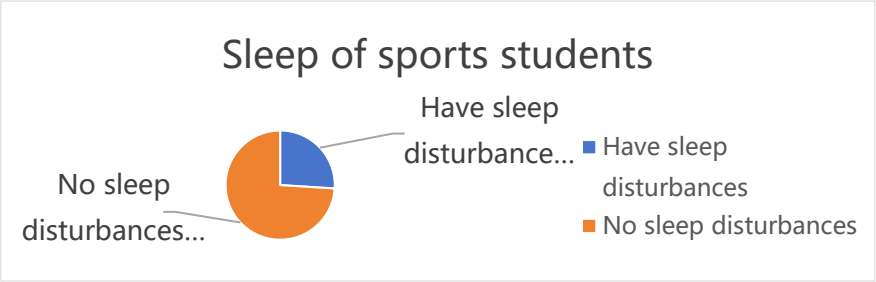

Figure 1. Statistical Chart of Sleep Quality Among Student-Athletes.

The Pittsburgh Sleep Quality Index (PSQI), developed by Dr. Buysse and colleagues at the University of Pittsburgh, was also used to assess sleep conditions. This scale has been widely employed by numerous scholars in China, and is highly effective in reflecting an individual's sleep quality and the extent of sleep disorders over the past month. Currently, both domestic and international research commonly uses the Pittsburgh Sleep Quality Index (PSQI) to evaluate individual sleep quality[7]. The scale consists of 24 questions, with 5 being evaluation items by others, and the self-evaluation item in question 19 not included in the assessment score. Thus, the scale is divided into 7 components: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. Each component is scored from 0 to 3, and the scores are summed to calculate the total PSQI score (0-21). A higher total score indicates poorer sleep quality. Studies have classified a PSQI score below 7 as indicating good sleep quality, meaning these individuals do not have sleep disorders, while a score of 7 or above is recorded as having sleep disorders[8].

The survey found that the overall sleep performance of physical education students was better, with a score of 5.29±2.58 for sleep quality.

The Table 1 shows that physical education students generally consider their sleep quality to be good, with sleep onset difficulties at a medium-low level. The actual sleep duration is ≥6 hours for all, indicating sufficient overall sleep duration and high sleep efficiency (>85%). A small number of individuals experience sleep disturbances due to feeling too cold/hot or having nightmares, and only a very few take hypnotics when experiencing sleep difficulties. Some students feel drowsy and lack energy during daytime study and life due to poor sleep.

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Table 1. Sleep Quality Subscale Score Statistics .(N=90)

	Minimum	Maximum	Average	Standard deviation
A Sleep quality	0	3	0.98	0.67
B Time to fall asleep	0	3	1.03	0.785
C Sleep time	0	2	0.6	0.536
D Sleep efficiency	0	3	0.2	0.565
E Sleep disturbances	0	3	0.98	0.58
F Hypnotic drugs	0	3	0.18	0.592
G Daytime dysfunction	0	3	1.32	0.859

2.1 Sleep Quality

Sleep quality is part of the total score of the Pittsburgh Sleep Quality Index, calculated based on the score of item 6 (individual perception of their own sleep quality). As shown in Table 2, 19 individuals rated their sleep quality as very good (0 points), accounting for 21.1%; 56 students reported their sleep quality as relatively good (1 point), accounting for 62.2%; another 13 students felt their sleep quality was relatively poor (2 points), accounting for 14.4%; and only two students rated their sleep quality as very poor (3 points), accounting for 2.2%. Among them, 83.3% of the students had good sleep quality with no sleep disorders, while the remaining 16.7% had some sleep quality issues.

Table 2. Sleep quality.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	19	21.1	21.1	21.1
1	56	62.2	62.2	83.3
2	13	14.4	14.4	97.8
3	2	2.2	2.2	100.0
Total	90	100.0	100.0	

2.2 Sleep Onset Time

Sleep onset time is calculated by combining item 2 (time taken from going to bed to falling asleep) and item 5a (frequency of difficulty falling asleep). The longer the time taken to fall asleep, the poorer the sleep quality, and the higher the frequency of difficulty falling asleep, the worse the sleep quality. As shown in Table 3, 22 people scored a total of 0 points for sleep onset time, accounting for 24.4% of the sample. This group had sufficient time to fall asleep, experienced no difficulty falling asleep, and had good sleep quality. Forty-seven people scored a total of 1 point, accounting for 52.2% of the sample. This group had adequate time to fall asleep and no difficulty falling asleep. Seventeen people scored a total of 2 points, accounting for 18.9% of the sample. These individuals had less time to fall asleep and experienced some difficulty falling asleep. The remaining 4.4% of students not only had insufficient time to fall asleep but also experienced a high frequency of difficulty falling asleep.

Table 3. Time to fall asleep.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	22	24.4	24.4	24.4
1	47	52.2	52.2	76.7
2	17	18.9	18.9	95.6
3	4	4.4	4.4	100.0
Total	90	100.0	100.0	

2.3 Sleep Duration

Sleep duration is derived from item 4, with lower scores indicating longer sleep duration for individuals. The Table 4 shows that 38 individuals scored 0, indicating that these students had long sleep durations, accounting for 42.2% of the total. Fifty students scored 1, meaning their sleep duration was between 6–7 hours, which is relatively sufficient, cumulatively accounting for 97.8% of students with qualified sleep duration. Additionally, two individuals scored 2, with sleep durations between 5–6

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hours, indicating insufficient sleep duration that negatively impacts sleep quality.

Table 4. Sleep time.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	38	42.2	42.2	42.2
1	50	55.6	55.6	97.8
2	2	2.2	2.2	100.0
Total	90	100.0	100.0	

2.4 Sleep Efficiency

Sleep efficiency is calculated by dividing item 4 by the time in bed derived from items 3 and 1, then multiplying by 100. As shown in Table 5, 77 students, accounting for 85.6%, had very high sleep efficiency, all exceeding 85%. Ten students had sleep efficiency between 75% and 84%, with a cumulative percentage of 96.7%, indicating relatively good sleep quality among these students. Only one student had sleep efficiency between 65% and 74%, reflecting lower efficiency and mild sleep disturbance. Additionally, two students had sleep efficiency below 65%, indicating poor sleep efficiency and the presence of sleep disorders.

Table 5: Sleep efficiency.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	77	85.6	85.6	85.6
1	10	11.1	11.1	96.7
2	1	1.1	1.1	97.8
3	2	2.2	2.2	100.0
Total	90	100.0	100.0	

2.5 Sleep Disorders

Sleep disorders are calculated based on the total score of items 5a~5j. As can be seen from Table 6, 13 students reported no difficulties falling asleep, waking up easily at night or early in the morning, breathing problems, or other conditions affecting sleep. Sixty-nine students experienced only one of the above conditions, five students experienced two of the phenomena, and three students experienced three phenomena. Overall, most students do not have sleep disorders, with only a few experiencing factors that interfere with sleep.

Table 6. Sleep disorders.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	13	14.4	14.4	14.4
1	69	76.7	76.7	91.1
2	5	5.6	5.6	96.7
3	3	3.3	3.3	100.0
Total	90	100.0	100.0	

2.6 Hypnotic Drugs

Few students use drugs for sleep induction. According to item 7 and shown in Table 7 ,only 8 students have taken drugs to varying degrees for sleep induction, accounting for 8.9%; the remaining 82 students have not used drugs for sleep induction.

Table 7. Hypnotic drugs.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	82	91.1	91.1	91.1
1	1	1.1	1.1	92.2
2	6	6.7	6.7	98.9
3	1	1.1	1.1	100.0
Total	90	100.0	100.0	

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2.7 Daytime Dysfunction

The scores from items 8 and 9 are summed, with lower scores indicating less daytime dysfunction. As shown in Table 8, only 16 individuals showed no dysfunction, accounting for 17.8%; the remaining 84 individuals exhibited varying degrees of dysfunction, either feeling drowsy during the day or lacking energy when performing tasks.

Table 8. Daytime dysfunction.

Score	Number	Percentage	Valid percentage	Cumulative percentage
0	16	17.8	17.8	17.8
1	36	40.0	40.0	57.8
2	31	34.4	34.4	92.2
3	7	7.8	7.8	100.0
Total	90	100.0	100.0	

3. Analysis of the Current Situation and Characteristics of Sports Students' Interoception

Operation Steps:

(1) Test time and Test location: 8:00 AM - 10:00 AM;Training Center and Dissection Room

(2) Procedure:This is shown in Figure 2. First, connect the Polo watch to the phone and attach the watch to the left chest of the test subject. The subject needs to focus on perceiving their heartbeat and must not touch the pulse area with their hands during the test. Upon hearing the "start" command, the subject should silently count their heartbeats, while the observer also records the heartbeat count via the phone. Both the observer and the subject should stop simultaneously upon hearing the "end" signal and note down their respective heartbeat counts after each session. Silence must be maintained during the test. Each person undergoes a total of 4 sessions: one 25-second practice session, followed by formal sessions of 25, 35, and 45 seconds. The actual heartbeat count measured by the Polo watch is compared with the subject's self-perceived heartbeat count.

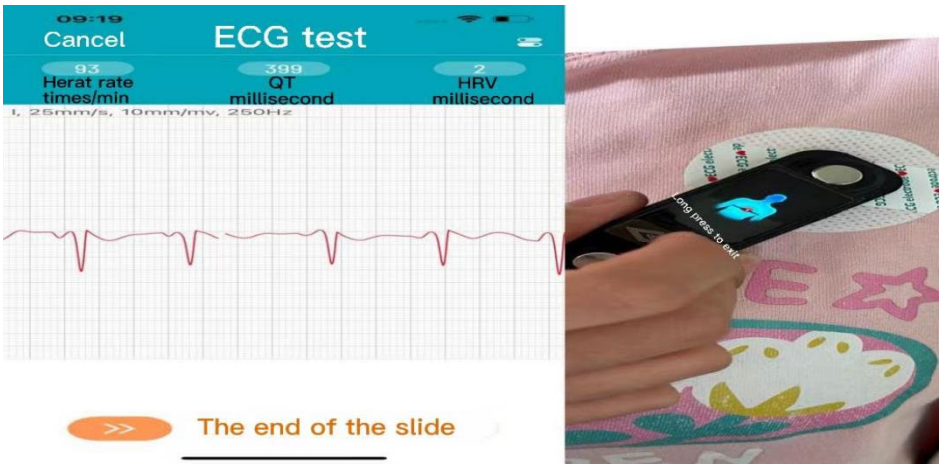

Figure 2. Testing Instrument.

(3) Algorithm: Subtract the objectively measured one-minute heartbeat count (from the device) from the subjectively reported one-minute heartbeat count by the participant. Take the absolute value of this difference, then divide it by the objective one-minute heartbeat count to obtain the error rate. Subtract the error rate from 1 to get the accuracy rate. The final actual accuracy rate requires multiplying the value by an additional 1/4[3].

(4) Scoring criteria: A score of 8 or above indicates excellent interoceptive accuracy; 6~7.9 suggests moderate interoceptive accuracy; 5.9 or below reflects poor interoceptive accuracy.

The interoceptive self-report survey was conducted using the Multidimensional Assessment of Interoceptive Awareness (MAIA-2C), originally created by Wolf E. Mehling and translated and validated by Teng Binyu, Wang Dan, et al. in 2022. The MAIA-2C demonstrates a Cronbach's α of

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0.822 and Kaiser-Meyer-Olkin (KMO) validity of 0.821, proving to be a reliable and effective instrument[9]. This scale has been widely adopted in over 20 countries with high reliability and validity, hence this study directly employs the MAIA multidimensional assessment scale. The scale consists of 37 items across 8 dimensions. For interoceptive measurement, participants were first instructed to scan a QR code to complete the questionnaire.

The survey found that, as shown in Figure 3, most of the students showed good internal feelings, that is, they could clearly perceive the changes in their own bodies and were sensitive to their own body signals. There are also most students with a moderate level of internal sensation, and they generally report that they can sometimes perceive changes inside the body more accurately, and usually cannot detect them without deliberate observation. At the same time, 1/4 of the students had poor internal sensations, they could barely feel their heartbeat, even when they were very quiet and focused.

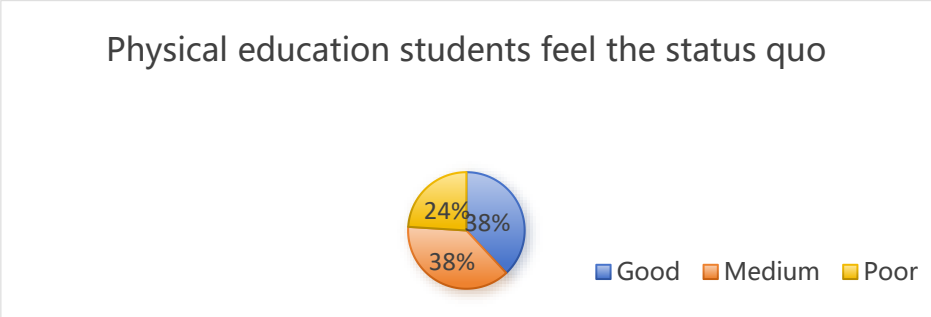

Figure 3. Statistics on the Current State of Interoception Among Sports Students

According to Table 9,sports majors demonstrated a moderate level of interoceptive awareness (6.22±1.98), with most participants showing relatively high confidence in their self-assessment results. Overall, their interoceptive accuracy was relatively good, as they could perceive their heartbeat count with reasonable accuracy (7.33±1.64).

Table 9. Statistics on Interoceptive Awareness and Accuracy. (N=90)

	Average	Maximum	Minimum	Standard deviation
Awareness	6.22	10.00	0.00	1.98
Precision	7.33	9.72	3.52	1.64

As shown in Table 10, the scores for all factors of sensitivity are at a moderate level, with the factor (attention) being the highest, indicating their keen awareness of bodily changes.

Table 10. Statistical table of intrinsic sensitivity. (N=90)

	Pay attention	Stay focused	Don't worry	Mind your balance	Emotional Awareness	Self-Regulation	Body Listening	Trust
Average	2.96	2.75	2.25	2.28	2.89	2.70	1.84	2.87
Standard deviation	0.82	0.84	0.84	0.86	0.85	0.87	1.01	0.84
Maximum	4.50	4.83	4.80	4.85	5.00	5.00	4.33	4.66
Minimum	0.75	1.33	0.80	0.28	1.00	0.50	0.00	0

4. Analysis of the Relationship Between Interoception and Sleep

4.1 The Relationship Between Interoceptive Accuracy and Sleep

Table 11 reveals that the total sleep quality score is significantly correlated with interoceptive accuracy (P=0.003, P<0.01), and interoceptive accuracy is significantly correlated with daytime dysfunction (P=0.000, P<0.01). This indicates that better sleep quality is associated with higher interoceptive accuracy, enabling individuals to more accurately reflect changes in their internal state. These individuals do not experience drowsiness or lack of energy during daytime work or study. However, no correlation was found between accuracy and the other six components of sleep quality (P>0.05).

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Table 11. Statistical Chart of the Correlation Between Accuracy and Total Sleep Score and Sleep Components.

		Accuracy	Total Sleep Quality Score	Sleep Quality	Time to Fall Asleep	Sleep duration	Sleep efficiency	Sleep disorders	Hypnotic drugs	Daytime dysfunction
Accuracy	Pearson correlation	1	-.314**	-0.174	0.029	-0.161	-0.203	-0.202	-0.124	-.389**
	Sig.		0.003	0.102	0.787	0.129	0.055	0.056	0.244	0

Note: ** Significant at the 0.01 level (two-tailed). * Significant at the 0.05 level (two-tailed).

4.2 The Relationship Between Interoceptive Awareness and Sleep

As shown in Table 12, there is no correlation between the total sleep quality score or its components and interoceptive awareness ($P > 0.05$).

Table 12. Statistical Chart of Correlation Between Awareness and Total Sleep Score and Its Components.

		Awareness	Total Sleep Quality Score	Sleep Quality	Time to Fall Asleep	Sleep duration	Sleep efficiency	Sleep disorders	Hypnotic drugs	Daytime dysfunction
Awareness	Pearson correlation	1	0.069	0.183	-0.014	-0.052	-0.028	0.046	0.171	-0.022
	Sig.		0.52	0.084	0.897	0.628	0.793	0.668	0.106	0.84

Note: ** Significant at the 0.01 level (two-tailed). * Significant at the 0.05 level (two-tailed).

4.3 The Relationship Between Interoceptive Sensitivity and Sleep

The interoceptive sensitivity was divided into 8 factors, as shown Table 13 and 14, and only the factor (attention) had a relatively weak negative correlation with the total sleep quality score, indicating that the student with poor sleep quality was able to be aware of the state of his body (comfortable/uncomfortable) at all times.

Table 13. Correlation Statistics Between Sensitivity (Attention) and Sleep.

		Attention	Total Sleep Quality Score	Sleep Quality	Time to Fall Asleep	Sleep duration	Sleep efficiency	Sleep disorders	Hypnotic drugs	Daytime dysfunction
Attention	Pearson correlation	1	-.215*	-0.123	-0.107	-0.117	-0.138	-0.048	-0.185	-0.129
	Sig.		0.042	0.246	0.316	0.272	0.196	0.65	0.081	0.226

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

Table 14. Correlation Statistics Between Sensitivity (Attention) and its item.

		Attention	No distractions	Don't worry	Pay attention to the adjustment	Emotional awareness	Self-regulating	Body listening	Trust
Attention	Pearson correlation	1	-0.139	-.208*	.362**	.387**	.350**	.333**	.475**
	Sig.		0.192	0.049	0	0	0.001	0.001	0

Note: ** Correlation is significant at the 0.01 level (2-tailed). * Correlation is significant at the 0.05 level (2-tailed).

5. Discussion

5.1 Group Characteristics and Mechanisms of Sleep and Interoception in Student Athletes

The study found that 74% of student athletes exhibited good sleep quality, a phenomenon that may be closely related to the regular exercise-induced increase in melatonin secretion. During physical activity, the body's physiological processes influence the endocrine system, promoting the synthesis and release of melatonin. As a key hormone regulating the sleep cycle, melatonin effectively improves sleep quality, helping student athletes fall asleep faster and maintain deep sleep states[10]. However, 26% of students still experienced sleep disturbances, with daytime dysfunction being particularly prominent.

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This may be due to the long-term high-intensity training loads and competitive pressures endured by student athletes, which keep the sympathetic nervous system in a state of sustained arousal, thereby disrupting sleep architecture. Post-training physical fatigue may not be promptly alleviated, and pre-competition anxiety can also interfere with sleep onset, leading to issues such as light sleep and frequent awakenings. Ultimately, these factors manifest as daytime symptoms of drowsiness and reduced energy levels.

Student athletes scored relatively high in interoceptive accuracy (7.33±1.64), aligning with the findings of Zhou Huimei's research. This can be attributed to the long-term integration and enhancement of proprioception and visceral sensation through sports training[11] . During training, athletes must continuously perceive the movements, strength, and states of various body parts and internal organs. This repeated perceptual practice sharpens their awareness and accuracy in detecting internal bodily states. However, the "body listening" ability under the interoceptive sensitivity factor scored only 1.84±1.01, indicating a relatively low level. This reflects a current training tendency that prioritizes "skill performance over internal perception," with a focus on external skills such as movement precision and strength improvement, while neglecting attention to and training of internal bodily signals (e.g., heartbeat, breathing, muscle soreness). Consequently, students lack sufficient awareness of their own bodily changes.

5.2 The Pathway of Sleep's Influence on Interoception

When sleep is insufficient, the brain's cognitive resources are depleted, leading to a decline in the prefrontal cortex's regulatory control over the insular cortex. This, in turn, affects the accuracy of receiving, analyzing, and interpreting interoceptive information. In this study, daytime dysfunction showed a strong negative correlation with interoceptive accuracy ($r = -0.389$), meaning that the more severe the daytime impairment, the lower the interoceptive accuracy. This result directly confirms the mediating mechanism of cognitive resources in the process of sleep affecting interoception[6].

The "attention" factor in interoceptive sensitivity exhibited a weak negative correlation with sleep quality ($r = -0.215$), which may reflect the body's compensatory response to sleep deprivation. When sleep quality declines, the body activates compensatory mechanisms by enhancing subjective attention to counteract the decrease in interoceptive accuracy, attempting to more actively perceive internal bodily states. However, this compensation has its limits. Over-reliance on attentional compensation can further deplete cognitive resources, exacerbating perceptual biases and preventing effective improvement—or even causing a decline—in interoceptive ability.

5.3 Intervention Strategies in Sports Practice

Physical education students should avoid high-intensity training 3 hours before bedtime and use mindfulness meditation (15 minutes a day) to reduce sympathetic excitement. They can use a blackout eye mask and a white noise machine to control the temperature of the bedroom at 20-22° C, and conduct 3 sets of internal sensory training of different durations (25-45 seconds) 3 times a week - heartbeat tracking training (heartbeat silent number exercise) with real-time feedback from the polo meter to detect the sensations of each part from the feet to the head in turn, and improve the "body listening" ability.

5.4 Research Limitations and Future Directions

The data sample was limited to a single institution and did not differentiate between specialties, while also exhibiting significant limitations in interdisciplinary scope, as it only explored the relationship between sleep and interoception from the perspective of sports science, lacking in-depth integration of psychology and neuroscience. The study did not analyze the regulatory mechanisms of emotional factors such as anxiety and stress on the sleep-interoception interaction from a cognitive psychology perspective, nor did it employ neuroimaging techniques to reveal functional changes in the prefrontal cortex-insula circuit under sleep deprivation. Future research should establish an interdisciplinary framework combining "sports science-psychology-neuroscience." From a psychological perspective, incorporating emotion regulation scales and mindfulness training techniques could explore the psychological mechanisms by which anxiety affects interoception through sleep mediation. From a neuroscience dimension, combining fMRI and polysomnography (PSG) could clarify the neural correlations between sleep stages and interoceptive brain region activation. From a sports science standpoint, integrating interoceptive training into sports rehabilitation programs and

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validating the interdisciplinary intervention pathway of "psychological regulation-sleep improvement-interoceptive enhancement" through physiological indicators like heart rate variability (HRV) could ultimately form a unified theoretical framework that integrates mental state regulation, sleep health management, and interoceptive training.

6. Conclusions and Recommendations

6.1 Conclusion

(1) Most sports students have good sleep quality, at a normal level, without sleep disorders, while a small portion have poor sleep conditions and low sleep quality. The overall interoceptive level among sports students is relatively high, with a minority having low interoceptive ability.

(2) Sleep quality is closely related to interoceptive levels. Poor sleep quality, feeling drowsy or lacking energy during daytime work and study, can impair the daytime functioning of sports students and reduce interoceptive accuracy and sensitivity (attention). This makes it difficult to accurately reflect changes in their internal state and to consistently notice their body's condition (comfort/discomfort), resulting in slower awareness of bodily sensations.

6.2 Recommendations

(1) Schools can establish more psychological counseling rooms and incorporate interoception testing into daily student management regulations at student affairs offices, youth league committees, university psychological counseling centers, and student clubs. Schools can offer an elective course on "Exercise Sleep and Interoception" to teach sleep hygiene knowledge and intrinsic training skills. Coaches incorporate sleep monitoring (wearing smart bracelets) into their training plans to establish a dynamic adjustment mechanism for sleep-training load. In addition, observe students' sleep in a timely manner, conduct more surveys on sleep quality, and pay more attention to students' learning and living conditions. Early-stage psychological issues can manifest through sleep quality, so improving their sleep is crucial for enhancing mental health. To address the various challenges caused by declining sleep quality among students, relevant exercise prescriptions should be formulated, and professional instructors should be arranged to guide and supervise.

(2) Schools should organize various sports activities and events to foster a campus-wide fitness trend while ensuring reasonable frequency of activities. Moderate physical exercise or training can help students improve self-regulation, enhance interoception, improve sleep quality, and promote physical and mental well-being. Incorporate interoception training (breath control) into warm-up and cool-down sessions, at least twice a week for 10 minutes each time.

(3) To address the challenges caused by declining sleep quality among sports majors, relevant exercise prescriptions can be formulated, and professional instructors should be arranged to guide and supervise. Students need to maintain a regular routine, develop a fixed biological clock, do not do high-intensity training close to bedtime, and if they are training at night, let them do the necessary stretching and relaxation after the end. In order to ensure a restful sleep environment, PE students are required to abstain from electronic devices 1 hour before bedtime, and can choose to read, meditate or take deep breaths. Instructors can also use meditation, yoga, and Pilates exercises to help physical education students focus on their physical sensations and improve their inner feelings. Additionally, journaling about physical sensations and emotions can help identify connections between the body, training, and daily life, thereby enhancing students' self-regulation and promoting physical and mental health.

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