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The Relationship Between Sleep Quality Heart Rate Variability (HRV) and Functional Recovery in Players at the Samarra Basketball Club

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ABSTRACT

The present study aims to investigate the relationship between sleep quality, heart rate variability (HRV) and functional recovery among players of the Samarra Basketball Club. The researcher employed a descriptive approach using correlational methods, as this was deemed appropriate for the nature of the research problem and its objectives. The study population comprised the players of the Samarra Basketball Club for the 2025–2026 season, totalling 14 players representing the club's advanced team, All were selected as the research sample using a comprehensive enumeration method, representing 100% of the original population. The Pittsburgh Sleep Quality Index (PSQI) was used to measure the players' sleep quality, alongside heart rate variability (HRV) measurements using the RMSSD and SDNN indices, In addition, the Functional Recovery Scale (TQR) was used to determine the players' level of recovery following training loads. The researcher also utilised a number of tools and devices, including a heart rate monitor, HRV measurement applications, data recording forms, and SPSS for data processing and statistical analysis. The main conclusions were that sleep quality and HRV are important indicators in assessing the functional and recovery status of basketball players, and that improving sleep quality and increasing HRV values contribute to improved recovery processes and physical readiness, as well as reducing instances of fatigue and sports-related stress.

Keywords: Quality of sleep; Heart Rate Variability (HRV); Functional Restoration; Basketball athletes; Samarra Basketball Club

ABSTRAK

Studi ini bertujuan untuk menyelidiki hubungan antara kualitas tidur, variabilitas detak jantung (HRV) dan pemulihan fungsional di antara pemain Klub Bola Basket Samarra. Peneliti menggunakan pendekatan deskriptif menggunakan metode korelasional, karena dianggap sesuai dengan sifat masalah penelitian dan tujuannya. Populasi penelitian terdiri dari para pemain Klub Bola Basket Samarra untuk musim 2025–2026, dengan total 14 pemain yang mewakili tim lanjutan klub, Semua dipilih sebagai sampel penelitian menggunakan metode pencacahan komprehensif, mewakili 100% dari populasi asli.

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Indeks Kualitas Tidur Pittsburgh (PSQI) digunakan untuk mengukur kualitas tidur para pemain, di samping pengukuran variabilitas detak jantung (HRV) menggunakan indeks RMSSD dan SDNN, Selain itu, Skala Pemulihan Fungsional (TQR) digunakan untuk menentukan tingkat pemulihan pemain setelah beban latihan. Peneliti juga menggunakan sejumlah alat dan perangkat, termasuk monitor detak jantung, aplikasi pengukuran HRV, formulir perekaman data, dan SPSS untuk pemrosesan data dan analisis statistik. Kesimpulan utamanya adalah bahwa kualitas tidur dan HRV adalah indikator penting dalam menilai status fungsional dan pemulihan pemain bola basket, dan bahwa meningkatkan kualitas tidur dan meningkatkan nilai HRV berkontribusi pada peningkatan proses pemulihan dan kesiapan fisik, serta mengurangi kelelahan dan stres terkait olahraga.

Kata Kunci: Kualitas Tidur; Heart Rate Variability (HRV); Pemulihan Fungsional; Atlet Bola Basket; Klub Bolabasket Samarra.

INTRODUCTION

Recent years have witnessed a remarkable development in the sciences of sports training and sports physiology, as interest is no longer limited to the development of players' physical and technical abilities, but has extended to include the physiological processes associated with recovery and functional adaptation resulting from training loads and sporting competitions. The process of sports recovery has become one of the key indicators relied upon by coaches and researchers in assessing the functional status of athletes, due to its direct role in maintaining performance efficiency and reducing the likelihood of stress and sports injuries, particularly in team sports that require high physical and mental exertion, such as basketball.

Basketball is considered a sport of complex physiological nature, as it requires repeated high-intensity performance that combines speed, strength, endurance and the ability to make decisions in a short space of time, which exposes players to training loads and closely spaced competitions that may directly affect the efficiency of the autonomic nervous system and the level of functional recovery. Furthermore, failure to achieve adequate recovery may lead to a decline in physical and technical performance and an increase in feelings of fatigue and chronic stress among players.

Among the factors influencing the athletic recovery process, sleep quality stands out as one of the most important physiological and psychological variables associated with restoring the body's homeostasis following physical exertion. Good sleep contributes to improving central nervous system function, regulating hormonal processes, and rebuilding muscle tissue, as well as playing a role in enhancing cognitive processes, attention and concentration. Conversely, sleep disturbances or poor sleep quality may lead to impaired recovery processes, increased levels of fatigue and stress, and reduced physical and technical performance in athletes.

In this context, heart rate variability (HRV) has emerged as a modern indicator used to assess autonomic nervous system activity and the body's ability to adapt to and recover from training loads. HRV refers to the temporal variations between successive heartbeats; an increase in HRV is indicative of efficient neural regulation and balance between the sympathetic and parasympathetic nervous systems, whilst a decrease may reflect states of fatigue, stress and impaired recovery processes.

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In recent years, researchers have shown increasing interest in studying the relationship between sleep quality and HRV, given their complementary roles in assessing the functional and recovery status of athletes, as numerous studies indicate that poor sleep quality is associated with lower HRV values and higher indicators of physiological stress, which negatively impacts athletic performance and functional recovery. However, Arab studies – particularly in the field of basketball – remain limited in their interrelated examination of these variables.

The significance of this research stems from the importance of the variables it addresses, as sleep quality is considered a key indicator linked to the general health and physical and mental efficiency of athletes, given its direct role in physiological recovery processes and the restoration of the body's functional balance following physical exertion. Furthermore, sleep disturbances or poor sleep quality may lead to impaired neural and hormonal responses and a reduced ability to tolerate training loads, which negatively impacts athletic performance.

Despite the importance of these factors in the sporting arena, the researcher observed – through field monitoring of basketball players – that there was a clear disparity in levels of functional recovery and physical readiness among the players, as well as the emergence of fatigue and stress in some of them during training and competition periods, which may be linked to sleep quality and the efficiency of autonomic nervous regulation, as represented by the HRV index. Furthermore, most previous studies have addressed these variables separately, whilst Arab studies investigating the integrative relationship between sleep quality, heart rate variability and functional recovery in basketball players remain limited. Hence, the research problem is defined as an attempt to answer the following question:

Is there a statistically significant relationship between sleep quality, heart rate variability (HRV) and functional recovery in basketball players? The study aimed to identify the levels of sleep quality, heart rate variability (HRV) and functional recovery in basketball players, to reveal the relationship between sleep quality and heart rate variability (HRV) in basketball players, and to reveal the relationship between sleep quality and heart rate variability (HRV) and functional recovery in basketball players. The study hypothesised that there is a statistically significant correlation between sleep quality and heart rate variability (HRV) in basketball players, and that there is a statistically significant correlation between sleep quality and functional recovery in basketball players. as well as a statistically significant correlation between heart rate variability (HRV) and functional recovery in basketball players.

METHODS

Research Methodology

The researcher employed a descriptive approach using correlational methods, as this was appropriate to the nature of the research problem and its objectives.

Research Population and Sample

The research population comprised the players of the Samarra Basketball Club for the 2025–2026 season, numbering 14 players representing the club's advanced team. They were selected using purposive sampling as they represented the actual research population and possessed the required characteristics consistent with the study's objectives.

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The researcher adopted a comprehensive enumeration approach in selecting the sample, as the research sample comprised the entire research population (100%), due to the limited number of players and the researcher's desire to obtain accurate and comprehensive data reflecting the players' true physiological and functional characteristics.

Table 1. Showing the research population, sample and percentage

No	Original population	Population size	Sample used	Percentage of sample from population
1	Players of Samarra Basketball Club for the 2025-2026 season	14 players	14 players	100

The researcher set the following conditions for the sample participants:

1. The player must participate regularly in training sessions.
2. They must be free from injuries or illnesses affecting the circulatory or nervous systems.
3. Adherence to the measurement procedures specified by the researcher.
4. No consumption of stimulants or strenuous physical activity prior to the measurements.

Measures and tests used

1. The Sleep Quality Index (PSQI)

The researcher adopted the sleep quality scale known as:

Pittsburgh Sleep Quality Index

which is one of the most widely used scales in medical, sports and psychological studies relating to sleep. It was developed by Buysse et al. in 1989 to measure sleep quality over the past month.

The scale consists of 19 items distributed across seven main components, which are:

1. Subjective sleep quality.
2. Sleep duration.
3. Time taken to fall asleep.
4. Sleep efficiency.
5. Sleep disturbances.
6. Use of sleeping pills.
7. Daytime lethargy or activity disturbance.

The total score for the scale is calculated by summing the scores for the seven dimensions, with a high score indicating poor sleep quality, whilst a low score indicates better sleep quality.

The researcher used the validated Arabic version of the scale after confirming its reliability, validity and suitability for the sporting environment.

2. Heart Rate Variability (HRV) Scale

Heart rate variability (HRV) was measured using a specialised electronic device or application that measures the temporal variations between successive heartbeats, which is an important indicator of autonomic nervous system activity and the body's ability to adapt to and recover from training loads.

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The researcher relied on the most commonly used time-based measurements in the field of sports, namely: RMSSD

It refers to the square root of the mean of the squares of the differences between successive heartbeats and is considered an indicator of parasympathetic nervous system activity. SDNN

Represents the standard deviation of the time intervals between heartbeats and reflects the overall balance of autonomic nervous system activity.

Measurements were taken in the early morning and before any physical activity to ensure the players' physiological state was stable, with an emphasis on: abstaining from caffeine, Adequate sleep, No strenuous physical exertion prior to measurement.

3. The Functional Recovery Scale (TQR Scale)

The researcher adopted the:

Total Quality Recovery Scale

To measure the level of functional recovery among players. This is one of the scales used in the field of sport to assess the extent to which a player has regained their physical and functional condition following training loads. The scale consists of rating scales based on the player's self-assessment of their recovery status, with ratings ranging from feeling extremely fatigued and not fully recovered to feeling fully recovered and in peak physical condition. The scale was administered following specific training sessions and under standardised conditions for all members of the sample.

The exploratory study

The researcher conducted the pilot study on a number of players outside the main research sample, with the aim of:

1. Ensure the clarity of the scale items.
2. Determining the time required to conduct the measurements.
3. Ensuring the suitability of the equipment and tools used.
4. Identify potential obstacles and difficulties during implementation.
5. Train the support team on the measurement procedure and data recording.

The pilot study helped to create the right conditions for carrying out the main study in an accurate and organised manner.

Field Procedures

After obtaining official approval from the management of the Samarra Basketball Club, the researcher carried out the field procedures in the following order:

1. Explaining the research objectives and procedures to the players.
2. Distributing sleep quality questionnaires to the sample participants.
3. Scheduling HRV measurements for the morning hours.
4. Conducting HRV measurements before performing any physical activity.
5. Administering the functional recovery scale after the specified training session.
6. Collect and organise the data using specific forms.
7. Entering the data into the statistical package (SPSS) for processing and analysis.

The researcher took care to standardise the measurement conditions in terms of:

1. Timing.
2. Test location.
3. Temperature.
4. The players' state of health.
5. Avoiding stimulants and stress prior to the measurements.

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This is to minimise extraneous factors and increase the accuracy of the results obtained.

Statistical methods

The researcher used SPSS to process the data and extract the results, and the following statistical methods were adopted: Arithmetic mean, Standard deviation, Pearson's correlation coefficient, Percentage.

RESEARCH RESULTS

Table 2. Shows the means and standard deviations of the research variables for the players of the Samarra Basketball Club

Variable	Unit	Mean	Standard deviation	Variable
Sleep quality (PSQI)	Score	5.21	1.34	Average to good
HRV (RMSSD)	milliseconds	48.36	9.12	Good
Functional recovery (TQR)	Score	15.42	1.18	Good

Note: Negative change values indicate improvement (reduction in time).

Table 3. Shows the relationship between sleep quality and heart rate variability (HRV)

Variables	Correlation coefficient (r)	Significance level	Type of relationship
Sleep quality x HRV	0.71	Significant at 0.05	Strong positive

Table 4. Shows the relationship between sleep quality and functional recovery

Variables	Correlation coefficient (r)	Significance level	Type of relationship
Sleep quality x functional recovery	0.76	Significant at 0.05	Strong positive

Table 5. Shows the relationship between HRV and functional recovery

Variables	Correlation coefficient (r)	Significance level	Type of relationship
x HRV Functional recovery	0.81	Significant at 0.05	Very strong positive

Table 6. Shows the contribution of sleep quality and HRV to predicting functional recovery

Contributing variables	R ² value	Contribution	Significance level
Sleep quality HRV+	0.68	68%	Significant at 0.05

DISCUSSION

Table 2. shows that the players of the Samarra Basketball Club have relatively good levels in the research variables, with the mean score for sleep quality (5.21) tending towards good, whilst the HRV value, as measured by the RMSSD index, was 48.36 milliseconds, which falls within the acceptable range for athletes with good physiological adaptation. The results for functional recovery also showed a good level, with a mean of 15.42. The researcher attributes this to the players' regular training and gradual adaptation to physical loads, as well as their acceptable level of neural and functional recovery.

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The results in Table 3 showed a strong positive correlation between sleep quality and HRV, with a correlation coefficient of 0.71, which is statistically significant at the 0.05 level. The researcher believes that good sleep contributes to improving the activity of the parasympathetic nervous system, which is responsible for rest and recovery processes, leading to higher HRV values and an improved ability to adapt to training loads. Furthermore, sleep disturbances negatively affect autonomic nervous regulation and lead to increased sympathetic activity associated with stress and fatigue, which is reflected in lower HRV values

The results in Table 4 indicate a strong positive correlation between sleep quality and functional recovery, with a correlation coefficient of 0.76, which is statistically significant. The researcher attributes this result to the important role of sleep in restoring energy, rebuilding muscle tissue and regulating hormonal and neurological processes following physical exertion, which has a direct impact on the efficiency of functional recovery in players. Furthermore, adequate sleep helps reduce feelings of fatigue and muscular and neurological stress, which helps players to better restore their physical readiness.

Table 5 shows a very strong positive correlation between HRV and functional recovery, with a correlation coefficient of 0.81, indicating a high correlation between the two variables. The researcher considers HRV to be one of the most important physiological indicators reflecting the efficiency of the autonomic nervous system and the body's ability to adapt to and recover from training loads, as high HRV values indicate increased parasympathetic activity and improved recovery processes. Furthermore, athletes with high levels of HRV often have a greater ability to resist fatigue and recover functional balance following training and sporting competitions.

The results in Table 6 indicate that sleep quality and HRV account for 68% of the variation in functional recovery among basketball players, which is a relatively high proportion. The researcher believes that this result confirms the physiological link between sleep, the autonomic nervous system and athletic recovery processes, as improved sleep quality and higher HRV values lead to an improvement in the body's ability to restore its functional state following physical exertion. This result also indicates the potential for using these two variables as modern indicators for monitoring the training and recovery status of athletes.

CONCLUSIONS AND RECOMMENDATIONS

In light of the research objectives and results, the researcher reached the following conclusions:

1. The players of the Samarra Basketball Club have relatively good levels of sleep quality, heart rate variability (HRV) and functional recovery.
2. There is a statistically significant positive correlation between sleep quality and heart rate variability (HRV) in basketball players, indicating that improved sleep quality is associated with improved autonomic nervous system activity.
3. There is a positive correlation between sleep quality and functional recovery, as good sleep contributes to improved recovery processes and the restoration of functional balance following training loads.

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4. There is a strong positive correlation between HRV and functional recovery, confirming the importance of HRV as a modern physiological indicator for monitoring athletic recovery.
5. Both sleep quality and HRV contribute to predicting the level of functional recovery in basketball players.
6. Sleep and HRV indicators can be used to monitor training loads and for the early detection of fatigue and stress in players.

Based on the research findings and conclusions, the researcher recommends the following:

1. Coaches and specialists should pay attention to monitoring sleep quality in basketball players, given its direct impact on functional recovery and athletic performance.
2. HRV measurements should be taken periodically as a modern physiological indicator for monitoring players' functional and recovery status.
3. Training loads should be adjusted in line with players' functional status and recovery levels to avoid stress and overtraining.
4. Raising players' awareness of the importance of healthy sleep and avoiding factors that negatively affect sleep quality, such as staying up late and using electronic devices before bed.
5. Incorporate sleep quality and HRV indicators into training programmes designed to monitor athletic recovery and physical readiness.
6. Conduct similar studies across different sports and age groups to investigate the relationship between sleep quality, HRV and functional recovery.

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