

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

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Article History

Received: 08-05-2026;

Reviewed: 14-06-2026;

Accepted: 17-06-2026;

Published: 17-06-2026

ABSTRACT

This study examined the relationship between sleep quality, heart rate variability (HRV) and the level of functional recovery among players at the Samarra basketball club. The researcher adopted a descriptive, correlational approach, in line with the nature of the research problem and the objectives the study aimed to achieve. The study population consisted of the players in the first team of the Samarra Basketball Club for the 2025–2026 season, totalling 14 players. Given the small size of the population, the research procedures covered all the players, representing 100 per cent of the initial population. To assess the sleep quality of the sample members, the researcher used the Pittsburgh Sleep Quality Index (PSQI), whilst heart rate variability (HRV) was measured using the RMSSD and SDNN indices. The Functional Recovery Scale (TQR) was also used to assess the players' level of recovery following training sessions. The measurement tools used included a heart rate monitor, dedicated HRV measurement apps, as well as data-recording questionnaires and SPSS software for data processing and statistical analysis. The results showed that the club's players exhibited relatively good levels with regard to the variables of sleep quality, heart rate variability and functional recovery. A positive and statistically significant correlation was also observed between sleep quality and HRV (0.71), as well as between sleep quality and functional recovery (0.76), whilst the correlation between HRV and functional recovery reached a correlation coefficient of 0.81. Furthermore, the variables of sleep quality and HRV together accounted for 68 per cent of the variance observed in the players' functional recovery. These results highlight the importance of using sleep indicators and heart rate variability to monitor the functional status, level of recovery and physical condition of basketball players, as well as the potential to use them to monitor fatigue and stress associated with training loads.

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

Jurnal Pendidikan Kepelatihan Olahraga: Pejuang

Volume 2 Nomor 2 Juni 2026

E-ISSN: 3090-1278

ABSTRAK

Studi ini meneliti hubungan antara kualitas tidur, variabilitas detak jantung (HRV), dan tingkat pemulihan fungsional di antara pemain di klub bola basket Samarra. Peneliti mengadopsi pendekatan deskriptif dan korelasional, sesuai dengan sifat masalah penelitian dan tujuan yang ingin dicapai studi tersebut. Populasi studi terdiri dari pemain tim utama Klub Bola Basket Samarra untuk musim 2025–2026, dengan total 14 pemain. Mengingat ukuran populasi yang kecil, prosedur penelitian mencakup semua pemain, mewakili 100 persen dari populasi awal. Untuk menilai kualitas tidur anggota sampel, peneliti menggunakan Indeks Kualitas Tidur Pittsburgh (PSQI), sementara variabilitas detak jantung (HRV) diukur menggunakan indeks RMSSD dan SDNN. Skala Pemulihan Fungsional (TQR) juga digunakan untuk menilai tingkat pemulihan pemain setelah sesi pelatihan. Alat pengukuran yang digunakan meliputi monitor detak jantung, aplikasi pengukuran HRV khusus, serta kuesioner pencatatan data dan perangkat lunak SPSS untuk pemrosesan data dan analisis statistik. Hasil menunjukkan bahwa para pemain klub menunjukkan tingkat yang relatif baik terkait variabel kualitas tidur, variabilitas detak jantung, dan pemulihan fungsional. Korelasi positif dan signifikan secara statistik juga diamati antara kualitas tidur dan HRV (0,71), serta antara kualitas tidur dan pemulihan fungsional (0,76), sementara korelasi antara HRV dan pemulihan fungsional mencapai koefisien korelasi sebesar 0,81. Selain itu, variabel kualitas tidur dan HRV bersama-sama menyumbang 68 persen dari variansi yang diamati dalam pemulihan fungsional para pemain. Hasil ini menyoroti pentingnya menggunakan indikator tidur dan variabilitas detak jantung untuk memantau status fungsional, tingkat pemulihan, dan kondisi fisik pemain bola basket, serta potensi penggunaannya untuk memantau kelelahan dan stres yang terkait dengan beban latihan.

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.

If an adequate level of recovery is not achieved, this can have a negative impact on players' physical performance and motor skills, as it may be associated with a decline

in performance as well as an increase in feelings of fatigue and chronic psychological stress.

Sleep quality is regarded as a key factor influencing the athletic recovery process, as it plays a crucial role in restoring the body's internal balance following physical exertion. Good sleep helps to support the functions of the central nervous system, regulate hormonal processes and rebuild muscle tissue; it is also associated with improvements in cognitive processes, attention and concentration. Conversely, sleep disorders or reduced sleep quality can impair the efficiency of the recovery process, increase fatigue levels and psychological stress, and have a negative impact on athletes' physical performance and motor skills.

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.

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. The sample was selected using a purposive sampling method, as the participants represent the actual research population and possess characteristics that align with the nature of the study's objectives and requirements.

Due to the limited number of players in the study population, the sample comprised all of them, representing 100 per cent of the original population. The researcher employed the exhaustive sampling method to select the sample members, with the aim of obtaining 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.

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.

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 2 Juni 2026

E-ISSN: 3090-1278

Field Procedures

1. After obtaining official approval from the management of the Samarra Basketball Club, the researcher began carrying out the field procedures in an organized sequence, starting by explaining the research objectives and the steps to be followed during the measurements of the players.
2. Explaining the research objectives and procedures to the sample participants, including the nature of the measurements and the steps they were required to follow.
3. Distributing sleep quality questionnaires to the study participants to collect data on their sleep quality.
4. Scheduling heart rate variability (HRV) measurements during the morning hours to ensure consistent timing of measurements across all players.
5. Conducting heart rate variability (HRV) measurements before engaging in any physical activity, in order to obtain measurements in the physiological state immediately preceding physical exertion.
6. Administering the functional recovery scale after the specified training session.
7. Collect and organise the data using specific forms.
8. 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.

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 × 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
× 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.

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.

The results in Table (5) showed a very strong positive correlation between heart rate variability (HRV) and functional recovery, with a correlation coefficient between the two variables of **(0.81)**, reflecting a high level of correlation between them.

Heart rate variability is considered one of the important physiological indicators that can be used to assess the efficiency of the autonomic nervous system and the body's ability to adapt to training loads and restore its functional state. High HRV values are

associated with increased parasympathetic nervous system activity, which is consistent with improved recovery processes.

Furthermore, athletes with high HRV levels may have a greater ability to resist fatigue and restore functional balance after training sessions and athletic 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.
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 quality indicators and heart rate variability (HRV) can be used to monitor training loads in athletes; they can also be applied to the early detection of signs of fatigue and training-related stress.

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

Recommendations:

1. It is recommended that coaches and specialists pay ongoing attention to monitoring the quality of sleep amongst basketball players, given its link to the level of functional recovery and sporting performance.
2. Periodic measurements of heart rate variability (HRV) should be taken and utilised as a modern physiological indicator for monitoring players' functional status and recovery levels.
3. Functional status and recovery levels should be taken into account when organising and adjusting training loads, thereby helping to minimise stress and overtraining.
4. Raise players' awareness of the importance of healthy and regular sleep, whilst emphasising the need to avoid practices that may negatively affect sleep quality, such as staying up late and using electronic devices before bed.

Jurnal Pendidikan Kepeleatihan Olahraga: Pejuang

Volume 2 Nomor 2 Juni 2026

E-ISSN: 3090-1278

5. Incorporate sleep quality and heart rate variability (HRV) indicators into training programmes designed to monitor athletes' recovery and physical readiness.
6. Conduct similar studies across different sports and age groups, with the aim of gaining a broader understanding of the relationship between sleep quality, heart rate variability and functional recovery.

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