EVALUATION OF PERIPHERAL MUSCLE STRENGTH, BEHAVIOR AND SLEEP QUALITY IN WOMEN'S AMATEUR BASKETBALL[1]

AVALIAÇÃO DA FORÇA MUSCULAR PERIFÉRICA, COMPORTAMENTO E QUALIDADE DO SONO NO BASQUETE FEMININO AMADOR

Carolina Quatrin[2], Luiz Fernando Rodrigues Junior[3], João Rafael Sauzem Machado[4], Lilian Oliveira de Oliveira[5] e Jaqueline de Fátima Biazus[6]

ABSTRACT

Introduction: Basketball is a team sport, characterized by repeated transitions between attack, defense and frequent changes in movement and direction, in which players need great athletic ability to demonstrate speed, strength and power. The grip becomes important because it is one of the basic basketball movements in controlling the ball, and the quality and behavior of sleep is configured as an important regeneration tool and can influence the recovery and the physical and sport performance of athletes, since the poor quality of sleep can affect the maximum performance and impair adaptations to training. **Methodology:** This was an exploratory study, with the purpose of analyzing the quality and behavior of sleep and handgrip strength in amateur basketball players from the Federal University of Santa Maria - RS. **Results:** Fourteen athletes with a mean age of 22.5±3.3 years participated in this study. In the athlete's sleep behavior questionnaire, 70% of the athletes pointed out a bad sleep behavior; in the Pittsburg Sleep Quality Index questionnaire, 78.6% presented a bad sleep quality. In relation to handgrip strength, the average was 27.4 kgf in the right upper limb and 25.7 kgf in the left upper limb. **Conclusion:** There is a pattern of poor sleep quality and poor sleep behavior, and no correlation with palmar grip strength, since no statistical difference was found between the right and left upper limbs.

Keywords: sports; hand strength; sleep.

RESUMO

Introdução: O basquete é um esporte de equipe, caracterizado por repetidas transições entre ataque, defesa e mudanças frequentes nos movimentos e na direção, em que os jogadores necessitam de grande habilidade atlética para demonstrar velocidade, força e potência. A preensão palmar torna-se importante por exercer um dos movimentos básicos do basquete no controle da bola, e a qualidade e o comportamento do sono se configura como uma ferramenta de regeneração importante e pode influenciar na recuperação e no desempenho físico e esportivo das atletas, uma vez que, a má qualidade de sono pode atingir o desempenho

1 Trabalho final de graduação.

2 Acadêmica do Curso de Fisioterapia - Universidade Franciscana - UFN. Santa Maria - RS, Brasil. E-mail: carolina.quatrin@ufn.edu.br. ORCID: 0009-0002-6697-7992

3 Colaborador. Docente do Curso de Engenharia Biomédica - Universidade Franciscana - UFN, Mestre em Engenharia e Ciências de Materiais - UFRGS, Santa Maria - RS, Brasil. E-mail: luiz.fernando@ufn.edu.br. ORCID: 0000-0002-5753-5503

4 Colaborador. Docente do Curso de Fisioterapia - Universidade Franciscana - UFN, Mestre Distúrbios da Comunicação Humana - UFSM, Santa Maria - RS, Brasil. E-mail: joaorafael@ufn.edu.br. ORCID: 0000-0003-0918-9682

5 Colaborador. Docente do Curso de Fisioterapia - Universidade Franciscana - UFN, Doutora em Educação em Ciência Química da Vida e Saúde-UFSM, Santa Maria - RS, Brasil. E-mail: lilian.oliveira@ufn.edu.br. ORCID: 0000-0002-41160866

6 Orientadora. Docente do Curso de Fisioterapia, Universidade Franciscana - UFN, Mestre em Saúde Coletiva - UNISUL, Santa Maria - RS, Brasil. E-mail: jaquebiazus@ufn.edu.br. ORCID: 0000-0002-7741-475X

máximo e prejudicar as adaptações ao treinamento. **Metodologia:** *Este estudo foi do tipo exploratório, com objetivo de analisar a qualidade e o comportamento do sono e da força de preensão palmar em jogadoras amadoras de basquete da Universidade Federal de Santa Maria - RS.* **Resultados:** *Participaram deste estudo 14 atletas com idade média de 22,5±3,3 anos. No questionário de comportamento do sono do atleta, 70% das atletas apontam um mau comportamento do sono; já no questionário Índice de qualidade do sono de Pittsburg, 78,6% apresentaram qualidade de sono ruim. Em relação à força de preensão palmar, a média foi de 27,4 kgf no membro superior direito e de 25,7 kgf no membro superior esquerdo.* **Conclusão:** *Existe um padrão de qualidade do sono ruim e mau comportamento do sono, não havendo correlação com a força de preenssão palmar, uma vez que não foi encontrada uma diferença estatística entre os membros superiores direito e esquerdo.*

Palavras-chave: *esporte; força da mão; sono.*

INTRODUCTION

Basketball is known in Brazil as one of the most popular sports. It is a collective sport of opposition and competition between two teams, which provides motivation among young people. It consists of a dynamic game of high intensity, with unpredictable situations, which helps with the development of tactical and technical skills. It is characterized by different multidirectional transitions and intense activities, such as jumps, runs, shuffles, and changes of direction, as well as technical skills, such as receiving, dribbling, shooting, and passing the ball. These movements make basketball a sport that requires high levels of muscular strength, speed, and power. (GUIMARÃES *et al.*, 2021; GOTTLIEB, SHALOM, CALLEJA-GONZALEZ, 2021).

For better and more precise defensive and offensive maneuvers and skills during the game, grip strength depends on a series of movements related to the wrist and finger flexors for catching, holding, shooting, and passing the ball, playing a fundamental role in this game (GUIMARÃES *et al.,* 2021; PIZZIGALLI *et al.*, 2017). Thus, improving muscular strength reduces the risk of injuries and plays an important role in learning, improving motor skills, and meeting the demands of the sport. It becomes important for its mobility and for performing one of the basic movements of basketball, as well as being used as one of the main indicators to test an individual's muscular strength. (GUIMARÃES *et al.*, 2021; KÜLÜNKOĞLU, AKKUBAK, ERGUN, 2018; ZACCAGNI *et al.*, 2020).

The ability of an athlete to reach their maximum potential and achieve a high level of performance is determined by various factors, among them the quality of sleep (BONNAR *et al.*, 2018). Sleep deprivation has important implications for the physical and technical performance of athletes, potentially interfering with maximal performance and impairing training adaptations. Changes in the duration and quality of sleep increase the chances of athletes developing higher levels of pain sensitization, fatigue, as well as an increase in pro-inflammatory cytokines, which

impair the function of the immune system (RANDELL *et al.,* 2021; BASCOUR - SANDOVAL *et al*., 2021).

This study aims to analyze the quality and behavior of sleep, as well as grip strength in amateur players from the UFSM women's basketball team at the Federal University of Santa Maria - RS.

METHODOLOGY

This study is one of exploratory nature, and was conducted at the Center for Physical Education and Sports (CEFD) of the Federal University of Santa Maria (UFSM), located in Santa Maria (RS), where questionnaires on sleep quality and behavior were collected, as well as the grip strength test. The research project was practically developed in April 2023.

The study sample consisted of amateur female basketball athletes from UFSM. Athletes met the following inclusion criteria: being within the age range of 18 to 35, undergoing training during the data collection period, being available for assessment, agreeing to participate in data collection, and signing the Informed Consent Form (TCLE). Exclusion criteria included: having cardiac, neurological, or bone diseases that would prevent the performance of the proposed tests, not being available for assessment, and/or not undergoing training.

A final sample was composed of athletes who met the inclusion criteria. The basketball players were in training and were between 19 and 31 years old.

This study is part of the research project titled "Analysis of Respiratory, Biochemical, Musculoskeletal Variables and Quality of Life of Athletes," approved by the Ethics Committee of the Universidade Franciscana under the number CAAE: 04319118.3.0000.5306. It follows the ethical criteria established by Resolution 466/12 of the National Health Council, dated December 12, 2012.

After the project execution proposal was authorized by the responsible authority at the Center for Physical Education and Sports (CEFD) of the Universidade Federal de Santa Maria, the athletes signed the TCLE and received the confidentiality agreement, signed by the research advisor, which specifies the use of the data obtained in the research, ensuring the confidentiality of the participants' identities and their personal data. During this process, doubts regarding the research, risks, and benefits of the evaluation were clarified. After signing the TCLE, the evaluation day was scheduled with all athletes at the Center for Physical Education and Sports (CEFD) of the Universidade Federal de Santa Maria. Initially, a form was filled out containing personal data, medication usage, training time, dominant limb, weight, and height. Subsequently, the athletes were directed to a quiet space where they completed the questionnaire on sleep quality and behavior in athletes, and the grip strength test was conducted the following day.

A descriptive statistics analysis (average, standard deviation, and percentage) was conducted, and the data was presented in graphs, tables, and figures to facilitate visualization and comprehension. The Shapiro-Wilk test was also performed to check the normality of the collected data. For comparison of the results obtained, the paired sample t-test was conducted. To evaluate the behavior of the results, analysis of variance (ANOVA) and Tukey's post-hoc test for average comparison were performed. The significance level used was $p \leq 0.05$. Origin software was used for statistical analyses.

The instruments used for data collection were: an identification form consisting of open and closed questions, containing personal information, training frequency and duration, position on the court, duration of practice in the position, dominant side, age, weight, height, and medication usage.

The Athlete Sleep Behavior Questionnaire (ASBQ) is an 18-item questionnaire containing questions related to behaviors and habits regarding sleep, considered concerning for athletes. The questionnaire was created with the aim of identifying areas that could improve athletes' habits regarding their sleep behavior (DRILLER, MAH, HALSON, 2018). The ASBQ asks participants about the frequency of specific behaviors (never, rarely, sometimes, frequently, and always). Each response is scored as follows (1 = never, 2 = rarely, 3 = sometimes, 4 = frequently, 5 = always). The questions are distributed into: routine and environmental factors, behavioral factors, and factors related to sports. Total scores equal to or less than 36 indicate good sleep behavior, while scores above or equal to 42 represent poor sleep behavior (FACUNDO *et al*., 2021).

The Pittsburgh Sleep Quality Index questionnaire consists of ten questions, nine of which are self-reported and the tenth is directed to the roommate (if applicable), assessing the quality and pattern of sleep in adults over the preceding month. It comprises seven components: subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medication, and daytime dysfunction. The components are graded on a score ranging from zero to three points, where three represents the most negative end of the scale. The total score values constitute the PSQI index, which, if equal to or greater than five, indicates significant difficulties and poor sleep quality (BERTOLAZI *et al*., 2010; SILVA *et al*., 2020).

For the evaluation of grip strength, the WTC Fitness digital hand grip dynamometer, model Hand Grip, was used. During the assessment, the athletes remained seated in a chair with an upright posture, arms supported, feet flat on the floor with knees flexed at 90 degrees, shoulder in adduction, and elbow at 90 degrees, forearm in semi-pronation, and wrist in a neutral position. Athletes were asked to squeeze the device with maximum force, performing three trials on each hand, with a one-minute interval between repetitions. The average of the three measurements was adopted as the strength result (ZALTRON *et al.,* 2020).

RESULTS

Fourteen female athletes from the women's amateur basketball team at the Federal University of Santa Maria - RS, aged between 19 and 31 years, participated in the study. They underwent evaluation of sleep quality and sleep behavior, as well as the handgrip strength test. All 14 athletes completed the subjective sleep assessment, while only 12 of them completed the handgrip strength test. Table 1 presents the characteristics of the athletes, with a mean age of 22.5 years (DP = 3.3), mean weight of 66.70 kg (DP = 14.3), and mean height of 1.7 m (DP = 0.1).

**Table 1 -** Characteristics of the athletes.

Nome	Idade (anos)	Data de Nascimento	Altura (m)	Peso (kg)
1	22	12/11/2000	1,53	51
2	22	15/01/2001	1,7	64
3	25	31/07/1997	1,8	110
4	23	07/10/1999	1,74	63
5	19	09/052004	1,7	70
6	31	25/04/1991	1,65	67
7	20	25/05/2002	1,72	75
8	20	15/01/2003	1,73	65
9	19	03/05/2004	1,63	60
10	25	23/07/1997	1,67	53
11	23	19/10/1999	1,63	54
12	20	08/02/2003	1,75	70
13	25	13/01/1998	1,7	62
14	21	29/09/2001	1,73	70
Média	22,5		1,7	66,7
DP*	3,3		0,1	14,3

*SD = Standard Deviation)
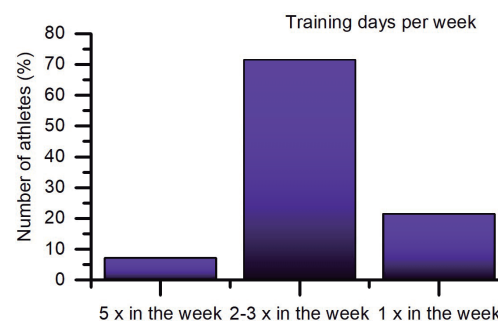Source: Authors' construction (2023).

Regarding medication use, three athletes are using both contraceptive and anxiolytic medication (21.43%), five are using only contraceptive medication (35.71%), and six athletes are not using any type of medication (42.86%).

Graph 1 displays the characteristics related to the training duration of the athletes, where three athletes have been training for 3 weeks (21.43%) and six athletes (42.86%) for 1 year. Data for the remaining athletes are provided below in the graph.

Graph 1 - Total training time.
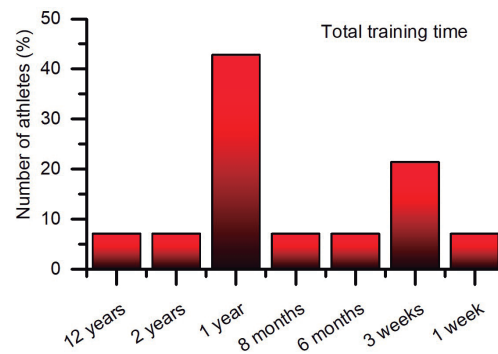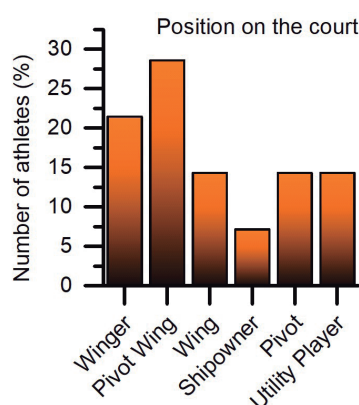

Source: Authors' construction (2023).

Regarding the weekly training frequency of the athletes (graph 2), 10 athletes (71.43%) train 2 to 3 times a week, 1 athlete (7.14%) trains 5 times a week, and 3 athletes (21.43%) train once a week.

Graph 2 - Training days per week.

Source: Authors' construction (2023).

In graph 3, the players' positions on the court are shown as follows: 3 athletes (21.4%) play as shooting guards; 4 athletes (28.6%) play as power forwards; 2 athletes (14.3%) play as small forwards; 1 athlete (7.1%) plays as a point guard; 2 athletes (14.3%) play as centers; and a total of 2 athletes (14.3%) do not have a fixed playing position.
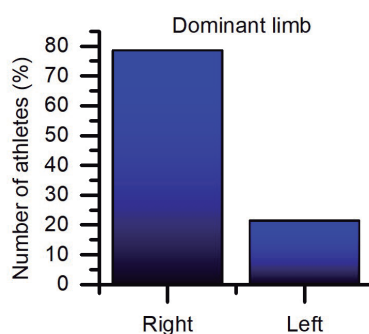
Graph 3 - Position on the court.

Source: Authors' construction (2023).

In graph 4, the dominant upper limbs of each of the 12 athletes are identified, where 78.57% have the right upper limb as dominant and 21.43% have the left upper limb dominant.
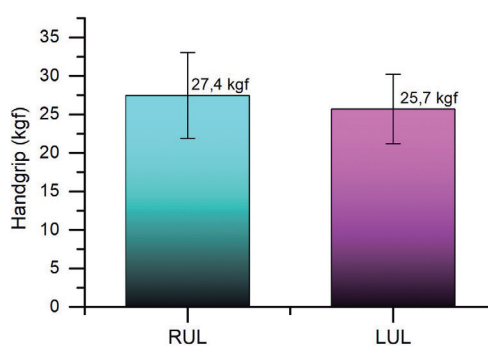
Graph 4 - Dominant limb.

Source: Authors' construction (2023).

In graph 5, the average values of the 12 athletes evaluated in the handgrip strength test of the right (27.4 kgf) and left (25.7 kgf) upper limbs are presented.

Graph 5 - Handgrip strength of the right and left upper limbs when compared individually.


(kgf=Kilogram force)
(RUL= Right upper right limb)
(LUL= Left upper limb)
Source: Authors' construction (2023).

The total results of the Pittsburgh Sleep Quality Index questionnaire assessed the quality and pattern of sleep of the athletes in relation to the month preceding the evaluation, across various components such as subjective sleep quality, sleep latency, sleep duration, habitual sleep efficiency, sleep disturbances, use of sleep medications, and daytime dysfunction. These results are available for visualization in graph 6, where it is noted that 78.6% of the evaluated athletes exhibited poor sleep quality, 14.3% exhibited sleep disturbances, and 7.1% exhibited good sleep quality.
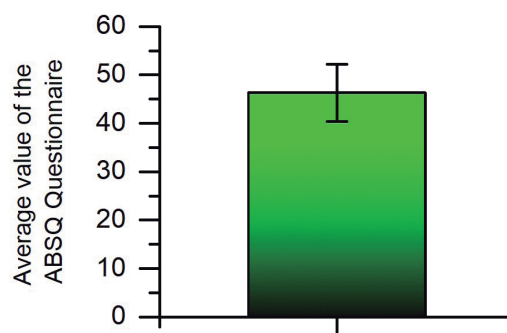
Graph 6 - Pittsburgh Sleep Quality Index.
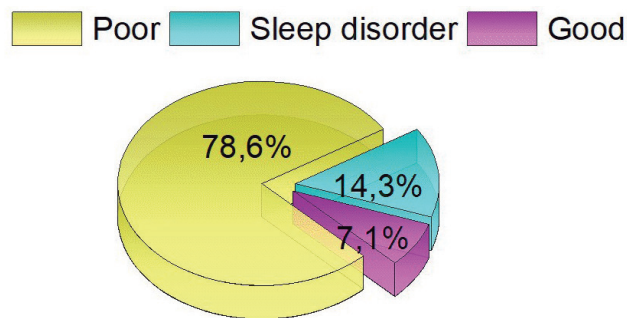
Source: Authors' construction (2023).

Graph 7 presents the results related to the Athlete Sleep Behavior Questionnaire (ASBQ), which assessed the behavior and sleep habits concerning common areas that athletes are concerned about. It was also designated as a practical tool to identify areas for improving sleep behavior habits. A total of 70% of the athletes indicate poor sleep behavior, with only 30% exhibiting good sleep behavior.

**Graph 7 -** Athlete Sleep Behavior Questionnaire - ASBQ.

Source: Authors' construction (2023).

As observed in Graph 8, there was no correlation between the Athlete Sleep Behavior Questionnaire (ASBQ) and the handgrip strength test of the athletes, nor between the Pittsburgh Sleep Quality Index (PSQI) and handgrip strength. A total of 70% of the athletes exhibited poor sleep behavior and did not show handgrip strength values close to or below the expected.

Graph 8 - Correlation between ABSQ and handgrip strength.
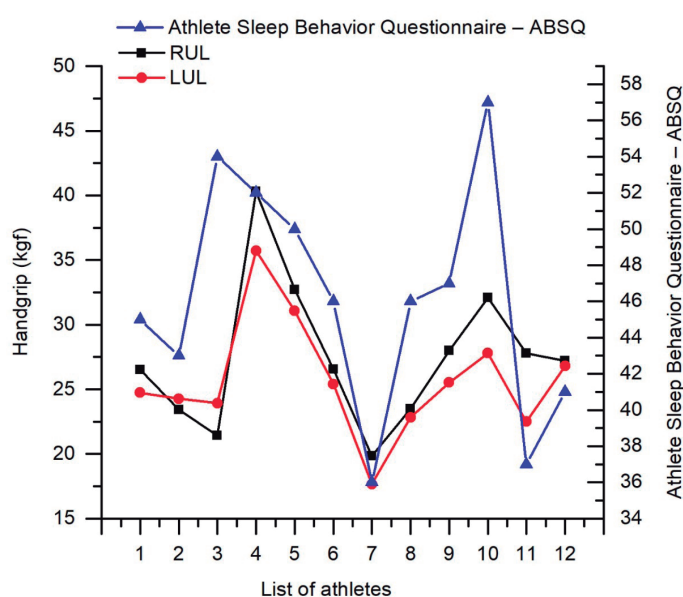
Source: Authors' construction (2023).

DISCUSSION

In this study, the quality and behavior of sleep and handgrip strength in amateur basketball athletes are described using validated and specific measures for athletes. After analyzing the variable of handgrip strength, it was found that there was homogeneity among the athletes when compared individually, with the dominant side showing higher levels of strength compared to the contralateral side.

In the study by Lijewski *et al.* (2021), 36 professional handball players participated, with an average age of 26.1 ± 6.44 years. They went through handgrip strength testing using a hand dynamometer, performing 2 repetitions at maximum intensity with a rest period of three minutes between attempts to minimize the effects of fatigue. When correlated, no statistically significant differences were found in the muscle mass of the right and left upper limbs. The bilateral variability in handgrip strength was also statistically significant, as the directional asymmetry index for handgrip strength indicates the prevalence of the right hand.

Zaccagni *et al.* (2020) conducted a cross-sectional study with young university students, including 544 Italian youths (356 males and 188 females) with a mean age of 21.3 ± 2.0 years for females. They assessed handgrip strength using a hand dynamometer, finding that in both sexes, the handgrip strength of the dominant hand was significantly greater than that of the non-dominant hand, except for left-handed women. Additionally, in ambidextrous individuals, the right hand was stronger than the left hand. It is noteworthy that there is a strong tendency for the dominant hand to exhibit a signifi-

cantly higher level of handgrip strength in both sexes. This is attributed to the dominant hand being used more frequently in various occupational tasks since childhood, unlike the non-dominant hand, resulting in the muscles of the dominant arm being larger and stronger when compared to the contralateral upper limb. Both studies on handgrip strength yielded the same result as found in this research.

Components of daily performance, such as physical effort, cognitive alertness, and memorization, are strongly influenced by sleep quality. Sleep is an essential component of athletes' psychophysiological state, crucial for optimizing recovery, physical restoration, and performance, ensuring that the body is prepared for demands during wakefulness. Poor sleep quality can lead to reduced daily performance and consequently, poor quality of human activity, such as increased fatigue, worsened mood, and decreased cognitive functions, including reaction time and decision-making (TABER *et al.*, 2021; AMARAL *et al.*, 2021).

In the present study, among the 14 athletes evaluated using the PSQI, 10 athletes exhibited poor sleep quality (78.6%), 2 athletes (14.3%) displayed sleep disturbances, and 1 athlete (7.1%) had good sleep quality. Two other studies yielded similar results and employed the same data collection instrument (PSQI). Randell *et al.* (2021) assessed 313 athletes across various sports and different competitive levels, finding that 55% of the athletes exhibited poor sleep quality, comparable to the findings of the present study. In the study by Leduc *et al.* (2020), 73 student-athletes (24 women and 49 men) across various sports were evaluated, with sleep quality assessed using the PSQI. The average score was 6.89 ± 3.03, with 65% of participants scoring above the threshold of 5, indicating poor sleep quality.

According to Singh *et al.* (2021), a decrease in sleep duration and, consequently, disruption of the circadian rhythm, along with increased training load, are associated with an increased risk of injuries in athletes overall. However, it is crucial for an athlete to properly plan their sleep to reduce the likelihood of getting injured and negatively impacting their athletic performance. Considering the higher physical demands, it is recommended that athletes aim for between 9 to 10 hours of sleep per night.

When evaluating the ASBQ, a total of 3 athletes exhibited good sleep behavior, while 11 showed poor sleep behavior, with overall sleep behavior scores ranging from 30% to 70%. These findings are similar to those of Rebello *et al.* (2022), who assessed 64 university students participating in various sports, with a mean age of 20.3 ± 1.7 years, and characterized 62% of the participants as having "poor sleep behaviors". The study highlights some factors related to issues present in the ASBQ that may positively influence these results, such as frequent/daily use of electronic devices 1 hour before bedtime (90%) and late-night training or competitions (after 7 pm), sometimes or frequently (65%). According to Silva *et al.* (2020), the use of electronic devices during times when athletes should be recovering is one of the factors responsible for sleep deprivation, as it can interfere with circadian rhythms, suppress melatonin production, and thereby hinder the onset of sleep.

However, it is important to consider that, in addition to the demands of sports, amateur athletes are also pursuing higher education. This involvement in university life brings along a series of challenges, including new social contexts, changes in sleep schedules, living conditions that disrupt sleep, demanding academic workloads, and financial stress. These factors can increase stress levels and, consequently, may affect sleep hygiene and sleep itself (REBELLO *et al.*, 2022).

The practice of regular routines and the creation of an ideal sleeping environment can be trained to provide healthy sleep for athletes, ultimately benefiting their peak performance. This can be achieved by adopting behaviors such as establishing a fixed wake-up time daily, having a nightly routine before bed, and avoiding stimulants and distractions before bedtime (AMARAL *et al.*, 2021).

However, a limitation of this study is the limited availability of research covering the population of female basketball athletes, both at the amateur and professional levels, which hinders the enrichment of the present study. Additionally, following the results, some perspectives were identified that should be taken into consideration. For instance, conducting studies comparing the effect of sleep quality and behavior on physical and athletic performance between amateur and professional athletes, as well as investigating whether there is a relationship with handgrip strength.

The sample size in this study is relatively small for a survey study, however, through this research, the need for athletes to receive individualized support and education regarding their sleep practices and recovery was ensured, thus aiding in injury prevention and performance improvement during training, which may be of interest to coaches and professionals involved. Nevertheless, the importance of the role of physiotherapy in the sports multidisciplinary team was recognized, as the sports domain encompasses injury prevention, rehabilitation, and the promotion of appropriate sleep patterns. This is because sleep quality influences the reduction of injury risk and athlete performance.

CONCLUSION

In this study, the quality and behavior of sleep, as well as handgrip strength, were evaluated in athletes. A pattern of poor sleep quality and poor sleep behavior was observed, and no statistical difference was found between the right and left upper limbs. However, it was identified that the dominant hand was significantly stronger in both athletes. Regarding parameters related to the behavior and quality of sleep of the athletes, no association was found with handgrip strength values close to or below the expected range.

REFERENCES

AMARAL, Adriana Souza *et al*. Influência da privação de sono no desempenho de atletas: uma revisão sistemática. **J. Phys. Educ.,** v. 32, p. 1-9, 2021. DOI: https://doi.org/10.4025/JPHYSEDUC.V32I1.3231.

BASCOUR-SANDOVAL, Claudio Bascour *et al*. Association between sleep quality and pain in young amateur athletes. **Revista Brasileira de Medicina do Esporte**, v. 27, n. 2, p. 165-169, 2021. DOI: https://doi.org/10.1590/1517-8692202127022019_0008.

BERTOLAZI, Alessandra Naimaier *et al*. Validation of the Brazilian Portuguese version of the Pittsburgh Sleep Quality Index**. Sleep Med**, [S. l.], v. 12, n. 1, p. 70-5, 9 dez. 2010. Disponível em: https://pubmed.ncbi.nlm.nih.gov/21145786/.

BONNAR, Daniel *et al*. Intervenções do sono projetadas para melhorar o desempenho atlético e a recuperação: uma revisão sistemática das abordagens atuais. Sports Med, v. 48, p. 683-703, jan. 2018. DOI: https://doi.org/10.1007/s40279-017-0832-x.

DRILLER M. W.; MAH, C. D.; HALSON, S. L. Development of the athlete sleep behavior questionnaire: A tool for identifying maladaptive sleep practices in elite athletes. **Sleep Sci.**, v. 11, n. 1, p. 37-44, jan./fev. 2018. Disponível em: https://pubmed.ncbi.nlm.nih.gov/29796200/.

FACUNDO, Lucas Alves *et al*. Cross-cultural adaptation of the Brazilian version of the Athlete Sleep Behavior Questionnaire. **Sleep Science**, v. 14, n. 2, p. 150-157, abr./jun. 2021. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8764952/.

GOTTLIEB, Roni; SHALOM, Asaf; CALLEJA-GONZALEZ, Julio. Physiology of basketball - field tests. Review article. **Journal of human kinetics**, v. 77, n. 1, p. 159-167, jan. 2021. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8008295/.

GUIMARÃES, Eduardo *et al*. Muscular strength spurts in adolescent male basketball players: The INEX study. **International Journal of Environmental Research and Public Health**, v. 18, n. 2, p. 776, 2021. DOI: 10.3390/ijerph18020776.

KÜLÜNKOĞLU, Bahar; AKKUBAK, Yasemin.; ERGUN, Nevin. The profile of upper extremity muscular strength in female wheelchair basketball players: a pilot study. **The Journal of Sports Medicine and Physical Fitness**, v. 58, n, 5, p. 606-611, maio 2018. Disponível em: https://www.minervamedica.it/en/journals/sports-med-physical-fitness/article.php?cod=R40Y2018N05A0606.

LEDUC, Cédric et al. The Quality, Quantity, and Intraindividual Variability of Sleep Among Students and Student - Athletes. **Sports Health**, v. 12, n. 1, p. 43-50, 2020. Disponível em: https://pubmed.ncbi.nlm.nih.gov/31730421/.

LIJEWSKI, Marcin *et al*. Asymmetry of Muscle Mass Distribution and Grip Strenght in Professional Handball Players. **Int. J. Environ. Res. Public Health**, v. 18, n. 4, 2021. DOI: https://doi.org/10.3390/ijerph18041913.

PASTRE, Tais Glauce Fernandes de Lima; PASTRE, Marcelo. **Basquetebol**: elementos para um processo de ensino-aprendizagem. Curitiba: Inter Saberes, v.1, p. 25-69, [On-line], 2021. Disponível em: https://plataforma.bvirtual.com.br/Acervo/Publicacao/187401.

PIZZIGALLI, Luisa *et al*. Hand grip strength and anthropometric characteristics in Italian female national basketball teams. **The Journal of Sports Medicine and Physical Fitness**, v. 57, n. 5, p. 521-528, maio 2017. DOI: 10.23736/S0022-4707.16.06272-1.

RANDELL, Rebecca K. *et al*. Self-reported current sleep behaviors of adult athletes from different competitive levels and sports. **Sleep science**, v. 14, n. 1, p. 1-7, 2021. DOI: 10.5935/1984-0063.20200044.

REBELLO, Lyndon J. *et al*. Sleep Quality and Sleep Behaviors in Varsity Athletes: A Pilot Study. **Front Sports Act Living**, 2022. Disponível em: https://pubmed.ncbi.nlm.nih.gov/35813053/.

SILVA, Andressa *et al*. Qualidade do sono e sua repercussão no desempenho e nas lesões esportivas em atletas. **PROFISIO: Programa de Atualização em Fisioterapia Esportiva e Atividade Física**, v. 4, ciclo 9, p.11-57, 2020.

SINGH, Meeta *et al*. Urgent wake up call for the National Basketball Association. **Journal of Clinical Sleep Medicine**, v. 17, n. 2, p. 243-248, fev. 2021. Disponível em: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7853218/.

TABER, Cristóvão et al. Sono e desempenho físico: um estudo de caso de jogadoras de basquete universitário da 1ª divisão feminina. 2021. 43ª Conferência Internacional Anual da IEEE Engineering in Medicine & Biology Society (EMBC). **Anais** [...] IEEE, 2021.

ZACCAGNI, Luciana *et al.* Força de preensão manual em adultos jovens: associação com variáveis antropométricas e lateralidade. **Revista Internacional de Pesquisa Ambiental e Saúde Pública**, v. 17, n. 12, p. 4273, 2020. DOI: 10.3390/ijerph17124273.

ZALTRON, Deborah Paula Almeida *et al.* Força de preensão palmar e frequência cardíaca em atletas amadoras de handebol. **Disciplinarum Scientia**. Série: Ciências da Saúde, Santa Maria, v. 21, n. 1, p. 59-65, 2020. DOI: https://doi.org/10.37777/dscs.v21n1-006. Acesso em: 09 jun. 2023.