

ASSOCIATION BETWEEN SLEEP QUALITY AND PAIN IN YOUNG AMATEUR ATHLETES

ASSOCIAÇÃO ENTRE QUALIDADE DO SONO E DOR EM JOVENS ATLETAS AMADORES

ASOCIACIÓN ENTRE CALIDAD DEL SUEÑO Y DOLOR EN JÓVENES ATLETAS AMATEURS

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ABSTRACT

Introduction: It has been shown that there is a close association between sleep quality and pain. In young athletes, sleep disorders and pain have a particularly high prevalence; however, the relationship between them has not been widely studied. **Objective:** To study the association between sleep quality and pain in young athletes. **Methods:** A cross-sectional study was conducted in which 71 young amateur athletes (39 males) were included. The mean age was 16.9 ± 1.2 years, with 6.5 ± 3.2 years of sports practice and 5.2 ± 1.2 hours of training per week. Sleep quality was evaluated using the Pittsburgh Sleep Quality Index (PSQI). The participants were classified according to sleep quality, as PSQI-I = without sleep disorders, PSQI-II = requiring medical assistance and PSQI-III = requiring medical assistance and treatment. Also, pain intensity was assessed on the Numerical Rating Scale, both at rest (NRSr) and during sports activity (NRSs), along with pain duration. **Results:** The individuals classified as PSQI-III presented higher NRSr (Mdn = 2.0; IQR = 4.0 vs. Mdn = 0.0; IQR = 2.0; $p = 0.04$) and higher NRSs (Mdn = 4.0; IQR = 5.0 vs. Mdn = 0.0; IQR = 2.0; $p = 0.03$) than the individuals classified as PSQI-I. No differences were observed in relation to pain duration. The PSQI score was positively but weakly associated with NRSr ($r_s = 0.24$, $p = 0.046$) and NRSs ($r_s = 0.27$, $p = 0.03$) but not with pain duration. **Conclusion:** Young athletes with lower levels of sleep quality show higher levels of pain at rest and during sports practice. Therefore, sleep quality and pain should be considered in the routine assessment of young athletes, by technical and health teams. **Level of evidence III; type of study: Cross-sectional.**

Keywords: Adolescent; Sports; Sleep hygiene; Sleep; Musculoskeletal pain.

RESUMO

Introdução: Demonstrou-se que existe estreita associação entre qualidade do sono e dor. Em atletas jovens, distúrbios do sono e dor têm prevalência bastante alta, no entanto, a relação entre eles não foi amplamente estudada. **Objetivo:** Estudar a associação entre qualidade do sono e dor em atletas jovens. **Métodos:** Foi realizado um estudo transversal, no qual foram incluídos 71 atletas jovens amadores (39 homens). A média de idade foi de $16,9 \pm 1,2$ anos, com $6,5 \pm 3,2$ anos de prática esportiva e $5,2 \pm 1,2$ horas de treinamento por semana. A qualidade do sono foi avaliada por meio do Índice de Qualidade do Sono de Pittsburgh (PSQI). Os participantes foram classificados de acordo com a qualidade do sono, PSQI-I = sem distúrbios do sono, PSQI-II = requer atendimento médico e PSQI-III = requer atendimento médico e tratamento. Além disso, intensidade da dor foi avaliada na Escala de Avaliação Numérica em repouso (EANr) e durante a atividade esportiva (EANe), juntamente com a duração da dor. **Resultados:** Os indivíduos classificados como PSQI-III apresentaram maior valor no EANr (Mdn = 2,0; IQR = 4,0 vs. Mdn = 0,0; IQR = 2,0; $p = 0,04$) e EANe maiores (Mdn = 4,0; IQR = 5,0 vs. Mdn = 0,0; IQR = 2,0; $p = 0,03$) do que os indivíduos classificados com PSQI-I. Nenhuma diferença foi observada com relação à duração da dor. O escore do PSQI foi positivo e com fraca associação a EANr ($r_s = 0,24$, $p = 0,046$) e EANe ($r_s = 0,27$, $p = 0,03$), mas não com a duração da dor. **Conclusão:** Atletas jovens com níveis mais baixos de qualidade do sono têm níveis mais elevados de dor em repouso e durante a prática esportiva. Portanto, a qualidade do sono e a dor devem ser consideradas pelas equipes técnicas e de saúde na avaliação rotineira de atletas jovens. **Nível de evidência III; Tipo de estudo: Transversal.**

Descritores: Adolescente; Esportes; Higiene do sono; Sono; Dor musculoesquelética.

RESUMEN

Introducción: Se demostró que existe estrecha relación entre calidad del sueño y dolor. En atletas jóvenes, los disturbios del sueño y dolor tienen prevalencia bastante alta, sin embargo, la relación entre ellos no fue ampliamente estudiada. **Objetivo:** Estudiar la asociación entre calidad del sueño y dolor en atletas jóvenes. **Métodos:** Fue realizado un estudio transversal, en el cual fueron incluidos 71 atletas jóvenes amateurs (39 hombres). El promedio de edad fue de $16,9 \pm 1,2$ años, con $6,5 \pm 3,2$ años de práctica deportiva y $5,2 \pm 1,2$ horas de entrenamiento por semana. La calidad del sueño fue evaluada por medio del Índice de Calidad del Sueño de Pittsburgh (PSQI). Los participantes fueron clasificados de acuerdo con la calidad del sueño, PSQI-I = sin disturbios del sueño, PSQI-II = requiere atención médica y PSQI-III = requiere atención médica y tratamiento. Además, la intensidad del dolor fue evaluada en la Escala de Evaluación Numérica en reposo (EANr) y durante la actividad deportiva (EANe), juntamente con la duración

del dolor. Resultados: Los individuos clasificados como PSQI-III presentaron mayor valor en el EANr (Mdn = 2,0; IQR = 4,0 vs. Mdn = 0,0; IQR = 2,0; $p = 0,04$) y EANE mayores (Mdn = 4,0; IQR = 5,0 vs. Mdn = 0,0; IQR = 2,0; $p = 0,03$) que los individuos clasificados con PSQI-I. No fue observada ninguna diferencia con relación a la duración del dolor. El puntaje del PSQI fue positivo y con débil asociación a EANr ($r_s = 0,24$, $p = 0,046$) y EANE ($r_s = 0,27$, $p = 0,03$), pero no con la duración del dolor. Conclusión: Los atletas jóvenes con niveles más bajos de calidad del sueño tienen niveles más elevados de dolor en reposo y durante la práctica deportiva. Por lo tanto, la calidad del sueño y el dolor deben ser considerados por los equipos técnicos y de salud en la evaluación rutinaria de atletas jóvenes. **Nivel de evidencia III; Tipo de estudio: Transversal.**

Descriptor: Adolescente; Deportes; Higiene del sueño; Sueño; Dolor musculoesquelético.

DOI: http://dx.doi.org/10.1590/1517-8692202127022019_0008

Article received on 06/10/2019 accepted on 09/14/2020

INTRODUCTION

Sleep quality and pain have shown a reciprocal relationship,¹ where it has been highlighted that alterations in sleep quality affect pain perception. For instance, several studies have described that sleep deprivation increases pain sensitivity^{2,3} and that the chances of developing chronic pain (i.e., for more than three months) are higher in the presence of sleep disorders.⁴ Furthermore, sleep disorders could reliably predict new episodes and exacerbations of chronic pain.⁵ Likewise, patients with chronic pain with concurrent sleep disorders show higher pain intensities than those with healthier sleep patterns.⁶ This finding could be because there is an association between the deep sleep activation of neurons with pain inhibitor functions,⁷ which increases neuro-modulatory actions such as serotonin secretion, which is related to analgesia, as well as deep sleep.⁸ In this context, higher mechanical pain tolerance levels have been described in people with longer periods of deep sleep after a period of sleep deprivation.⁹ On the other hand, alteration in the continuity of sleep causes the endogenous mechanisms that inhibit pain to deteriorate.¹⁰

The evidence is similar for youngsters, where it has been found that adolescents with chronic pain report sleep disorders more frequently than their healthy counterparts.¹¹ Similarly, pain intensity could contribute significantly to the prediction of sleep quality in adolescents and young adults with acute and chronic pain.¹²

The association between sleep quality and pain intensity has been studied mainly in young non-athletes. Thus, given that athletes present particular factors that would differentiate their perception of pain from that of non-athletes,¹³ it is not possible to generalize these results to young athletes. Both variables - pain and sleep quality - could interfere in participation and performance in athletic competitions, also affecting the quality and quantity of their training process.¹⁴ Interestingly, sleep alterations and pain are frequent among athletes;^{15,16} however, the relationship between them has not been widely studied in young athletes.

In summary, it is necessary to generate evidence that links sleep alterations in this type of population and to analyze their relationship with the presence or absence of pain. Therefore, the present work aimed to assess the association between sleep quality and pain in young athletes under the hypothesis that sleep alterations are positively associated with perceived pain.

METHODS

A cross-sectional study was carried out on young athletes, participating in an international competition in the disciplines of judo, track and field, cycling, basketball and swimming. All athletes representing the Los Ríos Region of Chile ($n=93$) were invited to participate. The inclusion criteria were: aged between 13 and 20 years old at the time of data collection, being part of a regional sports team, and agreeing to participate in the study. The exclusion criteria were: suffering an injury which excluded the athlete from participating in the event or presenting a diagnosis of psychiatric pathology.

Participants: 77 young amateur athletes met the inclusion criteria. Six subjects were excluded from the analysis due to incomplete data, leaving 71 (39 males) subjects for analysis. The mean age was 16.9 ± 1.2 years, 6.5 ± 3.2 years of sports practice and 5.2 ± 1.2 hours of weekly training. This study was approved by the Ethics Committee of the Universidad Austral de Chile (N°2411-16) and the information, informed consent were provided to the parents/guardians and the athletes themselves in the case of underage individuals. This study was conducted in compliance with the Declaration of Helsinki for human experimentation.

Measures: In order to get reliable information from the athletes, data was collected one day before the competition started. Participants answered a self-administered questionnaire given by a physical therapist. This questionnaire included three sections, described here.

Demographic and sports practice data. First, we collected demographic data such as age and gender, and data regarding sports practice, such as years practicing sport, weekly training hours and number of weekly training sessions.

Sleep Quality. In a second section, sleep quality was measured through the Pittsburgh Sleep Quality Index (PSQI), an instrument validated in Spanish.¹⁷ It is comprised of 24 questions, of which only 19 were used to obtain the overall sleep quality score (PSQIs), expressed on a scale from 0 to 21 points, where the higher scores reflect worse sleep quality. From this score, subjects could be classified as: "Without sleep problems" (less than 5 points, PSQI-I), "Requires medical attention" (between 5 and 7 points, PSQI-II), "Requires medical attention and treatment" (between 8 and 14 points, PSQI-III), or "Severe sleep problem" (equal to or higher than 15 points, PSQI-IV). Among other aspects, the questionnaire collects data regarding sleep hours, difficulties falling asleep, sleep interruptions, nightmares, snoring, respiratory alterations, sleep quality, consumption of sleep medication and existence of daytime drowsiness. The Spanish version PSQI has presented adequate reliability, with Cronbach's alpha values that vary between 0.67 and 0.72 in healthy young people.^{18,19} Our study yielded a Cronbach's alpha of 0.62.

Pain presence. To measure the presence or absence of pain we asked the participants: "Currently, are you in pain?", the answer being "yes" or "no".

Pain intensity. Pain intensity was assessed using the Numerical Rating Scale, a validated, highly reproducible instrument that is easy and fast to apply.²⁰ Pain intensity was assessed at rest and during movements related to sport practice. To measure resting pain intensity (NRSr) we asked, "How much pain do you feel right now?", "please qualify the pain intensity from 1 being minimum pain to 10 being the worst pain imaginable". To measure pain intensity during sports practice (NRSs) we asked, "How much pain do you feel while performing a particular sports movement?" "Please qualify the pain intensity from 1 being minimum pain to 10 being the worst pain imaginable". Differences of 30% or two points between groups are considered relevant in clinical contexts.²⁰

Pain Duration. To measure pain duration (LP) we asked the participants, "How many months have you suffered this current pain?"

Statistical Analyses. Data analysis was performed with the statistical software Stata, version 14. A descriptive analysis was performed of the main study variables using statistics of central tendency (i.e., mean, median) and dispersion (i.e., standard deviation, interquartile range) for quantitative variables. For the qualitative variables, absolute and relative frequencies were used. To verify normal distribution of the data we used the Shapiro-Wilk test. Given the non-compliance with the normality criterion by the variables of PSQIs with NRSr, NRSs and LP, non-parametric tests were used. To analyze the relationship between sleep quality and gender, a Chi-square test was used. The Wilcoxon rank-sum (Mann-Whitney) test was used to evaluate differences in PSQIs, NRSr, NRSs and LP according to gender. The Kruskal-Wallis test was applied to compare the NRSr, NRSs and LP scores according to the sleep quality categories, where statistical significance were found, planned comparisons with the Wilcoxon rank-sum (Mann-Whitney) test were used as a post hoc analysis considering the Bonferroni adjustment ($0.05/3 = 0.017$). To evaluate the correlation between the PSQIs and the NRSr, NRSs and LP, Spearman's Rho test (r_s) was used. The following values will be considered for the correlation: 0.1 weak, 0.3 moderate and 0.5 strong.²¹ A p value of 0.05 was considered statistically significant with the exception of planned comparisons where 0.017 was considered.

RESULTS

Sociodemographic, regular sports practice and clinical data are presented in Tables 1 and 2.

Table 1. Sociodemographic and sports characteristics of population.

Variable	n (%)	M (SD)	Range
Age (years)		16,9 (1.2)	14-19
Gender			
Male	39 (54.9)		
Female	32 (45.1)		
Discipline			
Judo	10 (14.1)		
Athletics	24 (33.8)		
Cycling	4 (5.6)		
Basketball	9 (12.7)		
Swimming	24 (33.8)		
Years of sport practice		6.5 (3.2)	0.6-12
Hours of training sessions		2.1 (0.5)	1-4
Hours of weekly training		5.2 (1.2)	2-9

n = number of subjects by variable, M = mean, SD = Standard deviation.

Table 2. Clinical characteristics of population.

Variable	n (%)	M (SD)	Range
Hours of sleep average in the last month		7.8 (1.4)	4.0-12.5
PSQI global score		4.8 (2.5)	1-12
Pain intensity during rest		1.2 (1.6)	0-5
Pain intensity during practice		1.9 (2.4)	0-8
Number of months with pain		1.6 (4.8)	0-35
Individuals sleeping < 8 hrs.	44 (62)		
Pain presence during rest	30 (42.9)		
Pain presence during sport practice	30 (42.9)		

n = number of subjects by variable, % = percentage, M = mean, SD = Standard deviation, PSQI = Pittsburgh Sleep Quality Index.

Wilcoxon rank-sum test showed significant differences in the PSQIs of women ($Mdn = 5.5, IQR = 4.5$) and men ($Mdn = 4.0, IQR = 2; p = 0.02$), with PSQIs being higher in women. The same test showed no significant differences between women and men in NRSr (women: $Mdn = 0, IQR = 3$ vs. men: $Mdn = 0, IQR = 2; p = 0.21$), NRSs (women: $Mdn = 0, IQR = 5$ vs. men: $Mdn = 0, IQR = 4; p = 0.63$), LP (women: $Mdn = 0, IQR = 2$ vs. men: $Mdn = 0, IQR = 1; p = 0.54$) and sleep hours (women: $Mdn = 7.87, IQR = 1.48$ vs. men: $Mdn = 7.66, IQR = 1.25; p = 0.62$). PSQI category distribution was associated with gender. Thus, it was observed that there was a greater percentage of women than men in the PSQI-III category (i.e., lower sleep quality category). Likewise, a lower percentage of women than men reported not having sleep disturbances (i.e., PSQI-I). These differences are statistically significant ($p=0.049$; see Table 3).

Analysis of pain intensity and duration according to PSQI categories using the Kruskal-Wallis test showed statistically significant differences to NRSr ($p = 0.04$) and NRSs ($p = 0.03$). No differences were observed for the LP between PSQI categories ($p = 0.41$). See details in Table 4.

A post hoc analysis using the Wilcoxon rank-sum test showed significant differences for NRSr ($p = 0.01$) and NRSs ($p = 0.01$) between the PSQI-I and PSQI-III categories, with the pain being noted as greater in the PSQI-III category for both variables. In contrast, there were no significant differences between PSQI-I and PSQI-II (NRSr: $p = 0.23$ and NRSs: $p = 0.14$) or between PSQI-II and PSQI-III (NRSr: $p = 0.15$ and NRSs: $p = 0.25$).

Regarding the correlations between sleep quality and pain characteristics, the PSQIs was directly and significantly associated with NRSr ($r_s = 0.24, p=0.046$); NRSs ($r_s = 0.27, p = 0.03$), but not with LP ($r_s = 0.12, p = 0.32$).

Table 3. Classification by Pittsburgh Sleep Quality Index according to gender.

PSQI ^a n (%)	Gender		Total n (%)
	Female n (%)	Male n (%)	
I-Without sleep disturbances	13 (33.3)	26 (66.7)	39 (54.9)
II-Deserves medical assistance	11 (52.4)	10 (47.6)	21 (29.6)
III-Deserves medical assistance and treatment	8 (72.7)	3 (27.3)	11 (15.5)

$\chi^2 = 6.022, p = 0.049$. PSQI = Pittsburgh Sleep Quality Index (^a There were no individuals classified in PSQI-IV = Serious sleep disorder, therefore it was not considered in the chi squared analysis χ^2). n = number of subjects, % = percentage.

Table 4. Intensity and duration of pain according to sleep quality categories.

Categories ^a	PSQI-I	PSQI-II	PSQI-III
	Mdn (IQR)	Mdn (IQR)	Mdn (IQR)
NRSr	0 (2) [†]	0.5 (2.5)	2 (4) [†]
NRSs	0 (2) [†]	1 (5)	4 (5) [†]
LP (months)	0 (0.75)	0 (1)	0.13 (5)

Mdn = Median, IQR = Interquartile range, PSQI = Pittsburgh Sleep Quality Index, PSQI-I = without sleep disorders, PSQI-II = requires medical assistance, PSQI-III = requires medical assistance and treatment, NRS = Numerical Rating Scale, NRSr = Pain intensity at rest, NRSs = pain intensity during sport practice, PL = Pain duration. ^a There were no individuals classified in PSQI-IV = Serious sleep problems. [†] Significant differences between groups, $p < 0.017$.

DISCUSSION

In this study we sought to investigate the association between sleep quality and pain characteristics (e.g., at rest, during sports-related activities, and duration) in young athletes.

We noticed that NRSr and NRSs varies according to sleep quality, showing that individuals with poorer sleep quality exhibit higher pain intensities. In terms of the questionnaire score, NRSs between PSQI-III and PSQI-I categories differed by two points, a difference defined as clinically relevant in populations suffering pain.²⁰ These data suggest that lower sleep qualities could be associated with higher levels of pain intensities at rest and during sports-related activities. In a recent study, Potter et al.²² reported that in young athletes the intensity of pain did

not vary significantly among those who reported poor sleep quality and good sleep quality. That study classified sleep quality considering a cut-off score of 5 points on the PSQI. This simple classification between poor and good sleep quality could explain these results, since it does not consider nuances within the group of poor sleep quality. Thus, when a multivariable regression analysis was performed, an association was found between worse sleep quality and higher pain intensity. In this sense, it can be considered that our results are in line with these findings.

Interestingly, even when none of the athletes had a diagnosed injury, 42.3% described the presence of pain. Bolling et al.²³ analyzed how elite athletes perceived sports-related injuries and concluded that this population associates sports injuries with performance limitations, but not necessarily with pain, which they stated was a normal consequence of training. There is a large body of evidence that athletes have high pain tolerance and a better modulation system than subjects who do not practice sports.¹³ This could be associated with psychological and social factors, generating pain-coping strategies since they understand it as a normal part of their training (i.e., no pain, no gain) by being constantly exposed to unpleasant experiences during competitions and trainings.²⁴ On the other hand, pain could also be associated with sports injuries that affect sports performance.¹⁴ It is important to consider that if the training volume, load periodicity and kinematic chains are not correct, this could make the athlete vulnerable to joint overload, producing painful stimuli²⁵ and fatigue, factors that favor the development of pain.²⁶

Another remarkable find is that 45.1% of our participants presented poor sleep quality according to PSQI. Other studies have reported similar results, such as Potter et al.²² and Bleyer et al.,²⁷ who reported 44.44% and 38% of participants with poor sleep quality respectively. However, it should be considered that the sample by Bleyer et al.²⁷ was made up of young and adult athletes. Moreover, 62% of the participants in our study reported sleeping less than 8 hours on average during the last month, which is also a risk factor for injury.²⁸ The above is consistent with the results by Bleyer et al.,²⁷ who reported 48.5% of the respondents declared sleeping fewer than 8 hours. Interestingly, regardless of the relevance of sleep quality in athletes, none of our participants had a sleep disorder diagnosis, which makes such assessments relevant and suggests that they should be performed periodically by the multidisciplinary team that accompanies them.

Although it was not part of the main goal of the study, it is relevant to highlight that, consistent with other research, women showed higher scores on the Pittsburgh Sleep Quality Index and more of them were

classified in PSQI-III, showing poorer sleep qualities than men.²² Even when previous studies have shown that healthy women have more sleep hours and quality than men,²⁹ it has also been demonstrated that women, especially in pubertal age, are more susceptible to alterations such as anxiety and depression, which could potentially lead to the development of sleep disorders.³⁰

The limitations of our research include this study being cross-sectional in nature, so we are not able to make causal associations. The heterogeneity in terms of sports level among the participants challenges the interpretation of these results, given the variability in terms of sports modality and training hours. Furthermore, it should be considered that athletes were evaluated in the period prior to a competition, and factors such as anxiety and stress may influence our results. However, considering the paucity of studies in the field, we believe this study could serve as a basis for future studies. Furthermore, these upcoming studies should include bigger sample sizes along with probabilistic sample designs, which would make it possible to generalize the findings.

Sleep quality and pain should be considered within the routine assessment of young athletes by technical and health teams given that the presence of poor sleep quality and pain, as our results show, are frequent and these factors can influence participation and sports performance. Likewise, the evaluation of interventions focused on improving sleep alterations could be relevant to improving the effectiveness of the treatment of syndromes or painful dysfunctions. Thus, in light of our results the idea that technical and health teams may include strategies to improve sleep quality, such as sleep hygiene counselling, becomes relevant as it could result in an improvement in pain perception. Furthermore, poor pain management during adolescence is more likely to have musculoskeletal pain in adulthood, so prevention and treatment in this age group would be essential. Future research should be focused on further exploring this association, along with the effectiveness of strategies that aim to improve sleep quality among young athletes.

CONCLUSION

In conclusion, young athletes with lower levels of sleep quality show higher levels of pain, both resting and during sports practice. Therefore, our results reinforce the idea that sleep quality and pain should be considered within the routine evaluation of young athletes by technical and health teams.

All authors declare no potential conflict of interest related to this article

AUTHORS' CONTRIBUTIONS: Each author made significant individual contributions to this manuscript. CBS: intellectual concept, writing, data analysis, statistical analysis, revision and organization of the entire research project. YNN: recording data, writing and revision. MMU: recording data, writing and revision. JFV: recording data and revision. GGG: data analysis, statistical analysis and revision. RGB: intellectual concept, writing, data analysis, revision and organization of the entire research project.

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