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Sleep quality affects health-related quality of life in young athletes during competition
La calidad de sueño afecta la calidad de vida relacionada con la salud en atletas jóvenes durante una competición

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Abstract. Cross-sectional, analytical study that examined the link between sleep quality (SQ) and health-related quality of life (HRQOL) in young athletes in a sports competition. SQ was measured through the Pittsburgh Sleep Quality Index (PSQI), and HRQOL through the SF36 v2 (SF36v2) short-form health survey in 71 young athletes (39 men; mean age 16.9, SD = 1.2 years; mean 6.5, SD = 3.2 years in sports and mean 10.8, SD = 3.3 hours of weekly training) on the day prior to a competition. When comparing the athletes according to SQ (poor SQ > 5 PSQI), significant differences were found ($p < .05$) in HRQOL in the domains bodily pain, general health, vitality, social function, emotional role and mental health, but not in the domains bodily function and physical role. Our results suggest poor SQ is associated with a worse perception of HRQOL in young athletes in competition.
Key words: Sleep hygiene, mental health, quality of life, athletes, youth sports.

Resumen. Estudio analítico transversal que examinó el vínculo entre la calidad del sueño (SQ) y la calidad de vida relacionada con la salud (HRQOL) en jóvenes atletas en una competencia deportiva. SQ se midió a través del índice de calidad del sueño de Pittsburgh (PSQI) y HRQOL a través de la encuesta de salud de formato corto SF36 v2 (SF36v2) en 71 atletas jóvenes (39 hombres; edad media 16,9, SD = 1,2 años; promedio 6,5, SD 3,2 años de práctica deportiva; y promedio 10,8, SD = 3,3 horas de entrenamiento semanal) el día anterior a una competición. Al comparar los atletas según SQ (SQ deficiente > 5 PSQI), fueron encontradas diferencias significativas ($p < ,05$) en la HRQOL en los dominios dolor corporal, salud general, vitalidad, función social, rol emocional y salud mental, pero no en los dominios función corporal y rol físico. Nuestros resultados sugieren que un SQ deficiente se asocia con una peor percepción de la HRQOL en atletas jóvenes en competencia.
Palabras clave: Higiene del sueño, salud mental, calidad de vida, atletas, deportes juveniles.

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Introduction

Sports participation has positive effects on health-related quality of life (HRQOL) in young athletes (Lam et al., 2013; Snyder et al., 2010). HRQOL can be defined as ''how well a person functions in their life and his or her perceived well-being in physical, mental, and social domains of health" (Karimi & Brazier, 2016). Various factors including sleep quality could influence HRQOL (Gomes et al., 2017; Miró et al., 2005; Stheneur et al., 2019).

Sleep quality is defined as an individual's self-satisfaction with all aspects of the sleep experience (Nelson et al., 2022). Sleep quality can affect HRQOL because it influences a person's physical, mental and emotional functions (Gomes et al., 2017; Miró et al., 2005; Stheneur et al., 2019). Thus, for athletes, sleep quality affects recovery from physical effort, the execution of sports activities that require alertness or vigilance, and learning of motor tasks (Simpson et al., 2017). A high prevalence of poor sleep quality has been found in athletes in periods of intense training, as well as before and during competitions (Bascour-Sandoval, Norambuena-Noches, et al., 2021), which could influence the perception of HRQOL, so analyzing its association is relevant.

Poor sleep quality has demonstrated detrimental effects in different dimentions for athletes. Concerning mental/emotional health, poor sleep quality negatively affects neurocognitive functions such as attention and executive functions (Juliff et al., 2015). Additionally, athletes with poor sleep quality have a lower perception of general health and greater stress (Biggins et al., 2018). Benjamin et al. (2020) found that poor sleep quality was related to negative mental health outcomes (i.e., tension, fatigue and concentration disruption) of university athletes. Concerning physical health, poor sleep quality reduces speed, resistance and precision in the execution of movements (Simpson et al., 2017). It also increases the risk of injuries, the susceptibility to disease, lowers the tolerance to pain (Simpson et al., 2017), and could be suggestive of overtraining in athletes (Campbell et al., 2021). This could explain the association in young athletes between poor sleep quality and low levels of HRQOL (Potter et al., 2020).

Sleep quality and the effect on HRQOL in adults are not entirely comparable to those youngers (i.e., ≤ 20 years old). For example, it is recommended that young people should sleep between 8-10 hours per night (Fox et al., 2020; Hirshkowitz et al., 2015), while adults should sleep 7-9

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hours per night. However, it has been documented that young people do not follow these recommendations (Anderson & Reale, 2020; Fox et al., 2020). This could be for a variety of reasons. In young people, a mismatch occurs between the natural day and the biological clock (i.e., circadian cycle), with the latter being longer (Potter et al., 2020). Furthermore, maturational changes in the sleep-wake homeostasis system occur, in addition to lifestyle changes (i.e., greater autonomy in social relations and more school and sport activities; Fox, et al., 2020). In young athletes, sleep quality can be affected by non-sports factors, as social demands and also study demands, because young-athletes have dual-role duties (Villarreal-Angeles et al., 2021). This situation, at the same time, could generate psychological distress as anxiety, apparently, more than adult-athletes (Contessoto et al., 2020; Villarreal-Angeles et al., 2021). By other hand, sports factor, such as training load and long-hour travel, also can affect sleep quality in young athletes. These factors can produce cognitive arousal, physiological arousal and circadian rhythm disruption, altering sleep quality and amount, mainly before sports competitions (Walsh et al., 2020).

Few studies examined the relationship between sleep quality and HRQOL in young athletes (Crane & Temple, 2015; Potter et al., 2020). There are no studies during competition. In a recent study, Potter et al. (2020) reported that poor sleep quality was associated with a lower HRQOL in young athletes during the evaluation at the beginning of a sports season. This study did not analyze a critical period like competition. Therefore, the purpose of the present study was to analyze the association between sleep quality and HRQOL in young athletes in a sports competition. Our hypothesis is that there is a direct association between sleep quality and HRQOL. The information provided by this study will contribute to the generation of proposals and recommendations for young athletes in terms of the influence that sleep quality has in the different dimensions on the HRQOL.

Methods

This study is part of a project investigating the sleep quality, pain and HRQOL of young athletes who participated in a competition. A manuscript has already been published on the relation between sleep quality and pain in the same population (Bascour-Sandoval, Norambuena-Noches, et al., 2021). This study was approved by the Ethics Committee of the Universidad Austral de Chile (N°2411-16) following the guidelines of the Declaration of Helsinki for research involving humans.

Procedures

A cross-sectional study design was used to examine the link between sleep quality and HRQOL in a group of young athletes who participated in a competition in judo, track and field, cycling, basketball and swimming during the second semester of 2018. Using non-probability sampling, all the athletes who represented the Los Ríos Region of Chile (n = 93) were invited to participate in this study. The data were collected the day prior to the beginning of the competition, during the rest hours. It is worth noting that they were attended, in case of any doubt, by physiotherapists previously trained in the administration of questionnaires.

Participants

The inclusion criteria were: aged between 13 and 20 years old, competing regionally, agreeing to participate in this study, and in the case of the minors, the informed consent of the parents. The exclusion criteria were being diagnosed with a pathology or injury that would prevent participation in a sporting event or a psychiatric disorder. Seventy-seven young athletes fulfilled the inclusion criteria. Six athletes were excluded for not completing all the required data, which is why finally the data of 71 participants were analyzed (39 men; Figure 1). The mean age was 16.9 (SD = 1.2) years, with 6.5 (SD = 3.2) years in sports and 10.8 (SD = 3.3) hours of weekly training. The collected data were anonymized and the responses were stored in a safe server with a unique number so no participant could be personally identified from the data set.

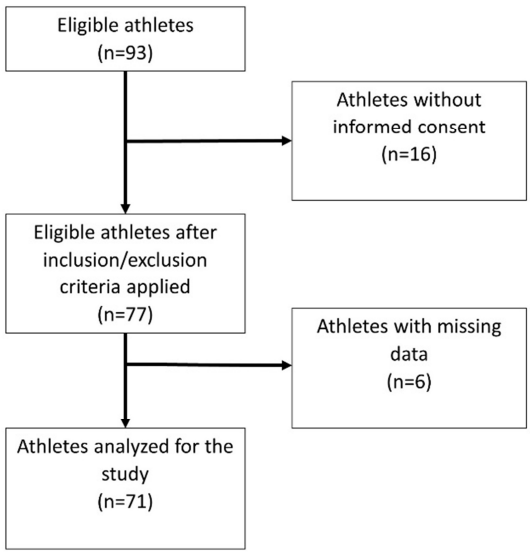

Figure 1. Flow chart of the inclusion of the athletes

Measurements

The athletes completed a self-report questionnaire specially designed for this study, where they gave sociodemographic information (i.e., age and sex) and sport information (i.e., years of practice, hours and number of weekly training sessions). In addition, they answered two self-report ques-

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tionnaires on sleep quality and HRQOL.

Sleep quality was evaluated through the Pittsburgh Sleep Quality Index (PSQI), a self-administered instrument previously validated in Spanish (Escobar-Córdoba & Eslava-Schmalbach, 2005); widely used, practical and brief, it measures sleep quality in the last month. It consists of 24 questions, of which 19 are used to obtain the overall sleep quality score, which is expressed on a scale of 0 to 21 points. A higher score is related to a worse sleep quality (Buysse et al., 1989). From the overall score, individuals assessed can be classified as: "Good sleep quality" (≤ 5 on the PSQI) or "Poor sleep quality" (> 5 on the PSQI), with a sensitivity of 89.6% and a specificity of 86.5%, according to Buysse et al. (1989). The Spanish version of the PSQI has demonstrated adequate reliability, with Cronbach's alpha values that vary between .67 and .72 in healthy young people (de la Vega et al., 2015; Royuela-Rico & Macías-Fernández, 1997).

HRQOL was evaluated using the Spanish version of the SF36 short-form health survey v2 (SF36v2; Dois Castellón et al., 2007). The SF36v2 presents a profile of the state of health, being applicable to both healthy people and those with pathologies over 14 years of age. The SF36v2 evaluates eight health-related domains (Dois Castellón et al., 2007): I) physical functioning (10 items); II) physical role (4 items); III) bodily pain (2 items); IV) general health (5 items); V) vitality (4 items); VI) social functioning (2 items); VII) emotional role (3 items) and VIII) mental health (5 items). The SF36v2 also includes a question about the evolution of the general state of health compared to the previous year, but this item is not used for the calculation of the other eight domains. For each domain, the items are encoded, totaled and transformed to a scale with a range of 0, the worst state of health, to 100, the best state of health.

Statistical analysis

A descriptive analysis was done of the main study variables using statistics of central tendency (median) and dispersion (interquartile range) for the quantitative variables. For the qualitative variables, absolute and relative frequencies were used. To verify the normal distribution of the variables, the Shapiro-Wilk test was used. Due to the non-fulfillment of the normality criteria for the variables of sleep quality and HRQOL, nonparametric tests were used. To analyze the relation between sleep quality, sex and athletic discipline, the Chi-squared test was used. To evaluate the differences between age, years in sports, weekly training hours and the scores on the eight domains of the SF36v2 according to the categories of sleep quality, the Mann-Whitney test was used, determining the effect size through the biserial correlation coefficient (Cureton, 1956). To describe the magnitude of the effect size, the following values were considered: .1: small; .3: medium; .5: large (Coolican, 2013). To evaluate the correlation between the sleep quality score and the eight quality of life domains, Spearman's Rho (r_s) test was used. For these correlations the following values were considered: .1 weak; .3 moderate and .5 strong (Cohen, 2013). A value of $p < .05$ was considered statistically significant. The data analysis was done using the SPSS 22 statistics software.

The sample size was calculated using G*Power 3.1.9.7. The Mann-Whitney (Wilcoxon) two-sample t test from the family of t tests was considered, with a large effect size (d = 0.8), statistical significance of .05 and power of 0.8. Thus, a minimum sample size of 54 individuals (27 per group) was obtained.

Results

A group of 71 young athletes answered both questionnaires and were included in this study. The median of the PSQI score was 4 [IQR 3-6] for all the participants, 3 [IQR 3-4] for the good sleep quality group and 6.5 [IQR 6-8] for the poor sleep quality group. The age and the proportion of women was greater in the poor sleep quality group than in the good sleep quality group. There was no difference in the sleep quality according to the sport discipline (Table 1).

Table 1. Characteristics of the young athletes according to sleep quality.

	Good sleep quality $n = 39$	Poor sleep quality $n = 32$	p-Value	Total $N = 71$
Age (years)[a]	17.0 [16.0-17.0]	18 [16.0-18.0]	.019*	17.0 [16.0-18.0]
Years in sports[a]	5.0 [4.0-9.0]	6.0 [4.5-10.0]	.703	6.0 [4.3-10.0]
Weekly training hours[a]	10.5 [8.0-12.0]	12.0 [9.5-12.0]	.674	12.0 [8.3-12.0]
Sex[b]			.028*	
Female	13 (40.6)	19 (59.4)		32 (45.1)
Male	26 (66.7)	13 (33.3)		39 (54.9)
Discipline[b]			.142	
Judo	6 (60.0)	4 (40.0)		10 (14.1)
Track and field	10 (41.7)	14 (58.3)		24 (33.8)
Cycling	3 (75.0)	1 (25.0)		4 (5.6)
Basketball	8 (88.9)	1 (11.1)		9 (12.7)
Swimming	12 (50.0)	12 (50.0)		24 (33.8)

[a] Mann-Whitney U test: Median [IQR]; [b] Chi-squared: number (percentage).
* Significant differences ($p < .05$).

The participants with good sleep quality got better scores in the dimensions of bodily pain, general health, vitality, social functioning, emotional role and mental health from the SF36v2 than those classified with poor sleep quality ($p < .05$; see details in Table 2).

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Table 2.
Comparison of the domains of health-related quality of life according to the category of sleep quality of the young athletes.

	Good sleep quality $n = 39$	Poor sleep quality $n = 32$	*p*-value	Effect Size Biserial correlation coefficient [CI]	Total $N = 71$
SF36v2[a]					
Physical Health					
Physical functioning	100.0 [90.0-100.0]	100.0 [90.0-100.0]	.749	-.041 [-.303 a .227]	100.0 [90.0-100.0]
Physical role	50.0 [0.0-75.0]	25.0 [0.0-87.5]	.578	.074 [-.195 a .333]	25.0 [0.0-75.0]
Bodily pain	72.0 [51.0-84.0]	51.0 [41.5-73.0]	.014*	.340 [.080-.557]	62.0 [51.0-84.0]
General health	85.0 [72.0-97.0]	80.0 [57.0-88.5]	.019*	.324 [.064-.542]	82.0 [62.0-95.0]
Mental Health					
Vitality	70.0 [50.0-85.0]	50.0 [30.0-60.0]	<.001*	0587 [.381-.738]	60.0 [45.0-70.0]
Social functioning	87.5 [75.0-100.0]	62.5 [50.0-81.3]	<.001*	.523 [.297-.693]	75.0 [62.5-100.0]
Emotional role	66.7 [33.3-100.0]	0.0 [0.0-50.0]	.002*	.421 .171-.621]	33.3 [0.0-100.0]
Mental health	80.0 [68.0-88.0]	72.0 [48.0-80.0]	<.001*	.482 [.248-.662]	78 [64.0-84.0]

[a] Mann-Whitney U test: Median [IQR]; CI = 95% confidence interval. * Significant differences ($p < .05$).

The dimensions of bodily pain, general health, vitality, social functioning, emotional role and mental health were negatively and significantly correlated with sleep quality (PSQI; see details in Table 3).

Table 3.
Correlation of sleep quality (PSQI) with health-related quality of life (SF36v2 score) of the young athletes.

SF36v2 items	r_s	95% CI		*p*-value
		LL	UL	
Physical Health				
Physical functioning	.021	-.240	.256	.867
Physical role	-.135	-.358	.076	.268
Bodily pain	-.346	-.544	-.116	.004*
General health	-.303	-.513	-.058	.011*
Mental Health				
Vitality	-.483	-.648	-.293	<.001*
Social functioning	-.463	-.648	-.234	<.001*
Emotional role	-.437	-.627	-.219	<.001*
Mental health	-.413	-.580	-.196	<.001*

r_s = Spearman's rho; 95% CI = 95% confidence interval; LL = Lower limit; UL = Upper limit; *Significant relation ($p < .05$).

Discussion

The aim of this study was to analyze the link between sleep quality and HRQOL in young athletes during a competition. Our findings indicate that poor sleep quality is associated with lower levels of HRQOL in this population, particularly in the domains of bodily pain, general health, vitality, social functioning, emotional role and mental health, but not in the domains of physical functioning and physical role. Although each of these components accounts for a specific aspect of quality of life, they are inter-related and thus we can analyze two large components – mental health and physical health – to gain a more comprehension view of quality of life. To the best of our knowledge, this is the first study to analyze this association in young athletes during a competition.

Our results highlight that poor sleep quality is associated with a decrease in all the mental health-related domains of HRQOL (i.e., vitality, social functioning, emotional role and mental health). Therefore, this condition with the mental health components could be due to poor sleep quality producing drowsiness during the day (Benjamin et al., 2020). It has been related to depression (Stheneur et al., 2019), reduced motivation (Ritland et al., 2019), and fatigue, affecting the emotional and psychological sphere in general (Kahn et al., 2013). This may lead to dysfunctions in relations with family or peers. All this carries with it a reduction in mental health. This is in line with the study by Potter et al. (2020), where the relation between quality of life and sleep quality was assessed in young athletes at the beginning of the season, finding differences among the participants with good and poor sleep quality, with the latter presenting higher levels of anxiety, depression and fatigue. Lam et al. (2013) compared the quality of life in teenage athletes and generally healthy adolescents (i.e., non-athletes) between 14 and 18 years, finding a better quality of life in the group of athletes, especially in the domains of emotional health. These findings suggest that young athletes experience greater emotional, mental and social well-being due to the benefits of regular physical activity compared to their non-athlete peers (Lam et al., 2013; Marques et al., 2017; Snyder et al., 2010). Our results could indicate that the benefits in the mental health components of the HRQOL, associated with doing sports, could be lost due to an alteration in sleep quality, but this should be clarified in future studies.

Bodily pain and general health (i.e., physical health components) were associated with sleep quality, but not bodily function and physical role. Poor sleep quality has been linked to a greater perception of pain, both in athletes (Bascour-Sandoval, Norambuena-Noches, et al., 2021) and individuals with musculoskeletal disorders (Alsaadi et al., 2014; Bascour-Sandoval, Belmar-Arriagada, et al., 2021), which, added to the decrease in mental health, would explain the reduced perception of overall health within the physical components. Potter et al. (2020) found that poor sleep quality was associated with higher levels of interference with pain and pain intensity, but not in the domain of physical function/mobility, on the quality of life questionnaire, "Patient-Reported Outcome Measurement Information System" (PROMIS). This is consistent with our results. The lack of

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association between sleep quality and bodily function and physical role could be because most of the questions on the two questionnaires (PROMIS and SF36v2) are related to daily low-load physical activities such as walking or climbing stairs and not sports activities. This could explain the ceiling effect in the score in this dimension. This is a point that must be considered, since it is necessary to establish normative values and specific assessment instruments that can determine quality of life in athletes (Huffman et al., 2008).

Sport discipline could influence the perception and sleep habits, specifically due to the game hours of some sports or morning/evening training hours. It has been shown in sports such as judo, that night training causes increased sleep latency and awakenings (Fullagar et al., 2015). Some authors have shown that team sports tend to have more hours of sleep than individual sports, while others haven't found significant differences (Lastella et al., 2015). However, we did not find no difference in the sleep quality according to the sport discipline. The potential effect of different sports disciplines on sleep quality, and whether this affects the relationship between sleep quality and HRQOL, should be addressed by future research.

The interpretation of our results must allow for some limitations. The first is the cross-sectional nature of our study design. This provides a snapshot of the link between the variables, but it prevents us from drawing a conclusion on the causal directionality of our findings. In addition, HRQOL is a multidimensional concept, so confounding variables could be modifying this association, making further research necessary for clarification.

Conclusion

To sum up, our results suggest poor sleep quality is associated with a worse perception of HRQOL in young athletes during a competition, especially in domains related to their mental health. This information is relevant to the understanding of the relevance of sleep quality in the perception of HRQOL both for athletes and the technical and health teams that work with them.

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