



SLEEP DISTURBANCES AND PERCEIVED SLEEP QUALITY IN CROATIAN FOOTBALL PLAYERS: AN EXPLORATORY PILOT CROSS-SECTIONAL STUDY

POREMEĆAJI SNA I PERCEPCIJA KVALITETE SNA KOD HRVATSKIH NOGOMETAŠA: EKSPOLORATORNA PILOT PRESJEČNA STUDIJA

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Cite as: Lončarić Kelečić I, Gosić E, Schuster S. Sleep disturbances and perceived sleep quality in Croatian football players: An exploratory pilot cross-sectional study. *Croat Sports Med J.* 2026;41(1):73-81.

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DOI: 10.69589/hsv.41.1.8

ABSTRACT

Sleep quality (SQ) is essential for recovery in athletes, yet the patterns and determinants of specific sleep disturbances (SDs) remain poorly characterised in the football context. This exploratory pilot study aimed to characterise SD symptoms and overall SQ in Croatian male and female football players, and to identify predictors of good SQ.

A cross-sectional online survey conducted between January and March 2025 collected demographic data, anthropometric measures (BMI), indicators of training and leisure activity, daily rest duration (excluding sleep), and selected items from the Pittsburgh Sleep Quality Index (PSQI). An SD score was calculated as the sum of nine PSQI-derived disturbance items, while overall SQ was analysed separately. Group differences and associations were examined using nonparametric tests. Internal consistency was assessed using McDonald's omega and Cronbach's alpha, and predictors of good SQ were identified using binomial logistic regression.

Of 113 respondents, 94 football players (33 males, 61 females; age 23.1±5.6 years; BMI 22.46±2.22 kg/m²) were analysed. The SD score showed acceptable internal consistency ($\omega=0.722$; $\alpha=0.690$) and was significantly associated with overall SQ ($\rho=0.491$, $p<0.001$). Higher SD score was independently associated with lower odds of good SQ (OR=0.516, 95% CI 0.401–0.663, $p<0.001$), whereas age (OR=1.345, 95% CI 1.110–1.630, $p=0.003$) and male

SAŽETAK

Kvaliteta sna (KS) ključna je za oporavak sportaša, no obrasci i odrednice specifičnih poremećaja sna (PS) u nogometnom kontekstu još uvijek nisu dovoljno istraženi. Cilj ovog eksploratornog pilot-istraživanja bio je opisati simptome poremećaja sna i ukupnu kvalitetu sna kod hrvatskih nogometašica i nogometaša te identificirati prediktore dobre kvalitete sna.

U presječnom online istraživanju provedenom između siječnja i ožujka 2025. prikupljeni su demografski podaci, antropometrijske mjere (ITM), pokazatelji trenažnog i slobodnog vremena, trajanje dnevnog odmora (bez sna) te odabrane čestice iz Pittsburgh indeksa kvalitete sna (PSQI). Rezultat poremećaja sna (PS skor) izračunat je kao zbroj devet čestica povezanih s poremećajima sna preuzetih iz PSQI-a, dok je ukupna kvaliteta sna analizirana zasebno. Razlike među skupinama i povezanosti ispitane su neparametrijskim testovima. Unutarnja konzistencija procijenjena je McDonaldovom omegom i Cronbachovim alfa koeficijentom, a prediktori dobre kvalitete sna utvrđeni su binarnom logističkom regresijom.

Od 113 ispitanika, analizirano je 94 nogometaša (33 muškarca, 61 žena; dob 23,1±5,6 godina; ITM 22,46±2,22 kg/m²). PS skor pokazao je prihvatljivu unutarnju konzistenciju ($\omega=0,722$; $\alpha=0,690$) te je bio značajno povezan s ukupnom kvalitetom sna ($\rho=0,491$; $p<0,001$). Viši PS skor bio je neovisno povezan s nižim izgledima za dobru kvalitetu sna (OR=0,516; 95% CI 0,401–0,663; $p<0,001$),

sex (OR=15.059, 95% CI 2.118–107.071, $p=0.007$) were associated with higher odds of good SQ.

While these early findings point to a meaningful association between SDs and SQ in football players, the pilot nature of the research and reliance on self-reported cross-sectional data warrant validation in larger, confirmatory studies.

Keywords: sleep quality, sleep disturbances, football, athletes, logistic regression

dok su viša dob (OR=1,345; 95% CI 1,110–1,630; $p=0,003$) i muški spol (OR=15,059; 95% CI 2,118–107,071; $p=0,007$) bili povezani s većim izgledima za dobru kvalitetu sna.

Iako ovi preliminarni nalazi upućuju na značajnu povezanost između poremećaja sna i kvalitete sna kod nogometaša, pilot-karakter istraživanja i oslanjanje na samoprocjenske presječne podatke zahtijevaju potvrdu u većim, konfirmatornim studijama.

Ključne riječi: kvaliteta sna, poremećaji sna, nogomet, sportaši, logistička regresija

INTRODUCTION

Sleep has a substantial potential for athlete recovery. In team sports such as football, it is often disrupted by late training sessions, matches, travel, and psychological stress. Among football players, poor sleep quality has been linked to adverse health and performance outcomes, highlighting the importance of monitoring sleep in the sporting environment.¹⁷ In addition to its impact on performance, sleep is also crucial in the context of injury. Research suggests that sleep characteristics are associated with injury occurrence during the season, making sleep a potentially modifiable risk factor.³ It is particularly emphasised that sleep disturbances are common and can be associated with workload, recovery, and injuries, yet there remains a lack of practical work that measures sleep disturbances through specific symptoms and links them to a general subjective assessment of sleep quality.⁶

Recent work has moved away from judging footballers' sleep simply by how many hours they get, and instead looks at their habits and the real-world challenges they face, such as evening training or games, travel, competitive pressure, and the way each athlete differs from one another. It is particularly highlighted that research, especially on female players, remains relatively scarce, and that substantial variations in sleep quality exist between players and across the season, making it difficult to draw universal conclusions.¹³ Data from elite soccer environments further confirm that sleep problems are present in top clubs and vary by sex and age category. A cross-sectional study in an elite club found that sleep-related behaviours and habits are relevant and potentially modifiable targets for intervention, which is important information for coaching and medical staff.²⁰

In addition, recent research on student-athletes suggests that subjective sleep assessment is not an isolated phenomenon but overlaps with aspects of mental health and sports functioning, and that there may be sex differences in the associations between sleep and psychological outcomes.⁵ In this regard, assessing sleep disturbance symptoms, in addition to a general assessment of sleep quality, may

be a practical way to better understand athletes' actual difficulties and identify groups that could benefit most from targeted interventions.

Because Croatian data are scarce and there is little practical evidence on specific sleep symptoms in football players, an exploratory approach was adopted to chart how common different sleep problems are, to identify early indicators of how players perceive their sleep quality, and to guide the design of future, more targeted and intervention-focused studies in this group. Therefore, the aim of this study was, through an exploratory approach, to map the most common sleep disturbances among male and female football players and to examine which sociodemographic, anthropometric, and training indicators predict a high perceived sleep quality. In accordance with the objective, three research questions (RQs) were posed.

RQ1: Which sleep problems appear most often and are most pronounced in football players, and how is perceived sleep quality spread across the sample?

RQ2: How strongly are these sleep problems related to how players rate the quality of their sleep?

RQ3: To what extent do basic characteristics of the players (such as age and body build) and their training habits help predict whether they report good sleep quality?

METHODS

Study design, time frame, and setting

This was an observational, cross-sectional study with an exploratory design. Data were collected between January and March 2025, a period that likely reflects a lower competitive load for many players. The study was carried out in an open online setting, with the survey made publicly accessible and shared through various social media channels. Recruitment via social networks was chosen to increase the study's reach and to simplify the inclusion of respondents in this exploratory design, in line with earlier methodological suggestions and prior experience with web-based recruitment.^{1,10} Participants completed the questionnaire anonymously and independently, outside of controlled conditions.

Ethical considerations

This study was conducted as an anonymous minimal-risk online survey and did not collect any personal identifiers. Participation was voluntary, and electronic informed consent was obtained prior to completing the survey. Data processing and storage were conducted in accordance with GDPR principles (Regulation (EU) 2016/679)¹⁸, including data minimisation and restricted access to the research team. The study procedures adhered to the principles of the Declaration of Helsinki.²⁵ In line with COPE guidance on publication ethics and ethical oversight in low-risk research⁷, participant protection measures and data management procedures are transparently reported. The study was conducted in accordance with the relevant national ethical framework in Croatia, and did not include patients, interventions, or healthcare settings.

Participants

The research included active male and female football players residing in Croatia. Participants were recruited through convenience sampling via a publicly available online survey distributed on social media during the previously noted data collection period. Inclusion criteria were: (1) active football player, (2) age ≥ 18 years, (3) understanding of the Croatian language, and (4) completing the questionnaire with electronic consent. Exclusion criteria included: (1) age < 18 years, (2) incomplete questionnaires, and (3) insufficient data to calculate key analysis variables. A total of 113 responses were collected. Following data screening and the application of exclusion criteria, the final analytical sample was reduced (see Results for details).

Measurement instruments

The study used an online questionnaire consisting of three sections: (1) sociodemographic and anthropometric data, (2) training/individual indicators, and (3) sleep assessment.

The first section included questions about sex (female/male) and age (years), as well as height (cm) and weight (kg), from which the body mass index (BMI) was calculated. The second section included questions about sports engagement and daily regimen, including time dedicated to recreational training (leisure training hours) and an assessment of daily rest, excluding sleep.

The third section focuses on sleep assessment. In line with the exploratory design and public distribution of the survey, the full Pittsburgh Sleep Quality Index (PSQI) was not used. Instead, we included only selected items on subjective sleep quality and sleep disturbances to reduce respondent burden and improve feasibility in the online setting. The PSQI is a widely used and validated instrument for assessing sleep quality and related difficulties⁴. The literature supports the use of shortened or selected versions

of the PSQI in research when the goal is a pragmatic assessment of key aspects of sleep.^{9,19} Subjective sleep assessment scales are widely used in athlete research due to their simplicity and speed of application. The PSQI is among the most commonly used instruments in this field.²²

Selected PSQI items were translated into Croatian using forward translation by a native Croatian speaker fluent in English. The translation was then checked through a team approach (expert/team review), in which the researchers compared it with the original and agreed on the final version to ensure semantic clarity and content consistency; the face validity of the translated items by reviewing their clarity and understandability before the survey^{2,16,24} was conducted. A composite sleep disturbance score (SDS) was computed by summing responses across nine sleep disturbance items (e.g., difficulty falling asleep, sleep interruptions, early awakenings), each rated 0–3; total range 0–27. Although based on PSQI sleep disturbance items, SDS was analysed as a symptom-level composite score for exploratory purposes. Summed composite scores based on multiple Likert-type items are commonly used to quantify underlying constructs in applied research, and their internal consistency was examined using reliability indices of Cronbach's α and McDonald's ω .^{11,21,23}

Perceived sleep quality was assessed with a single item examining a general subjective assessment of sleep quality, with responses on an ordinal scale from very good (0) to very poor (3).

Statistical analysis

Statistical data processing was performed in the Jeffreys's Amazing Statistics Program (JASP) software (version 0.95.4, JASP Team, University of Amsterdam). The analyzes were planned in accordance with the research objectives: (1) describe the pattern and patterns of sleep disturbances, (2) check the internal consistency of the derived sleep disturbance index (SDS), (3) examine sex differences in sleep indicators, (4) examine the association of SDS with perceived sleep quality and, (5) determine preliminary predictors of good perceived sleep quality.

Before the inferential analyses, the distribution of the results was checked. The normality of the distribution of key continuous/ordinal variables was assessed with the Shapiro–Wilk test. Given the deviations from normality and the ordinal nature of some variables, nonparametric statistical procedures were used in further analyses.

Categorical variables are presented as frequencies and percentages. Continuous variables are presented using median and interquartile range (IQR), in addition to minimum and maximum values. The distributions of responses to individual sleep disturbance items are presented descriptively (frequencies by category) to identify the most frequently reported sleep problems.

The internal reliability of the SDS was assessed using Cronbach's α and McDonald's ω to evaluate the extent to

which the selected items cohere in measuring the same construct (sleep disturbance) in this sample.

In line with the research objective, sex differences were analysed. Differences in SDS and other relevant indicators between male and female football players were examined using the Mann–Whitney U test, and the associations between variables of interest were examined using Spearman’s rank correlation coefficient (ρ).

To identify predictors of good perceived sleep quality, a binary logistic regression was performed. The outcome variable of sleep quality was coded as “good” (1) and “poor” (0) sleep quality, based on a predefined criterion (very + fairly good vs very + fairly bad). Based on theoretical foundations and previous studies, the SDS and selected sociodemographic, anthropometric, and training indicators were included in the model. Results are presented as odds ratios (ORs) with 95% confidence intervals (CIs) and p-values.

The statistical significance threshold was set at $p < 0.05$, and effect sizes were reported where relevant. Considering the exploratory nature of the study, the findings are interpreted concerning the direction and magnitude of the effects, as preliminary results that may inform future confirmatory research.

RESULTS

Sample characteristics

As shown in Table 1, 94 football players were included in the final analysis, comprising 33 males (35.1%) and 61 females (64.9%). The median age of the overall sample was 21 years (IQR = 8; 18–40). Median BMI was 22.57 kg/m² (IQR = 3.03; 17.92–28.41). Regarding training exposure

over the past 30 days, participants reported a median of 4 training days (IQR = 2.75; 0–26) and 1.5 training hours/day (IQR = 1.0; 0–8). Leisure-time training outside the primary training process was less frequent (2 days; IQR = 3; 0–24), with a median of 1 hour/day (IQR = 1; 0–3). Median daily rest, excluding sleep, was 6 hours (IQR = 4.75; 1–12). When stratified by sex, male participants were older (24 years; IQR = 12; 19–40) than female participants (20 years; IQR = 5; 18–33), and presented higher values for height and body mass. Males also reported a higher number of training days over the past 30 days (5 days; IQR = 2.50; 0–26) than females (3 days; IQR = 2.00; 0–6).

Sleep disturbances and perceived sleep quality

Table 2 summarises the distribution of sleep disturbance symptoms, the composite SDS, and perceived overall sleep quality. The most commonly reported disturbances were difficulty falling asleep within 30 minutes (any occurrence ≥ 1 : 76.6%) and waking up during the night or early morning (71.3%). More than half of the participants reported getting up to use the bathroom at least occasionally (51.1%). Respiratory-related symptoms were less frequent, including “cannot breathe comfortably” (20.2%) and “coughing or loud snoring” (18.1%). The median SDS in the overall sample was 5 (IQR = 5; range = 0–15), and most participants rated their sleep quality as fairly good (45.7%) or very good (35.1%), while 19.1% reported poorer sleep quality (fairly bad 17.0%; very bad 2.1%).

Unidimensional reliability of the SDS (PSQI-derived items) was acceptable ($\omega = 0.722$, SE = 0.043, 95% CI [0.637, 0.806]; $\alpha = 0.690$, SE = 0.039, 95% CI [0.614, 0.767]). The average inter-item correlation was 0.204. Item-rest correlations ranged from 0.207 (sleep difficulty due

Table 1. Sample characteristics of the study sample (N = 94).
Tablica 1. Obilježja uzorka ispitanika (N = 94).

| Variable | Total (N=94) | Male (n=33) | Female (n=61) |
|--|----------------------------|----------------------------|----------------------------|
| Age (years) | 21 (8) [18–40] | 24 (12) [19–40] | 20 (5) [18–33] |
| Height (cm) | 172 (14.75) [157–199] | 183 (10) [172–199] | 167 (9) [157–181] |
| Weight (kg) | 65 (18.75) [47–100] | 81 (10) [65–100] | 60 (9) [47–74] |
| BMI (kg/m ²) | 22.57 (3.03) [17.92–28.41] | 23.91 (1.98) [20.83–28.41] | 21.88 (2.76) [17.92–27.34] |
| Training days (past 30 days), n | 4 (2.75) [0–26] | 5 (2.50) [0–26] | 3 (2.00) [0–6] |
| Training hours/day (past 30 days), h | 1.5 (1.0) [0–8] | 2.0 (0.5) [0–4] | 1.5 (1.0) [0–8] |
| Leisure training days (past 30 days), n | 2 (3) [0–24] | 2 (2) [0–17] | 2 (3) [0–24] |
| Leisure training hours/day (past 30 days), h | 1 (1) [0–3] | 1 (1) [0–2] | 1 (1) [0–3] |
| Daily rest excluding sleep (past 30 days), h | 6 (4.75) [1–12] | 6 (4.0) [1–11] | 5 (4.0) [1–12] |

Note: Continuous variables are presented as median (IQR) [min–max] due to non-normal distribution. BMI = body mass index; IQR = interquartile range.

to breathing discomfort; 95% CI [0.005, 0.393]) to 0.633 (sleep difficulty due to waking up during the night or early morning; 95% CI [0.494, 0.741]), supporting adequate item contribution to the total score.

Sex differences in sleep outcomes

Table 3 presents sex differences in key sleep outcomes. Female players showed a slightly higher SDS than males (median 5 [IQR=6] vs. 4 [IQR=4]); however, this difference

was statistically insignificant ($U=825.0$, $p=0.149$; $r_{rb}=0.180$). Overall sleep quality was similar between sexes (both groups median 1 [IQR=1]), with no significant difference observed ($U=958.0$, $p=0.681$; $r_{rb}=0.048$). Among individual symptoms, a significant sex difference emerged only for waking up during the night/early morning, which was more frequently reported by females (median 1 [IQR=1] [0–3]) than males (median 1 [IQR=2] [0–2]) ($U=736.5$, $p=0.026$; $r_{rb}=0.268$).

Table 2. Sleep disturbances and perceived sleep quality in the study sample (N = 94).

Tablica 2. Poremećaji sna i percipirana kvaliteta sna u uzorku ispitanika (N = 94).

| Outcome, | 0 n (%) | 1 n (%) | 2 n (%) | 3 n (%) | Any occurrence (≥1), n (%) |
|---|---------------|-----------|-----------|-----------|----------------------------|
| Sleep disturbance symptoms (past month) | | | | | |
| Difficulty falling asleep within 30 min | 22 (23.4) | 25 (26.6) | 29 (30.9) | 18 (19.1) | 72 (76.6) |
| Waking up in the night / early morning | 27 (28.7) | 30 (31.9) | 29 (30.9) | 8 (8.5) | 67 (71.3) |
| Getting up to use the bathroom | 46 (48.9) | 20 (21.3) | 21 (22.3) | 7 (7.4) | 48 (51.1) |
| Cannot breathe comfortably | 75 (79.8) | 10 (10.6) | 7 (7.4) | 2 (2.1) | 19 (20.2) |
| Cough or snore loudly | 77 (81.9) | 15 (16.0) | 2 (2.1) | 0 (0.0) | 17 (18.1) |
| Feeling too cold | 71 (75.5) | 17 (18.1) | 6 (6.4) | 0 (0.0) | 23 (24.5) |
| Feeling too hot | 65 (69.1) | 21 (22.3) | 7 (7.4) | 1 (1.1) | 29 (30.9) |
| Having bad dreams | 64 (68.1) | 20 (21.3) | 10 (10.6) | 0 (0.0) | 30 (31.9) |
| Pain interfering with sleep | 66 (70.2) | 23 (24.5) | 4 (4.3) | 1 (1.1) | 28 (29.8) |
| Sleep disturbance score (SDS) | 5 (5) [0–15]* | | | | |
| Perceived sleep quality (past month) | | | | | |
| Very good | 33 (35.1) | | | | |
| Fairly good | 43 (45.7) | | | | |
| Fairly bad | 16 (17.0) | | | | |
| Very bad | 2 (2.1) | | | | |

Note: Values are presented as n (%) unless otherwise stated. Item coding: 0 = not during the past month; 1 = less than once a week; 2 = once or twice a week; 3 = three or more times a week. *SDS is presented as median (IQR) [min–max].

Table 3. Sex differences in sleep outcomes.

Tablica 3. Spolne razlike u pokazateljima sna.

| Outcome | Male (n = 33) | Female (n = 61) | U | p | Effect size (r_{rb}) |
|--|---------------|-----------------|-------|-------|--------------------------|
| Sleep Disturbance Score (SDS) | 4 (4) [0–15] | 5 (6) [0–14] | 825.0 | 0.149 | 0.180 |
| Overall sleep quality (0–3) | 1 (1) [0–2] | 1 (1) [0–3] | 958.0 | 0.681 | 0.048 |
| Waking up during the night / early morning (0–3) | 1 (2) [0–2] | 1 (1) [0–3] | 736.5 | 0.026 | 0.268 |

Note: Values are presented as median (IQR) [min–max]. Sex differences were tested using the Mann–Whitney U test; effect size is reported as rank-biserial correlation (r_{rb}). Overall sleep quality was coded 0 (very good)–3 (very bad), and the symptom item was coded 0 (not during the past month)–3 (≥3 times/week) (higher scores indicate worse/more frequent disturbance). Only symptom items with $p < 0.05$ are shown; SDS and overall sleep quality are reported regardless of significance.

Table 4. Correlations between sleep outcomes and training/rest indicators (N = 94).

Tablica 4. Korelacije između pokazatelja sna i pokazatelja treninga/odmora (N = 94).

| Pair of variables | ρ | 95% CI | p |
|---|--------|------------------|---------|
| Sleep Disturbance Score (SDS) – Overall sleep quality | 0.491 | 0.320 to 0.631 | < 0.001 |
| Leisure training hours/day – Overall sleep quality | -0.222 | -0.406 to -0.020 | 0.032 |
| Training days (past 30 days) – Daily rest hours excluding sleep | 0.285 | 0.088 to 0.461 | 0.005 |

Note: Spearman's rank correlation (ρ) was used. Overall sleep quality was coded from 0 (very good) to 3 (very bad) (higher scores indicate poorer sleep quality). Training and rest indicators refer to the past 30 days. Only theoretically relevant and statistically significant correlations are reported.

Table 5. Logistic regression predicting good perceived sleep quality (N = 94).

Tablica 5. Logistička regresija za predviđanje dobre percipirane kvalitete sna (N = 94).

| Predictor | OR | 95% CI for OR | p |
|---|--------|------------------|---------|
| Sleep Disturbance Score (SDS; PSQI-derived) | 0.516 | 0.401 to 0.663 | < 0.001 |
| Age (years) | 1.345 | 1.110 to 1.630 | 0.003 |
| Sex (male vs female) | 15.059 | 2.118 to 107.071 | 0.007 |
| Body mass index (kg/m ²) | 0.869 | 0.554 to 1.363 | 0.542 |
| Average leisure training hours/day (past 30 days) | 2.593 | 0.703 to 9.573 | 0.153 |

Model fit: $\Delta\chi^2 = 47.364$, $p < 0.001$; Nagelkerke $R^2 = 0.635$.

Note: Binomial logistic regression was used. Results are reported as odds ratios (OR) with 95% confidence intervals (CI). "Good sleep quality" was coded as class 1. Higher SDS indicates greater sleep disturbance burden.

Associations between sleep outcomes and selected training/rest indicators

The associations between sleep outcomes and selected training/rest indicators are presented in Table 4. SDS showed a moderate positive association with overall sleep quality ($\rho = 0.491$, 95% CI 0.320 to 0.631; $p < 0.001$), indicating that a higher sleep disturbance was associated with poorer perceived sleep quality. A small negative association was observed between leisure training hours per day and overall sleep quality ($\rho = -0.222$, 95% CI -0.406 to -0.020; $p = 0.032$). In addition, training frequency (training days over the past 30 days) was positively correlated with daily non-sleep rest hours (excluding sleep; $\rho = 0.285$, 95% CI 0.088 to 0.461; $p = 0.005$), suggesting that participants with more training days also reported more non-sleep rest.

With regard to these associations, a binomial logistic regression model was subsequently applied to examine which sociodemographic and training-related indicators independently predicted good perceived sleep quality.

Predictors of good perceived sleep quality

In the binomial logistic regression model predicting good perceived sleep quality (Table 5), higher sleep disturbance burden was associated with lower odds of reporting good sleep quality (SDS: OR = 0.516, 95% CI

0.401 to 0.663; $p < 0.001$). Age was positively associated with good sleep quality (OR = 1.345, 95% CI 1.110 to 1.630; $p = 0.003$). Male sex was also associated with higher odds of good sleep quality compared with female sex (OR = 15.059, 95% CI 2.118 to 107.071; $p = 0.007$). BMI and average leisure training hours per day were not statistically significant predictors ($p > .05$). Overall, the model showed a substantial fit ($\Delta\chi^2 = 47.364$, $p < 0.001$; Nagelkerke $R^2 = 0.635$).

Figure 1 illustrates the predicted probability of good perceived sleep quality across SDS and age, showing a marked decline in probability with increasing SDS and a gradual increase with age.

DISCUSSION

This exploratory cross-sectional pilot study provides an initial symptom-level map of sleep disturbances and perceived sleep quality in Croatian football players, additionally offering early insight into factors associated with reporting good sleep quality. In our sample, sleep disturbances were common despite generally good self-rated sleep quality; difficulty falling asleep within 30 minutes and waking up during the night or early morning were the most frequently reported symptoms, each affecting more than two-thirds of participants at least occasionally. The composite SDS, derived from nine PSQI-based disturbance symptoms, was moderately associated with perceived

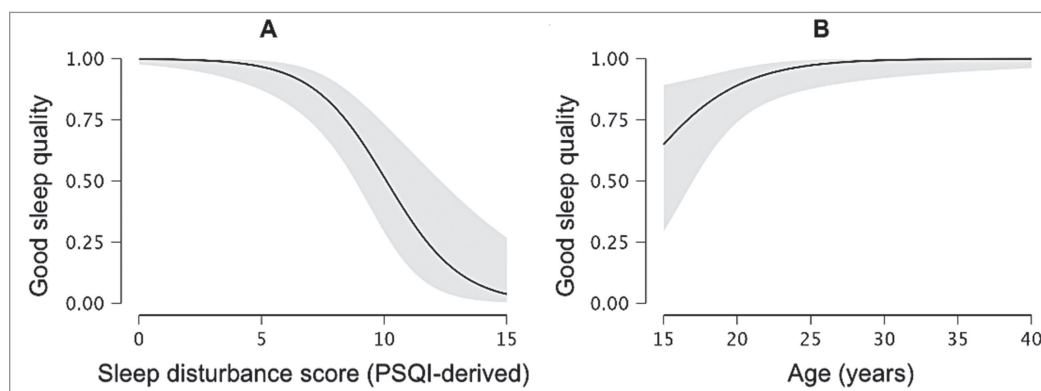


Figure 1. Predicted probability of reporting good sleep quality as a function of (A) Sleep Disturbance Score (SDS; PSQI-derived) and (B) age, based on the binomial logistic regression model. Shaded areas indicate 95% confidence intervals.

Slika 1. Predviđena vjerojatnost prijave dobre kvalitete sna kao funkcija (A) rezultata poremećaja sna (SDS; izvedenog iz PSQI-a) i (B) dobi, na temelju binarne logističke regresije.

sleep quality. In multivariable analysis, SDS emerged as the strongest independent predictor of good sleep quality, while age and male sex were also associated with higher odds of reporting good sleep quality. The BMI and leisure training exposure did not show statistically robust effects.

These findings point to a practical monitoring issue in football: players can feel they sleep well while still having many specific sleep problems. This shows the value of using short, symptom-based checklists in addition to single questions about sleep quality, especially for spotting trouble falling asleep and staying asleep, which can affect recovery. The strong, independent effect of SDS also suggests that having more symptoms in different areas, such as taking a long time to fall asleep, waking up often, and related issues, clearly affects how players rate their sleep, even when they are otherwise healthy athletes. Although we saw only small differences between male and female players, and these should be interpreted carefully because this was a pilot study, the patterns we observed should be explored further in larger, better-balanced groups using objective sleep measures and information about training and match load.

Our findings align with recent research indicating that sleep problems are common among football players. Many players report specific sleep issues, like taking more than 30 minutes to fall asleep and waking up during the night or early in the morning. These problems affected more than two-thirds of players at least occasionally, even though their overall view of their sleep was generally positive. This pattern is consistent with international football-specific epidemiological data showing a high prevalence of poor sleep quality, excessive daytime sleepiness, and sleep deficit, particularly in adult players.⁸ Importantly, Cunha et al. highlighted that an evening chronotype and later training schedules may increase the risk of sleep deficit among football players, supporting the notion that sleep in football is strongly influenced by behavioural and circadian factors rather than sleep duration alone.⁸ In this context, the

symptom pattern we found may reflect everyday challenges in football, such as going to bed late after evening training, feeling too alert to wind down, or not being fully recovered.

The added value of our study is the symptom-level SDS approach, based on nine PSQI disturbance items. It showed acceptable internal consistency and a moderate link with how players rated their sleep quality. This suggests that when specific problems accumulate, for example, taking a long time to fall asleep, waking often during the night, feeling too hot or too cold, having disturbing dreams, or pain disrupting sleep, individuals may experience their sleep as worse. Similar calls for more nuanced ways of assessing sleep have been made in the wider athlete literature, which highlights that sleep quality is multidimensional and shaped by both physical and psychological factors.¹⁵ From a method-practice perspective, our findings highlight that brief symptom checks are useful. However, although a single question can give a general sense of how someone is sleeping, it can miss important sleep problems, especially in athletes, who often see sleep difficulties as a normal part of training and competition.

The link between sleep problems and injury risk is increasingly recognised, and our findings support sleep symptoms as an important monitoring target in football. While we did not directly measure injuries, a recent study indicates that consistently obtaining ≤ 7 hours of sleep for at least 14 days may be associated with ~ 1.7 -fold greater injury risk, positioning sleep as a potentially modifiable risk factor in athletic health management.¹⁴ Even in a group that generally reports good sleep, frequent sleep-related symptoms may still point to poorer recovery and a higher risk of problems, particularly during periods of loaded training or competition.

Regarding predictors, SDS was the strongest independent predictor of perceived sleep quality, while older age and being male were linked to higher odds of reporting good sleep in our model. As illustrated in Figure 1, the probability of reporting good sleep quality declines sharply as SDS

increases, particularly beyond a score of approximately 5, suggesting a potential threshold effect. These results should be interpreted with caution, given the exploratory design and the disproportionate number of males and females, but they broadly align with previous research showing substantial individual differences and possible sex-related differences in sleep behaviour and sleep-related issues in football; for example, females may experience more fragile sleep across the season and under stress.^{13,20} Furthermore, emerging evidence suggests that subjective sleep complaints overlap with mental health indicators and sports functioning, and these associations may differ by sex.⁵ These links may help explain why overall sleep quality in football is influenced not only by objective sleep measures but also by players' biopsychological state.

Although our data showed that male players were more likely to report good sleep quality, this finding should be interpreted with caution, particularly given the very wide confidence interval, which indicates substantial statistical uncertainty and suggests that the estimate is unstable. This is likely a consequence of the small and imbalanced sample. In addition, male participants were older and reported higher training exposure, which may have further confounded the observed association between sex and sleep quality. Therefore, this result should not be interpreted as evidence of a true sex-based effect, but rather as a preliminary observation that requires confirmation in larger and more balanced samples.

The existing literature provides additional interpretation context and supports the practical relevance of our findings. Systematic evidence indicates that sleep extension strategies, such as increasing nighttime sleep or structured napping, are the most consistently practical approaches for improving athletic performance outcomes, while sleep hygiene and assisted sleep interventions may also contribute to better sleep and mood.^{8,12} Therefore, identifying the dominant symptom profile in a given athletic subgroup, such as sleep latency and nocturnal awakenings in our sample, may support coaches and medical teams in tailoring intervention priorities and help athletes utilize sleep hygiene principles. Overall, findings of this study suggest that screening for sleep-related symptoms may be a pragmatic and useful first step toward more targeted sleep management in football, especially in settings where sleep assessment and outcome measures are not routinely applied.

Limitations and future research directions

As an exploratory pilot study, our main aim was to map the most common sleep disturbances among male and female football players and to examine which sociodemographic, anthropometric, and training indicators predict a high perceived sleep quality. These preliminary findings need to be confirmed in larger, longitudinal in-season studies.

Several limitations should be kept in mind when interpreting our results and comparing them with previous work. In contrast to studies conducted during the competitive season or across different season phases, our data were collected mainly outside the competitive period, in the off-season/transitional phase, likely reducing exposure to some of the main sleep disruptors in football, such as match-related stress, travel, and congested schedules, and may partly explain why players reported generally good overall sleep quality despite frequent symptom-level disturbances. As a result, caution is needed when generalising these findings to in-season conditions. Compared with longitudinal monitoring, our cross-sectional design does not allow for conclusions about temporal or causal relationships. In addition, sleep was assessed only through self-report, without using objective measures, such as monitoring devices or technology. Data on additional football-specific contextual factors, including injury outcomes, were not collected.

Future research should, through longitudinal designs, especially during periods of fixture congestion, pair symptom-based screening with objective sleep measures. Including key contextual variables and clinical outcomes, such as injuries or illnesses, would help determine whether the burden of sleep symptoms can serve as an early risk marker and a practical target for intervention in football settings. Additionally, future studies should combine subjective symptom-based measures with objective sleep monitoring methods, such as actigraphy, to improve the validity and clinical interpretability of findings.

CONCLUSIONS

This exploratory pilot study provides an initial symptom-level profile of sleep disturbances and perceived sleep quality in Croatian football players. Although most of the sample generally rated their sleep quality as good, many still struggled to fall asleep and often woke up during the night or early in the morning. The PSQI-derived Sleep Disturbance Score (SDS) showed acceptable internal consistency, was moderately associated with overall sleep quality, and emerged as the strongest independent predictor of good sleep quality. Screening for sleep-related symptoms may be a pragmatic and useful step toward targeted sleep management in football, especially in settings where sleep outcome measures are not routinely used. Due to the cross-sectional design, self-report, and convenience sampling during the off-season/transitional phase, conclusions should remain cautious. Further longitudinal in-season studies incorporating objective sleep measures and contextual load indicators are needed to validate symptom patterns and clarify their clinical relevance, including links with injury outcomes.

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