Translation and validation of sleep questionnaires in Jordanian and Qatari athletes

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Abstract

Purpose To translate two prominent sleep questionnaires, the Functional Outcomes of Sleep Questionnaire 10 (FOSQ-10) and the Sleep Hygiene Index (SHI), into Arabic.

Methods The translations adhered to the established international criteria and underwent subsequent validation among 130 Arabic-speaking athletes from Jordan and Qatar. The validation process involved comparison against existing Arabic sleep questionnaires to ensure linguistic and cultural appropriateness.

Results Of the 130 participants, 70 completed the test-retest for FOSQ and 58 the test-retest for the SHI. The internal consistency reliability was excellent for the Arabic FOSQ-10 (0.824) and the Arabic SHI (0.892). The assessment of test-retest reliability of the total score for both measures showed that the Arabic FOSQ-10 had moderate reliability (ICC = 0.468, 95% CI = 0.263–0.633), whereas the Arabic SHI had excellent reliability (ICC = 0.952, 95% CI = 0.921–0.972). Both newly developed Arabic sleep measures had significant associations with almost all other established Arabic sleep questionnaires, indicating good validity. Exploratory factor analysis identified 5 factors for FOSQ and 3 factors for SHI, with significant loadings indicating distinct domains related to sleepiness, tiredness, discomfort, behavior, and sleep patterns. Confirmator factor analysuis confirmed these factors for both FOSQ and SHI, though the RMSEA values (0.132 for FOSQ and 0.171 for SHI).

Conclusions the Arabic FOSQ-10 and the Arabic SHI were established and showed satisfactory reliability and validity in athletes. Further studies are needed to validate those measures in Arabic clinical populations.

Keywords Arabic · Reliability · Validity · Sleep quality · Daytime sleepiness · Sleep hygiene

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Introduction

Sleep is an essential human need that has recently gained greater attention from the health sector [1]. Although good quality of sleep (QOS) is associated with enhanced mental and physical health [2, 3], there is an escalating prevalence of poor QOS reported in the general population [4]. The reasons behind the increase in poor QOS is still not well explained due to the multifactorial nature of sleep that may encompass various dimensions, including sleep environment, mood disturbances, the use of electronic devices, the presence of chronic diseases, and nutritional factors [5, 6]. Sleep is fundamental in maintaining overall health, cognitive functioning, and emotional well-being [7]. Therefore, proper assessment of sleep quality is paramount in understanding the complex interplay of these dimensions and identifying potential sleep disorders. Sleep disorders can manifest in diverse ways, such as insomnia, sleep apnea, parasomnias, and circadian rhythm disorders, each presenting unique challenges to sleep architecture and overall sleep experience [8].

Abnormality in sleep patterns stems from intrinsic factors, such as health-related conditions, and extrinsic influences, including the use of electronic devices, engagement in shift work, and exposure to jetlag [9]. Sleep-wake cycle disturbances are highly associated with abnormalities in levels of serotonin, acetylcholine, GABA, histamine and other neurochemicals [10]. Dysregulation in the secretion of these neurotransmitters may manifest as insomnia, hypersomnia, or daytime sleepiness [10]. The consequential impact of sleep deprivation extends to profound effects on cognitive abilities [7] and mood disturbances [11].

Athletes are one of the populations in which sleep holds significant implications for their health and subsequent performance. Sufficient and good QOS has been identi- fied as paramount for injury prevention and performance enhancement among athletes [12]. Moreover, the perception of enhanced recovery after training or competition is predominantly associated with optimal QOS in athletes [13]. Disturbances in sleep patterns among athletes are reported to compromise their cognitive abilities and ele- vate their risk of injuries [14]. Notably, among adoles- cent athletes, those with poor QOS exhibit a higher risk of sustaining injuries compared to counterparts with good QOS [14].

Several studies have revealed that athletes suffer from poor QOS [15–17]. A survey-based study indicated that 42% of collegiate athletes reported having sleep disturbances [16]. Another study noted that 41% of elite athletes may experience poor QOS, with 12% exhibiting clinical sleep disorders [15]. Additionally, adolescent athletes frequently fall short of meeting the recommended sleep duration, with 30% classified as poor sleepers [17]. Poor QOS was reported in 68.5% of soccer players in Qatar [18]. Moreover, 27% of Qatari players suffered from insomnia, and 22.5% of them showed daytime sleepiness [18].

Reliable and valid measures are essential for a comprehensive evaluation of sleep quality. Objective measures, such as polysomnography, provide detailed information about sleep indices. However, subjective measures, such as self-report questionnaires, capture individuals' percep- tions of their sleep quality, including sleep latency, satisfac- tion, and daytime sleepiness. The availability of quick and easy-to-administer means in athletes' mother language has paramount advantages. Combining objective and subjective assessments offers a holistic understanding of sleep quality, acknowledging both physiological and experiential dimensions [19].

The potential ramifications of sleep disturbances on athletes' well-being and performance emphasize the need to cultivate awareness regarding these issues for athletes, sports medicine teams, and other stakeholders. This awareness is crucial for the early detection and management of sleep disorders by sports medicine teams, thereby mitigating their adverse consequences. Moreover, heightened awareness among athletes regarding sleep disorders can foster improved reporting behaviors and encourage the proactive seeking of assistance when necessary [20].

Pre-participation screening for sleep disturbances is essential because existing research posits a correlation between poor QOS and heightened susceptibility to sports-related injuries [19].

Utilizing valid sleep questionnaires tailored to an athlete's first language is advantageous to effectively assess potential underlying sleep impairments. Regrettably, the lack of various sleep questionnaires in Arabic hinders the comprehensive assessment of sleep disorders in Arabic-speaking athletes. Although some sleep questionnaires exist in the Arabic language, each one of them can capture different dimensions of sleep disorders. For example, the Pittsburgh Sleep Quality Index (PSQI) measures sleep disorders during the night whereas the Epworth Sleepiness Questionnaire (ESQ) quantifies sleepiness during the day.

More than 400 million people speak Arabic globally [21] and hold official status in the United Nations [22] and the World Health Organization [23]. Consequently, developing various sleep questionnaires in Arabic is paramount for effectively screening Arabic-speaking athletes. This study aims to address this gap by translating two additional sleep questionnaires into Arabic and validating them among Jordanian and Qatari athletes who are native Arabic speakers compared to existing Arabic sleep questionnaires. Those questionnaires that were translated and validated were

Functional Outcomes of Sleep Questionnaire 10 (FOSQ-10) [24] and Sleep Hygiene Index (SHI) [25]. The FOSQ-10 quantifies the impact of daytime sleepiness on performing daily living activities, an aspect not covered by other existing Arabic sleep questionnaires. Identifying the impact of sleep disorders on performance is essential for athletes. The second questionnaire selected for translation and validation was the Sleep Hygiene Index (SHI) which assesses sleep hygiene behaviors. Although the SHI was recently translated and validated in Arabic [26], it was not validated in the athletic population. Sleep hygiene is a highly important aspect when dealing with QOS in the general population and athletes specifically. Athletes travel frequently for competitions and change their sleeping environment, which may affect their sleep hygiene behaviors. Therefore, there was a need to validate the SHI in athletes to ensure it captures this aspect in this population.

Materials and methods

This test-retest reliability study developed the Arabic version of two sleep outcome measures and validated them in athletes in two Arab countries, Qatar and Jordan. The University of Jordan and Aspetar Hospital ethics committee approved the conduction of this study. Athletes from both countries were informed about the purpose and procedures of the study. Afterwards, eligible subjects consented to participate in this study.

Participants

Data was collected prospectively from athletes from different sports in Jordan and Qatar. All athletes who were at least 18 years of age and could read and write Arabic were included.

Translation process

Two sleep instruments, including Functional Outcomes of Sleep Questionnaire 10 (FOSQ-10) [24] and Sleep Hygiene Index (SHI) [25] were selected for translation into Arabic. The translation and cross-cultural adaptation of the questionnaires was conducted in accordance with the recommendations of the World Health Organization (WHO) forward/backward translation protocol for translating assessment tools and international guidelines [27].

Bilingual healthcare professionals from Jordan and Qatar translated the questionnaires from English into Arabic. Both healthcare professionals met to discuss and compare translations and agreed on the final version. The final Arabic version of the questionnaires was then sent to a group of Arabic-speaking health and language professionals to assess language clarity and cultural suitability. This panel of experts had several rounds of editing to ensure that the language of the questionnaires could be understood clearly by all Arabic-speaking individuals regardless of their country of residence or dialect. Afterwards, a backward translation of the questionnaires from Arabic into English was conducted and sent to the same panel of experts for further revision. The final version of the Arabic questionnaires was piloted on several athletes to further validate the clarity of the language and for cultural adaptation purposes.

Test-retest reliability

Participants were asked to complete the questionnaires (FOSQ-10 and SHI) twice before and once again after one-week interval to assess the reliability and reproducibility of the questionnaires. The agreement on the item and total scores were assessed between the first and the second visit. The assessment of test-retest reliability and reproducibility of a questionnaire encompasses no-to-minimal changes in the measured construct, i.e. the interval selected between test and retest visits should ensure no genuine changes. In our study, we selected a one-week interval to ensure that participants don't recall the items of the questionnaires but at the same time short enough to avoid big changes in their sleep behaviors, especially since athletes frequently travel, a factor that has a huge impact on their sleep.

Validation of the translated instruments

Three validated sleep questionnaires in Arabic were used with the newly translated measures to assess their validity. Those questionnaires included the Arabic Insomnia Severity Index (ISI) [28], the Arabic Pittsburgh Sleep Quality Index (PSQI) [29], and the Arabic Caen Chronotype Questionnaire (CCQ) [30].

Outcome measures

The survey of this study included three sections to collect data from athletes. The first section asked about the demographics and health-related information of participants. The second part included the newly translated outcome measures. The last part comprised the validated Arabic outcome measures about sleep quality.

The Functional Outcomes of Sleep Questionnaire (FOSQ) is a 30-item questionnaire developed to measure the effect of sleepiness on daily living activities and quality of life [31]. However, a shorter version of 10 items (FOSQ-10) was developed in 2009 [24]. The FOSQ-10 was found to be

a valid instrument to detect daytime sleepiness with psychometric solid properties similar to the original version [24]. The FOSQ-10 items are scored on a five-point Likert scale from 0 to 4, with a lower score indicating a greater impact of daytime sleepiness on performing daily living activities.

The Sleep Hygiene Index (SHI) was developed in 2006 to assess sleep hygiene behaviors [25]. The SHI consists of 13 items scored on a five-point Likert scale (0–4). The total score of the SHI ranges between 0 and 52, with a lower score indicating better sleep hygiene practices [25]. Cho, et al. (2013) reported that the SHI is a good and valid clini- cal tool to assess patients' sleep hygiene [32]. The SHI was found to have good psychometric properties [25, 33]. An Arabic version of the SHI was developed recently in Lebanon and has good reliability and validity [26].

The Insomnia Severity Index (ISI) is a self-report measurement tool developed to assess insomnia symptoms [34]. The ISI consist of 7 items, each rated on a scale from 0 to 4 with a total score ranging from 0 to 28, with a higher score indicating more severe insomnia [34]. The ISI was found to be a valid and reliable assessment tool [35]. The ISI was translated and validated into Arabic [28].

The Pittsburgh Sleep Quality Index (PSQI) is a self-reported questionnaire to assess QOS during the previous month. The questionnaire consists of 19 items included under 7 components [36]. A total PSQI score of 6 and above indicates poor QOS [37]. The PSQI was found to have good test-retest reliability (0.87) [38], internal consistency [39], and validity [37]. PSQI was translated into Arabic and validated [29]. Moreover, PSQI has been widely used in athletes [40].

The Caen Chronotype Questionnaire (CCQ) was developed in 2017 as an updated version of the original Chronotype Questionnaire [41]. The scale consists of 16 main items scored on a five-point Likert scale from 1 to 5, with a higher score indicating a worse sleep. The CCQ has 2 subscales, including "morningness-eveningness" and "distinctness" [41]. The CCQ was found to have good psychometric properties [42]. The Arabic version of the CCQ was developed and validated [30].

Statistical analysis

The sample size calculation for the test-retest study validating the translated questionnaire with 10 items determined that approximately 20 participants were sufficient to achieve an Intraclass Correlation Coefficient (ICC) of 0.8, with 80% power and a 95% confidence level. However, the recommended sample size for performing factor analysis is generally 10 subjects per item. In our study, the sample size was increased to 130 to account for the fact that the Sleep Hygiene Index (SHI) had 13 items, while the Functional Outcomes of Sleep Questionnaire (FOSQ) had only 10 items.

All data was coded and analyzed using IBM SPSS v21.0. Data was expressed as means ± standard deviation (SD) or counts and percentages based on continuous or categorical data types, respectively. Normality of the data was assessed using the Shapiro-Wilk test. An independent t-test or non-parametric equivalent was used to compare the means of FOSQ-10, SHI, CAEN, PSQI and ISI between Jordanian and Qatari-based athletes. In order to determine the agreement between the test and retest of FOSQ-10 and SHI total scores, the Intra-Class Correlation (ICC) (two-way random mixed with absolute agreement) was computed along with 95% CI. The ICC values under 0.5 were generally regarded as poor, 0.5 to 0.75 moderate, 0.75 to 0.9 good, and above 0.9 excellent in terms of reliability. For the FOSQ-10 and SHI questionnaires, the first assessment was used to determine the internal consistency between items within each questionnaire using Cronbach's alpha statistic.

An exploratory factor analysis (EFA) was conducted on the baseline assessment data from the translated version of the FOSQ and SHI questionnaire. The analysis utilized the minimum residual extraction method to identify underlying factors within the dataset. Varimax/Oblimin rotation was applied to enhance interpretability and ensure the factors were as uncorrelated as possible. Following the EFA, a confirmatory factor analysis (CFA) was performed on the follow-up assessment data to validate the factor structure identified in the EFA. Model fit indices, including CFI, TLI, SRMR, and RMSEA, were reported to assess the adequacy of the model as per recommendations [43].

Results

A total of 130 athletes participated in this study, with 61% Jordanian and 39% Qatari athletes. The majority of participants (76.2%) were males from football (28.5%), followed by rugby and judo (16.2% each). Appendix 1 outlines all specific sports that participated in this study.

There were more afternoon/evening training sessions than morning sessions, with most sessions taking 1–2 h. The type of training included mainly mixed exercises (aer- obic and anaerobic). Table 1 lists the rest of the sample characteristics.

Both the Arabi FOSQ-10 (Appendix 2) and the Arabi SHI (Appendix 3) were developed and culturally adapted. The internal consistency of the Arabic FOSQ-10 and Arabic SHI using Cronbach's alpha was 0.824 and 0.892, respectively. The test-retest reliability of the Arabic FOSQ-10 total score was poor to moderate [ICC = 0.468 (95% CI = 0.263–0.633)], whereas the test-retest reliability of the Arabic SHI total score was excellent [ICC =0.952 (95% CI =0.921–0.972)]. The results of sleep questionnaires between Jordanian and Qatari athletes revealed significant differences in most sleep indices (Table 2).

Table 1 Characteristics of the sample

Variable	Jordan	Qatar	Overall
Age	22.9 ± 4.6	24.6 ± 5.6	23.5 ± 5.1
BMI (Kg/M^2)	24.4 ± 4.5	23.5 ± 2.4	24.0 ± 3.8
Sex			
Male	50 (63.3)	49 (96.1)	99 (76.2)
Female	29 (36.7)	2 (3.9)	31 (23.8)
Sport type			
Football	10 (12.7)	27 (52.9)	37 (28.5)
Rugby	21 (26.6)	0 (0.0)	21 (16.2)
Judo	21 (26.6)	0 (0.0)	21 (16.2)
Boxing	7 (8.9)	0 (0.0)	7 (5.4)
Hand Ball	1 (1.3)	6 (11.8)	7 (5.4)
Other sports*	19 (14.6)	18 (13.8)	37 (28.5)
Level of competition			
Professional	27 (34.2)	30 (58.8)	57 (43.8)
Semi-professional	21 (26.6)	21 (41.2)	42 (32.3)
Amateur	19 (24.1)	0 (0.0)	19 (14.6)
Sport institute or university athlete	12 (15.2)	0 (0.0)	12 (9.2)
Years of experience	6.9 ± 5.2	9.4 ± 4.3	7.9 ± 5.0
Number of morning training sessions per week	2.7 ± 2.2	2.4 ± 2.0	2.6 ± 2.1
Duration (time spent in sessions)			
(0–60) min (0–1) h	25 (31.6)	24 (47.1)	49 (37.7)
(60–120) min (1–2) h	48 (60.8)	21 (41.2)	69 (53.1)
(120–180) min (2–3) h	5 (6.3)	3 (5.9)	8 (6.2)
(180–240) min (3–4) h	1 (1.3)	3 (5.9)	4 (3.1)
Number of afternoon/evening training sessions per week	4.0 ± 1.8	5.2 ± 1.3	4.5 ± 1.7
Duration (time spent in sessions)			
(0–60) min (0–1) h	8 (10.1)	0 (0.0)	8 (6.2)
(60–120) min (1–2) h	55 (69.6)	34 (66.7)	89 (68.5)
(120–180) min (2–3) h	16 (20.3)	13 (25.5)	29 (22.3)
(180–240) min (3–4) h	0 (0.0)	4 (7.8)	4 (3.1)
Type of training			
Aerobic exercises	19 (24.1)	3 (5.9)	22 (16.9)
Anaerobic exercises	3 (3.8)	4 (7.8)	7 (5.4)
Mix of exercises	57 (72.2)	44 (86.3)	101 (77.7)

*Other sports: the details are presented in Appendix 1

Table 2 The sleep measures information for all athletes in the first visit athletes

Outcome measure	Jordan	Qatar	Overall	*P*-value	Total score
Functional Outcomes of Sleep Questionnaire	26.2 ± 10.7	32.9 ± 6.5	29.6 ± 9.4	< 0.001	Higher is better
Sleep Hygiene Index	22.5 ± 12.0	15.3 ± 5.7	19.7 ± 10.6	< 0.001	Higher is worse
Caen Chronotype I (Morningness-Eveningness)	23.6 ± 4.6	20.6 ± 5.5	22.5 ± 5.2	0.001	Higher is worse
Caen Chronotype II (distinctness)	24.3 ± 4.4	23.9 ± 4.5	24.1 ± 4.4	0.673	Higher is worse
Pittsburgh Sleep Quality Index	5.0 ± 3.1	3.3 ± 2.7	4.4 ± 3.1	0.002	Higher is worse
Insomnia severity index	10.2 ± 5.5	3.9 ± 5.5	7.7 ± 6.3	< 0.001	Higher is worse

Table 3 The correlations association between FOSQ-10 and SHI with other sleep measures

	FOSQ	SHI	CAEN I	CAEN II	PSQI	ISI
FOSQ	1					
SHI	−0.246*	1				
CAEN I	−0.109	0.277**	1			
CAEN II	−0.078	0.349**	0.260**	1		
PSQI	−0.250*	0.495**	0.216*	0.339**	1	
ISI	−0.279**	0.430**	0.264**	0.438**	0.650**	1

FOSQ Functional Outcomes of Sleep Questionnaire, *SHI* Sleep Hygiene Index, *PSQI* Pittsburgh Sleep Quality Index, *ISI* Insomnia Severity Index. Spearman correlation coefficients are shown

* $P < 0.05$, ** $P < 0.01$

Table 4 Factor loading from exploratory factor analysis of FOSQ-10 at first assessment ($n = 130$) using oblimin roation method

	Component				
	1	2	3	4	5
FOSQ1			0.959		
FOSQ2			0.903		
FOSQ3		0.959			
FOSQ4		0.953			
FOSQ5	0.911				
FOSQ6	0.910				
FOSQ7	0.847				
FOSQ8					−0.623
FOSQ9					−0.949
FOSQ10				0.979	

FOSQ Functional Outcomes of Sleep Questionnaire

Table 5 Factor loadings from exploratory factor analysis of SHI questionnaire with minimum residual extraction and varimax rotation

	1	2	3
SHI1			0.380
SHI2			0.754
SHI3			0.858
SHI4	0.68		
SHI5		0.592	
SHI6	0.574		
SHI7		0.681	
SHI8	0.486		
SHI9		0.697	
SHI10	0.798		
SHI11	0.920		
SHI12		0.700	
SHI13		0.744	

SHI Sleep Hygiene Index

Table 3 presents the validation of the translated sleep questionnaires. Significant weak to moderate correlations were found between the Arabic FOSQ-10, SHI and most other established sleep measures (Table 3).

The exploratory factor analysis (EFA) conducted during the baseline assessment with a sample size of 130 participants identified five distinct factors in the translated version of the Functional Outcomes of Sleep Questionnaire (FOSQ). These factors are General Productivity, Vigilance, Social Relationships, Intimacy, and Activity Level, reflecting various domains impacted by sleepiness and tiredness (Table 4). The adequacy of the sample was confirmed by the Kaiser-Meyer-Olkin (KMO) measure of 0.663, and Bartlett's Test of Sphericity indicated that the data was suitable for factor analysis ($p < 0.001$). In the follow-up assessment with a sample size of 80, confirmatory factor analysis (CFA) validated the factor structure identified in the baseline assessment. Most items loaded significantly onto their respective factors, confirming the reliability of the translated version in measuring these domains. However, some factor covariances, particularly those involving the Intimacy factor, were weaker, indicating more complex relationships between factors. The model fit indices from CFA showed mixed results, with the SRMR indicating a good fit (0.0750), while the CFI (0.880) and TLI (0.792) suggested an acceptable but improvable fit. The RMSEA (0.132) pointed to a poorer fit, indicating that further refinements to the model might be necessary.

The Exploratory Factor Analysis (EFA) conducted on the baseline data ($n = 130$) identified a three-factor structure for the Arabic version of the Sleep Hygiene Index (SHI) (Table 5), with items loading significantly onto factors related to discomfort and stress, behavioral aspects, and inconsist- ent sleep patterns. The Confirmatory Factor Analysis (CFA) performed on follow-up data ($n = 58$) largely confirmed this structure, with significant loadings on Factor 1 (e.g., item J: 0.905, $p < 0.001$) and Factor 2 (e.g., item G: 1.064, $p < 0.001$). However, item A ("Taking naps during the day") showed a non-significant loading in the CFA (0.301, $p = 0.077$), indicating potential inconsistency. The model fit indices in the CFA were less than ideal, with an RMSEA of 0.171 (90% CI: 0.140 to 0.202), CFI of 0.770, and TLI of 0.711.

Discussion

The current study aimed to translate two sleep questionnaires that measure different dimensions of sleep disorders into Arabic and validate them compared to existing Arabic sleep questionnaires among Jordanian and Qatari athletes. Both FOSQ-10 and SHI were translated into Arabic using robust and standardized procedures in 2 Arab countries: Jordan and Qatar.

Almost all sleep outcome measures, encompassing newly translated and previously validated instruments, indicated significant differences between Jordanian and Qatari athletes. The Jordanian athletes consistently showed a poorer QOS pattern compared to Qatari athletes. This consistent pattern enhances the discriminant validity of the recently developed Arabic questionnaires, as their outcomes align coherently with the existing Arabic measures. The original English FOSQ-10 showed discriminant validity between normal individuals and people with obstructive sleep apnea [24].

The Arabic FOSQ-10

The internal consistency reliability of the Arabic FOSQ-10 was excellent (0.82) and similar to the English FOSQ-10 (0.87) [24]. This finding indicates that the Arabic FOSQ-10 captures the intended constructs of daytime sleepiness and its impact on daily living activities. The assessment of test-retest reliability of the Arabic FOSQ-10 total score showed poor reliability (ICC= 0.468). The poor reliability in the test-retest assessment of the FOSQ-10 total score in athletes can be justified by considering the complex interplay of individual and situational factors inherent in the athletic population. The dynamic nature of an athlete's lifestyle, training, and competitive demands can contribute to variability in sleep-related outcomes over time. The nature of the main question in the FOSQ-10, which lacks a specific time frame, allows athletes to reflect on their recent experiences when responding. This emphasis on recent experiences makes the questionnaire sensitive to short-term fluctuations in sleep patterns and the dynamic nature of an athlete's lifestyle. The interval between the testing and retesting was 1 week, which means many things may change for athletes regarding training and games. Consequently, the poor reliability observed in the test-retest assessment can be attributed, in part, to the inherent variability in how athletes interpret and respond to the questionnaire based on their immediate circumstances and recent sleep experiences.

The combined results from the exploratory and confirmatory factor analyses suggest that the translated version of the FOSQ reliably captures multiple domains affected by sleepiness and tiredness. The factor structure identified in the baseline assessment was largely confirmed in the follow-up assessment, indicating good construct validity across both time points.

The validity of the Arabic FOSQ-10 revealed significant weak inverse correlations with the PSQI (r=−0.250) and the ISI (r=−0.279). These findings indicate that lower scores (worse) on the FOSQ-10 are associated with worse QOS using PSQI and worse insomnia severity using ISI. All previous findings indicate that poor QOS (using PSQI and ISI) negatively affects daytime sleepiness, affecting the performance of daily living activities using the Arabic FOSQ-10. The relationship between poor QOS, daytime sleepiness, and the subsequent impact on daily living activities is supported by a wealth of research in sleep medicine. The interconnectedness of sleep with cognitive, emotional, and physical functioning underscores the importance of addressing sleep quality to promote overall well-being and optimal daily functioning.

Daytime sleepiness, that the Arabic FOSQ-10 can capture, may result from poor QOS and can contribute to irritability, mood swings, and a generally reduced capacity to cope with stress, making it challenging for athletes to engage effectively in daily activities. Sleep is also essential for physical recovery and coordination [44, 45], which is highly important for athletes [46]. Moreover, poor QOS can result in physical fatigue and reduced motor coordination, impacting the ability to perform routine physical activities. Due to poor QOS (captured by the PSQI and ISI), daytime sleepiness in athletes may increase the risk of accidents and errors in sports tasks requiring precision and coordination. Chronic daytime sleepiness can decrease overall productivity and efficiency, affecting athlete's quality of life and potentially impairing social and occupational functioning. Consistently poor QOS and the resulting daytime sleepiness have been associated with a range of health issues, including cardiovascular problems, metabolic disorders, and compromised immune function [1]. The negative health consequences further contribute to the overall decline in well-being, making it challenging for athletes with poor QOS to maintain an active and productive lifestyle.

The Arabic SHI and sleep hygiene

The internal consistency reliability of the Arabic SHI was found to be excellent (0.892) and higher than the English SHI (0.66) [25]. This finding indicates that the Arabic SHI captures the intended constructs of sleep hygiene behaviors. The assessment of test-retest reliability of the Arabic SHI total score revealed excellent reliability (ICC = 0.952), which is also higher than that of the original SHI (r = 0.71) [25]. The results indicate that the translated Arabic ver- sion of the SHI exhibits moderate reliability and validity. The consistency of the three-factor structure between the EFA and CFA suggests good construct validity and inter- nal consistency, particularly for the majority of items that loaded significantly across both analyses.

The validity of the Arabic SHI showed significant weak correlations with CAEN I (0.277) and CAEN II (0.349). In contrast, significant moderate correlations were found between the Arabic SHI, PSQI (0.495) and ISI (0.430). The original SHI had a very similar correlation with PSQI (0.481) [25] to the Arabic SHI. This finding indicates that a worse sleep hygiene routine using the Arabic SHI is associated with worse QOS using the PSQI.

The relationship between a worse sleep hygiene routine and worse QOS in athletes could be explained by considering the impact of inconsistent sleep patterns, environmental factors, electronic device use, timing of physical activity, nutritional habits, stress management, pre-sleep routines, and cognitive factors. One factor in our sample is having a higher number of afternoon/evening training sessions (4.5 ± 1.7) compared to morning training sessions per week (2.6 ± 2.1), which may have introduced irregularities in their sleep patterns due to late exercise drills [47]. Another fac- tor is most of our participants' professional or semi-profes- sional status, with a percentage of 76.1%, which may con- tribute to a worse sleep hygiene routine by increasing stress levels and fostering an environment where the pressure to perform at a high level can adversely affect relaxation and sleep quality. Addressing these factors through optimizing sleep hygiene is essential for athletes to enhance the quan- tity and quality of their sleep, ultimately contributing to better overall performance, recovery, and well-being.

Early identification of sleep disorders through proper assessment is crucial for effective management and intervention. Untreated sleep disorders can have far-reaching consequences, impacting physical health, mental well-being, and daily functioning [2]. Early detection allows for the timely implementation of evidence-based interventions, ranging from behavioral and lifestyle modifications to pharmacological treatments when necessary [48]. By addressing sleep disorders in their early stages, healthcare professionals can mitigate potential long-term consequences and improve the overall quality of life for individuals affected by sleep disturbances. Therefore, a nuanced and thorough assessment using valid measures is a cornerstone in the proactive management of sleep disorders, promoting optimal health and well-being.

Limitations

This study has limitations related to the nature of reliability studies that do not allow for further validation of the Arabic sleep measures, such as responsiveness to treatment that needs longitudinal design. Therefore, we suggest future studies investigate other validity types of the Arabic FOSQ-10 and SHI. Furthermore, our study sample was healthy athletes in two Arabic countries. Therefore, the findings of our study can not be generalized to clinical patients diagnosed with sleep disorders such as sleep apnea. Therefore, future studies should utilize Arabic sleep measures for patients diagnosed with sleep disorders for further validation. Another important limitation of the study's external validity is the non-probabilistic sample of athletes from different sports and levels of competition. Therefore, future studies might need to focus on specific sports and competition level to enhance the results' applicability.

Conclusions

The Arabic FOSQ-10 and SHI were translated into Arabic utilizing rigorous standards in Jordan and Qatar. The internal consistency reliability of both newly developed Arabic measures was excellent, indicating that the Arabic FOSQ-10 and the Arabic SHI capture the intended constructs of daytime sleepiness and sleep hygiene, respectively. The assessment of test-retest reliability of the total score for both measures showed that the Arabic FOSQ-10 had poor reliability, whereas the Arabic SHI had excellent reliability. Both newly developed Arabic sleep measures had significant associations with almost all other established Arabic sleep questionnaires. This finding indicates that poor QOS, captured by available sleep measures, is associated with worse daytime sleepiness and poor sleep hygiene in athletes.

Appendix 1

Table 6

Table 6 Other sports that participated in this study

Sport	Jordan	Qatar	Overall
Karate	5 (6.3)	0 (0.0)	5 (3.8)
Athletics	0 (0.0)	5 (9.8)	5 (3.8)
Running 400 m	4 (5.1)	0 (0.0)	4 (3.1)
Mix	4 (5.1)	0 (0.0)	4 (3.1)
Basketball	0 (0.0)	3 (5.9)	3 (2.3)
Cycling	0 (0.0)	2 (3.9)	2 (1.5)
Volleyball	0 (0.0)	2 (3.9)	2 (1.5)
Jiujitsu	2 (2.5)	0 (0.0)	2 (1.5)
Gymnastics	1 (1.3)	1 (2.0)	2 (1.5)
Triathlon	1 (1.3)	0 (0.0)	1 (0.8)
Taekwondo	1 (1.3)	0 (0.0)	1 (0.8)
Body building	1 (1.3)	0 (0.0)	1 (0.8)
Beach ball	0 (0.0)	1 (2.0)	1 (0.8)
Shooting	0 (0.0)	1 (2.0)	1 (0.8)
Wrestling	0 (0.0)	1 (2.0)	1 (0.8)
Equestrian	0 (0.0)	1 (2.0)	1 (0.8)
Skiing	0 (0.0)	1 (2.0)	1 (0.8)
Total	19 (14.6)	18 (13.8)	37 (28.5)

Appendix 2

استبيان النتائج الوظيفية للنوم.

The purpose of the following questions is to find out if you generally have difficulty carrying out certain activi- ties because you are too sellpy or tired. In the questions, when the words “sleepy” or “tired” are used, it means the feeling that you can’t keep your eyes open, your head is droopy, that you want to “nod off”, or that you feel the urge to take a nap.

الهدف من الأسئلة التالية هو اكتشاف (تحديد) إذا ما كان عندك صعوبة في أداء بعض التمارين لأنك نعسان جدا أو متعب بشكل عام. في الأسئلة التي تحوي على كلمات "نعسان" أو "متعب" تعني بأنك تشعر بعدم القدرة على ابقاء عينيك مفتوحتين، وأن رأسك يقع من النعس كأنك تومئ برأسك، أو تشعر

بحاجة ماسة لأخذ غفوة.

These words do not refer to the tired or fatigued feeling you may have after you have exercised. Please try to be as accurate as possible.

هذه الكلمات لا تشير للشعور بالتعب أو الإجهاد بعد التمارين الرياضية. :رجاءا كن دقيقاً جداً قدر الإمكان

Table 7

Table 7 The arabic FOSQ-10

	Yes, extreme difficulty نعم صعوبة شديدة (4)	Yes, moderate difficulty نعم صعوبة معتدلة (3)	Yes, a little difficulty نعم صعوبة قليلة (2)	No difficulty لا صعوبة (1)	I don’t do this activity for other reasons لا أقوم بهذا النشاط لأسباب أخرى (0)
1	Do you have difficulty concentrating on the things you do because you are sleepy or tired? هل لديك صعوبة في التركيز على الأشياء التي تقوم بها بسبب الشعور بالنعس أو التعب ؟				
2	Do you generally have difficulty remembering things because you are sleepy or tired? عموماً هل لديك صعوبة في تذكر الأشياء بسبب النعاس أو التعب ؟				
3	Do you have difficulty operating a motor vehicle for short dis- tances (less than 100 miles) because you are sleepy or tired? هل تعاني من صعوبة في قيادة سيارة لمسافة قصيرة (أقل من 100 ميل) بسبب النعاس أو التعب ؟				
4	Do you have difficulty operating a motor vehicle for long distances (greater than 100 miles) because you are sleepy or tired? هل تعاني من صعوبة في قيادة سيارة لمسافة طويلة (أكثر من 100 ميل) بسبب النعاس أو التعب ؟				
5	Do you have difficulty visiting with your family or friends in their home because you become sleepy or tired? هل تعاني من صعوبة في زيارة أقاربك أو أصدقائك في منزلهم بسبب النعاس أو التعب ؟				
6	Has your relationship with family, friends or work colleagues been affected because you are sleepy or tired? هل تأثرت علاقتك بأقربائك أو أصدقائك أو زملائك بالعمل بسبب النعاس أو التعب ؟				
7	Do you have difficulty watching a movie or videotape because you become sleepy or tired? هل تعاني من صعوبة مشاهدة فيلم أو شريط فيديو بسبب النعاس أو التعب ؟				
8	Do you have difficulty being as active as you want to be in the evening because you are sleepy or tired? هل لديك صعوبة بالبقاء نشيطاً قدر ما تشاء في المساء بسبب النعاس أو التعب ؟				
9	Do you have difficulty being as active as you want to be in the morning because you are sleepy or tired? هل لديك صعوبة بالبقاء نشيطاً قدر ما تشاء في الصباح بسبب النعاس أو التعب ؟				
10	Has your desire for intimacy or sex been affected because you are sleepy or tired? هل تأثرت رغبتك في الحميمية أو الجنس بسبب النعاس أو التعب ؟				

Appendix 3

مؤشر صحة النوم.

أختر الاجابة التي تنطبق عليك:

Table 8

Table 8 The Arabic SHI

Never أبداً	Rarely نادراً	Sometimes أحياناً	Frequently كثيراً	Always دائماً
0	1	2	3	4

I take daytime naps lasting two or more hours. أخذ غفوات نهاراً تستمر ساعتين أو أكثر	1
I go to bed at different times from day to day. أذهب إلى السرير في أوقات مختلفة من يوم لآخر	2
I get out of bed at different times from day to day. أنهض من السرير في أوقات مختلفة من يوم لآخر	3
I exercise to the point of sweating within 1 h of going to bed أتمرن لدرجة التعرق قبل ساعة واحدة من ذهابي إلى النوم	4
I stay in bed longer than I should two or three times a week. أبقى في السرير فترة أطول من اللازم مرتين إلى ثلاث مرات في الأسبوع	5
I use alcohol, tobacco, or caffeine within 4 h of going to bed or after going to bed. أتناول الكحول ، التبغ أو الكافيين خلال 4 ساعات قبل الذهاب إلى السريرأو بعد ذهابي إلى السرير	6
I do something that may wake me up before bedtime (for example: play video games, use the internet, or clean). أقوم بعمل شيء من الممكن أن يبقيني مستيقظا قبل وقت النوم (مثل ألعاب فيديو، أستخدام الإنترنت، النظر إلى (الهاتف	7
I go to bed feeling stressed, angry, upset, or nervous. أذهب إلى السرير مضغوطاً، غاضباً، منزعجاً، أو متوترا	8
I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study). (أستخدم سريري لأشياء أخرى غير النوم والجنس (مثل أشاهد التلفاز، أقرأ، أكل، ألعب بالكمبيوتر	9
I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets). (أنام على سرير غير مريح (مثل الفرشة نوعيتها سيئة و/ أو وسادة	10
I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy). (أنام في غرفة نوم غير مريحة (مثل ساطعة جداً، فيها أشياء كثيرة، حارة جداً، بارد جداً، مزعجة جداً	11
I do important work before bedtime (for example: pay bills, schedule, or study). (أقوم بأعمال مهمة مباشرة قبل النوم (مثل دراسة، أدفع فواتير، أجدول اليوم التالي	12
I think, plan, or worry when I am in bed. أفكر، أخطط، أقلق أثناء استلقائي بالسرير	13

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Data availability Data sets generated during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval Was obtained from the Institutional Review Board of the University of Jordan (IRB No. 43-2020). All participants signed a written informed consent after informing them about the purpose and procedure of the study.

Conflict of interest The authors declare that they have no conflict of interest.

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