ORIGINAL ARTICLE

The validity and reliability of the Persian version of the Athlete Sleep Screening Questionnaire

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Background: Sleep as a biological phenomenon is effective in the performance and recovery of athletes. Questionnaires can be used as a cost-effective initial assessment tool for sleep. The Athlete Sleep Screening Questionnaire (ASSQ) demonstrated a clinically valid instrument for screening relevant sleep issues in athletic populations. Due to the lack of validated tools for adequate screening for sleep difficulties in the Iranian athlete population, the present study was conducted to evaluate the validity and reliability of the Persian version of the ASSQ. **Materials and Methods:** The translation process was performed using instructions by Beaton *et al*. Content validity was assessed by a panel of experts. Exploratory and confirmatory factor analysis was performed for two 5-item sleep difficulty scores (SDS) and a 4-item chronotype score. Internal consistency based on Cronbach's alpha and McDonald's omega and stability reliability were used to evaluate reliability. **Results:** The ASSQ achieved conceptual and semantic equivalence with the original scale. The item-level content validity index (I-CVI) of each item ranged from 0.87 to 1, and the averaging scale-level CVI/average was 0.95. In factor analysis, one factor for SDS and one factor for chronotype score were identified and confirmed. The internal consistency of the SDS scale (α =0.77, Ω =0.83) and chronotype (α =0.74, Ω =0.77) was acceptable. Stability reliability was confirmed for SDS scale (intra-class correlation [ICC] =0.87) and for chronotype (ICC = 0.83). **Conclusion:** Persian ASSQ has acceptable psychometric measurement properties as a screening tool to assess sleep in Iranian athletes.

Key words: Athlete, Persian, reliability, sleep screening, validity

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INTRODUCTION

Sleep is a complex biological phenomenon that is essential for health.[1,2] Adults need 7–9 h of sleep for optimal health.[3] Sleep loss can have several deleterious effects in healthy adults such as degraded cognitive performance[4] changes in glucose metabolism,[5,6] and impaired autonomic system related to cardiovascular function.[7,8]

In athletes, adequate sleep quantity and quality are considered foundational factors for optimal athletic performance, and recovery.[9] Furthermore, there is a wealth of literature that demonstrates athletes often suffer from inadequate sleep and related disorders.[10-14] Therefore, recognizing athletes' sleep behaviors, and how sleep parameters affect performance, besides the impact of specific interventions on sleep and performance is important. As a matter of fact, clinical methods such as polysomnography, actigraphy, and structured interviews with sleep specialists can provide high-quality diagnostic information but are time and resource intensive. Sleep Questionnaires on the other hand can assess an athlete's sleep and represents

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a cost-effective method relative to polysomnography, actigraphy, and structured interview.[15,16]

Different sleep questionnaires used in athletic populations such as the Epworth Sleepiness Scale and Pittsburgh Sleep Quality Index are well established to evaluate sleep in the general population but are not validated in an athletic population.[10,16,17] To date, there are two specific sleep questionnaires for athletes; the Athlete Sleep Behavior Questionnaire which was developed to evaluate the sleep behaviors of elite athletes,[10] and the Athlete Sleep Screening Questionnaire (ASSQ) which was initially developed in 2016 by Samuels *et al*.[16] and then clinically validated by Bender *et al*.[18] The questionnaire demonstrated valid and reliable psychometric values in athletic populations.[18]

Due to the lack of validated tools to adequately screen for sleep difficulties in the Iranian athlete population, the present study was conducted to evaluate the validity and reliability of the Persian version of the ASSQ.

MATERIAL AND METHODS

Athlete Sleep Screening Questionnaire

The ASSQ is a 16-item questionnaire that was developed to examine 6 key sleep parameters: sleep quality, total sleep time, circadian preference, insomnia, sleep disturbance while traveling, and sleep-disordered breathing (i.e. obstructive sleep apnea). A sleep difficulty score (SDS) based on the response to items 1, 3, 4, 5, and 6 with a higher score indicating poorer sleep. Item 1; during the recent past, how many hours of actual sleep did you get at night? (This may be different from the number of hours you spent in bed.); Item 3; How satisfied/dissatisfied are you with the quality of your sleep? Item 4; During the recent past, how long does it usually take for you to fall asleep each night?; Item 5; How often do you have trouble staying asleep?; and Item 6; During the recent past, how often have you taken medicine to help you sleep (prescribed or over-the-counter)? The SDS was calculated on a 17-point scale and used to classify participants into 4 different sleep difficulty categories: none (SDS: 0–4), mild (SDS: 5–7), moderate (SDS: 8–10), and severe (SDS: 11–17). Scores ≥8 are considered representative of athletes who could benefit from further assessment and, potentially, intervention. The chronotype score as a subscale of ASSQ is based on the response to items 7, 8, 9, and 10 with a score of ≤4, i.e., classified as an evening-type chronotype. Item 7; Considering only your own "feeling best" rhythm, at what time would you get up if you were entirely free to plan your day?; Item 8; How alert do you feel during the first ½-h after having awakened?; Item 9; Do you consider yourself to be a morning type person or an evening type person?; and item 10; Considering your own "feeling best" rhythm, at what time would you go to bed if you were entirely free to plan your evening? The ASSQ scale does not have a total score and consists of two subscales: SDS and chronotype. In addition, there are six items that are not included in the scoring process. These items (11–14) act as modifiers, providing specific education and recommendations for athletes. Furthermore, items 2, 15, and 16 and inform athletes about strategies for optimizing sleep.

Athlete Sleep Screening Questionnaire translation

After obtaining permission from the copyright owner of ASSQ (Center for Sleep and Human Performance), the translation process was done based on a guide provided by Beaton *et al*.[19]

First, two bilingual translators whose first language was Persian initially translated the ASSQ into the Persian language, then translation (T1 and T2) was obtained from each translator.

Two translators from Step 1 resolved any discrepancies and afterward, a preliminary initial translated version of the instrument was obtained.

To perform the backward translation stage, two translators blinded to the original version of the ASSQ performed two reverse translations (BT1 and BT2).

A committee (one expert in sleep medicine, one expert in sports medicine, one methodologist, and all four translators in Step 1 and Step 3), reviewed all translations, conceptual, semantic, and content equivalence assessed until reaching a final consensus, then a prefinal version was obtained.

The prefinal version was given to 30 national athletes whose language was Persian about understanding each of the items and to ensure that the adapted version still retains its equivalent in applied situations, so that after completing the questionnaire, each of them was asked about their opinion on the questions and the final report prepared.

All the information from the previous stages was reviewed and analyzed by the committee and the final version was obtained.

Content validity

Content validity ratio (CVR) and content validity index (CVI) were used to quantitatively evaluate the content validity using 8 experts (4 sleep medicine physicians and 4 sports medicine physicians). In the CVR index, the necessity of having an item is evaluated from the point of view of experts. In this study, the minimum CVR value was calculated to be 0.75 based on the Lawshe table.[20] For

content asked from experts to evaluate each item of the questionnaire for content equivalence using the following scale: 1 = not relevant, 2 = unable to assess relevance, 3 = relevant but needs minor alteration, and 4 = very relevant and succinct then the item-level CVI and the scale-level CVI/average (S-CVI/Ave) was calculated. Items with a minimum of 0.78 for CVI were considered acceptable, whereas an S-CVI/Ave of 0.90 was considered excellent content validity.[21,22]

Participants

The data collection was performed from national athletes in Iran 18–36 years old. Athletes who studied had a native Persian language or were fluent in the Persian language and script. The researcher first talked about the objectives of the study fully by phone with the athletes who wished to participate in the study, and after obtaining verbal permission, a message containing a questionnaire link was sent online to 250 athletes. After opening the link, the webpage displayed the purpose of the study and how to complete the questionnaire for athletes. By reading the information and accepting the written consent, the athlete could start to answer the questions. The steps of completing the questionnaires were done by athletes without registration and surname and only by a special code among athletes. After completing the questionnaire, the output was collected in Excel for final analysis. In our study, considering 10 samples per question, a minimum required sample size of 160 individuals was obtained. Finally, 206 athletes answered the questions in full. This study was carried out with the approval of the Ethics Committee of the Vice Chancellor for Research of Iran University of Medical Sciences (Approval ID: IR.IUMS.FMD.REC.1399.498) and adheres to the tenets of the Declaration of Helsinki.

Construct validity: Factor analysis

Exploratory factor analysis was performed performed for two 5-item (1, 3, 4, 5, 6) SDS and 4-item (7, 8, 9, 10) chronotype scores based on 206 samples. The Kaiser–Meyer–Olkin (KMO) test was used to assess sample adequacy and the Bartlett's Sphericity Test for Sphericity. KMO values between 0.7 and 0.8 are considered good and values between 0.8 and 0.9 are considered excellent. To check the construct validity of the ASSQ scale, exploratory analysis, and confirmatory factor analysis were performed. In EFA, principal axis factoring method and varimax rotation were used to extract factors. Furthermore, in the confirmatory factor analysis, the parameters of the model were estimated based on the maximum likelihood method, and the proposed model was based on the index comparative fit index (CFI), Tucker–Lewis index (TLI) (>0.9), Root Mean Square Error of Approximation (RMSEA), Standardized Root Mean Squared Residual (SRMR) (<0.08), Chi-square divided by degrees of freedom (CMIN/DF) (<3 good, <5 acceptable), evaluated.[23]

Ceiling and floor effect

The effect of the ceiling and floor were calculated. Based on the percentage of individuals that had the highest and lowest scores if more than 15% of participants achieved the lowest or highest possible score the effects were perceived.[24]

Convergent validity

At this stage, average variance extracted (AVE) and composite reliability (CR) were used to evaluate the convergent validity of SDS-5 and Chronotype-4 scales. Acceptable indicators for convergent validity are AVE >0.5, CR >0.7, and CR >AVE.[25] In addition, the correlation of each item with the scale was added and a value higher than 3.0 indicates acceptable convergent validity. Of course, the analysis of the known groups was also carried out by examining the difference in the scores of the scales at the levels of gender and education level based on independent T and ANOVA.

Reliability

Internal consistency and stability reliability were used to evaluate reliability. Internal consistency was assessed based on Cronbach's alpha and McDonald's omega (Ω).[24,26] Values >0.7 were considered a suitable criterion for confirming internal consistency. Test–retest reliability was used to evaluate the stability. In this method, 31 people were randomly selected and completed two scales SDS and Chronotype twice for a period of 2 weeks to calculate the degree of reliability (stability), the intra-class correlation index (ICC) has been used and scores were interpreted as poor (<0.5), moderate (0.5–0.75), and good (0.75–0.9) reliability.[27]

Data analysis

In this study, R4.5 software with the Psych package was used for exploratory factor analysis. Mplus 6.1 software (Muthén & Muthén, Los Angeles, CA, USA) was used to confirm the confirmatory factor analysis. Pearson correlation test with SPSS 26 software (IBM, Chicago, United States) was used to evaluate the convergent validity. The significance level in this study was $P < 0.05$.

RESULTS

Sample characteristics

In this study, 206 national sports champions of Iran were evaluated. The mean age of athletes was (25.3 ± 4.4) years and ranged from 18 to 36 years. Among the subjects, 68% (n = 140) were male and 32% (n = 66) were female. The study samples were selected from 16 different summer and winter sports [Table 1]. In this study,

51.5% (n = 106) of the athletes were members of team sports and 48.5% (n = 100) were members of individual sports. The average time to complete the questionnaire for athletes was 4.36 min.

Cross-cultural adaptation

In the pilot phase, the athletes reported that all the questions were understandable, and they did not report any ambiguity.

Content validation

The results for CVR and CVI are given in Table 2. Accordingly, all questionnaire questions remained in the analysis because the CVR value for all questions was more than 0.75 and CVI was calculated for all questions more than 0.70, I-CVIs ranged from 0.87 to 1.0 which was acceptable. S-CVI/AVE was another index which was 0.95. According to the results of CVIs, the ASSQ has acceptable content validity, so all questions have sufficient content validity [Table 2].

Table 1: Characteristics of participants in Iranian athletes

Sport	*n*	Sex (male), *n* (%)	Age, mean±SD
Soccer	41	38 (92.7)	24.9±3.4
Volleyball	41	39 (95.1)	23.1±5.7
Fencing	21	10 (47.6)	26.3±4.7
Taekwondo	14	11 (78.6)	26.0±2.9
Basketball	19	5 (26.3)	26.3±3.8
Track and field	7	2 (28.6)	28.1±3.6
Tennis	11	7 (63.6)	24.6±4.3
Rowing	8	2 (25)	24.5±4.3
Jujutsu	5	5 (100)	28.0±3.9
Alpine skiing	2	1 (50)	25.5±0.7
Speed skating	4	2 (50)	25.0±2.8
Karate	9	7 (77.8)	26.8±2.8
Cycling	4	2 (50)	22.0±2.1
Archery	10	4 (40)	29.0±5.0
Badminton	5	1 (20)	25.2±3.1
Water polo	5	4 (80)	25.2±2.1

Table 2: Description of quantitative content validity indicators (content validity ratio and content validity index) Iranian experts

Item	CVI	CVR	Agreement
q1	1	1	Accept
q2	1	1	Accept
q3	1	0.75	Accept
q4	1	1	Accept
q5	1	1	Accept
q6	1	1	Accept
q7	0.87	0.75	Accept
q8	0.87	0.75	Accept
q9	0.87	0.75	Accept
q10	0.87	0.75	Accept
q11	1	1	Accept
q12	1	1	Accept
q13	0.87	0.75	Accept
q14	1	0.75	Accept
q15	0.87	0.75	Accept
q16	1	1	Accept

CVI=Content validity index; CVR=Content validity ratio

Sleep difficulty scores scale exploratory and confirmatory factor analysis

Sampling adequacy indices (KMO) 0.784 and Bartlett test 80.821, $P < 0.001$ indicated that the data were suitable for exploratory factor analysis.[28] A factor with eigenvalues >1 was identified for the SDS scale and confirmed based on the screen plot diagram. In total, one factor could explain 44.01% (eigenvalue = 2.20) of the variance of the SDS scale. Table 3 shows that all factor loads of the five items on the SDS scale were higher than 0.4. The correlation between all items and the total was higher than the minimum acceptable value of 0.3 (range = 0.64–0.86, mean = 0.73). The single-factor model of the SDS scale obtained from exploratory factor analysis was also validated based on confirmatory factor analysis. In confirmatory factor analysis, the one-factor model with 5 items was tested. Fit indicators showed that the one-factor structure of the SDS scale had a good and acceptable fit in the Iranian athletes:

S-B χ^2 = 11.203, DF = 5, P = 0.047, CFI = 0.98, TLI = 0.96, RMSEA = 0.07 (90% CI: 0.05–0.088), SRMR = 0.06.

All factor loadings of items on the factor were significant (all Ps < 0.001). Table 4 shows the descriptive statistics and factor loads obtained from the exploratory and confirmatory factor analysis of the SDS single-factor scale.

Chronotype scale exploratory and confirmatory factor analysis

Sampling adequacy indices (KMO) 0.755 and Bartlett test 9.329, P = 0.025 indicated that the data were suitable for exploratory factor analysis.[28] A factor with eigenvalues >1 was identified for the chronotype scale and in total, a single factor was able to explain 42.99% (eigenvalue = 1.72) variance of the chronotype scale. Table 3 shows that all factor loads of the four items on the chronotype scale were higher than 0.4. The correlation between all items and the total was higher than the minimum acceptable value of 0.3 (range = 0.65–0.79, mean = 0.75). The one-factor model of the chronotype scale obtained from exploratory factor analysis was also validated based on confirmatory factor analysis. In confirmatory factor analysis, the one-factor model with 4 items was tested. Fit indices showed that the one-factor structure of the chronotype scale had a good and acceptable fit in the Iranian athletes:

S-B χ^2 = 1.681, DF = 2, P = 0.431, CFI = 0.99, TLI = 0.99, RMSEA = 0.01 (90% CI: 0.01–0.05), SRMR = 0.002.

The results of Table 4 showed that the factor loading of all items was higher than 0.4 and significant ($P < 0.001$).

Ceiling and floor effect

In this study, the Ceiling and Floor Effects for SDS and chronotype were 1.9% and 3.9%, respectively, so the ceiling and floor effect is not observed, and the total score is normally distributed.

Reliability (internal consistency and stability) and convergent validity

Internal consistency of SDS (Cronbach's alpha = 0.77; 95% CI 0.71–0.81) and chronotype scale (Cronbach's alpha = 0.74; 95% CI 0.68–0.79) were confirmed. The stability of SDS (ICC = 0.87; 95% CI 0.75–0.94) and chronotype scale (ICC = 0.83; 95% CI 0.81–0.95) were also confirmed. Furthermore, the ICC coefficient for 2 weeks for SDS and chronotype scales was equal to ($r = 0.880$; $P < 0.001$) and ($r = 0.849$; $P < 0.001$), respectively. In addition, in SDS and chronotype scales, the values of AVE > 0.5 and CR > AVE were indicative of convergent validity [Table 5].

Furthermore, the correlation of each item with its factor was at an acceptable level above 0.3, which indicates acceptable convergent validity of the scale.

The results showed that there is a positive and significant correlation between SDS with age ($r = 0.28$, $P < 0.01$) and there is a significant negative correlation between chronotype with age ($r = -0.21$, $P < 0.01$).

Independent *t*-test results showed that there is a significant difference between gender, SDS, and chronotype ($P < 0.01$). Furthermore, the results of ANOVA showed that there is a significant difference between education level with SDS and chronotype ($P < 0.01$).

There was no significant difference between the individual and team sports groups in SDS ($P = 0.182$) and chronotype ($P = 0.886$) scores.

Table 3: Descriptive statistics, exploratory and confirmatory factor analyses of the sleep difficulty scores and chronotype (*n*=206)

Items	Mean±SD	ITC	EFA	CFA λX
SDS	4.66±3.18			
1	1.96±0.98	0.55	0.43	0.40
3	1.06±1.10	0.38	0.84	0.88
4	0.68±0.87	0.36	0.63	0.69
5	0.72±0.72	0.59	0.69	0.73
6	0.22±0.63	0.51	0.65	0.81
Chronotype	9.01±2.41			
7	2.34±0.87	0.48	0.67	0.73
8	2.39±0.71	0.54	0.51	0.57
9	2.12±0.79	0.33	0.69	0.74
10	2.14±0.82	0.87	0.73	0.81

EFA=Exploratory factor analysis; SD=Standard deviation; ITC=Item-total correlation; CFA=Confirmatory factor analysis; λx=Standardized coefficients; SDS=Sleep difficulty score

Table 4: Confirmatory factor analyses of the sleep difficulty scores and chronotype

Items	CFA λX
SDS	
1	0.40
3	0.88
4	0.69
5	0.73
6	0.81
Chronotype	
7	0.73
8	0.57
9	0.74
10	0.81

CFA=Confirmatory factor analysis; λx=Standardized coefficients; SDS=Sleep difficulty score

DISCUSSION

Questionnaires are often applied as initial sleep assessment tools as they are considered easy to use and inexpensive to provide.[29] Among all questionnaires, ASSQ developed and validated to screen sleep problems in athletes.[16,18] Hence, the present study worked on applying cross-cultural adaptation to the validation and reliability of the Persian version of ASSQ for screening sleep problems among Persian-language athletes.

The first part of this study was a cross-cultural adaptation, which ensured that athletes answered all the items and clarified the truly inferred meaning of things without any ambiguity.

In the present study, internal consistency (Cronbach's alpha) and stability reliability (test–retest) were used to measure the reliability of the Persian version of ASSQ. Cronbach's alpha of SDS and chronotype were 0.77 and 0.74, respectively. Stability reliability was also confirmed for SDS scale and chronotype scale. Furthermore, the correlation

Table 5: Reliability (internal consistency and stability) and convergent validity of sleep difficulty scores and chronotype scales

Scale	Number of items	Cronbach's alpha	Ω	ICC (CI 90%)	AVE	CR
SDS	5	0.77 (0.71–0.81)	0.83	0.87 (0.75–0.94)	0.51	0.83
Chronotype	4	0.74 (0.68–0.79)	0.77	0.83 (0.81–0.95)	0.51	0.81

Ω=McDonald omega coefficient; CR=Construct reliability; AVE=Average variance extracted; ICC=Intra-class correlation; CI=Confidence interval; SDS=Sleep difficulty score

coefficient at 2-week intervals for SDS and chronotype scales was statistically significant.

The clinical validation of the ASSQ was later reported by Bender *et al*.[18] who found that the ASSQ, when properly scored, showed high agreement with the recommendations of a sleep medicine physician (Cohen's κ =0.84), with a sensitivity of 81%, specificity of 93%, a positive predictive value of 87%, and negative predictive value of 90%. Bender *et al*.[18] also found that the ASSQ had good reliability by internal consistency (SDS-Cronbach's alpha = 0.74, chronotype-Cronbach's alpha = 0.73) and test–retest reliability (SDS-*r* = 0.86, chronotype-*r* = 0.78). The validity results of our study in line with Bentler's results showed that the ASSQ is a reliable tool to use in athletes.

The exploratory factor analysis showed that one factor for the SDS scale with 5 items and one factor for the chronotype scale with 4 items were identified and confirmed. Based on these results, the ASSQ questionnaire is a valid tool for screening sleep difficulty in Iranian athletes.

Rabin *et al*.[13] showed in their study, a substantial portion of college athletes experience poor sleep health (23.7%) and would benefit from interventions aimed at improving sleep. Furthermore, Bender *et al*.[18] found that 25.1% of athletes had clinically meaningful sleep problems, categorized as moderate to severe. In this study, 15% of athletes had moderately to severe SDS. This difference was considered due to many factors such as differences in the time of the season when athletes complete the questionnaire and different types of training.

The correlation results show that sleep disorders were higher in older ages, higher education, and more in women. Also Rabin *et al*.[13] found that female athletes were slightly more likely to report more sleep difficulty.

Due to the COVID-19 pandemic and the avoidance of filling out questionnaires in person, questionnaire forms were prepared online for both testing and retesting. Sometimes, filling out questionnaires in person may clear up ambiguities and provide more accurate answers to questions. On the other hand, filling out questionnaires online provides the conditions for athletes to be more relaxed than in other centers. In addition, the design of the online questionnaire prevented patients from passing any of the unanswered questions.

Comparing the prevalence of sleep problems at the clubs and national levels and further identifying these problems can be a step toward further evaluation and advice and interventions to improve the performance of athletes at the clubs and national levels. It is recommended that future studies be conducted at different clubs and national levels.

CONCLUSION

Overall, ASSQ has been shown to provide a reliable and valid expression for assessing sleep health in native Persian athletes. It is suggested that the ASSQ could be a useful way for physicians overseeing a wide variety of exercise programs to screen Iranian athletes for clinical sleep-related issues.

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Conflicts of interest

There are no conflicts of interest.

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