




Cleveland Adolescent Sleepiness Questionnaire (CASQ): a translation and validation study of the Persian version

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Abstract

Introduction The purpose of this study was to assess the validity and reliability of the Persian version of the Cleveland Adolescent Sleepiness Questionnaire (CASQ) in Iranian adolescents.

Methods The CASQ consists of 16 items measuring extreme sleepiness during the day in adolescents aged 11–17 years old. The questionnaire includes two dimensions: Sleepiness Statements and Alertness Statements. This study was a descriptive cross-sectional study. The original English text of CASQ was translated into Persian using backward-forward translation. Then, 310 secondary school adolescents aged 11–17 years old completed that in Kashan. The internal validity of the questionnaire was determined two times at an interval of two weeks using Cronbach's alpha coefficient. The concurrent validity was determined using Spearman correlation coefficient. Factor analysis was used by performing principle component analysis for assessing construct validity.

Results 199 (47.1%) of the adolescents participated in this study, were male and 111 (52.9%) were female. Mean and standard deviation of the age of adolescents were 14.31 ± 0.9 . The Cronbach's alpha coefficient for the entire CASQ was the satisfactory value of 0.8. The intra-class correlation coefficient (ICC coefficient) of the tool was 0.78, which confirmed the repeatability of this test. Spearman's correlation coefficient between CASQ and Epworth sleepiness scale (ESS) was equal to 0.21, and the correlation coefficient between CASQ and Pittsburg Sleep Quality Index (PSQI) was 0.25. Both were significant at $P < 0.05$ level.

Conclusions Based on the present study findings, we concluded that the Persian version of CASQ has an appropriate validity and reliability for assessing the sleepiness of adolescents in the Persian language community.

Keywords Cleveland Adolescent Sleepiness Questionnaire · Iran · Reliability · Validity

Introduction

One third of people's lives is spent in sleep. It should not be a waste of time because sleep reduces stress, anxiety, and nervous pressure, and help the person recycle energy for more focus and adaptation of the benefits of daily activities [1]. Prevalence of sleep problems is 25–40% among

adolescents and young people. These problems are often unknown and untreatable. Inadequate sleep and sleep deprivation result in neurological, behavioral, and physiological changes [2]. It is also associated with a decline in academic performance and a decrease in daily performance in classroom.

A significant number of teenagers in the United States complains about excessive sleepiness during the day. Research about adolescent sleeping habits shows that in each region between 84 and 87% of adolescents do not have enough sleep [3–6]. A similar trend has been observed among teens from other countries [7].

Sleepiness during the day leads to problems such as increased aggression and other behavioral problems, poorer academic performance, increased risk of injury (including workplace accidents), and increased use of caffeine, nicotine, and other stimulants in adolescents. Sleep is very important

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for physical growth, emotional stability, and behavior and cognitive functions [8, 9]. Today, computer games, social networking and chat are exacerbating factors of sleep disorders and sleep deprivation in adolescents [10–12]. Various studies have reported different prevalence rate of sleep disorders. This difference is due to the methodology such as the use of various interviews, various questionnaires, and the lack of sleep monitoring tools for verifying the validity and reliability [13].

An alternative for evaluating sleepiness in this population is the use of questionnaires. The Pediatric Daytime Sleepiness Scale (PDSS) [14], one of the most often used, indicates limitation as it restricts age group for adolescents. The Modified Epworth Sleepiness Scale (ESS) [15], which is an adaptation of the ESS, contains few questions in its evaluation and has been used widely in both clinical and research setting worldwide. Therefore, even though the Cleveland Adolescent Sleepiness Questionnaire (CASQ) does not have a cutoff point for the classification of presence or absence of sleepiness since it addresses questions from four subscales, it is one of the most complete questionnaires to assess excessive sleepiness in the targeted population.

This questionnaire is a new questionnaire to assess sleepiness. Other questionnaires commonly applied to children and adolescents are used for smaller population, and have limited national application. Therefore, we evaluated the reliability and validity of the Persian version of the CASQ.

Materials and methods

Cleveland adolescent sleepiness question (CASQ)

This questionnaire was first designed and validated by Spilsbury in 2007. There are 16 items to measure extreme sleepiness during the day in adolescents aged 11–17 years old, and assess the degree of sleepiness in adults. Its limit values are 16–20 points. There is no cutoff point for the classification of the presence or absence of sleepiness. Measure CASQ is organized in four subscales: (1) sleeping in school, (2) alertness/wakefulness in school, (3) sleeping during the evening, and (4) sleeping during transportation; all items refer to everyday situations in which adolescents might feel sleepy or even fall asleep. The questionnaire has two dimensions: Sleepiness Statements and Alertness Statements; items are scored from 1 (never) to almost every day (5 or more). To produce an overall score (items related to alertness were reversed), participants' responses were summed up. Higher scores indicate daytime sleepiness, and it is required adolescents to sleep more on school nights. Higher scores also indicate sleeping problems like obstructive sleep apnea. The Cronbach's alpha in this questionnaire was calculated at 0.89

with an average of 35.2 and a standard deviation of 11.0 in the James' questionnaire [7].

Translation

Initially, in a correspondence with developers of CASQ, Spilsbury et al., required permission to prepare the Persian version of the questionnaire for the study was obtained. The English version of the questionnaire was also provided by the author to the project implementers. The questionnaire was then translated from English to Persian using standard methods, including forward–backward and pre-test by two independent bilingual researchers. Then a new version was developed and delivered to a group composed of four judges with advanced training in sleep medicine to revise the translated items. Afterwards, five adolescents were asked to complete the questionnaire through the thinking-aloud method to review this CASQ version. A final revised version was developed, and the questionnaire was distributed among the secondary schools.

Participant

In this study, a questionnaire was distributed among 310 adolescents aged 11–17 years old in secondary schools of Kashan. Sampling method in this study was cluster random sampling. At first, the list of all schools was originally provided. Then, in each cluster, all the students in each school were randomly selected. All the students of the class were assessed if they would have criteria of the research. Confidentiality and voluntary participation in the study were explained for all students, and then a total of 360 questionnaires were distributed. 310 students completed questionnaires and 50 questionnaires were removed due to defect. The protocol was approved by the institutional review board of Kashan University of Medical Sciences (2017/96191).

Inclusion criteria were being 11–17 years old and living with both biological parents. Exclusion criteria were serious stress during the previous year, the death of first-degree relatives, migration (major failures in life, both emotional and academic), the onset of a disease requiring hospitalization or requiring serious and long-term treatment according to health records), and taking sleep medications.

Additional measures

Pittsburg sleep quality index (PSQI)

The PSQI contains 19 questions that are self-rated and 5 questions that the bed partner or roommate (if one is available) rates them. In the scoring, just self-rated questions are included. To form seven "component" scores with a range of 0–3 points for each one, the 19 self-rated items are

combined. A score of "0" shows no difficulty and the score of "3" means severe difficulty. Then to produce one "global" score with a range of 0–21 points, the seven component scores are added. In all areas, "0" shows no difficulty and "21" shows severe difficulties. The validity and reliability of this tool in Iran was reviewed by Farahani Moghadam et al. Cronbach's alpha coefficient for the whole questionnaire was 0.77, which was 0.52 in the case group and 0.78 in the control group. The correlation coefficient of the sub-scales was calculated from 0.3 to 0.75 for the seven subscales [16].

Epworth sleepiness scale (ESS)

The ESS is a self-administrated eight-item questionnaire that has been proposed as a simple method for measuring daytime sleepiness in adults. The score for each question is between zero and 3. In other words, the overall score of ESS is determined from zero (no sleepiness in any situation) to 24 (high probability of sleepiness in all 8 situations). The final score of the ESS scale in the range of zero to 8 indicates normal sleepiness, 9–12 indicates mild sleep deprivation, 13–16 indicates moderate sleepiness, and a score of more than 16 indicates severe sleepiness. Clinically, ESS more than 10 is considered to be important and indicates sleepiness [15]. Validity and reliability of this questionnaire were reported in Ghaffari et al. with a reliability coefficient of 0.73 [17].

Reliability and validity

In this study, we assessed reliability through several methods. For internal consistency the Cronbach's alpha coefficient and test–retest analysis were used, and validity of the CASQ was assessed by two methods: Construct validity and concurrent validity.

Statistical analysis

Cronbach's alpha coefficient was assessed for evaluating internal consistency, and alpha values equal or greater than 0.7 considered satisfactory [18]. Test–retest reliability was assessed using intra-class correlation coefficient (ICC). To measure the sampling adequacy, Kaiser–Meyer–Olkin (KMO) test, and Bartlett's test of sphericity were applied [19]. The sample was considered adequate if: (1) KMO value was more than 0.5 and (2) Bartlett's test was significant ($P < 0.05$). In extraction of components, principal Component Analysis (PCA) method was applied. Components with Eigenvalues of over 1 were retained as components. With the assumption that all items were uncorrelated, Varimax rotation was applied to optimize the loading factor of each item on the extracted components. Items with loading factor of more than plus or minus 0.4 were considered as an acceptable loading factor [19]. Spearman's rank correlations were

Table 1 Participant characteristics

Variable	N (%)	Mean (SD)
Total	310 (100)	
Sex		
Girl	111 (52.9)	
Boy	199 (47.1)	
Age		14.3 ± 0.9
11–12	49 (16)	
13–15	185 (60)	
16–17	76 (24)	
Average of education		17.1 ± 3.9

Table 2 Mean and standard deviation of dimensions of CASQ dimensions

Dimensions	Min	Max	Mean	Std deviation
Sleepiness Statements	0	30	9.5	5.8
Alertness Statements	10	25	15.5	3.8
Cleveland total	10	43	25	7.5

considered as follows: $r = 0.21$ – 0.4 (sufficient $r = 0.41$ – 0.6 (good), and $r = 0.61$ – 0.8 (very good) [20]. $P < 0.05$ was considered statistically significant. SPSS statistics 16 was used for statistical analysis.

Results

In this study, 310 students, 199 (47.1%) males and 111 (52.9%) females were examined. The mean age was 14.31. Table 1 shows descriptive features. Mean and standard deviation of dimensions of CASQ are presented in Table 2. A frequency distribution of the CASQ total is presented (Fig. 1). The Cronbach's alpha coefficient for the reliability of CASQ was 0.87. By removing any of the items, no significant change was observed in Cronbach's alpha. The range of this coefficient varied from 0.66–0.78 among questions. Using a re-test on 30 participants, after 2 to 4 weeks, the intra-class correlation coefficient (ICC coefficient) was calculated to estimate the reliability of the CASQ tool. The amount of ICC in Sleepiness Statements was 0.87 and in the Alertness Statements 0.66. In the whole questionnaire, this coefficient was 0.78, which confirmed the repeatability of this test. Table 3 shows the coefficient of ICC (Table 3).

Content validity

To ensure the most relevant and correct items, the Content Validity Index (CVR) was used, and to ensure the most measurable items, Content Validity Index (CVI) was used.

Fig. 1 Frequency distribution of the CASQ score

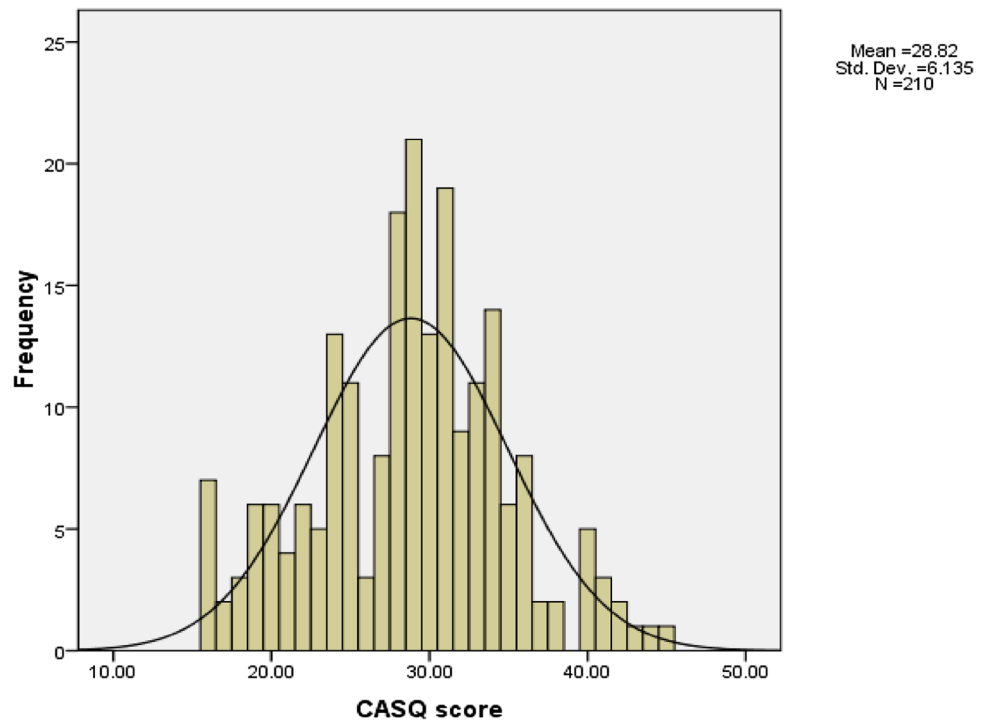


Table 3 Intra correlation coefficient dimension of CASQ

Name of dimension	ICC	CI (95%)
Sleepiness statements	0.87	0.78–0.93
Alertness statements	0.66	0.44–0.81
All	0.78	0.64–0.88

Content validity of the scale was determined by quantitative and qualitative methods using CVI, which determined by 3 experts as panel of experts. To determine the face validity of the items, the level of difficulty, and the degree of non-proportionality and ambiguity were studied and corrected. The experts also gave their opinions on editing questions and its relevance to the cultural conditions of the country.

Concurrent validity

To assess the concurrent validity, the correlation coefficient between ESS and CASQ and PSQI was calculated using Spearman’s correlation coefficient. The correlation coefficient between two scales was equal to 0.215, and correlation coefficient between CASQ and PSQI was 0.25. Both were significant at $P < 0.05$ level (Table 4). Association between CASQ scores and "daytime dysfunction" domain of PSQI is $r = 0.35$ $P < 0.001$, and the association between CASQ scores and sleep durations was $r = 0.1$ $P < 0.34$. In addition, the reliability was assessed. First, the raters were trained. Then, they independently provided

Table 4 Correlation between CASQ with ESS and PSQI

Dimension		PSQI	ESS
Sleepiness statements	<i>r</i>	0.38**	0.39**
	<i>P</i>	0.001	0.001
Alertness statements	<i>r</i>	0.15	0.16
	<i>P</i>	0.13	0.10
CASQ	<i>r</i>	0.25*	0.21*
	<i>P</i>	0.02	0.04

* $P < 0.05$

** $P < 0.001$

Table 5 Mean and standard deviation of CASQ score based on normal and abnormal sleep quality according to the ESS and PSQI

Instruments	Cutoff point	Status	Mean ± SD	<i>P</i>
ESS	Lowest through 9	Normal	28.03 ± 5.86	0.002
	Highest through 10	Abnormal	31.05 ± 6.27	
PSQI	Lowest through 5	Normal	28.03 ± 5.91	0.007
	Highest through 6	Abnormal	30.8 ± 6.5	

their ratings. The correlation coefficient between the ratings and the Intra-class Correlation Coefficient (ICC) was used to assess the reliability (Table 4). The mean and standard deviation of the CASQ are shown in terms of normal and abnormal sleep according to the ESS and PSQI (Table 5).

Table 6 KMO and Bartlett's test of sphericity as a result of the correlation matrix for CASQ

Kaiser–Meyer–Olkin measure of sampling adequacy	0.748
Bartlett's test of sphericity	
Approx. Chi-square	566.595
df	120
Sig	<0.001

Construct validity

To perform exploratory factor analysis, the sample size was appropriate. The criterion of the adequacy of the sample size used for factor analysis was values of 0.6 and higher, using the Kaiser–Meyer–Olkin Measure (KMO) test. Exploratory factor analysis was used for construct validity. The main purpose of the factor analysis is to diagnose a large number of variables in a limited number of factors so that there was the least amount of data loss. As shown in Table 6, the KMO value was higher than 0.6 and the significance level of Bartlett's test was less than 0.001. Therefore, based on the two criteria, it could be concluded that the implementation of the factor analysis based on the correlation matrix in the sample groups could be justified (Table 6).

In the present study, to achieve the definitions of factors, the coefficient equal to 0.40 was considered as the load factor. Thus, based on the results of the analysis of the factor analysis and the indicators mentioned, from among the questions, 2 factors with an Eigenvalue greater than 1 was obtained which explained 57% of the variance. To obtain a meaningful structure for the analyzed data, the extracted factors were transferred to the new axis using the varimax rotation. The one factor with 11 questions has a strong correlation, and it was called Sleepiness Statements, and includes questions 10, 8, 15, 1, 9, 6, 3, 14 and 4, 16 and 12. The second factor had a strong correlation with 5 questions, and was called "Alertness Statements"; including questions 13, 7, 5, 2, and 11 (Table 7).

Discussion

The main purpose of this research was to provide an appropriate tool for assessing the CASQ in Iranian youth, and also the existing relationships among various dimensions of the CASQ. The results showed that this questionnaire has a good validity and reliability in the study of adolescents sleep, and could be used as a suitable tool in scientific research. Also, the relationship obtained from the dimensions of this questionnaire could be considered as a guide to prevent sleepiness.

According to the CASQ questionnaire in Iran, no study has been made, and this study was the first one. In this study,

Table 7 Structural validity: factorial structure of the Cleveland scale after varimax rotation

CASQ questions	Component	
	1	2
Question 10	0.421	
Question 8	0.445	
Question 15	0.517	
Question 1	0.590	
Question 9	0.609	
Question 6	0.628	
Question 3	0.695	
Question 14	0.774	
Question 4	0.786	
Question 16	0.805	
Question 12	0.825	
Question 13		0.716
Question 7		0.724
Question 5		0.728
Question 2		0.733
Question 11		0.803

the mean and standard deviation of the questionnaire were 25 ± 7.5 . The mean and standard deviation in a study performed in Brazil were 38.6 ± 6 [21], in the United States [7]. They were 35.2 ± 11 , and in the Indian study they were 36 ± 9 [22]. These results indicate that Iranian children are better off than those in the above mentioned countries and that sleepiness in these countries is higher than that of Iranian adolescents.

According to the results of this study, there was no significant correlation between sleep duration and CASQ score. In Spilsbury study [7] contradictory results were reported. No significant difference was found between healthy subjects and OSA in terms of sleep duration at non-school night, sleep duration at school night, and sleep debt. There was no significant correlation between sleep duration at school nights and CASQ score and no significant correlation was observed in other cases.

The findings of this study showed that Cronbach's alpha coefficient for the whole questionnaire was 0.87 which is a satisfactory indicator of Iranian adolescents. In the study by Spilsbury et al., Cronbach's alpha coefficient for all questions was 89% [7]. In the study by Pinto et al. in Portugal, Cronbach's alpha for the questionnaire dimensions was 0.68 and 0.83, respectively [23] and in line with the results of our study. It seems that the differences in the studies are due to different groups of children. Similar studies showed that the number of participants under study did not affect the Cronbach's alpha coefficient.

The cultural and geographical differences of different populations should not be ignored in the assessment of

adolescents' sleep through the CASQ questionnaire, and one cannot expect different standardized versions to have the same results in terms of the language, culture and customs of different nations. Another point is that in the present study, the case group was healthy adolescents, and was not comparable with those with sleep problems.

Content validity, concurrent validity, and factor analysis were used to calculate the validity. Content validity was calculated by adding up the percentage reported by each expert and calculating the mean of CVI. The percentage of content validity was calculated to be 97%. The Concurrent validity of the CASQ questionnaire showed a significant correlation with the ESS and PSQI. To examine the internal consistency of this tool, all correlation coefficients between the dimensions of the CASQ questionnaire were significant at the level of 0.05. The remaining correlations were significant ($P < 0.001$). The KMO sample sufficiency index for the data in this questionnaire was 0.74, the Bartlett score was 566 and the P value was zero. So, the data were suitable for exploratory factor analysis.

The results of the exploratory factor analysis showed that 2 components had a specific value of more than 1, which means that these 16 questions are summarized in 2 dimensions. The two selective factors explain 57% of the total variance (observational changes). In the 2017 study of Pinto, Joana Carneiro et al., in Portugal, 53.2% of the total variance was explained [23]. This means that summarizing the 16 questions of this tool in two areas in Iranian culture was better than Portugal. In general, the CASQ questionnaire is a tool that measures a daily sleepiness and night vigilance.

In this study, there was no objective measure of excessive daytime sleepiness and the use of an objective measure related to sleep duration. The important thing is that the use of subjective measures such as a self-completed questionnaire or diary makes estimates of sleep duration consistent with an objective measure such as actigraphy [24].

Nevertheless, future research is required to examine the association between the CASQ and additional objective measure of sleepiness and sleep duration. There is a need for additional studies on various subpopulations of adolescents, which permit more precise estimates of the CASQ's psychometric properties. Also, adolescents with a known sleep problem potentially leading to daytime sleepiness less than those with sleep-disordered breathing.

In this study, the validity and reliability of this instrument were fully evaluated. The results showed that this tool has good validity in Iranian society. Therefore, it is suggested that in this study, the instrument should be used to measure daily sleepiness in adolescents. One of the limitations of this study was cross-sectional design, which could not provide a causal relationship between variables. On the other hand, the other limitation of this study was that it was not possible to study the group that

did not return the questionnaires and this group may have a significant difference with other children.

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Compliance with ethical standards

Conflict of interest The authors report no actual or potential conflicts of interest.

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