Athens Insomnia Scale: validation of an instrument based on ICD-10 criteria

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Abstract

Objectives: To describe and validate the Athens Insomnia Scale (AIS). Methods: The AIS is a self-assessment psychometric instrument designed for quantifying sleep difficulty based on the ICD-10 criteria. It consists of eight items: the first five pertain to sleep induction, awakenings during the night, final awakening, total sleep duration, and sleep quality; while the last three refer to well-being, functioning capacity, and sleepiness during the day. Either the entire eight-item scale (AIS-8) or the brief five-item version (AIS-5), which contains only the first five items, can be utilized. The validation of the AIS was based on its administration to 299 subjects: 105 primary insomniacs, 144 psychiatric patients and 50 non-patient controls. Results: Regarding internal consistency, for both versions of the scale, the Cronbach's α was around 0.90 and the mean item–total correlation coefficient was about 0.70. Moreover, in the factor analysis, the scale emerged as a sole component. The test–retest reliability correlation coefficient was found almost 0.90 at a 1-week interval. As far as external validity is concerned, the correlations of the AIS-8 and AIS-5 with the Sleep Problems Scale were 0.90 and 0.85, respectively. Conclusion: The high measures of consistency, reliability, and validity of the AIS make it an invaluable tool in sleep research and clinical practice. © 2000 Elsevier Science Inc. All rights reserved.

Keywords: Scale; Validation; Insomnia; Sleep disorders; ICD-10

Introduction

Problems with poor sleep are quite frequent in the general population; their prevalence ranges from 10% to 30% [1–5] and it is much higher among patients with psychiatric disorders [5–8]. In most studies assessing subjective sleep difficulties, self-devised questionnaires and sleep diaries are utilized. Such instruments may be adequate for the purposes of a given study allowing comparisons between conditions or groups of individuals, but they are usually not standardized or uniform — making the integration of results from various studies impossible. Some standardized instruments, however, have been developed for the measurement of sleep difficulties in clinical settings: the Leeds Sleep Evaluation Questionnaire [9,10], the St. Mary’s Hospital Sleep Questionnaire [11,12], the Sleep Problems Scale [13], the Pittsburgh Sleep Quality Index [14], and the Karolinska Sleep Diary [15,16].

The evolution of diagnostic concepts regarding insomnia is reflected in the various classification systems, which have been in use over the last two decades [17–21]. The classification published in 1979 by the Association of Sleep Disorders Centers required a sleep laboratory based criterion of reduced sleep quantity for the diagnosis of insomnia [17]. In drafting the DSM-III-R, the clinical approach prevailed, according to which the diagnosis of insomnia is based on the patient’s subjective perception of unsatisfactory sleep quantity and/or quality [18]. Ever since, for the diagnosis of insomnia impaired sleep quality is given equal importance as that of reduced sleep quantity and the patient’s subjective assessment is not discarded [19–21].

Following the publication of the ICD-10 diagnostic criteria for insomnia [20], the need arose to develop a scale as a tool to assist clinicians in assessing the severity of insomnia based on these globally accepted criteria. The rationale for the development of such a tool, the Athens Insomnia Scale (AIS), has been presented previously [22].
The purpose of the present paper is to provide a detailed description of the AIS and documentation of its validation.

Methods

Description of the scale

The AIS is a self-administered psychometric instrument consisting of eight items (Appendix A). The first five items of the AIS (assessing difficulty with sleep induction, awakenings during the night, early morning awakening, total sleep time, and overall quality of sleep) correspond to criterion A for the diagnosis of insomnia according to ICD-10, while the requirements of a minimum frequency (at least three times a week) and duration (1 month) of any complaint correspond to criterion B of the ICD-10 [20]. The ICD-10 requirements of marked distress caused by the sleep problem and/or interference with ordinary activities of daily living (criterion C) are covered through the strictly subjective nature of the response options for every item of the scale as well as through the content of the last three items pertaining to the next day consequences of insomnia (problems with sense of well-being, functioning, and sleepiness during the day).

Each item of the AIS can be rated 0–3, (with 0 corresponding to “no problem at all” and 3 “very serious problem”). The respondents are requested to rate positive if they had experienced the sleep difficulty described in each item at least three times a week during the last month or some other period of time, whose length depends on the purpose of a given study.

Two versions of the scale can be used. Either the entire eight-item scale (AIS-8) — with a total score ranging from 0 (denoting absence of any sleep-related problem) to 24 (representing the most severe degree of insomnia) — or the brief five-item version (AIS-5), which is limited to the first five items — with a total score ranging from 0 to 15. The AIS-8 is intended for use in a fully developed clinical setting, while the AIS-5 is mainly used when there is a need to focus just on difficulty with sleep quantity and quality. The last three items of the AIS-8 refer to daytime symptoms that often emerge as a consequence of nocturnal sleep disturbance in insomniac patients. However, these symptoms may be also caused by sleep disorders other than insomnia, such as narcolepsy and obstructive sleep apnea.

The AIS was first developed in English by the senior author (C.R.S.), who was the expert responsible for drafting the original diagnostic criteria for the sleep disorders section of ICD-10 [20]. For the purposes of the present study, however, the AIS had to be translated in Greek. Thus, in order to secure equivalence of the Greek translation to the original English text the guidelines of the World Health Organization were followed [23]. According to these guidelines, a bilingual group of three experts examined and approved the conceptual structure of the English text, noting its simple and straightforward format, which would be expected to pose no major problems for the translation. Then, one of the authors (D.G.D.) translated the scale into Greek. The Greek translation was examined by the bilingual group as well as by a three-member unilingual group, who proposed only a few minor modifications of the Greek wording. The modified Greek text was back-translated into English by the third author (T.J.P.). Finally, the back-translation was carefully examined by the bilingual group, who decided that the Greek translation of the AIS — as had been amended by the unilingual group — was equivalent to the original English text.

Sample characteristics

Following the approval of the project by the institutional review committee, the AIS was given to 105 primary health care patients presenting with a complaint of insomnia not attributed to any obvious underlying cause (primary insomnia), 100 psychiatric outpatients, 44 psychiatric inpatients, and 50 non-patient controls. Thus, the total sample consisted of 299 subjects. As Table 1 shows, 42% of the subjects were males and 58% females with a similar sex ratio across the four subgroups of subjects. The age distribution differed somewhat among these subgroups; primary insomniacs were the oldest and psychiatric inpatients the youngest (Table 1).

All subjects were informed on the research nature of the project and all agreed to participate. Primary health care patients were recruited through general practitioners and other non-psychiatric physicians functioning in out-patient services of the Hellenic National Health System or in private medical practice settings. Psychiatric patients were those attending the facilities of the Department of Psychiatry of the University of Athens. Finally, non-patient controls were recruited from among the researchers’ friends and acquaintances.

Assessment procedures

The subjects were asked to record on the AIS their estimate of any sleep difficulty they might have experienced

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Characteristics of the sample in terms of sex and age</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Male</td>
</tr>
<tr>
<td>Primary insomniacs (n = 105)</td>
<td>43</td>
</tr>
<tr>
<td>Psychiatrist outpatients (n = 100)</td>
<td>41</td>
</tr>
<tr>
<td>Psychiatrist inpatients (n = 44)</td>
<td>20</td>
</tr>
<tr>
<td>Non-patient controls (n = 50)</td>
<td>24</td>
</tr>
<tr>
<td>Total sample (n = 299)</td>
<td>127</td>
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</tbody>
</table>
during the period of the last month. To evaluate test–retest reliability, all psychiatric patients and the controls (N = 194) were assessed through the AIS at two time points a week apart from each other. The controls and psychiatric inpatients (N = 94) were also administered the Sleep Problems Scale [13] as an external validator.

Data analysis

The internal consistency of the scale was measured based on Cronbach’s \( \alpha \) [24] for the whole scale, as well as for all-but-one items if any one was deleted (“\( \alpha \) if item deleted”). The correlation of each item score to the total scale score (“item–total correlation”) was also measured through Pearson’s correlation coefficients. Additionally, the scale was subjected to factor analysis; in the extraction method of the principal component analysis, the eigenvalue threshold was set at 1.0. Pearson’s correlation coefficients were computed for the evaluation of test–retest reliability and for the external validation of the AIS against the Sleep Problems Scale [13]; the respective correlations pertained to total scale scores as well as to single-item ratings. All assessments were performed for both the AIS-8 and the AIS-5 and were executed through the use of the Statistical Package for Social Sciences (SPSS-8.0).

Results

The internal consistency measures of AIS-8 and AIS-5, based on Cronbach’s \( \alpha \), are quite high for the total group and each subgroup of subjects (Table 2). Cronbach’s \( \alpha \)

Table 2
Internal consistency of the AIS (Cronbach’s \( \alpha \))

<table>
<thead>
<tr>
<th></th>
<th>AIS-8</th>
<th>AIS-5</th>
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</thead>
<tbody>
<tr>
<td>All subjects (n = 299)</td>
<td>0.89</td>
<td>0.87</td>
</tr>
<tr>
<td>Primary insomniac patients (n = 105)</td>
<td>0.90</td>
<td>0.85</td>
</tr>
<tr>
<td>Psychiatric outpatients (n = 100)</td>
<td>0.86</td>
<td>0.81</td>
</tr>
<tr>
<td>Psychiatric inpatients (n = 44)</td>
<td>0.85</td>
<td>0.86</td>
</tr>
<tr>
<td>Controls (n = 50)</td>
<td>0.75</td>
<td>0.75</td>
</tr>
</tbody>
</table>

remained practically unchanged when any one of the items was removed from the calculation (\( \alpha \) if item deleted ranging from 0.83 to 0.89). Also, the mean item–total correlation coefficients were high (0.67 for AIS-8 and 0.69 for AIS-5), with individual item values ranging from 0.53 to 0.75 (\( p < 0.001 \) for each one of the correlations). For both versions of the AIS, the factor analysis demonstrated that the entire scale emerged as a sole component (i.e., only one component had an eigenvalue greater than 1.0) with high percentages of variance explained and all items contributing practically equally to the component either in the case of AIS-8 or in that of the AIS-5 (Table 3).

The correlations of either the AIS-8 or the AIS-5 score with the Sleep Problems Scale score were found to be very strong, with Pearson’s correlation coefficients of 0.90 and 0.85, respectively (\( p < 0.001 \) in either case). Finally, the test–retest reliabilities for both the AIS-8 and AIS-5 total scores, as well as for every individual item, were also found to be very satisfactory (Table 4).

Discussion

The rationale for the development of the AIS, a scale for the assessment of insomnia according to ICD-10 principles, is based on the necessity to give appropriate importance to subjective sleep difficulty and to specify a time-frame as well as a minimum frequency for various sleep related problems [22]. In this paper, we present the validation of the AIS, based on a large sample of subjects including many users of health services with frequent sleep problems. The administration and assessment of AIS showed that this scale is very reliable, practical, and easy to use. Its utilization provides a reliable measure of the intensity of insomnia. Moreover, the consistency, reliability, and validity of the scale were found to be very satisfactory.

Consistency of the AIS

The internal consistency of the AIS, either in the AIS-8 version or the AIS-5 version, was found to be very
satisfactory (Cronbach’s $\alpha$: 0.89 and 0.87, respectively). This demonstrates the very high degree of homogeneity of the AIS, which is further supported by the finding that $\alpha$ does not practically change if any one of the items is deleted and by the high correlation coefficients of the item–total correlations. As expected, the lowest internal consistency measures for both AIS-8 and AIS-5 were found for the subgroup of healthy controls. Even then, however, the Cronbach’s $\alpha$ values were quite high (0.75 for either the AIS-8 or the AIS-5).

The internal consistency of the AIS is very satisfactory not only by itself, but also in comparison to other standardized scales for the measurement of sleep difficulty in clinical settings. Indeed, the Cronbach’s $\alpha$ for the AIS is higher than that for the Pittsburgh Sleep Quality Index [14,25], the Sleep Problems Scale [13], and the Karolinska Sleep Diary’s sleep quality index component [26]. The mean item–total correlation coefficient of the AIS was found to be 0.67 for the AIS-8, and 0.69 for the AIS-5, while the mean component–total correlation coefficient of the Pittsburgh Sleep Quality Index was 0.58 [14]. The mean item–total correlation of the Sleep Problems Scale (0.79) was somewhat higher than that of the AIS, but the calculation for the Sleep Problems Scale was based on a homogeneous sample of air-traffic controllers to whom a shorter form of the scale, which included only four items closely related to sleep difficulty, was administered [13].

The factor analysis provided further evidence for the homogeneity of the AIS. From this analysis, the whole scale emerged as only one component; the eigenvalue was 4.6 for AIS-8 with nearly 60% of the variance explained and all item loadings being equally high. Similarly satisfactory were the eigenvalue, percentage of variance explained, and the item loadings for the AIS-5. Three other sleep scales have been subjected to factor analysis: the Karolinska Sleep Diary, the St. Mary’s Hospital Sleep Questionnaire, and the Leeds Sleep Evaluation Questionnaire. The Karolinska Sleep Diary was found to consist of two well-defined components that explained the 68% of the total variance with eigenvalues 2.9 and 1.8 [26]. The St. Mary’s Hospital Sleep Questionnaire was also found to consist of two components (eigenvalues 4.6 and 1.4), which actually could not be clearly defined [27]. The Leeds Sleep Evaluation Questionnaire was found to be even less compact, having four separate components that pertain to sleep latency, quality of sleep, awakening from sleep, and behavior following wakefulness [28]. Thus, the AIS emerges as more compact than all previously published scales. However, the high degree of homogeneity of the AIS shown in the present study may be due to the fact that the patients presented either with primary insomnia or with psychogenic sleep difficulties. It is quite possible that a lower degree of homogeneity of the AIS could have been found among patients suffering from a variety of other sleep disorders, such as narcolepsy, sleep apnea, etc. In this context, it would be useful to test the performance of the AIS in patient samples different than those utilized in the present study.

**Reliability of the AIS**

The test–retest reliability of the AIS was very satisfactory both for the whole scale in its two versions (0.89 for the AIS-8 and 0.88 for the AIS-5) and for each individual item (ranging from 0.70 to 0.86). The test–retest correlation coefficient of the total score of the Pittsburgh Sleep Quality Index (0.85) and the range of single-item coefficients of the St. Mary’s Hospital Sleep Questionnaire (from 0.70 to 0.96) were similarly high [12,14]. The total score test–retest coefficients for the Sleep Problems Scale were much lower (0.59 at the 3-month retest and 0.42 at the 6-month retest), but the reexamination was performed at a much later time compared to the other scales [13].

**Validity of the AIS**

The external validity of the AIS was measured against the total score of the Sleep Problems Scale [13]. The correlation with that scale was very high, with coefficients being 0.90 and 0.85 for the AIS-8 and AIS-5, respectively. The Sleep Problems Scale is similar to the AIS in that it is comparatively simple and contains about the same items, although for its rating, it is based on frequency of occurrence, rather than severity, of the sleep problems [13]. To our knowledge, the AIS is the only scale that has been correlated with another sleep scale. The Sleep Problems Scale was correlated with psychopathology scales not specifically pertaining to sleep [13]. Polysomnographic measures have been used for the external validation of the Karolinska Sleep Diary and the Pittsburgh Sleep Quality Index; the correlations of the Karolinska Sleep Diary scores with the polysomnographic measures were satisfactory [26], while those of the Pittsburgh Sleep Quality Index were not [14]. Another important measure of external validity of a given scale is its sensitivity to the change of severity of the condition it assesses. For example, the effects of a hypnotic therapy should be detected through a significant change in the scale score. Such an external validity measure is obtained for AIS, based on a study in which a hypnotic drug of known potency is used (publication in preparation).

**Applicability of the AIS**

The AIS can be utilized in clinical practice to measure reliably the intensity of perceived sleep-related problems by a given patient. More specifically, the first five items provide a measure of difficulty with sleep quantity and quality, while a measure of the daytime consequences of insomnia is provided by the last three items. Besides its use in clinical practice, the AIS can be also utilized as a research tool. The usual time-frame of assessment according to ICD-10, is 1 month. However, when the scale is used for specific
The AIS is devised to measure purely subjective estimates of sleep difficulty. Should the need arise for the AIS to be rated by an interviewer (e.g., when dealing with illiterate or sight-impaired subjects), the rater must always bear in mind that only the subjective feelings of the interviewee are considered for the rating. Thus, the severity of the interviewee’s sleep difficulty as estimated by the interviewer (based on his/her own evaluation of any additional information, e.g. number of hours of sleep or approximate duration of sleep onset latency, etc.) should not be taken into account since it may actually be at variance with the interviewee’s subjective assessment.

The Leeds Sleep Evaluation Questionnaire, the St. Mary’s Hospital Sleep Questionnaire, and the Karolinska Sleep Diary [9–12,15,16] are relatively simple in their use, but they are designed to evaluate mainly the sleep of the previous night and their purpose is not to assess sleep difficulties over periods of time comparable to those required in most diagnostic classification systems in use [18–21]. Similarly to the AIS, the Sleep Problems Scale and the Pittsburgh Sleep Quality Index have wide applications, including their use in a variety of clinical and research settings [13,14]. Compared to the Pittsburgh Sleep Quality Index, the AIS is much simpler and easier to use. The Pittsburgh Sleep Quality Index has 18 questions to be answered by the subject, plus an additional six by a roommate [14]. To score the Pittsburgh Sleep Quality Index, many relatively complex calculations are needed, which make it rather cumbersome for clinicians and could substantially increase the time and cost of any investigation in which it is utilized.

In conclusion, the AIS is a scale for use in a large variety of clinical and research settings where the quantification of sleep problems is required. The AIS compares favorably against other scales regarding all measures of consistency, reliability, and validity. These properties, of the AIS together with its simplicity, make it an invaluable psychometric instrument in sleep research and clinical practice.

Acknowledgments

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Appendix A.
Athens Insomnia Scale

ID:_________ Age:_________ Sex:_________ Date:_______

Instructions: This scale is intended to record your own assessment of any sleep difficulty you might have experienced. Please, check (by circling the appropriate number) the items below to indicate your estimate of any difficulty, provided that it occurred at least three times per week during the last month*

Sleep induction (time it takes you to fall asleep after turning-off the lights)
0: No problem 1: Slightly delayed 2: Markedly delayed 3: Very delayed or did not sleep at all

Awakenings during the night
0: No problem 1: Minor problem 2: Considerable problem 3: Serious problem or did not sleep at all

Final awakening earlier than desired
0: Not earlier 1: A little earlier 2: Markedly earlier 3: Much earlier or did not sleep at all

Total sleep duration
0: Sufficient 1: Slightly insufficient 2: Markedly insufficient 3: Very insufficient or did not sleep at all

Overall quality of sleep (no matter how long you slept)
0: Satisfactory 1: Slightly unsatisfactory 2: Markedly unsatisfactory 3: Very unsatisfactory or did not sleep at all

Sense of well-being during the day
0: Normal 1: Slightly decreased 2: Markedly decreased 3: Very decreased

Functioning (physical and mental) during the day
0: Normal 1: Slightly decreased 2: Markedly decreased 3: Very decreased

Sleepiness during the day
0: None 1: Mild 2: Considerable 3: Intense

* The period of the self-assessment may vary, depending on the design of a given study. Whenever the self-assessment pertains to a period other than that of the last month, the second sentence of the instructions should be rephrased accordingly.
References


