Consistency and internal structure of the Athens Insomnia Scale in colombian climacteric women

Adalberto Campo-Arias [1], Álvaro Monterrosa-Castro [2], Edwin Herazo [3], Angélica Monterrosa-Blanco [4]

[1] Specialist in psychiatry. Instituto de Investigación del Comportamiento Humano, Bogotá, Colombia. Professor. Universidad del Magdalena, Santa Marta, Colombia; [2] Specialist in gynecology and obstetrics. Grupo de Investigación Salud de la Mujer. Professor. Facultad de Medicina. Universidad de Cartagena. Colombia; [3] Specialist in psychiatry. PhD (c) Public health. Instituto de Investigación del Comportamiento Humano, Bogotá, Colombia. [4] Grupo de Investigación Salud de la Mujer. Facultad de Medicina. Universidad de Cartagena. Colombia.

ABSTRACT

Introduction: It is necessary to validate the consistency and internal structure of biomedical scales in different population groups.

Objective: This research was conducted to study the internal consistency and structure of the Athens Insomnia Scale (AIS) in climacteric women from the Colombian Caribbean.

Methodology: A methodological study was conducted including 1358 women aged 40 - 59 years (M=40, SD=5,8). 70.3% of them were mestizo, 18.2% Afro-Colombian and 11.6% Amerindian. 55.5% were postmenopausal. The AIS is an eight-item instrument based on the criteria for insomnia of the International Classification of Mental Disorders (World Health Organization, 1992). Its internal consistency was estimated with the coefficients of Cronbach's alpha and McDonald's omega, and internal structure (dimensionality) was tested by confirmatory factor analysis and the calculation of goodness-of-fit indicators: root mean square error of approximation and 90%CI (RMSEA), comparative fit index (CFI), Tucker-Lewis index (TLI), and standardized mean square residual (SMRM). The following were considered adequate: RMSEA (<0.06); CFI (>0.90); TLI (>0.90) SMRM (<0.05).

Results: The AIS showed a Cronbach's alpha and a McDonald's omega of 0.93. The internal structure showed a dimension with an Eigen value of 5.43, which explained 67.9% of the total variance. The commonality between 0.538 and 0.733. The coefficients between 0.774 and 0.880. RMSEA=0.111 [90%CI: 0.101-0.121): CFI=0.96; TLI=0.94 and SMRM=0.03. These findings need to be corroborated in other Colombian and Latin American populations.

Conclusion: The ASI presents high internal consistency with a one-dimensional structure and acceptable values for three of four goodness-of-fit indices.

KEYWORDS

Insomnia; Climacteric. Menopause; Reliability and validity; Validation studies.

Introduction

The World Health Organization (WHO) defines insomnia as a sleep disorder whose features include difficulties with initiation or maintenance of sleep, as well as the sensation of restless sleep, which has been present for at least three weeks during the last month, and interferes with social or work performance [1]. Insomnia is highly frequent in the general population and can reach a prevalence of 38% in some contexts [2,3]. Sleep disorders are more frequent in women in peri and postmenopause than in other periods of life, reaching rates of 51% and 31%, respectively [4,5]. This is particularly important because the presence of insomnia increases two-fold the risk of a major depressive episode [6].

Several self-administered instruments are available to identify, in particular, possible cases of insomnia, and sleep disorders in general [7]. Soldatos, Dikeos, and Paparrigopoulos [8] designed one of them, the Athens Insomnia Scale [AIS], based on the criteria of the International Classification of Diseases-10 [ICD-10]. The AIS showed high internal consistency, a Cronbach's alpha of 0.89, and a single factor or dimension that ex-

plained 56.9% of the variance. It is a simple eight-item psychometric tool that is rated using a Likert-type scale.

Psychometric performance must be assessed in different populations. In Spanish versions of the AIS [9,10] internal consistency values of 0.86 and 0.90 were observed, and the internal structure was again found to be one-dimensional, accounting for 51.5 and 59.5% of the total variance. In other languages, internal consistency has been equally high. In Taiwan, in patients with cancer, a Cronbach's alpha of 0.83 was reported; the authors did not report on dimensionality [11]. In turn, in Poland, in a group of people with and without sleep problems, it was observed that the internal one-dimensional structure explained

60.2% of the variance and the internal consistency was 0.90 [12].

In Japan, the AIS has shown inconsistent results. In a first investigation a one-dimensional structure was observed and an internal consistency of 0.70 [13]. However, in a second study [14] the scale showed two dimensions. One, referring to problems with night sleep, showed an internal consistency of 0.85, while in the other, relating to diurnal dysfunction, it was 0.78. The global scale showed a Cronbach's alpha of 0.88. The authors did not report on the variance explained by each dimension. In Korea, a single dimension was observed, which explained 95.7% of the total variance and the internal consistency was 0.88 [15].

The studies performed to observe the performance of the AIS show an important limitation: the factorial analysis was limited to an exploratory approach, without carrying out a confirmatory analysis to corroborate the dimensionality of the scale with the report of goodness-of-fit indicators [16]. Sleep assessment is one of the priorities in the study of quality of life in climacteric women. There is a need for an adequate insomnia measurement tool for climacteric women in the Latin American population. The availability of such information will allow the of AIS to be used with the guarantee of the validity of the construct [17,18]. The objective of the present research was to study the consistency and internal structure, with confirmatory analysis, of the AIS in a large sample of Colombian women in the climacteric stage.

Methodology

A methodological or validation study of a health measurement instrument was carried out. This study is a secondary analysis of the database of the project "Quality of life in menopause and ethnic groups of Colombia" [CAVIMEC]. The project was approved by the research ethics committee of the University of Cartagena, Colombia. The prevalence of insomnia in this population group was previously published [19]. All participants signed an informed consent document after being informed of the objectives of the investigation and made aware that no intervention would be carried out.

The women involved were either mestizo (also called Hispanic), indigenous (direct descendants of native Zenú) or black (direct African descendants). Mestizo women were recruited from urban and surrounding peripheral areas (Barranquilla and Cartagena on the Caribbean coast and Cali on the Pacific coast) and from rural regions of the Colombian departments of Bolívar (North) and Valle del Cauca (South). The Afro-descendant participants (mother and father black) were natural residents of San Cayetano Municipality and nearby areas (San Juan Nepomuceno Municipality) in the Bolivar Department, and of Cartagena, Colombia. San Cayetano Municipality is a small village, which is populated by approximately 4000 low-income black individuals who are direct descendants of African slaves who settled in the area during the colonial days. Indigenous Zenú women came from the San Andrés de Sotavento fortress. This fortress was created by the Spanish crown in 1773 and is located on the North Colombian coast (Department of Córdoba). This low socioeconomic population is an ancestral settlement of native indigenous individuals who have not blended with any other race. They are engaged in basic agricultural tasks and the manufacturing of textiles and baskets. Despite the fact that the participants came from various Colombian sites and ethnicities they all share a common language and Hispanic cultural background. Door-to-door visits were carried out by trained personnel in the cited communities, seeking women meeting the inclusion criteria. We excluded those who refused to take part, had undergone surgery in the last 6 months, had cancer or any other serious illness, had a previously diagnosed sleep disorder, were pregnant, or who did not complete the socio-demographic questionnaire or were incapable of understanding its content.

The participants completed the AIS, which is an eight-item instrument that provides four response options, from none [zero points] to much difficulty [three points], with two intermediate scores. Possible final scores range from 0 to 24. Higher scores indicate worse evaluations of the single items and the scale. A score higher than 5 indicates the presence of insomnia [8].

A minimal sample size of 1037 participants was calculated assuming a 50% prevalence of insomnia with a 4% desired precision and a 99% confidence level.

To estimate the internal consistency, the coefficients of Cronbach's alpha [20] and McDonald's omega [21] were calculated. The internal consistency for a scale is acceptable if it is between 0.70 and 0.95 [22]. To know the internal structure or dimensionality, confirmatory factor analysis [CFA] was performed. The dimensionality, added to other measures, is an element used to support the construct validity. CFA is usually done to corroborate the internal structure of a scale when the instrument is completed by a new population or community [23]. To establish goodness-of-fit indicators, the following four coefficients were found: the root mean square error of approximation [RMSEA] with its 90% confidence interval, the comparative fit index [CFI], the Tucker-Lewis index [TLI], and the standardized mean square residual [SRSR]. The RMSEA is acceptable if it is less than 0.06, the CFI should be greater than 0.90, the TLI is adequate if it is greater than 0.90 and the SRSR is expected to be less than 0.05 [24]. The calculations were done with the STATA program.

Ethics: Participation was voluntary and anonymous and the participants gave their prior informed consent according to the Declaration of Helsinki (http://www.isciii.es/ISCIII/ es/contenidos/fd-investigacion/fd-evaluacion/fd-evaluacion-etica-investigacion/Declaracion-Helsinki-2013-Esp. pdf). Biological samples were not taken. The scientific, technical and administrative rules for health research, established in the Resolution 008430 of 1993 by the Ministry of Health and Social Protection of Colombia were adhered to, and the present study was free of risks (http://www.urosario.edu.co/urosario_files/a2/a24fb07a-f561-4fcc-b611-affff4374bb7.pdf). Participants could stop filling out the form whenever they wanted to. All incomplete documents were destroyed.

Results

1325 Colombian climacteric women, residents of urban and rural locations on the Caribbean and Pacific coasts, participated in the research. They were between 40 and 59 years of age with 10.4 years of formal schooling. 53.2% were engaged in domestic activities; 55.9% reported one year or more of absence of menstruation; 70.3% were mestizas, 18.2% Afro-Colombians, and 11.6% Amerindians (Table 1). It was observed that 365 women (27.5%) had a score higher than 5, the cut-off identify-

Table 1 General demographic data of studied women N=1325.

Age (years)	48.0 [10.0]
Education (years)	11.0 [6.0]
Parity	3.0 [2.0]
Time since menopause onset (years)	5.0 [5.0]
Body mass index – BMI (kg/m²)	25.3 [4.7]
40 - 45 (years)	345 (26.0)
46 - 50 (years)	449 (33.9)
51 - 55 (years)	300 (22.6)
56 - 59 (years)	231 (17.4)
Mestizo	927 (70.0)
Black	153 (11.5)
Zenú indigenous	245 (18.5)
No children	73 (5.5)
1 - 2 children	547 (41.3)
3 or more children	705 (53.2)
Married	586 (44.2)
Single	137 (10.3)
Widowed	92 (6.9)
Divorced	178 (13.4)
Co-habiting	332 (25.1)
Less than six years of study	255 (19.2)
Seven to twelve years of study	651 (49.1)
More than thirteen years of study	419 (31.6)
Premenopausal	481 (36.3)
Perimenopausal	269 (20.3)
Postmenopausal	575 (43.4)
≤5 years of postmenopause	325 (56.5)
>5 years of postmenopause	250 (43.5)
BMI Low	45 (3.4)
BMI Normal	594 (44.8)
BMI Overweight	549 (41.4)
BMI Obese	137 (10.3)
Current smoking	135 (10.2)
Coffee consumption	893 (67.4)
Hypertension	241 (18.2)
Hormone therapy use	67 (5.1)

Data are presented as medians [interquartile ranges] or absolute numbers and (percentages)

ing participants with insomnia. No differences were observed according to ethnic groups: mestizas 277 (29.9%), black 38 (28.8%) and Zenú indigenous 50 (20.4), p = 0.29.

When evaluating the internal consistency, a McDonald's omega of 0.93 and a Cronbach's alpha of 0.931 [95%CI: 0.927-0.936] were found. The analysis of the internal structure showed a dimension with its own value of 5.43, which explained 67.9% of the total variance. The commonalities were observed between 0.538 and 0.733 and the coefficients between 0.774 and 0.880 (Table 2). The values obtained for the goodness-of-fit indicators were: RMSEA = 0.111 [90%CI: 0.101-0.121], CFI = 0.96, TLI = 0.94, SMRM = 0.03.

Discussion

In the present study, the AIS showed high internal consistency and a one-dimensional structure, evaluated through CFA, in a large sample of Colombian women aged between 40 and 59 years, from three different ethnic groups.

The AIS was found to show high internal consistency in climacteric women, both with Cronbach's alpha and with McDonald's omega coefficient, data not reported in previous research. This finding is consistent with those reported by other studies, in other population and age contexts, which showed internal consistency in the range of 0.70 to 0.90 [8-14]. It is well known that variations in the values of internal consistency coefficients may occur, according to population characteristics. However, such differences are irrelevant if the value is between 0.70 and 0.95 [22].

In relation to the internal structure of the AIS, in the present analysis a one-dimensional structure responsible for 67.9% of the variance was identified. This observation is consistent with the study introducing the scale carried out in Greece by Soldatos *et al*. [8] and with other research conducted in Spain by Nenclares and Jiménez [10], in Mexico by Gómez-Benito *et al*. [9], and in Poland by Fornal-Pawłowska *et al*. [12]. However, in Japan, the AIS has shown variable structure, of one or two dimensions in two different samples, in research conducted by the same authors [13,14]. Like internal consistency, the internal structure of scales usually shows different patterns in different populations [23]. These discrepancies in findings concerning the internal structure of measurement scales suggest that there is a

Table 2 Athens insomnia scale commonalities and loading for the items.

Item	Commonality	Loading
Difficulty with sleep induction	0.612	0.782
Awakening during the night	0.538	0.733
Early morning awakening	0.558	0.747
Total sleep time (sufficiency)	0.746	0.864
Overall quality of sleep	0.774	0.880
Well-being during the day	0.696	0.834
Functioning during the day	0.596	0.772
Sleepiness during the day	0.551	0.742

need for permanent revision of the constructs in order to integrate the instruments of measurement of all health conditions [22-26]. The present study reports what seems to be the first AFC for the AIS. However, it is limited by the conformation of the study group, which cannot be generalized to other groups of women of other ages or from other Colombian regions. These findings need to be corroborated in other Colombian and Latin American populations. Its strength is that it provides validation of a short scale that is easy to apply and has been the subject of numerous studies in different geographical scenarios, and in different clinical contexts. Since women in the climacteric stage, especially in postmenopause, have a significant presence of sleep disorders [19,27]. The AIS is recommended for assessment of this alteration, both in primary health care and in specialized medical consultation settings. Findings suggest that the scale can be used as a clinical screening instrument, however a detailed clinical evaluation will always be necessary to establish the diagnosis of non-organic insomnia. It is appropriate to note that with the AIS, the number of false positives is high, as with other scales used to identify insomnia, so the use of clinical assessment and the application of specific diagnostic methods, such as polysomnography, are always needed to substantiate findings obtained with the use of scales [28].

Conclusion

The AIS, used in a population group of Colombians in the climacteric stage, showed high internal consistency and a one-dimensional structure, with aceptable values for three of four indicators of goodness of fit.

References

1. WHO. The International Classification of Diseases, 10. Classification of Mental and Behavioural Disorders. F-51 Nonorganic sleep disorders, p. 136. Available at: http://www.who.int/classifications/icd/en/bluebook.pdf [accessed 5-june-2019].

2. Cao XL, Wang SB, Zhong BLet al. The prevalence of insomnia in the general population in China: A meta-analysis. PLoS One. 2017;12:e0170772.

3. Jiang XL, Zheng XY, Yang J, Ye CP, Chen YY, Zhang ZG, Xiao ZJ. A systematic review of studies on the prevalence of insomnia in university students. Public Health. 2015;129:1579-84.

4. Kravitz HM, Ganz PA, Bromberger J, Powell LH, Sutton-Tyrrell K, Meyer PM. Sleep difficulty in women at midlife: a community survey of sleep and the menopausal transition. Menopause. 2003;10:19-28.

5. Xu Q, Lang CP. Examining the relationship between subjective sleep disturbance and menopause: a systematic review and meta-analysis. Menopause. 2014;21:1301-18.

6. Baglioni C, Battagliese G, Feige B, et al. Insomnia as a predictor of depression: a meta-analytic evaluation of longitudinal epidemiological studies. J Affect Disord. 2011;135:10-9.

7. Monterrosa-Castro Á, Portela-Buelvas K, Salguedo-Madrid M, Mo-Carrascal J, Duran-Méndez Leidy C. Instruments to study sleep disorders in climacteric women. Sleep Sci. 2016;9:169-78.

8. Soldatos CR, Dikeos DG, Paparrigopoulos TJ. Athens Insomnia Scale: validation of an instrument based on ICD-10 criteria. J Psychosom Res. 2000;48:555-60.

9. Gómez-Benito J, Ruiz C, Guilera G. A Spanish version of the Athens Insomnia Scale. Qual Life Res. 2011;20:931-7.

10. Nenclares-Portocarrero A, Jiménez-Genchi A. Estudio de validación de la traducción al español de la Escala Atenas de Insomnio. Salud mental. 2005;28(5):34-9.

11. Sun JL, Chiou JF, Lin CC. Validation of the Taiwanese version of the Athens Insomnia Scale and assessment of insomnia in Taiwanese cancer patients. J Pain Symptom Manage. 2011;41:904-14.

12. Fornal-Pawłowska M, Wołyńczyk-Gmaj D, Szelenberger W. [Validation of the Polish version of the Athens Insomnia Scale]. Psychiatr Pol. 2011;45:211-21.

13. Okijama I, Nakajima S, Kobayashi M, Inoue Y. The reliability and validity of the Japanese version of Athens Insomnia Scale. Sleep Medicine. 2011;12(Suppl. 1), S66.

14. Okajima I, Nakajima S, Kobayashi M, Inoue Y. Development and validation of the Japanese version of the Athens Insomnia Scale. Psychiatry Clin Neurosci. 2013;67:420-5.

15. Jeong HS, Jeon Y, Ma J, et al. Validation of the Athens Insomnia Scale for screening insomnia in South Korean firefighters and rescue workers. Qual Life Res. 2015;24:2391-5.

16. Marsh HW, Morin AJ, Parker PD, Kaur G. Exploratory structural equation modeling: an integration of the best features of exploratory and confirmatory factor analysis. Annu Rev Clin Psychol. 2014;10:85-110.

17. Perry JL, Nicholls AR, Clough PJ, Crust L. Assessing Model Fit: Caveats and Recommendations for Confirmatory Factor Analysis and Exploratory Structural Equation Modeling. Measurement in Physical Education and Exercise Science. 2015;19(1):12-21.

18. Streiner DL, Kottner J. Recommendations for reporting the results of studies of instrument and scale development and testing. J Adv Nurs. 2014;70:1970-9.

19. Monterrosa-Castro A, Marrugo-Flórez M, Romero-Pérez I, Chedraui P, Fernández-Alonso AM, Pérez-López FR. Prevalence of insomnia and related factors in a large mid-aged female Colombian sample. Maturitas. 2013;74:346-51.

20. Cronbach J. Coefficient alpha and the internal structure of test. Psychometrika. 1951;16:297-334.

21. McDonald RP. Theoretical foundations of principal factor analysis and alpha factor analysis. British Journal Mathematics and Statistical Psychology. 1970;23:1-21.

22. Keszei AP, Novak M, Streiner DL. Introduction to health measurement scales. J Psychosom Res. 2010;68:319-23.

23. Campo-Arias A, Herazo E, Oviedo HC. Análisis de factores: fundamentos para la evaluación de instrumentos de medición en salud mental. Revista Colombiana de Psiquiatría. 2012;41:659-71.

24. Brown TA. Confirmatory factor analysis for applied research. New York: Guilford Press. 2006. p. 494.

25. Reise SP, Waller NG, Comrey AL. Factor analysis and scale revision. Psychol Assess. 2000;12:287-97.

26. Worthington RL, Whittaker TA. Scale development research: A content analysis and recommendations for best practices. The Counseling Psychologist. 2006;34:806-38.

27. Monterrosa-Castro A, Marrugo-Flórez M, Romero-Pérez I, Fernández-Alonso AM, Chedraui P, Pérez-López FR. Assessment of sleep quality and correlates in a large cohort of Colombian women around menopause. Menopause. 2013;20:464-9.

28. Chiu HY, Chang LY, Hsieh YJ, Tsai PS. A meta-analysis of diagnostic accuracy of three screening tools for insomnia. J Psychosom Res. 2016;87:85-92.