Psychometric properties of the Spanish version of the Sleep Hygiene Index (SHI)

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CONFLICT OF INTERESTS

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The authors declare that there is no conflict of interests.

ABSTRACT

The Sleep Hygiene Index (SHI) has shown adequate psychometric properties in samples from several countries but has not been validated in Spanish. The aims of the study were to translate the original (i.e., English) version of the SHI into Spanish and to evaluate the psychometric properties of this instrument (i.e., factor structure, internal consistency reliability, and concurrent, predictive and discriminant validity) in Spanish adults. The overall sample, comprising 548 university students, was divided into two groups based on their self-reported insomnia symptoms (Insomnia Severity Index) because sleep hygiene has been shown to be closely related to insomnia. The Pittsburgh Sleep Quality Index and Stanford Sleepiness Scale were used for testing concurrent validity. The Depression, Anxiety and Stress Scale was used for testing predictive validity. Three items were dropped from the original SHI scale due to their low factor loadings. A principal component analysis revealed a four-factor solution for the SHI, accounting for 65.58% of the total variance in the overall sample, for 65.34% in the non-insomnia group, and for 63.50% in the insomnia group. Factor 1 comprised items regarding sleep-disrupting behaviors; Factor 2 comprised items regarding cognitive activation; Factor 3 comprised items about bedroom comfort; and Factor 4 comprised items on sleep/wake time. Omega coefficient indices for the SHI ranged from .751 to .878 in the overall sample, from .734 to .822 in the non-insomnia group, and from .724 to .835 in the insomnia group. The Spanish version of the SHI can be regarded as a reliable tool with adequate concurrent and predictive validity for assessing sleep hygiene in Spanish people with or without insomnia symptoms.

1 | INTRODUCTION

The International Classification of Sleep Disorders (ICSD-II) published by the American Academy of Sleep Medicine (AASM) has defined inadequate sleep hygiene as "engaging in behaviors such as improper sleep scheduling, using sleep disturbing products, activating or arousing activities close to bedtime, using the bed for activities other than sleep, and maintaining an uncomfortable sleep environment" (AASM, 2014; Jansson-Fröjmark et al., 2019, pp. 129). These unhealthy sleep related-behaviors are considered as a discrete diagnostic entity due to their relevance for sleep problems (AASM, 2014; Jansson-Fröjmark et al., 2019). Specifically, sleep hygiene includes a wide range of behavioral factors and environmental conditions such as physiological activation (e.g., exercise too late/getting regular exercise, stimulants), conditioning (e.g., TV in the bedroom), sleep restriction (e.g., napping too long or taking late-afternoon naps), waking at a different time each day, caffeine intake, or alcohol consumption (Brown et al., 2002; Jansson-Fröjmark et al., 2019).

Sleep hygiene has often been considered to play a contributing role in insomnia (AASM, 2014; Jansson-Fröjmark et al., 2019). Several studies have shown a significant relationship between poor sleep hygiene practices and sleep problems in persons with insomnia (Irish et al., 2015; Jansson-Fröjmark et al., 2019; Lacks & Rotert, 1986; Mastin et al., 2006). In student populations, 40% to 77% of participants report frequent awakenings, difficulties initiating sleep, non-restful sleep, and fewer hours of total sleep than those recommended for adults (Gellis et al., 2014). Specifically, a prevalence of insomnia ranging between 9% and 38% has been estimated in university students (Jiang et al., 2015). Some researchers have also explored the relationship between sleep hygiene practices and self-reported insomnia by assessing the frequency of sleep hygiene behaviors in poor sleepers or exploring several sleep incompatible behaviors related to the bed and the bedroom, such as reading or watching TV in bed (Jansson-Fröjmark et al., 2019). Thus, there is growing awareness of the importance of

sleep hygiene as a construct that reflects sleep-related habits in humans and/or an educational resource to improve public health (Chung et al., 2018; Irish et al., 2015).

Several instruments have been used to measure sleep hygiene. Some examples are the Sleep Hygiene Awareness and Practice Scale, the Sleep Hygiene Self-Test, and the Adolescent Sleep Hygiene Scale (Blake, 1998; Lacks & Rotert, 1986; Mastin et al., 2006). The most used questionnaire to assess this construct is the Sleep Hygiene Index (SHI). Its original version is a 13-item scale derived from the diagnostic criteria of "inadequate sleep hygiene". The first validation of this scale was conducted among 603 American university students and showed moderate internal consistency (Cronbach's alpha = .66) and a good 2-week test-retest reliability (r = .71) (Mastin et al., 2006). Subsequent validations in other countries in the clinical and healthy population have found similar psychometric properties (Chehri et al., 2016; Cho et al., 2013; Ozdemir et al., 2015; Seun-Fadipe et al., 2018). Nevertheless, a review of the literature has not revealed any Spanish psychometric studies on instruments measuring sleep hygiene. Hence, researchers and clinicians do not have any tools available to assess the most common key behaviors and environmental factors directly associated with sleep hygiene in the Spanish general and insomnia population.

For these reasons, a sleep hygiene scale is needed for research and clinical areas. This scale would be helpful to guide the clinical tailoring of cognitive behavioral therapy intervention programs focused on improving sleep function. It could also be used to guide case formulation and treatment design in the non-clinical population and in people reporting insomnia symptoms. A previously validated scale with appropriate psychometric properties such as the SHI would be useful in clinical decision-making on sleep issues but has not been validated in Spanish yet. Considering this, the aims of the current study were to translate the original (i.e., English) SHI into Spanish, and to evaluate the psychometric properties of the translated instrument (i.e., factor structure, internal consistency reliability, and concurrent, predictive and discriminant validity) in Spanish adults with and without self-reported insomnia.

2 | METHODS

2.1 | Design

The validation process was based on a cross-sectional study design.

2.2 | Setting and sample

The initial sample consisted of 618 undergraduate university students from the University of Granada, Spain. They originated from several academic areas such as health sciences, arts and humanities, sciences, social and legal sciences, engineering, and architecture. After applying the selection criteria, 548 students were included in the study. The final sample was divided into two groups based on the self-reported insomnia symptoms of participants: insomnia group versus non-insomnia group. This division made it possible to conduct a subgroup analysis to determine whether both groups behaved in the same way in terms of structure, reliability, and validity, because sleep hygiene has been shown to be closely related to insomnia. Several authors have reported that poor sleep hygiene practices are associated with a greater incidence of insomnia in the general population (Brown et al., 2002). The flow diagram of participant recruitment according to the STROBE guidelines (von Elm et al., 2014) is depicted in Figure 1.

The inclusion criteria to participate in the study were: 1) being over 18 years old and 2) having Spanish as a native language. The exclusion criteria were: 1) having a diagnosed sleep disorder other than insomnia (previous diagnosis self-reported by the participant) and/or receiving treatment for sleep-related clinical conditions (i.e., hypnotic drugs); 2) being pregnant; 3) reporting alcohol and/or drug abuse; and 4) having a severe mental illness in an acute phase.

2.3 | Procedures

Participants were recruited personally or by sending an email to the degree coordinators of the University of Granada that explained the objectives and procedures of the study. Coordinators who accepted to collaborate in the recruitment were asked to distribute a standard participation

email to their undergraduate students through the official platform of the University of Granada, called PRADO2. The email consisted of an explanatory text of the study with an invitation to voluntarily participate in the study by accessing a link with an online questionnaire. The recruitment and administration of the questionnaires took place between January and June 2017. We first divided the sample into two groups according to their insomnia complaints. Participants who scored over 10 in the Insomnia Severity Index (ISI) were assigned to the insomnia group, and those below this clinical cut-off score were assigned to the non-insomnia group (Bastien, 2001).

The protocol of the study was approved by the Ethics Committee on Human Research of the University of Granada (reference number: 312/CEIH/2017). All participants signed the informed consent form online before being included in the study. All data and outcomes of participants were anonymous. Participants were never asked for any identifying data such as name, passport number, or other aspects.

2.4 | Translation of the SHI from English into Spanish

We followed a similar process to the previous translation and adaptation of the SHI to the Korean population conducted by Cho et al. (2013). Two Spanish-speaking clinical psychologists independently translated the SHI into Spanish. One of them was specialized in sleep and its related factors and was aware of the purpose of the SHI. The agreement between them was assessed and any inconsistencies were adjusted. Next, a blinded Spanish-English translator translated the previous Spanish translation of the SHI into English again. The back-translation and the original version were revised and compared to identify possible inconsistences. The final version of the SHI was examined by five undergraduate students, who provided feedback on the understandability (i.e., wording and meaning) of each item of the instrument.

2.5 | Instruments

Sociodemographic information was obtained with an ad-hoc questionnaire that included data about age, sex, civil status, who participants lived with, weekly physical activity (hours), occupational status, weekly work (hours), income of the family unit (monthly), and alcohol, tobacco, and drug use.

Sleep Hygiene Index: The original SHI is a 13-item self-report index developed by Mastin et al. (2006) to assess the presence or absence of sleep hygiene behaviors. The item construction of the SHI is based on the diagnostic criteria for inadequate sleep hygiene of the International Classification of Sleep Disorders (AASM, 2014). The SHI is a one-factor instrument according to its original validation performed by Mastin et al. (2006). By contrast, other validations of the SHI have resulted in two factors in Korean patients suffering from chronic pain (Cho et al., 2013) and three factors when the instrument was applied to the general Iranian population (Chehri et al., 2016) and when it was validated in Nigerian university students (Seun-Fadipe et al., 2018). The initial target population in the first validation of this instrument was university students (Mastin et al., 2006). However, subsequent psychometric validations in several countries have been made in the general population (Chehri et al., 2016) and specific population segments such as adolescents (Setyowatic et al., 2020), older people (Chehri et al., 2016), and patients with various diseases such as depression (Ozdemir et al., 2015) or chronic pain (Cho et al., 2013).

In the SHI, individuals are asked to report how frequently they have engaged in sleep hygiene behaviors. Each item ranges on a five-point Likert scale from 0 points (never) to 4 points (always). The total score ranges from 0 to 52 points, with higher scores showing more inadequate sleep hygiene behavior. In previous validations of the SHI, the delivery mode was paper-and-pencil, although the procedure was not clear in some studies (Chehri et al., 2016, 2020; Setyowatic et al., 2020). Cho et al. assessed test-retest reliability using a stamped addressed envelope for a second administration, and other researchers met participants in the same setting where they had first been assessed (Mastin et al., 2006; Ozdemir et al., 2015).

Thus, this is the first study where an electronic delivery mode has been used for validating the SHI. The original validation of the SHI scale exhibited moderate internal consistency (Cronbach's alpha of .66) and good test-retest reliability ($r = 0.71$, $p < 0.01$) (Mastin et al., 2006).

The Insomnia Severity Index was used to create groups for testing discriminant validity. The Pittsburgh Sleep Quality Index and Stanford Sleepiness Scale were used for testing concurrent validity. Finally, the Depression, Anxiety and Stress Scale was used for testing predictive validity. These are described as follows:

Insomnia Severity Index (ISI): This instrument is a self-report measure to assess insomnia severity. It consists of 7 questions scored individually from 0 to 4 points. The total score ranges from 0 to 28 points. A higher score represents more severe insomnia. The items are as follows: 1) severity of sleep onset, 2) sleep maintenance, 3) early morning awakening problems, 4) sleep dissatisfaction, 5) interference of sleep difficulties with daytime functioning, 6) noticeability of sleep problems by others, and 7) distress caused by the sleep difficulties. The ISI has shown adequate psychometric properties in the Spanish population (Sierra et al., 2008). A cut-off score of 10 was considered to reflect an insomnia complaint that was below the clinical threshold (i.e., minimal or no sleep difficulties, minimal impairment, and no or little distress) (Bastien, 2001; Ellis & Allen, 2019; Riemann, 2018).

Pittsburgh Sleep Quality Index (PSQI): The PSQI is a self-administered questionnaire that evaluates sleep quality and disturbances over one month. It is composed of 24 questions, 19 of which are self-rated and 5 are answered by the participant's spouse or roommate. The 19 self-rated questions assess 7 factors of sleep quality: sleep disturbances, sleep latency, subjective sleep quality, medication use for sleep, daytime dysfunction, habitual sleep efficiency, and sleep duration. Total scores range from 0 to 21 points, with higher scores revealing worse sleep quality. The Spanish version of the PSQI was used in this study. The PSQI has shown an internal consistency ranging between .67 (obtained in a sample of students) and .81 (in a clinical

sample). Regarding its validity, the sensitivity of the questionnaire is 88.63%, and its specificity is 74.19% (Buysse et al., 1989; Sierra et al., 2002).

Depression, Anxiety and Stress Scale (DASS-21): The DASS-21 is a 21-item self-report that assesses the severity of the main symptoms of depression, anxiety, and stress over the previous week. Each item is scored on a four-point Likert-scale ranging between 0 (does not apply to me at all) and 3 (applies to me very much, or most of the time). This scale includes the three dimensions Depression, Anxiety, and Stress, with 7 items per dimension. The Spanish DASS-21 version showed acceptable internal reliability, exhibiting the lowest value for the Anxiety dimension, with a Cronbach's alpha of .73 (Fonseca-Pedrero et al., 2010; Lovibond & Lovibond, 1995).

Stanford Sleepiness Scale (SSS): This measure quantifies subjective changes in sleepiness over the course of the day. The SSS has two versions: one measures sleepiness every hour during the day, and the other assesses the level of sleepiness at three time points of the day (i.e., wake time, middle of the day, and bedtime) in the last week. It contains seven statements ranging from "feeling active, vital, alert, or wide awake" (score 1) to "no longer fighting sleep, sleep onset soon, having dream-like thoughts" (score 7). The adapted Spanish language version used in the present study measured sleepiness at wake time, in the middle of the day, and at bedtime. The total score ranges from to 3 to 21 points. Higher scores indicate a greater level of sleepiness. This scale has shown significant convergent validity with the Epworth Sleepiness Scale and good test-retest reliability (Buela Casal & Sánchez, 1999; Hoddes et al., 1973; Maclean et al., 1992).

2.6 | Statistical analyses

SPSS 21.0 software for Windows (IMB Corp., 2011) was used for the validation analyses. Participants were allocated to the insomnia or non-insomnia group, considering the clinical cut-off point (i.e., 10 points on the total ISI score) (Bastien, 2001). First, the suitability of the

dataset of the present study for factor analysis was assessed by using the Kaiser-Meyer-Olkin measure of sampling adequacy and Bartlett's test of sphericity. An exploratory factor analysis was conducted to determine the factor structure of the SHI. A principal component analysis (PCA) algorithm was used to reduce the dimensionality of the data while retaining most of the variation in the dataset. We used an orthogonal rotation by Varimax method to ease the interpretation of the rotated factors. To assess internal reliability, we calculated the Omega coefficient of the SHI factor scores. The Omega coefficient measures the composite reliability of a series of items but, unlike the Alpha coefficient, it is unbiased when dealing with congeneric items that have uncorrelated errors. This coefficient is calculated considering item factor loadings and uniqueness according to a factor analysis (Padilla & Divers, 2016). The Omega coefficient and the Alpha coefficient are interpreted in a similar way. To assess criterion validity (i.e., concurrent validity and predictive validity), we calculated Pearson's correlation coefficient between the SHI factors and the following constructs: sleep quality (PSQI total and subscales), depression, anxiety, and stress symptoms (DASS-21), and sleepiness (SSS). Finally, to evaluate discriminant validity, we performed comparisons between groups (i.e., insomnia vs. non-insomnia) in the mean scores of the factors of the Spanish SHI.

3 | RESULTS

3.1 | Description of the sample: sociodemographic characteristics

Of a total of 548 Spanish adults who participated in the study, 333 participants did not report insomnia (mean age = 20.84 years, *SD* = 2.85, 61.6% women) and 215 reported insomnia symptoms (mean age = 20.97 years, *SD* = 2.41, 64.2% women). The sociodemographic characteristics of the sample and groups are shown on Table 1. There were no differences in sociodemographic characteristics between both groups ($p > 0.05$).

3.2 | Sampling adequacy and sphericity

The factor analysis showed a Kaiser-Meyer-Olkin measure of sampling adequacy of .694, .651, and .628 for the overall sample, non-insomnia and insomnia group, respectively. Likewise, Barlett's test allowed us to reject the null hypothesis (i.e., sphericity) for these groups ($p < .001$). These results showed that the data obtained met the adequacy and sphericity criteria to perform a factor analysis.

3.3 | Factor structure of the SHI

After several factor analysis iterations, items 1, 4, and 6 were removed due to their low factor loadings. In addition, these three items reduced the reliability of the measure because they did not load strongly on any factor. For these reasons, these weak items were omitted in the final version. In the overall sample, exploratory factor analyses of the Spanish SHI using the principal component extraction method showed a four-factor solution accounting for 65.58% of the total sample variance (F1 = 28.11, F2 = 15.00%, F3 = 11.63%, F4 = 10.84%). In the non-insomnia group, the same four-factor solution accounted for 65.34% of the total sample variance (F1 = 26.81%, F2 = 16.44%, F3 = 11.80%, F4 = 10.28%). In the insomnia group, the four-factor structure accounted for 63.50% of the total variance (F1 = 24.88%; F2 = 14.53%; F3 = 13.27%; F4 = 10.82%). The factors obtained for the overall sample and both groups were: Factor 1 (sleep-disrupting behaviors): items 5, 7 and 9; Factor 2 (cognitive activation): items 8, 12 and 13; Factor 3 (bedroom comfort): items 10 and 11; and Factor 4 (sleep/wake time): items 2 and 3. Factor loadings shown by the principal component analysis of each SHI item for the overall sample and both groups are shown on Table 2. Spanish version of the SHI questionnaire and instructions to apply it to this Spanish population with and without insomnia is shown in **Supplementary material**.

3.4 | Internal consistency reliability

Omega coefficients for the SHI ranged from .734 to .822 in the non-insomnia group, and from .724 to .835 in the insomnia group. They were satisfactory for most factors. The omega coefficient for each SHI factor in the overall sample and both groups is shown on Table 3.

3.5 | Criterion validity (concurrent and predictive validity)

PSQI and SSS scores were used to test concurrent validity. In the overall sample, SHI Factor 1 ("sleep-disrupting behaviors") was correlated with the total score of the PSQI and the sleep duration and sleep disturbances dimensions of the PSQI ($p < .001$); Factor 2 ("cognitive activation") was correlated with all the PSQI dimensions ($p < .001$); Factor 3 ("bedroom comfort") was correlated with the PSQI (total score), sleep disturbances, sleep latency, subjective sleep quality, daytime dysfunction ($p < .05$); and Factor 4 ("sleep/wake time") was correlated with the sleep latency dimension. All the SHI factors except Factor 3 ("bedroom comfort") were correlated with the total score of the SSS ($p < .05$). In the non-insomnia group, only SHI Factor 2 ("cognitive activation") was correlated with all the PSQI scores, except for the sleep quality dimension of sleep latency ($p < .001$). This factor was also correlated with the SSS score ($p < .001$). In the insomnia group, SHI Factor 1 ("sleep-disrupting behaviors") was correlated with the PSQI sleep latency dimension ($p < .001$); SHI Factor 4 ("sleep/wake time") was correlated with the PSQI subjective sleep quality dimension ($p < .05$). The correlations between SHI factors and the PSQI and SSS for the overall sample, non-insomnia, and insomnia groups are shown in Table 4.

The DASS-21 score was used to test predictive validity. In the overall sample, the SHI factors were correlated with depression, anxiety and stress symptoms ($p < .001$), except for Factor 4 ("sleep/wake time") and stress symptoms. In the non-insomnia group, SHI Factors 1 ("sleep-disrupting behaviors"), 2 ("cognitive activation"), and 3 ("bedroom comfort") were correlated with all scores of the DASS-21 dimensions ($p < .05$). In the insomnia group, SHI Factor 1 ("sleep-disrupting behaviors") was correlated with anxiety and stress symptoms ($p <$

.05); Factor 2 ("cognitive activation") was correlated with depression symptoms ($p < .05$), and factor 4 ("sleep/wake time") was correlated with all the DASS-21 subscales (see Table 4).

3.6 | Discriminant validity (comparison between non-insomnia and insomnia) and descriptive mean scores of SHI factors

There were statistically significant differences between groups (i.e., insomnia vs. non-insomnia) for all factors of the SHI ($p < .001$). Mean scores were higher in the insomnia group across all factors (see Table 5).

4 | DISCUSSION

The purpose of this study was to translate the original (i.e., English) version of the SHI into Spanish and analyze the psychometric properties of this instrument (i.e., factor structure, internal consistency reliability, and concurrent, predictive and discriminant validity) in a sample of Spanish adults with and without insomnia symptoms. The factors were labelled as "sleep-disrupting behaviors" (Factor 1: items 5, 7, and 9), "cognitive activation" (Factor 2: items 8, 12, and 13), "bedroom comfort" (Factor 3: items 10 and 11), and "sleep/wake time" (Factor 4: items 2 and 3). This four-factor structure accounted for a reasonable percentage of the total variance of the construct in participants reporting insomnia and participants without insomnia. Findings regarding structural validity showed a four-factor structure in both groups. The number of items was reduced from thirteen to ten items. Three items (1, 4, and 6) were removed from the Spanish version during statistical analysis due to their low factor loadings. The information carried by these three items in the original version of the SHI was probably lost during the implementation of the instrument because of Spanish cultural habits and contextual aspects. The descriptive results of these items showed, in a range from 0 to 4 points, mean scores of .76 points for item 1, .43 points for item 4, and .58 points for item 6. This meant that the overall sample exhibited adequate levels of sleep hygiene behaviors such as daytime naps lasting less than two hours, avoiding exercise to the point of sweating within one hour of going to bed, and

avoiding the use of alcohol, tobacco or caffeine within four hours of going to bed or after going to bed, respectively (Mastin et al., 2006).

Previous validation studies of the SHI have shown various factor solutions. The Turkish version of the SHI, which was validated by using a clinical sample of patients with major depression versus a non-clinical sample, suggested a unidimensional factor structure (Ozdemir et al., 2015). Cho et al. (2013) found that a two-factor solution was the most appropriate dimensionality in the Korean population. In that case, the authors validated it using a sample of patients with chronic pain, but this solution accounted for 43.23% of the variance of the sleep hygiene construct. In the Persian version of the SHI, exploratory factor analysis resulted in three factors, termed as "sleep-wake cycle behaviors" (four items), "bedroom factors" (three items), and "behaviors that affect sleep" (six items) (Chehri et al., 2016). Similarly, a validation conducted in a sample of Nigerian undergraduate students revealed a three-factor structure that cumulatively accounted for 50% of the total sample variance (Seun-Fadipe et al., 2018). The four-factor structure of the Spanish SHI is probably justified by differences in the physical environment as well as the cultural habits of Spain compared to other countries (Sierra et al., 2002).

In terms of reliability, the overall sample and both groups (i.e., insomnia and non-insomnia) showed a similar internal consistency for each factor of the Spanish SHI, obtaining reliability omega coefficients higher than .72. Previous findings on reliability obtained with samples using the original English version SHI and other language versions have been reported. Mastin et al. (2006) showed a Cronbach's alpha of .66. and Seun-Fadipe et al. (2018) reported a Cronbach's alpha of .64. Studies such as that of Cho et al. (2013) study show higher reliability indices for SHI factors. Cronbach's alphas of their factors termed as sleep-disturbing behavior and environment and irregular sleep-wake schedule were .74 and .70, respectively; however, these authors calculated Cronbach's alpha for a two-factor dimension (Cho et al., 2013). The Persian version of the SHI showed a Cronbach's alpha of .89 (Chehri et al., 2016) and the

Turkish version showed Cronbach's alphas of .70 in a community sample and .71 in patients with major depression (Ozdemir et al., 2015).

The concurrent and predictive validity (i.e., criterion validity) of the factors of the SHI were analyzed by calculating correlations between these factors and the subscales of the PSQI, the subscales of the DASS-21, and the SSS. The criterion validity of the SHI was satisfactory for the overall sample and both subgroups, with directions of the correlations as expected (Brown et al., 2002; Chehri et al., 2016; Cho et al., 2013; Mastin et al., 2006; Seun-Fadipe et al., 2018). That is, higher scores on the SHI factors, indicating poorer sleep hygiene behaviors, were correlated with lower levels of sleep quality and higher levels of depression, anxiety and stress symptoms, and daytime sleepiness.

With respect to concurrent validity, in the non-insomnia group, only Factor 2 (i.e., cognitive activation) was correlated with all dimensions of quality of sleep and daytime sleepiness, except for the dimension sleep latency (quality of sleep). Hence, poor sleep hygiene in the non-insomnia group was correlated with daytime sleepiness, which is consistent with the findings reported in previous studies (Chehri et al., 2016; Cho et al., 2013; Mastin et al., 2006; Seun-Fadipe et al., 2018). Inversely, in the insomnia group, only factors 1 and 4 were related to the dimension of quality of sleep of sleep latency and subjective sleep quality, respectively. These findings are consistent with studies that have shown that maladaptive sleep hygiene behaviors are strongly related to poorer sleep quality (Brown et al., 2002; Chehri et al., 2016; Mastin et al., 2006). Chehri et al. (2016) reported a positive relationship between SHI scores, sleep quality, insomnia, and sleepiness. Additionally, Seun-Fadipe et al. (2018) showed this relationship with the preference for activity in the morning or evening (i.e., sleep chronotype).

Regarding predictive validity, in the overall sample, the SHI factors were directly correlated with the three depression, anxiety, and stress symptoms recorded by the DASS-21 ($p<.001$), except for Factor 4 ("sleep/wake time") and stress symptoms. In the non-insomnia group, depression, anxiety, and stress symptoms were significantly correlated with factors 1, 2,

and 3; in the insomnia group, several of these symptoms were correlated with factors 1, 2, and 4. Similarly, the study by Cho et al. (2013) found a correlation between SHI scores, sleep quality, and depression.

In terms of discriminant validity, comparisons between non-insomnia and insomnia participants in the mean scores of the factors of the Spanish SHI showed that significant differences across all these factors, indicating that the SHI can discriminate between people reporting and not reporting insomnia. Discrimination between both of these dissimilar constructs (i.e., sleep hygiene and insomnia) has been well documented (Chung et al., 2018; Ellis & Allen, 2019; Gellis et al., 2014; Riemann, 2018).

4.1 | Limitations and future research

In interpreting our results, three possible limitations of this research should be considered. First, the sample was based on a subset of the population by including Spanish undergraduate students. Hence, generalization of our findings may be limited. Accordingly, future studies should use a more diverse sample. Samples including older people should be considered to verify if all the items of the original version of the instrument can be included. However, to our knowledge, this is the first version of the SHI developed for the Spanish population. Second, we did not check the test-retest reliability of the SHI and only assessed its internal consistency. Third, we only used self-reported measures (i.e., self-rating scales) to evaluate sleep-related constructs (i.e., sleep quality, sleepiness, and insomnia), which may have been subject to recall bias. The use of objective evaluations with actigraphy or other similar wearable assessment tools may help improve the reliability of outcomes. Moreover, because chronotype and circadian disruption may affect sleep-related variables and behaviors, it would have been desirable to include this type of measure in the study of concurrent validity of the SHI. Reliable validated wearable devices can objectively measure sleep/wake-related parameters related to sleep quality and continuity, and provide valuable information on the state of the circadian system of participants (Sarabia-Carrazo et al., 2012). These objective measures may warrant new

validations of the SHI variables using these types of devices. Finally, participants were recruited through a standard participation email sent by the degree coordinators from the University of Granada, who were asked to distribute them to their undergraduate students through the official platform of the university. In future studies, undergraduate students could be approached by a non-teaching staff member to avoid possible biases.

5 | CONCLUSIONS

The findings of this study suggest that the Spanish version of the SHI is a useful research or clinical assessment instrument for assessing sleep hygiene in university students. Youth and academic life impose specific circumstances that impact sleep and related-health behaviors. Hence, this first validation is a test of a tool that could be used to guide case formulation and design education or intervention programs for students and the general healthy population with similar characteristics. This instrument could also be advisable for researchers or clinicians to use with people self-reporting insomnia symptoms and people not reporting such symptoms, because it seems to have appropriate and similar psychometric properties for assessing both. This research provided evidence of the four-factor structure of the SHI as well as its reliability and criterion validity for both populations. However, given that this is the first attempt to validate the SHI in a sample of Spanish citizens reporting insomnia, its application in the clinical scenario should be consolidated in subsequent studies. Such studies should address the usefulness of the SHI in clinical decision-making. Because this tool is now available to Spanish health professionals, future research should approach the effects of sleep hygiene practices on several health outcomes and sleep.

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Figure captions

Figure 1

Flow diagram of participant recruitment according to the STROBE guidelines

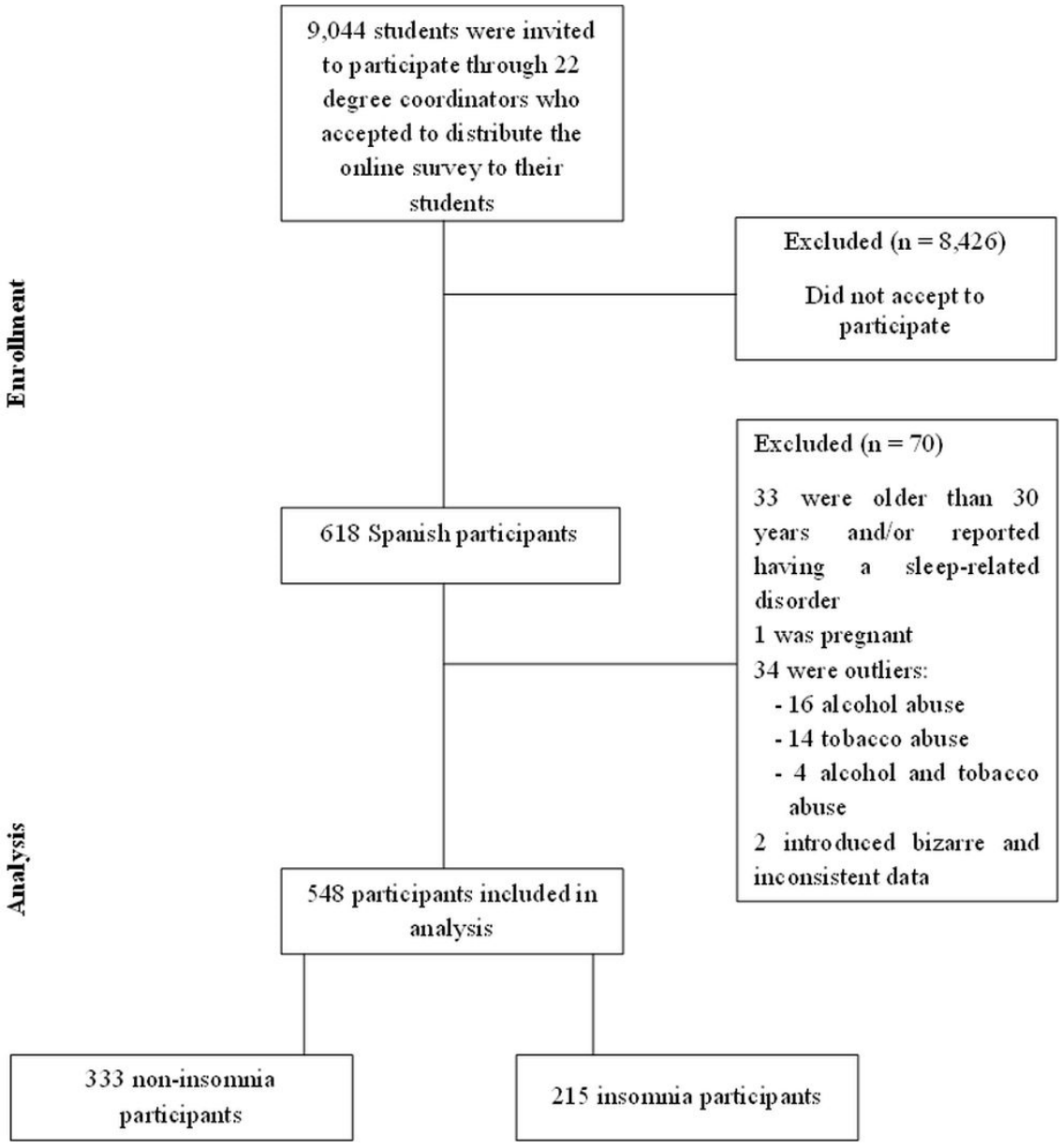

Table 1

Sociodemographic characteristics of the overall sample and groups(non-insomnia and insomnia)

Sociodemographic Characteristics	Overall sample Mean (*SD*) / *n* (%)	Non-insomnia group Mean (*SD*) / *n* (%)	Insomnia group Mean (*SD*) / *n* (%)
Civil status			
Single	517 (94.3)	314 (94.3)	203 (94.4)
Who is the participant living with?			
Parents/legal tutors	196 (35.8)	127 (38.1)	69 (32.1)
Flatmates	278 (50.7)	162 (48.6)	116 (54.0)
Alone	29 (5.3)	15 (4.5)	14 (6.5)
Others	45 (8.2)	29 (8.7)	16 (7.4)
Occupationally active?			
Yes	210 (38.3)	132 (39.6)	78 (36.3)
Weekly work (hours)	2.02 (6.42)	1.88 (6.05)	2.24 (6.98)
Night workshift			
Not working	338 (61.7)	201 (60.4)	137 (63.7)
No night workshift	197 (35.9)	128 (38.4)	69 (32.1)
Sometimes	8 (1.5)	2 (0.6)	6 (2.8)
Almost always	5 (0.9)	2 (0.6)	3 (1.4)
Income of the family unit (monthly)			
Less than 1,000 €	135 (24.6)	72 (21.6)	63 (29.3)
From 1,000 to 2,000 €	249 (45.4)	149 (44.7)	100 (46.5)
From 2,000 to 3,000 €	113 (20.6)	79 (23.7)	34 (15.8)
Over 3,000 €	51 (9.3)	33 (9.9)	18 (8.4)
Alcohol use			
Never	91 (16.6)	54 (16.2)	37 (17.2)
Sometimes	365 (66.6)	225 (67.6)	140 (65.1)
Only on weekends	92 (16.8)	54 (16.2)	38 (17.7)
Drug use			
Never		289 (86.8)	176 (81.9)
Sometimes		44 (13.2)	39 (18.1)
Tobacco use (No. of cigarettes per day)	0.75 (2.52)	0.64 (2.08)	0.92 (3.09)
Weekly physical activity (hours)	4.84 (4.68)	5.00 (4.59)	4.59 (4.81)

Note. *n* = absolute frequency; *SD* = standard deviation.

Table 2

Four-factor solution: factor loadings in the principal component analysis of the SHI

	Factor loadings											
	Overall sample				Non-insomnia group				Insomnia group			
SHI item content	1	2	3	4	1	2	3	4	1	2	3	4
Item 9. I use my bed for things other than sleeping or sex (for example: watch television, read, eat, or study)	**.75**	.26	.05	-.09	**.75**	.34	-.01	-.13	**.75**	.16	.14	-.05
Item 7. I do something that may wake me up before bedtime (for example: play video games, use the Internet, or clean)	**.75**	.04	.12	.12	**.73**	.09	.13	.11	**.71**	-.09	.06	.10
Item 5. I stay in bed longer than I should two or three times a week	**.62**	.05	.01	.39	**.66**	-.07	.08	.37	**.60**	.08	-.10	.35
Item 8. I go to bed feeling stressed, angry, upset, or nervous	.05	**.79**	.08	.04	-.02	**.79**	.06	.03	.12	**.79**	.05	-.03
Item 13. I think, plan, or worry when I am in bed	.08	**.78**	.12	.07	.13	**.76**	.12	.01	-.08	**.72**	.06	.16
Item 12. I do important work before bedtime (for example: pay bills, schedule, or study)	.17	**.62**	.08	.14	.29	**.50**	.13	.17	.07	**.66**	.06	.11
Item 10. I sleep on an uncomfortable bed (for example: poor mattress or pillow, too much or not enough blankets)	.09	.10	**.89**	.03	.13	.08	**.89**	-.00	.03	.12	**.87**	.06
Item 11. I sleep in an uncomfortable bedroom (for example: too bright, too stuffy, too hot, too cold, or too noisy)	.07	.16	**.88**	.04	.05	.18	**.87**	-.02	.08	.05	**.89**	.08
Item 3. I get out of bed at different times from day to day	.11	.04	-.01	**.85**	.06	.00	-.08	**.84**	.18	.082	.05	**.85**
Item 2. I go to bed at different times from day to day	.09	.19	.08	**.83**	.14	.15	.05	**.83**	.06	.141	.12	**.85**

Note. Boldface indicates factor loadings of >.30 that were considered significant. Extraction method: principal-components analysis Rotation method: Varimax with Kaiser normalization.

Table 3

Internal consistency reliability of each factor in non-insomnia vs. insomnia participants

	Overall sample	Non-insomnia group	Insomnia group
SHI factor	Omega coefficient	Omega coefficient	Omega coefficient
Factor 1	.751	.756	.724
Factor 2	.776	.734	.766
Factor 3	.878	.755	.746
Factor 4	.827	.822	.835

Note. Factor 1 (items 5,7,9); Factor 2 (items 8,12,13); Factor 3 (items 10,11); Factor 4 (items 2,3).

**$p < .001$

Table 4

Association (Pearson correlation) between the SHI subscale and outcome variables (i.e., concurrent validity)

	Overall sample				Non-insomnia group				Insomnia group			
	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	Factor 4	Factor 1	Factor 2	Factor 3	Factor 4
PSQI												
PSQI (total score)	.102*	.316**	.155**	.067	.022	.277**	.082	.072	.122	-.040	.085	.123
Sleep duration	.104*	.250**	.046	.048	.036	.231**	-.005	.105	.021	-.011	.038	.123
Sleep disturbances	.125**	.145**	.130**	0.45	.078	.189**	.099	.132	.115	.000	.046	-.026
Sleep latency	.045	.151**	.158**	.089*	-.005	.061	.062	.016	.192**	.004	.120	.075
Subjective sleep quality	.067	.261**	.091*	.066	-.038	.169**	.000	.100	.098	-.039	.102	.147*
Medication use for sleep	.023	.151**	.020	.040	-.009	.156**	.040	.009	-.037	-.032	.069	.070
Daytime dysfunction	.025	.252**	.096*	-.012	.008	.225**	.078	-.054	.039	-.049	-.050	.121
Habitual sleep efficiency	.057	.157**	.080	.043	.006	.186**	.024	.040	.068	-.025	.053	-.037
DASS-21												
Depression symptoms	.182**	.558**	.181**	.118**	.198**	.502**	.150**	.059	.117	.120*	.022	.485**
Anxiety symptoms	.161**	.519**	.248**	.110*	.140*	.452**	.220**	.061	.186**	.038	.075	.426**
Stress symptoms	.215**	.586**	.227**	.070	.231**	.494**	.205**	.055	.145*	.013	.004	.527**
SSS (total score)	.112**	.235**	.072	.096*	.096	.194**	.017	.019	.042	.099	-.002	.068

Note. PSQI = Pittsburgh Sleep Quality Index; DASS-21 = Depression, Anxiety and Stress Scale; SSS = Stanford Sleepiness Scale.

*$p < .05$, **$p < .001$

Table 5

Descriptive results (mean, SD) and between-group comparisons (insomnia versus non-insomnia) of SHI factors

SHI factor	Sample/groups	n	Mean	SD	*t*	*p*
	Overall sample	548	5.57	2.95	-	-
Factor 1	Non-insomnia group	333	5.11	2.962	-4.239	<.001
	Insomnia group	215	6.19	2.808		
	Overall sample	548	5.38	2.77	-	-
Factor 2	Non-insomnia group	333	4.50	2.487	-10.041	<.001
	Insomnia group	215	6.74	2.631		
	Overall sample	548	1.58	1.98	-	-
Factor 3	Non-insomnia group	333	1.21	1.791	-3.826	<.001
	Insomnia group	215	1.89	2.178		
	Overall sample	548	3.11	1.84	-	-
Factor 4	Non-insomnia group	333	2.88	1.724	-3.650	<.001
	Insomnia group	215	3.46	1.954		

Note. Factor 1 (items 5,7,9); Factor 2 (items 8,12,13); Factor 3 (items 10,11); Factor 4 (items 2,3), *SD* = Standard deviation.

**$p < .001$

SUPPLEMENTARY MATERIAL Spanish version of the SHI questionnaire and instructions to apply it to this Spanish population with and without insomnia.

De las siguientes afirmaciones, por favor, elija cómo de cierta es cada una usando la escala que se muestra a continuación:

0	1	2	3	4
Nunca	Casi nunca	A veces	Con frecuencia	Siempre

Ítem 2. Mi hora de ir a la cama es diferente cada día	0 1 2 3 4
Ítem 3. Mi hora de levantarme es diferente cada día	0 1 2 3 4
Ítem 5. Me quedo en la cama más tiempo del que debiera 2 o 3 veces por semana	0 1 2 3 4
Ítem 7. Hago cosas que pueden despabilarme antes de ir a la cama (por ejemplo: jugar a videojuegos, usar internet o limpiar)	0 1 2 3 4
Ítem 8. Me voy a la cama sintiéndome estresado, enfadado, molesto o nervioso	0 1 2 3 4
Ítem 9. En la cama hago cosas distintas a dormir o tener sexo (por ejemplo: ver la televisión, leer, comer o estudiar)	0 1 2 3 4
Ítem 10. Duermo en una cama incómoda (por ejemplo: un mal colchón o almohada, demasiadas mantas o insuficientes)	0 1 2 3 4
Ítem 11. Duermo en una habitación poco confortable (por ejemplo: demasiada luz, mala ventilación, demasiado frío o calor, o demasiado ruido)	0 1 2 3 4
Ítem 12. Hago trabajo importante antes de ir a la cama (por ejemplo: revisar facturas, planificar horarios o estudiar)	0 1 2 3 4
Ítem 13. Le doy vueltas a la cabeza, planifico o siento preocupación cuando estoy en la cama	0 1 2 3 4