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Abstract

Sleep hygiene rules are a set of behavioural and environmental recommendations that promote healthy and good quality sleep, playing a role in insomnia disorder. The Sleep Hygiene Index is a self-report questionnaire developed to evaluate the practice of sleep hygiene behaviours with adequate psychometric properties in different samples.

This study aims to translate the original version of the Sleep Hygiene Index into Italian language evaluating the psychometric properties of this instrument in the Italian adult population. After the translation of the Sleep Hygiene Index from the original English version into the Italian version, factorial structure, internal consistency, as well as convergent and discriminant validity were estimated.

The principal component analysis showed a four-factor solution for the Sleep Hygiene Index, accounting for 52.03% of the total sample variance (F1=25.65%, F2=10.00%, F3=8.48% and F4=7.90%). Factor 1 comprised items regarding arousal; Factor 2 comprised items regarding regular sleep habits; Factor 3 comprised items about sleep environment, and Factor 4 comprised items on sleep disrupted behaviours.

The Italian version of the Sleep Hygiene Index can be regarded as a reliable tool with adequate concurrent and predictive validity for assessing sleep hygiene in Italian adults with or without insomnia symptoms.

Keywords: Sleep Hygiene Index; Sleep; Italian; Validation

Main Text

INTRODUCTION

Sleep hygiene rules are defined as a set of behavioural and environmental recommendations associated with healthy and good quality sleep and which their lack plays a role in insomnia disorder (American Academy of Sleep Medicine, 2014; Jansson-Fröjmark et al., 2018). Specifically, sleep hygiene is described as several behaviours that promote good quality sleep and prevent behaviours that worsen it (Riedel, 2000). Previous literature highlighted a significant relationship between poor sleep hygiene behaviours and sleep quality in persons with insomnia (Irish et al., 2015; Jansson-Fröjmark et al., 2018; Mastin et al., 2006). In turn, poor sleep quality and insomnia symptoms are associated with higher risk of psychopathology; emotional and cognitive impairment and increased risk for medical conditions and mortality (e.g. Hertenstein et al., 2019; Baglioni et al., 2011; Lovato & Lack, 2019; Bacaro et al., 2020). Recently increased attention and interest has been dedicated to poor sleep hygiene both for preventing insomnia symptoms and as an educational resource to improve public health (Chung et al., 2018). The first-line treatment of insomnia is the Cognitive Behavioural Therapy for Insomnia that typically includes the "sleep hygiene rules" session about health practices (e.g. clockwatching, physical exercise, substance use) and environmental factors (e.g. light, noise, temperature) that may promote or disrupt sleep (Hauri, 1991). Despite the use of sleep hygiene education may be limited in clinical setting, its utility could

be considered in different contexts to promote sleep and health in the general population (Irish et al., 2015).

Previous studies that focused on the Italian population have highlighted a poor societal knowledge of sleep (Bruni et al., 2004). Furthermore, recent historical events linked with the diffusion of Covid-19 pandemic and consequent restrictive measures showed alarming prevalence of poor sleep hygiene habits in the general population associated with high report of insomnia symptoms (e.g. Altena et al., 2020; Bacaro et al., 2020).

Several instruments exist to measure sleep hygiene. The most used questionnaire is the Sleep Hygiene Index (SHI, Mastin et al., 2006). The 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). Nevertheless, so far there is not in literature an Italian translation and validation of this scale. This could be particularly useful in the assessment of CBT-I outcomes and in the evaluation of possible preventing and promoting health interventions in the non-clinical population.

For these reasons, the present work aims to translate the original version of the SHI into Italian and to evaluate its psychometric properties in a sample of Italian adults with and without self-reported insomnia.

METHOD

Participants

The sample was composed of 1989 Italian adults that gave consent and answered an online survey on the Survey Monkey platform. The survey was distributed in all Italian territory with different strategies of dissemination: personal contacts of researchers (for sample and recruitment details please refer to Bacaro et al., 2020).

The sample was divided into two sub-groups based on the score on the Insomnia Severity Index (Bastien, 2001): non-insomnia symptoms and insomnia-symptoms groups. 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 is closely related to insomnia.

The inclusion criteria to participate in the study were (1) being over 18 years old and (2) having a good knowledge and understanding of the Italian language.

Procedure

The recruitment and administration of the questionnaires took place between April and May 2020. The protocol of the study was approved by the Ethics Committee of the University of Rome Guglielmo Marconi. All participants signed the informed consent form 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 (For detailed procedure information refers to Bacaro et al., 2020).

The validation process was based on a cross-sectional study design. Two Italian-speaking clinical psychologists translated the SHI into Italian (V.B. and C.B.). Both of them were specialized in sleep research and treatment. The agreement between them was assessed and any inconsistencies were adjusted. The final version of the SHI was examined and approved by the other authors of the study (Supplemental material Document S1).

Measures

An ad hoc questionnaire was created to collect general information; information on the pandemic impact and information on mental health.

- Sleep Hygiene Index (SHI, Mastin et al., 2006)

The Sleep Hygiene Index is a 13-item self-administered questionnaire which evaluates sleep hygiene behaviour, such as regular sleep times, sleep environment, pre-bed routines etc. The items included on the SHI were derived from the diagnostic criteria for inadequate sleep hygiene included in the International Classification of Sleep Disorders (American Academy of Sleep Medicine, 2005). Participants were asked to indicate how frequently they engage in specific behaviours (always = 5, frequently = 4, sometimes = 3, rarely = 2, never = 1). Higher scores are indicative of poorer sleep hygiene status. Higher scores indicate less sleep hygiene behaviours. Previous studies used a score below 26 as good sleep hygiene habits, 27–34 as on average, and 35 and above as poor sleep hygiene (Mastin et al., 2006).

ISI was used to create groups for testing discriminant validity. The Morningness Eveningness Questionnaire Reduced (MEQr) and the Dysfunctional Beliefs and Attitudes about Sleep (DBAS) were used for testing concurrent validity. Finally, the Hospital Anxiety and Depression Scale (HADS) was used for testing predictive validity. These are described as follows:

- Insomnia Severity Index (ISI, Bastien et al., 2001)

Participants provided answers on a five-point Likert scale, and summing up the results of the respective seven items, ranging from 0 to 28, a total score of insomnia severity during the preceding two weeks could be obtained. The total score is interpreted as follows: no insomnia (0 -7); subthreshold insomnia (8-14); moderate insomnia (15-21); and severe insomnia (22-28).

- Morningness Eveningness Questionnaire Reduced (MEQr, Natale et al., 2006)

MEQr included five questions: three items requested preferred time for going to bed, getting up and the hour of the day with maximum personal efficiency. Moreover, participants also had to assess the degree of tiredness within the first half an hour after their awakening and to indicate which circadian type they thought they belonged to. The MEQr score was obtained by summing scores of

each question and ranged from 4 to 25. Scores above 18 identified subjects as morning types and scores below 11 as evening types.

- Perceived Stress Scale (PSS, Coehn, 1983)

The PSS measures the perception of stress by asking respondents to rate the frequency of their thoughts and feelings related to situations occurred in the last month. It consists of 10 items rated on a five-point Likert-type scale, ranging from “Never”, coded 0, to “Very Often”, coded 4. Scores of from 1 to 10 indicates low levels of stress; 11 to 14 are average scores; scoring 15-18 are medium to high levels and 19 and above indicates high levels of perceived stress.

- Hospital Anxiety and Depression Scale (HADS, Zigmond, Snaith, 1983)

The HADS consists of seven items rating anxiety and seven items rating depression. Each item is scored from 0 to 3. Anxiety and depression values are the sums of the corresponding item scores. Patients can be subsequently allocated to one of the three following categories for anxiety and depression, based on the individual sum scores: non-case (0–7), borderline case (8–10) and clinical case (11 and above).

- Dysfunctional Beliefs and Attitudes about Sleep (DBAS-16, Morin et al., 2007)

The DBAS-16 was administered to evaluate beliefs and attitudes about sleep in this study. The scoring range for each item was from 1 (at the “strongly disagree” pole) to 5 (at the “strongly agree” pole). Lower scores represent more dysfunctional beliefs.

Data analysis

Collected data were analysed using SAS Software 9.4 version with SAS/STAT version 14.1 (SAS Institute Inc., Cary, NC, USA) by a professional biostatistician (S.C.). Descriptive statistics were performed on demographic data and sleep parameters. Participants were allocated to insomnia-

symptoms or non- insomnia symptoms group, considering the clinical cut-off point. Correlations and linear regression analyses were performed to test the fit of the model. Insomnia symptoms and non-insomnia symptoms population differences were assessed using a non-parametric analysis of variance (ANOVA) with the group as a between-factor. The Wilcoxon rank-sum test was employed for median split pair-wise comparison. A power analysis was conducted, using ANOVA in the subsample, to test the probability that the statistical test will reject the null hypothesis. The internal consistency of the Italian version of the Sleep Hygiene Index was studied calculating Cronbach's α coefficient, a statistic calculated from the pairwise correlation between the SHI items (good internal consistency was considered $0.70 > \alpha < 0.90$) (Cronbach, 1951).

Since the sample was unbalanced in gender prevalence (female gender was higher present compared to male gender) ANOVA analysis with gender as between-factor and Cronbach's α coefficient in the two sub groups were calculated.

An exploratory factor analysis was conducted to determine the factor structure of the SHI using the principal component extraction method. This method was used in previous studies that evaluated the validation of the SHI scale in the version Persian Version (Chehri et al., 2016) and in the Spanish version (Prados et al., 2020). We used an orthogonal rotation by the Varimax method to ease the interpretation of the rotated factors. In a second step, CFA was performed dividing the whole population into two subsamples obtained with simple random sampling and insomnia symptoms group and non-insomnia symptoms group. In line with the literature, these multi-group CFAs tested the configural equivalence (the number of factors and their loading pattern are invariant across groups) and the measurements or metric equivalence (the factor loading are invariant across groups). Model parameters were estimated using the maximum likelihood (ML) estimation method, and the quality of the measurement model was visually examined through the fit indices estimates. The literature indicates the following as good fit models indices: CFI

(Comparative Fit Index) values close to 0.95, SRMR (Standardized root-mean-square residual) value below 0.08 and RMSEA (Root mean square error of approximation) value below 0.06.

RESULTS

Description of the sample

A total of 1989 Italian adults participated in the study (F: 1515; M:474; mean age = 38.4 ± 12.8 years; age range: 18-90 years). With concern to age groups, 666 were aged 18-30 years old; 1258 were aged 31-65 years old and only 65 were aged more than 65 years old. Of the included participants, 370 reported insomnia symptoms. For specific sample characteristics please refer to Bacaro et al., 2020. The equality of variances test does not indicate a significant difference in the two variances ($F=1.20$, $p=0.0190$) showing that data were normally distributed. No significant differences were detected between males and females.

Internal consistency reliability

The Cronbach's α coefficient for the SHI was 0.74 in the total sample. Furthermore, the internal consistency was also confirmed in this subpopulation of non-insomnia symptoms ($\alpha= 0.72$) and insomnia symptoms group ($\alpha=0.69$). The internal consistency of the scale was also confirmed in females ($\alpha= 0.75$) and males ($\alpha= 0.73$).

Sampling adequacy and sphericity

The factor analysis showed a Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy of 0.780, 0.769, and 0.669 for the overall sample, non-insomnia symptoms and insomnia-symptoms group, respectively. Moreover, Bartlett's test of sphericity was statistically significant ($p < .001$) overall and in all subsets. The KMO value greater than 0.50 and significant value of Bartlett test of sphericity were considered satisfactory indicators of the appropriateness of the data for subjection to factor analysis.

Factor structure of the SHI

In the overall sample, exploratory factor analyses of the Italian SHI using the principal component extraction method showed a four-factor solution accounting for 52.03% of the total sample variance (F1=25.65%, F2=10.00%, F3=8.48% and F4=7.90%). In Table 1 the factors loading coefficient estimated by regression are reported and in Figure 1 the scree plot and the variance explained are reported.

Please insert here Table 1: "Factor loadings in the principal component analysis of the Sleep Hygiene Index"

Particularly, the first factor, was composed of five items 7, 8, 9, 12, 13; the second factor was composed of 3 items 2, 3 and 5; the third factor was composed of 2 items 10 and 11; and finally fourth factor was composed of 3 items 1, 4, 6. The four factors were denominated as follow:

Factor 1: "Arousal at bedtime"

Factor 2: "Regular routines"

Factor 3: "Sleep environment"

Factor 4: "Sleep disrupted behaviours"

Please insert here Figure 1: "Factor analysis"

Furthermore, CFA was conducted on 2 different confirmatory subset called Sample 1 (N=995) and Sample 2 (N=994). The whole population was divided into two subsamples obtained with simple random sampling in order to confirm factor analysis results.

In Sample 1the model fit chi-square is 251.6102 (df = 59, p <.0001). This shows that statistically you cannot reject the confirmatory factor model for the test scores. However, the root mean square error of approximation (RMSEA) estimate is 0. 0573, which is close than the conventional 0.06 value for a good model fit. Bentler's comparative fit index is 0. 9093, which indicates a good model fit. In Sample 2 the model fit chi-square is 226.4857 (df = 59, p <.0001). This shows that statistically you cannot reject the confirmatory factor model for the test scores. However, the root mean square error of approximation (RMSEA) estimate is 0. 0535, which is close than the conventional 0.06 value for a good model fit. Bentler's comparative fit index is 0. 9194, which indicates a good model fit. Path diagrams are resumed in Document S2.

This diagram shows the parameter estimates under the current model specification.

In a second step, CFA was tested in insomnia-symptoms group and non-insomnia symptoms group. The model fit chi-square was 149.7572 (df = 59, p <.0001). This shows that statistically you cannot reject the confirmatory factor model for the test scores. However, the root mean square error of approximation (RMSEA) estimate is 0. 0646. Bentler's comparative fit index is 0. 8646, which indicates a quite good model fit. In Figure 2 the path diagram for insomnia-symptoms group is reported.

Please insert here Figure 2: "Confirmatory factor analysis path diagram (Insomnia-symptoms group)"

In Non Insomnia symptoms sample the model fit chi-square is 328.003 (df = 59, p <.0001). This shows that statistically you cannot reject the confirmatory factor model for the test scores. However, the root mean square error of approximation (RMSEA) estimate is 0. 0531. Bentler's comparative

fit index is 0. 9119, which indicates a good model fit. In Figure 3 the path diagram for non-insomnia symptoms group is reported.

Please insert here Figure 3: "Confirmatory factor analysis path diagram (Non Insomnia symptoms group)"

Criterion validity

In table 2 correlations for all sample and for insomnia-symptoms and non-insomnia symptoms groups. In the overall sample, SHI Factor 1 ("arousal in bedtime") was positively correlated with DBAS (0.29756 p=<.001), HADS Anxiety (0.41605 p=<.001), HADS Depression (0.302 p=<.001), ISI (0.40722 p=<.001) and PSS (0.43249 p=<.001). Factor 2 2 ("regular routines") positively correlated with DBAS (0.19187p=<.001), HADS Anxiety (0.14778p=<.001), and HADS Depression (0.16392p=<.001), ISI (0.20204 p=<.001) and PSS (0.17854 p=<.001). Factor 3 ("environment") positively correlated with DBAS (0.12363 p=<.001), HADS Anxiety (0.12878 p=<.001), and HADS Depression (0.11223 p=<.001), ISI (0.13508 p=<.001) and PSS (0.10841 p=<.001). Factor 4 ("sleep disrupted behaviors") does not seem to bring great correlation results with respect to the other indices.

In the non-insomnia symptoms group, similar results were found but Factor 3 and Factor 4 were not significantly correlated with ISI. In the insomnia symptoms group, only Factor 2 was positively and significantly correlated to ISI.

Please insert here Table 2: "Correlation with factors"

DISCUSSION

The present work aimed to translate the original version of the Sleep Hygien Index by Mastin and colleagues into Italian, analysing the psychometric properties of this instrument in a sample of Italian adults with and without insomnia symptoms. A four factors structure was highlighted with factors labelled as “Arousal at bedtime” (Factor 1: items 7, 8, 9, 12, 13), “Regular routines” (Factor 2: items 2, 3, 5), “Environment” (Factor 3: items 10,11) and “Sleep disrupted behaviours” (Factor 4: items 1,4,6). These factors are well representative of the most important and used sleep hygiene rules. For example, sleep hygiene recommendations often encourage regularity in the sleep/wake cycle in order to decrease inter-night variability. Moreover, sleep disrupted behaviours are discouraged in the typical sleep hygiene recommendations such as: avoiding napping in order to preserve the homeostatic sleep drive and avoiding the use of exciting substances (Riemann et al., 2017).

This structure confirms previous validation studies of the SHI such as the validation study of the Spanish version of the SHI, which was validated by using a sample of adults with ad without insomnia (Prados et al., 2020). At the same time, other validation studies found different factor structures of the SHI. For example, the Persian version of the SHI found with an exploratory factor analysis a three factors structure, labelled as “sleep-wake cycle behaviours” (four items), “bedroom factors” (three items), and “behaviours that affect sleep” (six items) (Chehri et al., 2016).

Furthermore, results showed that higher scores on the SHI factors, indicating poorer sleep hygiene behaviours, were correlated with higher levels of depression, anxiety and stress symptoms, and more dysfunctional beliefs about sleep. The discriminant validity results showed that the comparisons between non- insomnia symptoms and insomnia-symptoms samples in the mean scores of the factors of the Italian SHI were significant, indicating a good ability of the Italian SHI in discriminating between people with and without insomnia symptoms.

Particularly in the post-pandemic context, to have an Italian validated scale that assess sleep hygiene it seems of utmost importance. Thus, previous studies highlighted that sleep hygiene behaviours are one of the most significative factors in predicting insomnia symptoms in the Italian adults (Bacaro et al., 2020). In this second phase of the pandemic, mental health operators should make all efforts to contain and repair the damages which the pandemic has provoked, focusing on general population and in mental disorders patients through the use of sleep hygiene based interventions.

This study has some possible limitations. First, the sample was based on a subset of the Italian population that was recruited during the pandemic situation in Italy. Despite that, the factorial model was confirmed both in the insomnia-symptoms and non-insomnia symptoms groups and randomizing the sample in two sub-sets. Future studies should include more variety samples including older people and using both self-reported and objective measures. Furthermore, the female gender was overrepresented in the study and future studies should balance the sample recruitment. Another important point to consider is that in the considered sample the elderly age group was under-represented (3.2%). Previous study highlighted that in this specific population, typical sleep hygiene rules are not associated with poor sleep and insomnia symptoms (Desjardins et al., 2019). Future studies should investigate the validation of this scale on this specific population in order to clarify the potential clinical use of this instrument. Finally, it was no possible to analyse the test–retest reliability of the SHI. Future studies should also explore the validity of this scale in specific clinical population such as patients with diagnosed different kind of sleep disorders (e.g. obstructive sleep apnoea; narcolepsy) in order to explore further if the use of Sleep Hygiene Index could be performed also in patient with other kind of sleep disorders beyond insomnia.

Concluding, this study could be important to maximise the use and the evaluation of sleep hygiene behaviours in both insomnia patients and general population, providing increased attention to these

aspects in the Italian population and understanding individual differences in the use and effectiveness of sleep hygiene recommendations.

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Tables

Table 1: “Standardized Factor loadings in the principal component analysis of the Sleep Hygiene Index”

Item	*Factor1*	*Factor2*	*Factor3*	*Factor4*
SHI1	-0.24488	0.29681	-0.01182	**0.42755**
SHI2	-0.0689	**0.46301**	-0.03735	-0.02392
SHI3	-0.08972	**0.50302**	-0.01858	-0.11472
SHI4	-0.06954	-0.12326	0.11372	**0.59811**
SHI5	0.11309	**0.20164**	0.01129	-0.15883
SHI6	0.06789	-0.06018	-0.14082	**0.48075**
SHI7	**0.25359**	-0.01422	-0.09921	0.14915
SHI8	**0.36543**	-0.06204	-0.02892	-0.08952
SHI9	**0.18889**	0.00691	0.03188	-0.0085
SHI10	-0.071	-0.0221	**0.60395**	-0.03486
SHI11	-0.04464	-0.02956	**0.57833**	0.00339
SHI12	**0.3003**	-0.20432	-0.06338	0.22303
SHI13	**0.41819**	-0.09285	-0.0237	-0.19001

Table 2: “Correlation with factors in insomnia-symptoms and non-insomnia symptoms group”

		Insomnia-Symptoms Group N=370				**Non-Insomnia Symptoms Group N=1619**			
		Factor 1	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**
DBAS	*r*	0.06796	0.17941	0.02612	0.06676	0.23761	0.11808	0.12521	0.01725
	p	0.1921	0.0005	0.6166	0.2001	<.0001	<.0001	<.0001	0.4878
HADS_Anxiety	*r*	0.24797	0.06327	-0.0582	0.04061	0.36254	0.09032	0.15795	-0.03111
	p	<.0001	0.2247	0.2641	0.4361	<.0001	0.0003	<.0001	0.211
HADS_Depression	*r*	0.12494	0.1588	-0.02957	-0.0334	0.23774	0.09005	0.12711	-0.01479
	p	0.0162	0.0022	0.5707	0.5219	<.0001	0.0003	<.0001	0.552
ISI	*r*	0.40722	0.20204	0.13508	-0.01329	-0.14816	-0.24006	-0.03386	0.01015
	p	<.0001	<.0001	<.0001	0.5538	0.0043	<.0001	0.5161	0.8458
MEQ	*r*	-0.28807	-0.27681	-0.00351	-0.02176	0.33461	0.16926	-0.08214	-0.00013
	p	<.0001	<.0001	0.8756	0.3322	<.0001	0.0011	0.1147	0.998

Figures:

Figure 1: “Factor analysis”

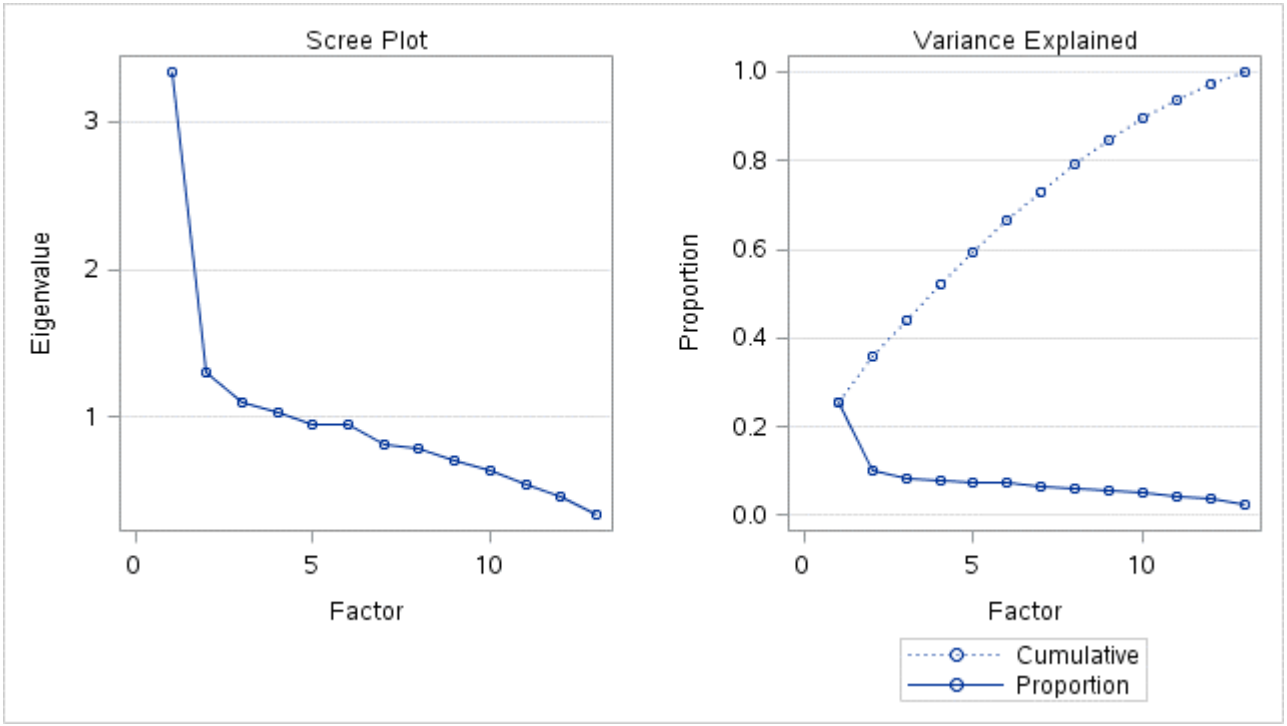

Figure 2: “Confirmatory factor analysis path diagram (Insomnia symptoms group)”

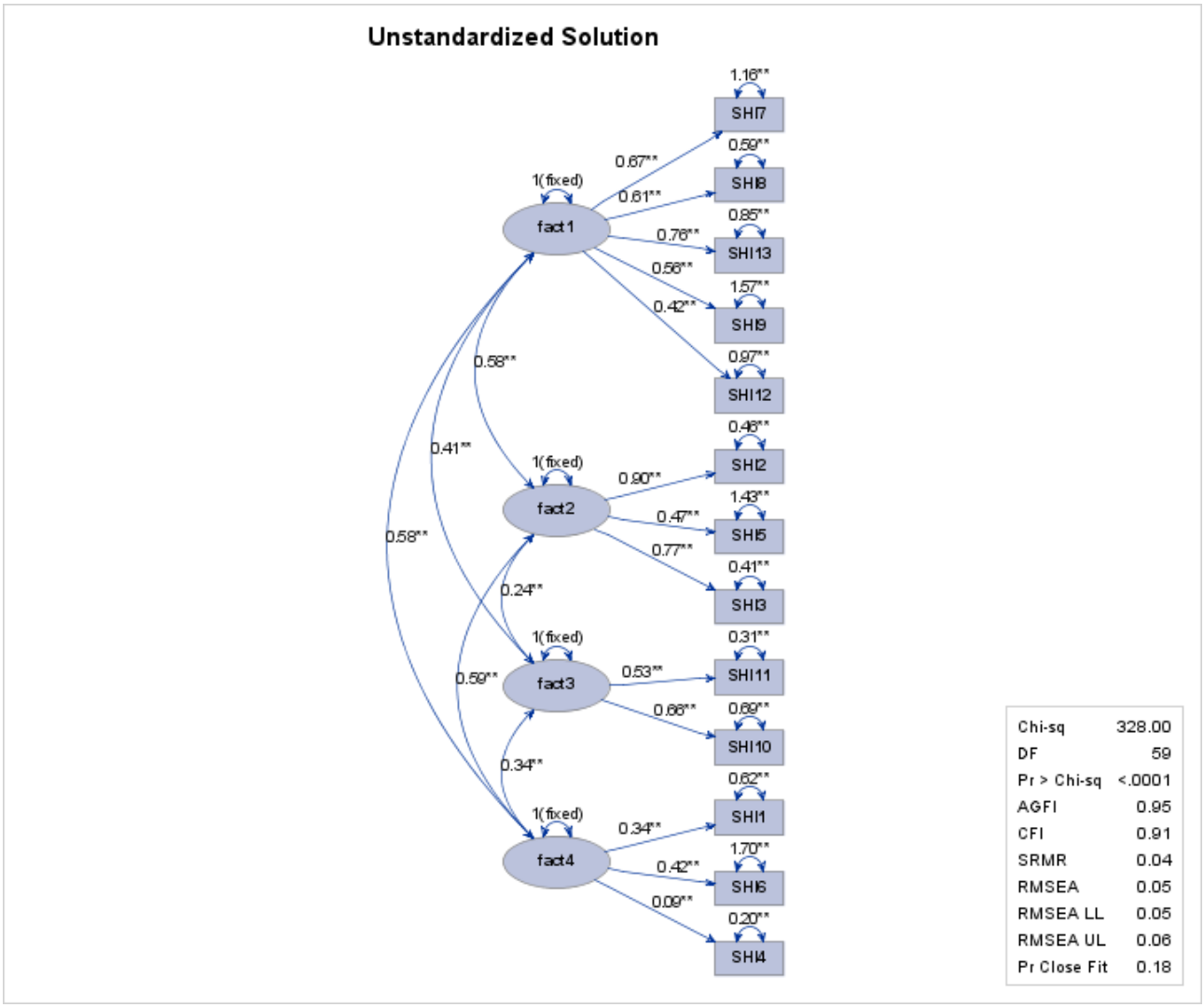

Figure 3: “Confirmatory factor analysis path diagram (Non-insomnia symptoms group)”