Ethiopian Journal of Health and Biomedical Sciences

Online ISSN: 2790-3087

Original article Open access

Factor Structure Analysis and Total Score Correlation of the Insomnia Severity Index and the Ford Insomnia Response to Stress Test in Patients with Multiple Somatic Complaints

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ABSTRACT

Background: Insomnia and sleep reactivity are common among individuals presenting with multiple somatic complaints. The Insomnia Severity Index (ISI) and the Ford Insomnia Response to Stress Test (FIRST) are widely used instruments for assessing insomnia severity and vulnerability to stress-related sleep disturbance, respectively. However, their factor structures and interrelationships have not been adequately examined in Nigerian population.

Objective: To determine the factor structure and internal consistency of the ISI and FIRST and to assess the correlation between their total scores among patients with multiple somatic complaints.

Methods: A cross-sectional study was conducted among 111 adult psychiatric outpatients with multiple somatic complaints at the Obafemi Awolowo University Teaching Hospitals Complex, Nigeria. Sociodemographic data were collected, and the participants completed the ISI and FIRST questionnaires. Exploratory factor analysis using maximum likelihood extraction with varimax rotation was applied to the ISI, while principal component analysis was used for the FIRST. Internal consistency was assessed using Cronbach's alpha. Correlation and simple linear regression analyses were performed to evaluate the associations between the instruments.

Results: Data from 110 participants were analyzed (mean age 39.4 ± 8.7 years; 58.2% female). The ISI demonstrated a two-factor structure explaining 47.22% of the variance, with an overall Cronbach's alpha of 0.67. The FIRST demonstrated a single-factor structure explaining 56.40% of the variance, with excellent reliability (Cronbach's alpha = 0.90). A significant positive correlation was observed between ISI and FIRST scores ($r = 0.40$, $p < 0.01$). Linear regression analysis showed that sleep reactivity accounted for 15% of the variance in insomnia severity (Adjusted $R^2 = 0.150$, $p < 0.01$).

Conclusion: The ISI and FIRST demonstrated acceptable construct validity and reliability in this population. Sleep reactivity was significantly associated with insomnia severity, supporting the clinical utility of the FIRST in identifying individuals at risk of insomnia.

***Keywords*:** Insomnia Severity Index, Ford Insomnia Response to Stress Test, insomnia, sleep reactivity, factor analysis, somatic symptoms

Article History: Received: March 17, 2025 Revised: July 12, 2025 Accepted: November 22, 2025

Citation: Mume C. O. Factor Structure Analysis and Total Score Correlation of the Insomnia Severity Index and the Ford Insomnia Response to Stress Test in Patients with Multiple Somatic Complaints. Ethiop J Health Biomed Sci. 2025 15(2): 16-22. https://doi.org/10.20372/ejhbs.1027

INTRODUCTION

Multiple somatic complaints are frequently encountered in general medical and psychiatric practice and are associated with substantial functional impairment and healthcare utilization. In the ICD-10, they are categorized under somatoform disorders (1), characterized by repeated presentation of physical symptoms and persistent requests for medical investigations, despite negative findings. In the International Classification of Diseases, 11th Revision (ICD-11), these conditions are categorized under bodily distress disorder, characterized by distressing bodily symptoms and excessive attention directed toward them (1, 2). These conditions often co-occur with depression and anxiety (1,2). Insomnia is highly prevalent among patients with psychiatric disorders, including those with multiple somatic complaints. Insomnia contributes to impaired functioning, poor quality of life, and worsening psychiatric symptoms. Reliable and valid tools are essential for accurate assessment of insomnia and related risk factors.

The Insomnia Severity Index (ISI) is a widely used self-report instrument assessing insomnia severity, its impact on daily functioning, and associated distress (3). The Ford Insomnia Response to Stress Test (FIRST) measures sleep reactivity, defined as the predisposition to experience sleep disturbances in response to stress (4).

According to the behavioral model of insomnia (5), insomnia arises from the interaction of trait vulnerabilities and precipitating factors. Individuals with high sleep reactivity (FIRST) may thus be more susceptible to insomnia (ISI), suggesting a potential positive correlation between the two measures. Therefore, a positive association between sleep reactivity and insomnia severity is expected. Despite widespread use of the ISI and FIRST globally, their psychometric properties and interrelationship have not been examined among patients with multiple somatic complaints in the Nigerian setting. This study aimed to (1) determine the factor structures of the ISI and FIRST, and (2) examine the correlation between their total scores in patients with multiple somatic complaints.

MATERIALS AND METHODS

Study setting and design

A cross-sectional study was conducted among psychiatric outpatients at Obafemi Awolowo University Teaching Hospitals Complex, Ile-Ife, Nigeria.

Participants

Adult patients aged 18–64 years presenting with multiple somatic complaints were consecutively recruited. Patients identified with psychotic disorders, psychoactive substance use disorders, or recent psychotropic medication use (within one month), according to the 10th Edition of the International Classification of Diseases (ICD-10) by the World Health Organization (1) were excluded.

Data Collection

Participants provided sociodemographic information and completed both the Insomnia Severity Index (ISI) and Ford Insomnia Response to Stress Test (FIRST).

Instruments

Insomnia Severity Index (ISI)

The ISI is a 7-item self-report instrument assessing insomnia severity over the past week. Each item is rated on a 0–4 scale, with total scores ranging from 0 to 28. Higher scores indicate greater insomnia severity (3). Scores ≥15 indicate clinically significant insomnia (3). Severity grades of insomnia on the ISI include the following: no clinically significant insomnia (0-7), subthreshold insomnia (8–14), clinical insomnia of moderate severity (15–21), and severe clinical insomnia (22–28) (6, 7, 8). In the present study, subjects who scored ≥15 were considered to have clinically significant insomnia, as has been done in previous studies (6, 7, 8). The ISI has been demonstrated to have an acceptable validity and reliability profile (9).

Ford Insomnia Response to Stress Test (FIRST)

The FIRST is a 9-item self-report questionnaire measuring sleep reactivity to stress (4). It requires the subjects to rate their likelihood of having sleep disruption in a variety of stressful situations during the day or evening. Items are rated on a 4-point Likert scale, with total scores ranging from 9 to 36. Scores ≥18 indicate high sleep reactivity (10). This study used this (≥ 18) as the cut-off score.

https://doi.org/10.20372/ejhbs.1027

Statistical Analysis

Data was analyzed using the Statistical Package for Social Sciences (SPSS) software, version 23. The general characteristics of the subjects were determined using descriptive statistics.

Exploratory factor analysis was performed to evaluate the construct validity and underlying dimensional structure of the Insomnia Severity Index (ISI) and the Ford Insomnia Response to Stress Test (FIRST). Factor analysis is a multivariate statistical technique used to identify latent constructs that explain correlations among observed variables and to assess whether questionnaire items measure distinct theoretical domains. The suitability of the data for factor analysis was assessed by examining the correlation matrix and sampling adequacy. Factor extraction was conducted using maximum likelihood extraction with varimax rotation for the ISI. Maximum likelihood extraction was selected because it provides statistically robust estimates of factor loadings and allows identification of latent constructs underlying insomnia severity. Varimax rotation was applied to enhance interpretability by maximizing the variance of factor loadings and improving the distinction between factors.

Principal component analysis (PCA) was used to examine the factor structure of the FIRST. PCA is an appropriate method for identifying the dimensional structure and explaining the maximum proportion of variance among items. Factors with eigenvalues greater than one were retained. Factor loadings of 0.30 or greater were considered significant.

Internal consistency reliability of the instruments and their subscales was assessed using Cronbach's alpha coefficient. Cronbach's alpha values of 0.70 or higher were considered acceptable indicators of reliability, while values above 0.90 indicated excellent reliability.

Pearson correlation analysis and simple linear regression were performed to examine the relationship between ISI and FIRST total scores. Statistical significance was set at $p < 0.05$.

Ethical Considerations

Ethical approval was obtained from the institutional review board. Written informed consent was obtained from all participants.

RESULTS

Participants characteristics

A total of 110 participants were included in the analysis, yielding a response rate of 99.1%. The age of the participants ranged from 24 to 52 years, with a mean age of 39.4 ± 8.7 years. Of the participants, 64 (58.2%) were female, and 46 (41.8%) were male. Forty-one participants (37.3%) were in an intimate relationship, while 69 (62.7%) were not.

Based on the Insomnia Severity Index (ISI), 26 participants (23.6%) had clinical insomnia (ISI score ≥15). In addition, 51 participants (46.4%) demonstrated significant sleep reactivity, as indicated by a Ford Insomnia Response to Stress Test (FIRST) score ≥18.

The descriptive statistics for participants' age and scores on the ISI and FIRST are presented in Table 1, while the clinical diagnoses of the participants are summarized in Table 2.

Table 1: Descriptive statistics of participants' age and scores on the Insomnia Severity Index (ISI) and Ford Insomnia Response to Stress Test (FIRST)

Variable	Range	Mean	Standard Deviation (SD)	Standard Error of Mean (SEM)
Age (years)	24-52	35.9	8.7	0.8
Insomnia Severity Index Score	14-27	20.8	2.9	0.3
Ford Insomnia Response to Stress Score	10-27	19.4	4.0	0.4

https://doi.org/10.20372/ejhbs.1027

Table 2: Clinical diagnoses of participants according to ICD-10 classification

ICD-10 Diagnosis	Frequency (n)	Percentage (%)
Depressive Episode	49	44.5
Generalized Anxiety Disorder	13	11.8
Phobic Anxiety Disorder	12	11.0
Posttraumatic Stress Disorder	3	2.7
Somatization Disorder	15	13.6
Undifferentiated Somatoform Disorder	18	16.4

Factor structure and reliability of the Insomnia Severity Index (ISI) and Ford Insomnia Response to Stress Test (FIRST)

Exploratory factor analysis of the Insomnia Severity Index (ISI), consisting of seven items, identified a two-factor structure using maximum likelihood extraction with varimax rotation. The two factors collectively accounted for 47.22% of the total variance. The factor loadings and structure are presented in Table 3.

The first factor comprised items related to sleep initiation, sleep maintenance, and early morning awakening, representing the core symptoms of insomnia. The second factor included items related to sleep satisfaction, noticeability of sleep problems, distress or worry about sleep difficulties, and interference with daytime functioning, reflecting the functional and psychological impact of insomnia.

Reliability analysis demonstrated acceptable internal consistency for the overall ISI, with a Cronbach's alpha coefficient of 0.67. The first factor demonstrated a Cronbach's alpha of 0.65, while the second factor demonstrated a Cronbach's alpha of 0.70, indicating acceptable reliability of both subscales.

For the Ford Insomnia Response to Stress Test (FIRST), factor analysis using principal component analysis identified a single-factor structure. This factor accounted for 56.40% of the total variance. All nine items loaded significantly on this factor, indicating that the instrument measures a single underlying construct, sleep reactivity. The factor loadings are presented in Table 4.

The FIRST demonstrated excellent internal consistency reliability, with a Cronbach's alpha coefficient of 0.90, indicating a high level of internal consistency among the items.

Overall, these findings support the construct validity and reliability of both the ISI and FIRST in assessing insomnia severity and sleep reactivity among patients with multiple somatic complaints.

Table 3: Factor Loadings of the Insomnia Severity Index (ISI)

Item Number	Item Description	Factor 1(Nocturnal Sleep Disturbance)	Factor 2 (Perceived Impact of Sleep Problems)
1	Severity of early insomnia	0.999 *	-0.001
2	Severity of middle insomnia	0.464 *	0.117
3	Severity of terminal insomnia	0.583 *	0.011
4	Sleep satisfaction	0.273	0.280 *
5	Noticeability of sleep problems	0.032	0.297 *
6	Worry/Distress about sleep difficulties	0.097	0.932 *
7	Interference with daytime functioning	0.219	0.754 *
	Total variance explained: 47.22%		
	Cronbach's alpha: Overall scale: 0.67	0.65	0.70

Extraction method: Maximum likelihood.

Highest loading for each item is marked with an asterisk ().*

 https://doi.org/10.20372/ejhbs.1027

Table 4: Factor Loadings of the Ford Insomnia Response to Stress Test (FIRST)

Item Number	Item Description	Factor Loading
1	Before an important meeting the next day	0.873
2	After a stressful experience during the day	0.715
3	After a stressful experience in the evening	0.766
4	After getting bad news during the day	0.666
5	After watching a frightening movie or TV show	0.941
6	After having a bad day at work	0.719
7	After an argument	0.603
8	Before having to speak in public	0.679
9	Before going on vacation, the next day	0.739

Extraction method: Principal Component Analysis

Total variance explained: 56.40%

Cronbach's alpha: 0.90

Correlation and Regression

Simple linear regression analysis demonstrated a significant positive association between the total scores of the Insomnia Severity Index (ISI) and the Ford Insomnia Response to Stress Test (FIRST) ($r = 0.40$, $p < 0.01$). This indicates that higher sleep reactivity, as measured by the FIRST, significantly predicts greater insomnia severity. The linear relationship accounted for 15% of the variance in ISI scores (Adjusted $R^2 = 0.150$, $p < 0.01$), as summarized in Table 5.

Table 5: Simple Linear Regression Analysis of ISI Scores Predicted by FIRST Scores

Variable	β (SE)	95% Confidence Interval	t	df	p-value
FIRST total score	0.284 (0.063)	0.160 to 0.408	4.536	108	<0.001

Model summary: $r = 0.400$, $R^2 = 0.160$, Adjusted $R^2 = 0.150$, $F(1,108) = 20.57$, $p < 0.001$.

Notes: ISI total score was the dependent variable, and FIRST total score was the independent variable. β = unstandardized regression coefficient; SE = standard error.

DISCUSSION

This study is the first to examine the factor structures of the Insomnia Severity Index (ISI) and the Ford Insomnia Response to Stress Test (FIRST) among patients with bodily distress disorder in this population. It is also the first to demonstrate a significant positive correlation between the total scores of the two instruments.

The ISI demonstrated a two-factor structure, comprising nocturnal sleep disturbances (early, middle, and terminal insomnia) and the perceived impact of sleep problems (sleep satisfaction, noticeability of sleep difficulties, distress/worry, and interference with daytime functioning). Previous studies have reported varying factor solutions for the ISI, including one-, two-, and three-factor models (11). The two-factor solution identified in this study is consistent with prior research, supporting the construct validity of the ISI in patients with multiple somatic complaints. The FIRST demonstrated a single-factor structure, confirming its utility as a unidimensional measure of sleep reactivity, in line with previous studies (12).

Sleep reactivity reflects an individual's trait-like predisposition to stress-related sleep disturbances and is a recognized risk factor for the development of insomnia (13). In this study, 23.6% of participants met the criteria for clinical insomnia (ISI ≥15), while 46.4% exhibited significant sleep reactivity (FIRST ≥18). This suggests that a substan-

tial proportion of individuals with high sleep reactivity do not currently experience insomnia but may be at elevated risk of developing it in the future. Prior research has shown that individuals with high sleep reactivity have more than three times the odds of developing insomnia within one year compared to those with low reactivity (13). Therefore, assessing sleep reactivity using the FIRST can aid in early identification of at-risk individuals, allowing for preventive interventions and targeted management strategies. This has important implications for clinicians, researchers, and patients in the field of sleep medicine.

The significant positive correlation between FIRST and ISI scores ($r = 0.40$, $p < 0.01$) further supports the theoretical model linking trait vulnerability (sleep reactivity) to insomnia severity. Regression analysis showed that sleep reactivity accounted for 15% of the variability in insomnia severity, highlighting its role as a meaningful predictor, though other factors likely contribute to insomnia in this population.

Strengths and Limitations

This study is strengthened by the use of validated instruments, a high response rate (99.1%), and the application of rigorous factor analytic methods. However, the sample size was relatively modest, limiting the generalizability of the findings. Additionally, the cross-sectional design precludes causal inference, and the study was conducted in a single clinical setting, which may not fully represent the broader population. Future studies with larger, multi-center samples and longitudinal designs are warranted to confirm these findings and examine the predictive validity of sleep reactivity over time.

CONCLUSION

The Insomnia Severity Index (ISI) and Ford Insomnia Response to Stress Test (FIRST) demonstrated acceptable construct validity and reliability in patients with multiple somatic complaints. The ISI displayed a two-factor structure, while the FIRST was unidimensional. Sleep reactivity, as measured by the FIRST, was significantly associated with insomnia severity, supporting its utility as a predictive tool. These findings highlight the clinical relevance of assessing both insomnia severity and sleep reactivity to guide early interventions and preventive strategies in high-risk populations.

Funding: This work was personally funded

Conflict of interests: None.

Data Availability Statement: The data supporting the findings of this study are available within the article and its supplementary materials. Any additional data required are available from the corresponding author upon reasonable request.

Author contributions: CM: Conceptualization, Data collection**,** Analysis, Manuscript writing, and Review and approval.

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