# The Psychometric Properties of the Turkish Version of Pre-sleep Arousal Scale

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## Ethical Committee Permission

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## Declarations

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**Consent to participate:** Informed consent was obtained from all individual participants included in the study.

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## Abstract

**Purpose:** The aim of the present study was to examine the psychometric properties of the Turkish version of PSAS which measures pre-sleep arousal, a significant predictor of insomnia disorder.

**Methods:** 651 participants were recruited via social media and the internet. Exploratory and confirmatory factor analyses were conducted in split-half samples (63.50% and 67.08% females; $M_{age1}$ = 28.56 ± 14.11, $M_{age2}$ = 27.63 ± 13.89). Convergent, divergent, incremental, and discriminant validity and internal consistency coefficients were assessed in a subsample of 556 participants (62.77% females; $M_{age3}$ = 29.25 ± 14.81). A third separate sample of 88 participants (80.68% females; $M_{age4}$ = 22.19 ± 4.98) was used to evaluate three-week test-retest reliability.

**Results:** The results of factor analyses yielded a two-factor structure comprising cognitive (PSAS-C) and somatic (PSAS-S) factors. The correlation of the PSAS with convergent and divergent measures showed that the Turkish form had good convergent and acceptable divergent validity. PSAS-C and PSAS-S were able to explain the extra variance (17.70%) in insomnia severity beyond depression, anxiety, and stress. Moreover, insomnia patients had significantly higher PSAS-C and PSAS-S scores than the good sleepers. Finally, the PSAS, PSAS-C, and PSAS-S had satisfactory internal consistency coefficients (α = .92, .93, and .86, respectively) and three-week test-retest correlations (ICC = .82, .82, and .71, respectively).

**Conclusion:** The Turkish form of PSAS was a valid and reliable measure of pre-sleep arousal and can be utilized in sleep studies.


**Keywords:** pre-sleep arousal, sleep, insomnia, cognitive, somatic, adaptation.

## Introduction

Although the term *insomnia* can be defined as an inability to sleep or the presence of sleep problems; insomnia disorder is regarded as a distinct sleep problem characterized by three symptoms: inability to fall asleep, inability to maintain sleep, and early morning awakenings [1]. As shown in a number of studies, 6.4-19.2% of the adult population met DSM-IV criteria for insomnia disorder [1–3]. Despite being a risk factor for many psychiatric disorders [4], insomnia comes with several personal and societal costs, including decreased quality of life [5], decreased daytime functioning [6], and impaired work performance [7]. Insomnia models and prior research have revealed that cognitive and physiological hyperarousal contribute to the vulnerability to and maintenance of insomnia disorder [8]. It has been hypothesized that the hyper-aroused state of insomnia patients during the pre-sleep phase disrupts the onset and maintenance of sleep, as if the sleep system is halted by the activation of the central nervous system [8]. Therefore, investigating the role of hyperarousal in insomnia disorder may bring a better understanding of the disorder and contribute to the development of treatments for it. Surely, it necessitates the use of valid and reliable measurement tools.

The Pre-sleep Arousal Scale [9] is one of the most frequently utilized sleep medicine tools for measuring pre-sleep arousal (PSA) in cognitive and somatic dimensions. Cognitive arousal corresponds to excessively negative mental activity, such as worrying and ruminating, the presence of a racing mind, and the inability to stop thinking [9]. Somatic arousal refers to the physiological responses of the body to threats, such as an elevated heart rate, increased breathing rate, increased glucose release, and increased perspiration [9,10]. So far, the evidence has shown that insomnia patients have higher cognitive and somatic PSA scores than good sleepers, and higher PSA is associated with longer sleep-onset latency, decreased total sleep time, more frequent night and early morning awakenings from sleep, decreased sleep quality,

higher daytime impairment, and higher insomnia severity [9,11–13]. Since there have been no prior attempts to adapt the PSAS to Turkish, little is known about its psychometric properties in the Turkish population. The purpose of this study was to investigate the validity and reliability of the PSAS in the samples of Turkish speakers.

## Materials and Method

### *Participants*

Data for the study was collected from 651 individuals recruited via social media and the internet. To avoid inaccurate results due to over-fitting [14], we randomly divided the sample in half and conducted exploratory (CFA) and confirmatory factor (EFA) analyses in separate samples. In a subsample of 556 individuals who completed all the questionnaires in the study, convergent, divergent, incremental, and discriminant validity were assessed. In addition, a third separate sample ($N$ = 88) was utilized to examine three-week test-retest reliability. Table 1 shows the demographics details of the samples.

**Table 1**

*The demographic characteristics of the samples*

| | First Sample | | Second Sample | | Subsample | | Third Sample | |
|---|---|---|---|---|---|---|---|---|
| | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| Age | 28.56 | 14.11 | 27.63 | 13.89 | 29.25 | 14.81 | 22.19 | 4.98 |
| | N | % | N | % | N | % | N | % |
| Gender | | | | | | | | |
| *Female* | 207 | 63.50 | 218 | 67.08 | 349 | 62.77 | 71 | 80.68 |
| *Male* | 119 | 35.89 | 107 | 32.92 | 207 | 37.23 | 17 | 19.32 |
| Education | | | | | | | | |
| *High School* | 9 | 2.76 | 6 | 1.85 | 15 | 2.70 | 0 | 0 |
| *University* | 290 | 88.96 | 287 | 88.31 | 482 | 86.69 | 100 | 100 |
| *Graduate* | 27 | 8.28 | 32 | 9.85 | 59 | 10.61 | 0 | 0 |
| Employment | | | | | | | | |
| *No* | 265 | 81.28 | 264 | 81.23 | 434 | 78.06 | 100 | 100 |
| *Yes* | 61 | 18.71 | 61 | 18.77 | 122 | 21.94 | 0 | 0 |
| Marital Status | | | | | | | | |
| *Single* | 253 | 77.61 | 263 | 80.92 | 421 | 75.72 | 83 | 94.31 |
| *Married* | 69 | 21.17 | 57 | 17.54 | 126 | 22.66 | 5 | 5.68 |
| *Divorced* | 4 | 1.23 | 5 | 1.54 | 9 | 1.62 | 0 | 0 |
| Socioeconomic Status | | | | | | | | |
| *Very Low* | 20 | 6.14 | 15 | 4.62 | 31 | 5.58 | 1 | 1.14 |
| *Low* | 47 | 14.42 | 47 | 14.46 | 80 | 14.39 | 10 | 11.36 |
| *Middle* | 219 | 67.18 | 216 | 66.46 | 370 | 66.55 | 57 | 64.77 |
| *High* | 39 | 11.96 | 46 | 14.15 | 73 | 13.13 | 9 | 21.59 |
| *Very High* | 1 | .31 | 1 | .31 | 2 | .36 | 1 | 1.14 |

### *Instruments*

#### Pre-sleep Arousal Scale

The PSAS was developed by Nicassio et al. [9] to assess levels of cognitive and somatic arousal in the pre-sleep phase. Sixteen items of the scale are rated on a 5-point Likert type scale, ranging from 1 (not at all) to 5 (extremely). The PSAS consists of two factors, each measuring pre-sleep cognitive (PSAS-C) and somatic (PSAS-S) arousal with eight items. Higher scores imply higher arousal.

**Beck Anxiety Inventory**

Beck et al. [15] developed the Beck Anxiety Inventory (BAI) to assess the severity of anxiety symptoms. Two factors (somatic and subjective anxiety-panic) are measured by 21 items rated on a 4-point Likert type scale, ranging from 0 (not at all) to 3 (seriously). Higher scores indicate increased anxiety levels. The BAI was adapted into Turkish by Ulusoy et al. [16]. In current study, the somatic subscale of BAI (BAI-Somatic) was used to investigate the convergent validity of PSAS-S.

**Ruminative Thought Style Questionnaire**

Brinker & Dozois [17] developed the Ruminative Cognitive Style Questionnaire (RTSQ) to measure ruminative thought style independently of depression. Twenty items are used to assess positive, negative, and neutral thoughts, as well as past and future oriented ruminative thoughts. The RTSQ is rated on a seven-point Likert type scale, ranging from 1 (not at all) to 7 (very well). Higher scores on the scale reflect a higher propensity for ruminative thought. The RTSQ was adapted by Karatepe [18] into Turkish. In the current study, the scale was utilized to evaluate the convergent validity of the PSAS-C.

**Insomnia Severity Index**

Bastien et al. [19] developed the Insomnia Severity Index (ISI) to create a brief screening measure of insomnia severity. The ISI consists of seven items covering insomnia symptoms as well as subjective satisfaction, impairment, and distress regarding sleep problems. The index is rated on a five-point Likert type scale. Higher scores indicate more severe cases of insomnia. The ISI was adapted into Turkish by Boysan et al. [20]. In the current study, the Turkish version of ISI was utilized to evaluate the incremental validity of PSAS-C and PSAS-S beyond

depression, anxiety, and stress.

**Depression Anxiety Stress Scale**

Lovibond and Lovibond [21] developed a 21-item version of the Depression Anxiety Stress Scale (DASS-21). The DASS-21 subscales consist of seven items assessing depression, anxiety, and stress. The items are rated on a four-point Likert type scale, ranging from 0 (did not apply to me at all) to 7 (applied to me very much or most of the time). Higher ratings on each subscale imply higher symptom severity. Yıldırım et al. [22] adapted the DASS-21 to Turkish. In the current study, the DASS-21 was used to assess the incremental validity of the PSAS. The internal consistency coefficient for depression, anxiety, and stress subscales of the DASS-21 were .89, .83, and .88, respectively.

**Gender Role Attitudes Scale**

Garcia-Cueto et al. [23] developed the Gender Role Attitudes Scale (GRAS) to assess gender role attitudes from the viewpoint of gender equality. Twenty items are rated on a 5-point Likert type scale, ranging from 1 (strongly disagree) to 5 (strongly agree). Higher scores indicate a stronger commitment to gender equality. Bakioğlu and Türküm [24] adapted the scale to Turkish. The GRAS was used to evaluate the divergent validity of the PSAS.

***Procedure***

After receiving the approval for the scale adaptation from the third author, the ethical approval for the study was obtained from the Middle East Technical University's Human Subjects Ethics Committee. For scale translation, a double-translation and reconciliation procedure was

employed[25]. The scale was translated into Turkish by two senior psychology researchers and the translations were then combined by a bilingual (English-Turkish) scholar. Twenty-five subjects participated in a pilot study which evaluated the translations' clarity. The final version was established based on the feedback from the pilot study. All scales were presented online via the Qualtrics Survey System in counterbalanced order. Participants were informed of the study's aims, confidentiality policies, and their right to decline or discontinue participation at any time during the study. The study took an average of 20 minutes to complete.

### *Statistical Analysis*

The data analyses were conducted in SPSS 25 and JASP 0.16.4. Multiple outliers were identified via Mahalanobis distance. The analyses to assess validity and reliability of the PSAS can be seen in Table 2.

**Table 2**
*Analyses to investigate the psychometric properties of the Turkish PSAS*

| Validity | Analysis | Indicators |
|---|---|---|
| *Construct validity* | Exploratory Factor Analysis | Sample size ≥ 130<br>Item correlations between .30-.80<br>KMO value ≥ .90<br>Significant Bartlett test of sphericity<br>Factor loading ≥ .40 |
| | Confirmatory Factor Analysis | Sample size ≥ 200<br>Insignificant $\chi 2$ test<br>SRMR ≤ .08<br>RMSEA ≤ .10<br>TLI ≥ .90<br>CFI ≥ .90 |
| *Convergent validity* | Pearson Correlation | Small to high significant correlations |
| *Divergent validity* | Pearson Correlation | No significant correlation or small significant correlations |
| *Incremental validity* | Hierarchical Regression | Significant explained variance beyond control variable |
| *Discriminant validity* | Student's T-test, Welch's t-test | Significant difference |
| **Reliability** | **Analysis** | **Indicators** |
| *Internal consistency* | Cronbach's Alpha | α ≥ 70 |
| *Test-retest reliability* | ICC | Sample size ≥ 66<br>ICC ≥ .75 |

*Note.* KMO: Kaiser-Meyer-Olkin Test of Sampling, SRMS: Standardized root-mean-square residual, RMSEA: Root-mean-square error of approximation, CFI: Comparative fit index, TLI: Tucker-Lewis index, ICC: Intra-Class Correlation.

## Results

### *Exploratory Factor Analysis*

To examine the PSAS's underlying factor structure, an EFA was performed in the first sample. Four outliers were excluded from further analysis. The final sample included 322 individuals. Most of the correlations between the PSAS items were between .30 and .80. Overall, the

Kaiser-Meyer-Olkin (KMO) test of sample adequacy was .91, and the Bartlett test of sphericity was statistically significant ($\chi^2(120) = 3065.18$, $p < .001$). These findings showed that the data was appropriate for EFA. A parallel analysis with principal axis factoring estimation and oblique-oblimin rotation was conducted due to the violation of multivariate normality and expected factor correlation. Parallel analysis, Kaiser's eigenvalue criterion, evaluation of the scree plot, and theory suggested a two-factor structure. All items had loadings greater than .40, except for Item-8. Item-8 was eliminated from further analysis, and a second solution was examined. The two-factor structure of the final solution explained 53.90% of the variance. All items had factor loadings between .45 and .95. Factor 1 consisted of 7 items measuring cognitive arousal, and Factor 2 included 8 items assessing somatic arousal (see Table 3).

**Table 3**

*The factor structure of the Turkish version of PSAS*

| | Factor | |
|---|---|---|
| | Cognitive | Somatic |
| 1. Worry about falling asleep. | **.48** | |
| 2. Review or ponder the events of the day. | **.77** | |
| 3. Depressing or anxious thoughts. | **.70** | |
| 4. Worry about problems other than sleep. | **.86** | |
| 5. Being mentally alert, active. | **.72** | |
| 6. Can't shut off your thoughts. | **.91** | |
| 7. Thoughts keep running through your head. | **.95** | |
| 9. Heart racing, pounding or beating irregularly. | | **.74** |
| 10. A jittery, nervous feeling in your body. | | **.61** |
| 11. Shortness of breath or labored breathing. | | **.69** |
| 12. A tight, tense feeling in your muscles. | | **.76** |
| 13. Cold feeling in your hands, feet or your body in general. | | **.45** |
| 14. Have stomach upset (knot or nervous feeling in stomach, heartburn, nausea, gas, etc.). | | **.61** |
| 15. Perspiration in palms of your hands or other parts of your body. | | **.50** |
| 16. Dry feeling in mouth or throat. | | **.61** |
| % of Variance | 30.70 | 23.10 |

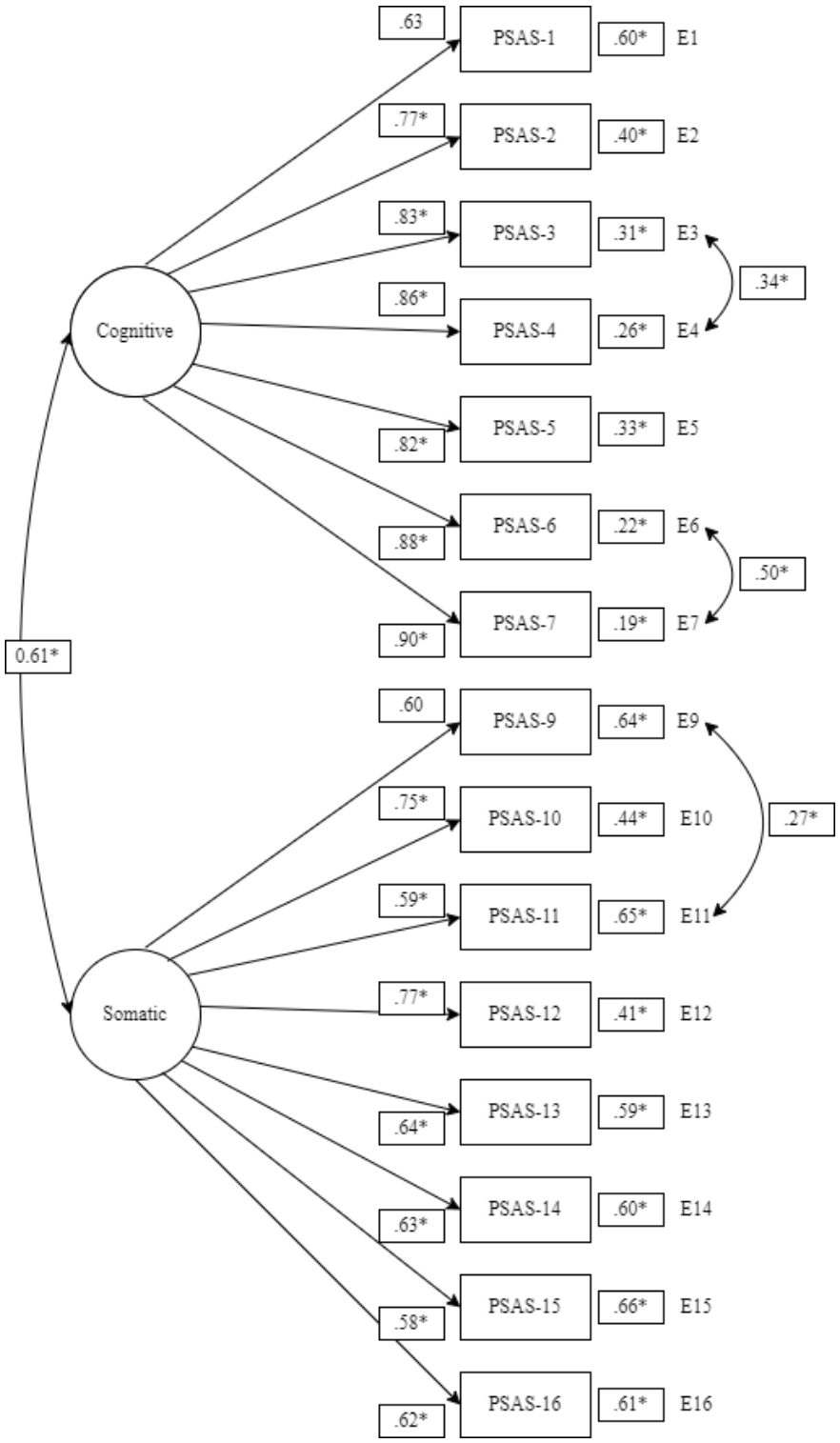
*Note.* Bold characters show items loaded to factors in respective columns.

### *Confirmatory Factor Analysis*

A CFA was conducted in the second sample. 11 outliers were eliminated from the subsequent analysis. The final sample included 314 individuals. On the basis of EFA results, a two-factor model with 15 items was hypothesized for the PSAS. Seven items were entered as the PSAS-C indicators, while the remaining eight were added as the PSAS-S indicators. Due to the lack of multivariate normality, CFA was conducted with maximum likelihood parameter estimates, Satorra-Bentler correction, and robust error calculation. The goodness-of-fit indices indicated that the two-factor model barely fit the data ($\chi^2(89) = 365.89$, $p < .001$, SRMR = .06, RMSEA = .10, 90% CI = [.09, .11], TLI = .89, CFI = .91). Several error covariances were added to the initial model (items 3-4, items 6-7, and items 9-11) to improve it, as recommended by modification indices. Each modification significantly contributed to the model's fit. The final model fit the data adequately ($\chi^2(86) = 257.63$, $p < .001$, SRMR = .06, RMSEA = .08, 90% CI [.07, .09], TLI = .93, CFI = .94) (see Figure 1).

**Figure 1**

*The CFA results of the two-factor model of Turkish PSAS*




*Note.* * $p < .001$. All reported estimates are standardized.

### *Convergent and Divergent Validity*

Convergent and divergent validity were examined by assessing Pearson correlations between the PSAS, PSAS-C, PSAS-S, BAI-Somatic, the RTSQ, the ISI in the subsample. PSAS-C and the RTSQ, PSAS-S and BAI-Somatic, and the PSAS and the ISI had significant and moderate to high positive correlations. However, there were also small significant correlations between PSAS-C, PSAS-S, and GRAS. The correlations between the study variables, descriptives, and internal consistency coefficients can be seen in Table 3.

**Table 3**

The correlations, descriptives, and internal consistency values of the scales

| Scales | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
|---|---|---|---|---|---|---|---|---|---|---|
| 1. PSAS | - | | | | | | | | | |
| 2. PSAS-C | .91** | - | | | | | | | | |
| 3. PSAS-S | .88** | .60** | - | | | | | | | |
| 4. RTSQ | .67** | .72** | .46** | - | | | | | | |
| 5. BAI-Somatic | .61** | .44** | .67** | .38** | - | | | | | |
| 6. GRAS | .25** | .28** | .15** | .26** | .11* | - | | | | |
| 7. ISI-1 | .59** | .60** | .43** | .38** | .33** | .12* | - | | | |
| 8. ISI-2 | .41** | .35** | .39** | .20** | .31** | -.03 | .53** | - | | |
| 9. ISI-3 | .24** | .17** | .26** | .08 | .21** | -.08 | .20** | .48** | - | |
| 10. ISI | .65** | .62** | .54** | .42** | .42** | .08 | .79** | .68** | .46** | - |
| Mean | 36.15 | 20.59 | 15.57 | 93.01 | 4.52 | 61.28 | 1.44 | .89 | 0.82 | 8.80 |
| *SD* | 12.01 | 7.22 | 6.22 | 31.35 | 4.19 | 10.40 | 1.22 | 1.04 | 1.12 | 5.20 |
| Min | 15.00 | 7.00 | 8.00 | 20.00 | .00 | 30.00 | .00 | .00 | .00 | .00 |
| Max | 71.00 | 35.00 | 37.00 | 160.00 | 22.00 | 75.00 | 4.00 | 4.00 | 4.00 | 26.00 |
| Cronbach's α | .92 | .93 | .86 | .96 | .81 | .86 | - | - | - | .80 |

*Note 1.* *p < .01, ** p < .001.
*Note 2.* PSAS: Pre-sleep Arousal Scale, PSAS-C: Pre-sleep Arousal Scale - Cognitive Subscale, PSAS-S: Pre-sleep Arousal Scale - Somatic Subscale, RTSQ: Ruminative Thought Style Questionnaire, BAI-Somatic: Beck Anxiety Inventory - Somatic Subscale, GRAS: Gender Role Attitude Scale, ISI: Insomnia Severity Index, ISI-1: Difficulty falling asleep, ISI-2: Difficulty staying asleep, ISI-3: Waking up too early.

### *Incremental Validity*

A two-step hierarchical multiple regression was conducted in the subsample to predict

insomnia severity by using depression, anxiety, stress, cognitive and somatic PSAs as the predictors. One outlier was removed from further analysis. The final sample consisted of 555 participants. In step one, depression, anxiety, and stress were entered, and in step two, cognitive and somatic PSAs were added. The first model significantly predicted insomnia severity, $F(3,551) = 62.67$, $p < .001$, $R^2 = .25$. Adding cognitive and somatic PSAs to the regression model accounted for an additional 17.70% of the variance in insomnia severity, $F(5,549) = 83.18$, $p < .001$; depression and anxiety became insignificant predictors and the total explained variance increased to 42.60%. Regression coefficients and standard errors can be seen in Table 4.

**Table 4**

*Hierarchical regression analysis summary for depression, anxiety, stress, cognitive and somatic pre-sleep arousal predicting insomnia severity*

| | | | | | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|
| Model | | B | SE | *β* | t | p | Tolerance | VIF |
| Step 1 | Intercept | 4.78 | .39 | | 12.25 | < .001 | | |
| | Depression | .18 | .06 | .17 | 3.23 | .001 | .47 | 2.15 |
| | Anxiety | .37 | .07 | .29 | 5.00 | <.001 | .40 | 2.50 |
| | Stress | .10 | .07 | .08 | 1.48 | .14 | .34 | 2.98 |
| Step 2 | Intercept | -1.19 | .59 | | -2.04 | .04 | | |
| | Depression | .04 | .05 | .04 | .81 | .42 | .44 | 2.27 |
| | Anxiety | .07 | .08 | .06 | .96 | .34 | .28 | 3.62 |
| | Stress | -.03 | .06 | -.03 | -.45 | .65 | .32 | 3.11 |
| | Cognitive Arousal | .32 | .03 | .45 | 10.13 | < .001 | .54 | 1.87 |
| | Somatic Arousal | .19 | .04 | .23 | 4.37 | < .001 | .39 | 2.56 |

### *Discriminant Validity*

It was tested whether there were significant differences between the scores of good sleepers and insomnia patients on the PSAS subscales in the subsample. The ISI scores (≥ 8) was used to distinguish good sleepers from insomnia patients [19]. Two independent t-tests on the

samples were performed. PSAS-C scores of good sleepers ($M$ = 16.52, $SD$ = 6.32, $N$ = 239) and insomnia patients ($M$ = 23.65, $SD$ = 6.29, $N$ = 317) differed significantly; $t(554) = -13.21$, $p < .001$, $d = -1.13$. Due to the violation of the assumption of equality of variances, a Welch t-test was performed for PSAS-S. There was a significant difference between the PSAS-S scores of good sleepers ($M$ = 12.62, $SD$ = 4.69, $N$ = 239) and insomnia patients ($M$ = 17.79, $SD$ = 6.32, $N$ = 317); $t(554) = -10.63$, $p < .001$, $d = -.91$. The result indicated that the Turkish version of PSAS showed satisfactory discriminant validity.

### *Internal Consistency and Test-Retest Reliability*

The reliability analysis conducted in the subsample ($N$ = 556) yielded that Cronbach's alpha coefficients were .92 (the PSAS), .93 (PSAS-C), and .86 (PSAS-S). In a third sample of 88 individuals, the three-week test-retest reliability of the PSAS was assessed. The intra-class correlation coefficients between the baseline and 21-day follow-up scores were found as .82 ($p < .001$) for the PSAS, .82 ($p < .001$) for PSAS-C, and .71 ($p < .001$) for PSAS-S. The findings yielded that the Turkish PSAS had good reliability.

## Discussion

The aim of the present study was to adapt the PSAS to Turkish. In the current study, EFA was carried out to determine the factor structure of the PSAS, and CFA was conducted to validate the two-factor structure found in EFA. The results of EFA were consistent with the original study [9], Swedish [12], German [11], Pakistani [26], Portuguese [13], and Japanese [27] adaption studies. All items, except Item 8, had factor loadings higher than .40. Item-8 [Being distracted by sounds, noise in the environment (e.g., clock ticking, house noises, traffic)] lacked adequate factor loading to be included in PSAS-C. This item also did not have sufficient factor

loading (.31) in Swedish adaptation study [12], did not load to PSAS-C in German adaptation study [11], and had the lowest factor loading (.37) to PSAS-C in Japanese adaptation study [27]. On the other hand, the item had adequate factor loading in the Pakistani (.56) and Portuguese (.52) adaption studies [13,26]. While the rest of PSAS-C items correspond to negative pre-sleep mental activities, Item-8 having no thought content but an experience of being distracted may be distinguished from the rest of the items of PSAS-C. Moreover, the differences between previous studies could be a result of different minimum factor loading thresholds (.30-.50) utilized by the researchers. The two-factor structure of PSAS with 15 items found in EFA was also assessed by CFA. After adding correlations between the errors of several items, CFA results indicated that the two-factor model fit the data well. Bollen and Lennox [28] argued that correlated errors could be a result of similar wording and adjacent items. Analysis of item dyads indicated that correlated errors may be a result of wording and being adjacent for Items 6 and 7, while a result of being adjacent for Items 3-4 and 9-11.

The correlations between PSAS-C, PSAS-S, RTSQ, BAI-Somatic, and ISI were used to test the convergent validity of the PSAS. Although the items of RTSQ are not specific to the pre-sleep phase, they pertain to ruminative thinking style or intrusive thoughts and therefore correspond to the cognitive mental activity items of PSAS-C. Similarly, BAI-Somatic consists of items that can be regarded as somatic manifestations of anxiety. In this sense, the items of PSAS-S overlap with the items of BAI-Somatic. The association between insomnia and PSA has long been argued and studied, therefore the correlation between the ISI and the PSAS was also investigated for convergent validity [9]. The high correlations between the RTSQ and PSAS-C ($r$ = .72), BAI-Somatic and PSAS-S ($r$ = .67), and the ISI and PSAS ($r$ = .65) implied that PSAS had good convergent validity. In line with the previous studies [12,13,27], PSA was more strongly associated with difficulty falling asleep than difficulty staying asleep or early

morning awakenings. In terms of divergent validity, it was anticipated that the GRAS would not be significantly or highly correlated with the PSAS and its subscales. Nevertheless, the findings revealed small positive correlations between the GRAS and the PSAS ($r$ = .25), PSAS-C ($r$ = .28), and PSAS-C ($r$ = .15). Rönkkö and Cho [29] asserted that the divergent validity must be evaluated by not only statistical testing but also considering context and relevant theories of the measures. The PSAS assesses cognitive and somatic arousal in pre-sleep phase, while the GRAS measure attitudes towards gender roles. Both the context and theories of these constructs are clearly distinct. In light of the context and theories underlying the two scales, the small correlations between the GRAS and the subscales of PSAS may therefore support the divergent validity of PSAS.

Hierarchical regression analysis was used to evaluate the incremental validity of the PSAS. The results yielded that PSAS-C and PSAS-S could explain extra variance in insomnia severity beyond depression, anxiety, and stress. Previous studies yielded that insomnia severity, and cognitive and somatic PSAs were significantly associated with depression, anxiety, and stress [12,30]. In the current study, depression and anxiety were not significant predictors of insomnia severity after cognitive and somatic PSA were added to the model. These findings may suggest that cognitive and somatic PSA may mediate the relationship between depression and insomnia severity or anxiety and insomnia severity. In terms of discriminant validity, insomnia patients (ISI $\geq$ 8) were shown to have significantly higher PSAS-C and PSAS-S scores than good sleepers similar to the original study [9], German [11] and Portuguese [13] adaptation studies. Internal consistency and test-retest analyses were used to evaluate PSAS's reliability. The Cronbach's alpha values of the PSAS ($\alpha$ = .90), PSAS-C ($\alpha$ = .90), PSAS-S, ($\alpha$ =.83) were greater than suggested values of .70-.80 [31]. Three-week test-retest intra-class correlations of the PSAS ($r$ = .84) and PSAS-C ($r$ = .84) were higher than the recommended value of .75

indicating good validity, while the correlation of PSAS-S ($r$ = 71) were higher than .50 indicating moderate validity [32]. Therefore, the findings implied that Turkish PSAS had good reliability.

The present study was not without limitations. First, the sample's male-to-female ratio was biased towards females and the majority of the participants were university students. Therefore, future studies should be conducted in larger and more representative samples. Second, the modification indices were utilized to determine which residual variances in the same latent factor are correlated. Correlated errors lead to neglecting variables not included in the model but cause error correlations [33]. Finally, the participants in discriminant validity analysis were categorized based on their ISI scores. A more robust way to diagnose people with insomnia disorder may be to use clinical interviews by psychiatrists.

To conclude, the findings indicated that the 15-item Turkish version of the PSAS was a valid and reliable measure of PSA. There may be several ways of utilizing the PSAS in sleep studies. It can be used in experimental and observational sleep and behavioral medicine studies that examine PSA. In addition, the PSAS scores can be used to predict the diagnosis of chronic insomnia and to distinguish chronic insomnia patients from patients with other disorders. Finally, the PSAS scores can serve as outcome measures for interventions targeting insomnia or sleep difficulties.

## Appendix A

**The Turkish version of Pre-sleep Arousal Scale (PSAS) instructions:**
***"****Lütfen aşağıdaki belirtilerden her birini, kendi yatak odanızda uykuya dalmaya çalışırken genelde ne yoğunlukta deneyimlediğinizi belirtiniz."*

1. Uykuya dalma ile ilgili endişe.
2. Gün içinde olanları gözden geçirme ya da üzerine düşünme.
3. Depresif ya da kaygı verici düşünceler.
4. Uyku dışındaki sorunlar hakkında endişelenme.
5. Zihinsel olarak tetikte ve aktif olma.
6. Düşüncelerinizi durduramama.
7. Düşüncelerin kafanızda dönüp durması.
8. Ortamdaki ses ve gürültülerden rahatsız olma (örn., saatin tik tak sesleri, evdeki gürültüler, trafik).
9. Kalp atışlarının hızlanması, küt küt atması ya da düzensiz kalp atışı.
10. Bedeninizde huzursuz, gergin bir his.
11. Nefes darlığı ya da zor nefes alma.
12. Kaslarınızda kasılma ya da gerginlik hissi.
13. Ellerinizde, ayaklarınızda ya da vücudunuzun genelinde soğukluk hissi.
14. Mide rahatsızlığı (midenizde düğümlenme ya da gerginlik hissi, mide yanması, bulantı, gaz vb.).
15. Avuç içlerinde ya da vücudunuzun diğer yerlerinde terleme.
16. Ağızda ya da boğazda kuruluk hissi.

**Response scale: 1 =** Hiç, 2 = Çok az, 3 = Orta derecede, 4 = Fazla, 5 = Aşırı derecede.

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