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Validity and reliability of the Turkish version of the Glasgow Sleep Effort Scale

Omer Faruk Uygur [a, *], Hilal Uygur [a], Seockhoon Chung [b], Oli Ahmed [c], Dudu Demiroz [d], Esat Fahri Aydin [e], Onur Hursitoglu [f]

[a] Department of Psychiatry, Dr. Ersin Arslan Training and Research Hospital, Gaziantep, Turkey
[b] Department of Psychiatry, Asan Medical Center, University of Ulsan College of Medicine, Seoul, South Korea
[c] Department of Psychology, University of Chittagong, Chattogram, Bangladesh
[d] Department of Psychiatry, Karaman Training and Research Hospital, Karaman, Turkey
[e] Department of Psychiatry, Ataturk University School of Medicine, Erzurum, Turkey
[f] Department of Psychiatry, Sular Academy Hospital, Kahramanmaras, Turkey

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ABSTRACT

Objective: We aimed to assess the validity and reliability of a Turkish adaptation of the Glasgow Sleep Effort Scale (GSES).
Methods: We randomly divided the data into two: one set (n = 374) was used for exploratory factor analysis (EFA) and the other (n = 373) for confirmatory factor analysis (CFA). The psychometric properties were assessed using the item response theory approach. Reliability analyses were assessed. Convergent validity of the GSES with the Dysfunctional Beliefs and Attitudes About Sleep Scale-16 (DBAS-16), Pittsburgh Sleep Quality Index (PSQI), Insomnia Severity Index (ISI), and Depression Anxiety Stress Scale-21 (DASS-21) were explored. For the predictive validity, we used an independent-samples *t*-test for comparing the total score of the GSES between poor sleepers and good sleepers following the PSQI, and between clinical insomnia and non-clinical insomnia groups according to the ISI. The cut-off score of the GSES was examined.
Results: A single factor structure explaining 49.2% of the total variance was detected using the EFA. The CFA also found single-factor good fit indices. Cronbach's alpha and omega values were 0.82 and 0.83, respectively. There were statistically significant correlations between the GSES and DBAS-16, ISI, PSQI, and DASS-21 in convergent validity. In the Graded Response Model, the GSES was more efficient and provided reasonable information at the −0.75 to 2.25 theta level. The GSES cut-off score was 6 points for clinical insomnia and 3 points for poor sleepers.
Conclusions: The GSES is valid and reliable for measuring sleep effort among Turkish university students.

1. Introduction[1]

Sleep occurs in every organism to some extent. It is about one-third of the human life span [1]. Restful and good sleep is necessary for a happy and healthy life [2]. Studies have shown that disrupted sleep can cause poor concentration, reduced energy levels, immune dysfunction, and increased risk of depression, anxiety, substance use, and suicide [3,4].

Sleep problems are common throughout life. Insomnia is the most commonly diagnosed sleep disorder, affecting 10%–20% of the general population [5]. The presenting complaints of insomnia are often that of difficulty falling asleep or frequent awakenings, inability to return to sleep, waking up too early in the morning or having an unrefreshing sleep, and marked deterioration in daytime functionality [6]. In a recent study conducted in Turkey during the Coronavirus Disease 2019 (COVID-19) pandemic, the prevalence of

* Corresponding author. Department of Psychiatry, Dr. Ersin Arslan Training and Research Hospital, 27010, Gaziantep, Turkey.
E-mail address: drofuygur@hotmail.com (O.F. Uygur).

[1] Abbreviations: Dysfunctional Beliefs and Attitudes about Sleep (DBAS); Glasgow Sleep Effort Scale (GSES); exploratory factor analysis (EFA); confirmatory factor analysis (CFA); item response theory (IRT); graded response model (GRM); root-mean-square-error of approximation (RMSEA); comparative fit index (CFI); Tucker-Lewis index (TLI); standardized root-mean-square residual (SRMR); Pittsburgh Sleep Quality Index (PSQI); Insomnia Severity Index (ISI); Depression Anxiety Stress Scale (DASS-21); principal component analysis (PCA).

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poor sleep was found in 55.1% of the adult population [7]. University students are a vulnerable group prone to developing insomnia, which can affect their academic performance [8,9]. In a 2014 study that investigated the sleep quality of university students in Turkey, 59% of the participants reported poor sleep [10]. In a thesis study in Turkey, 57.9% of university students were found to have poor sleep quality, and 12.1% of the students were diagnosed with insomnia disorder after clinical interviews according to the DSM-5 [11].

Current etiological models of insomnia are purposed to explain the development and maintenance of insomnia [12]. The psychobiological inhibition model is one of these models. It is based on the attention-intention-effort pathway and highlights sleep effort [13].

Sleep effort is defined as sleep-related performance anxiety, the need to control sleep, or trying too hard to sleep [14]. It is a multicomponent construct, including cognitive (e.g., "I must sleep" schema) and behavioral (e.g., performance effort) elements [15]. In addition, sleep effort includes two related aspects: direct effort (e.g., overexertion to fall asleep) and indirect effort (e.g., extended sleep opportunity) [16]. Indeed, sleep effort is significantly different between good and poor sleepers. For example, good sleepers say that they fall asleep automatically and effortlessly, and do not require any effort to sleep [13,17]. In contrast, poor sleepers try too hard to sleep, spend much time thinking about sleep, have intricate sleep hygiene routines, or use exotic teas and supplements before bedtime [13]. This evidence suggests that good sleep is a natural and spontaneous process, like breathing and pumping blood. Individuals should not need help to sleep [13,17].

The International Classification of Sleep Disorders has recognized that trying too hard to sleep is a core factor in psychophysiological insomnia [16]. To date, there are no psychometric tools to measure sleep effort. However, some items in the Dysfunctional Beliefs and Attitudes about Sleep (DBAS) scale may help with assessing sleep effort [18]. A previous study using the pilot form of GSES found that the sleep effort can distinguish between good and bad sleepers [19]. Another study, again using the pilot GSES, found that paradoxical intention therapy reduced sleep effort and improved sleep [20]. The results indicated that sleep effort is sensitive to change following behavioral intervention and plays a role in maintaining insomnia. However, a standard psychometric scale was not used to assess sleep effort in these studies. The Glasgow Sleep Effort Scale (GSES) by Broomfield and Espie was developed and validated to assess sleep effort psychometrically, instead of relying only on clinical observations [16].

The GSES was designed with seven items to assess persistent preoccupation with sleep. In the first validation study, the GSES was conducted on 89 patients diagnosed with insomnia according to DSM-IV criteria and 102 healthy controls [16]. The internal consistency reliability coefficient of the scale was good among the patients (Cronbach's alpha = 0.77). The GSES was significantly correlated with the DBAS ($r = 0.50$, $p < 0.001$). A single factor structure was used, which explained 62.6% of the variance in the factor analysis. The other findings showed that a cut-off GSES value of 2 was equivalent to 93.2%, and that this score correctly defined insomnia patients, while 87.3% correctly defined good sleepers. Kohen and Espie also reported that the GSES is an excellent instrument for differentiating patients with insomnia from good sleepers [16].

There have been two validation studies on the GSES since its development. The first study was conducted among university students in Portugal ($n = 2995$, mean age = 23.9 years) [21]. It was found that the scale had a single factor structure that explained approximately 45% of the variance. Cronbach's alpha value was 0.79 in this study. The GSES was moderately and positively correlated with the Glasgow Content of Thoughts Inventory [21] total score ($r = 0.56$, $p < 0.001$). Additionally, the insomnia symptoms group scored higher than the remaining groups (other sleep problems group and no sleep problems group) on all GSES items [22]. The second study had 120 patients diagnosed with insomnia according to DSM-5 diagnostic criteria and 110 people without insomnia in Iran [23]. In this study, the scale loaded under a single factor with an eigenvalue above 1 explained 64.7% of the variance. Cronbach's alpha was 0.75 for insomnia patients and 0.77 for the non-clinical samples. The re-test reliability analysis applied after four weeks was also significant. In addition, the cut-off score of the GSES was 6. This score correctly defined 855 of the patients with insomnia and 94.5% in the non-clinical sample [23].

There are several studies on insomnia and its management using GSES. In one of the studies, the GSES scores decreased significantly in patients who received stimulus control-based therapy for insomnia [24]. Similarly, the GSES scores of the patients decreased over time in another study that tested the effectiveness of mindfulness-based cognitive–behavioral therapy in primary insomnia patients [25]. In another study in which sleep restriction was applied to patients with insomnia patients, it was found that GSES scores decreased after treatment [26]. Espie, Barrie, and Forgan [27] compared patients with primary insomnia and those with idiopathic insomnia. They found that sleep effort was significantly higher in the primary insomnia group than in patients with idiopathic insomnia [27]. Despite these studies, there is a lack of research about sleep effort in the Turkish population. When considering the importance of sleep effort in insomnia, the first step is to adapt and validate the GSES for the Turkish population. Therefore, this study aimed to adapt and validate the GSES for the first time in Turkey.

2. Materials and methods

This was an online study conducted in Turkey in April 2022. This study was approved by the ethical committee at the Faculty of Medicine at the Karamanoğlu Mehmetbey (approval date and decision number: March 08, 2022/04).

2.1. Adaptation of the GSES

We obtained permission from Colin Espie, the original developer of the GSES, to translate and adapt it into Turkish. The language validity of this scale was performed by the back-translation method. At first, seven experts (two English language specialists, two sleep clinicians, and three psychiatrists) independently translated the scale into Turkish. Next, all the authors compared these translations and agreed on the final form. Later, the final form of the scale was translated back into English by two certified and professional translators and then finalized by another English language professional by comparing it with the original scale. Finally, we sent the back-translation version to Colin Espie via e-mail, and he provided feedback regarding the appropriateness of the back-translation version.

Content validity of the scale was tested by the Davis method with a non-face-to-face approach [28]. The final version of the scale was sent to 10 psychiatrists via e-mail. Each psychiatrist rated each item using a 4-point scale (1 = not clear, 2 = need some revision, 3 = clear but need minor revision, 4 = very clear). The Content Validity Index (CVI) was calculated using a scale-level content validity index based on the average method. When assessed by nine or more experts, a CVI value greater than 0.78 represents adequate content validity [29]. All items received a CVI score above 0.80. Hence, based on content validity, no item required revision or was excluded.

2.2. Instruments

2.2.1. Sociodemographic data form

We used a questionnaire to obtain demographic and sleep data, including age, sex, body mass index, educational status, chronic illness, and previous or current use of any hypnotic drug.

2.2.2. Glasgow Sleep Effort Scale (GSES)

The GSES consists of seven items on a 3-point Likert scale ranging from “not at all” (0), “to some extent” (1), and ”very much” (2). Originally, Broomfield and Espie [16] developed the scale to assess sleep effort. The final score of the scale is the average of the sum of the scores of all the items. A high score indicates that there was substantial sleep effort over the past week [16]. The GSES has adequate internal consistency (Cronbach's $\alpha = 0.77$) and can discriminate good sleepers from patients with insomnia [16].

2.2.3. Pittsburgh Sleep Quality Index (PSQI)

The PSQI [30] is a self-report questionnaire that evaluates sleep quality and sleep disturbance in the previous month to discriminate between good and bad sleepers. It includes 19 items rated on a four-point scale ranging from 0 to 3. The PSQI evaluates 7 components of sleep quality: subjective sleep quality, sleep latency, sleep duration, sleep efficiency, sleep disturbance, use of sleep medication, and daytime dysfunction [30]. The final score of the questionnaire is calculated as the summation of the component scores. A high total score on the scale indicates poor sleep quality. A total score of 5 or above suggests a bad sleeper [31]. The PSQI has robust psychometric properties in the Turkish population (Cronbach's $\alpha = 0.80$ and test-retest reliability = 0.93–0.98) [32]. In this study, the PSQI was found to have high internal consistency reliability (Cronbach's $\alpha = 0.82$, McDonald's $\omega = 0.81$).

2.2.4. Insomnia Severity Index (ISI)

The ISI was developed to assess the severity of insomnia [33]. The ISI is a self-report questionnaire consisting of 7 items, and each item is scored between 0 and 4. The total ISI score ranges from 0 to 28 points. High scores indicate greater severity of insomnia. The total score is interpreted as follows: absence of insomnia (0–7); sub-threshold insomnia (8–14); clinical insomnia (moderate severity) (15–21); and clinical insomnia (severe) (22–28) [33]. The internal consistency coefficient of the Turkish version was 0.79 [34]. The features evaluated by the ISI items include the severity of sleep onset, sleep maintenance, early morning awakening, sleep dissatisfaction, interference of sleep difficulties with daytime functioning, the noticeability of sleep by others, and the distress caused by sleep difficulties [34]. The ISI showed good internal consistency reliability (Cronbach's $\alpha = 0.85$, McDonald's $\omega = 0.85$) in this study.

2.2.5. Dysfunctional Beliefs and Attitudes About Sleep Scale-16 (DBAS-16)

The DBAS is a 16-item questionnaire assessing the presence and level of dysfunctional sleep-related beliefs [18]. It contains 16 dysfunctional statements about sleep. Items range from 1 (strongly disagree) to 10 (strongly agree). A higher score on the scale indicates more dysfunctional beliefs about sleep. The scale has good internal consistency ($\alpha = 0.77$). Turkish DBAS-16 has adequate internal consistency and test-retest stability ($\alpha = 0.82$, $r = 0.83$) [35]. In this study, the Turkish DBAS-16 showed good internal consistency reliability (Cronbach's $\alpha = 0.89$, McDonald's $\omega = 0.89$).

2.2.6. Depression Anxiety Stress Scale (DASS-21)

The DASS-21 was developed by Lovibond and Lovibond (1995) [36]. It consists of 21 items, three subscales (depression, anxiety, and stress), and a 4-point Likert-type scoring system (ranging between 0: Never and 3: Always). The total score of each subscale is calculated as the sum of the scores of the items obtained from the subscales. Higher scores for each subscale indicate the intensity of the individual's emotions [36]. For the depression, anxiety, and stress subscales, Cronbach's alpha internal consistency coefficients are 0.89, 0.87, and 0.90, and the test–re-test coefficients are 0.93, 0.83, and 0.82, respectively [37]. In this study, the Turkish DASS-21 showed good internal consistency reliability for the total scale, and the depression, anxiety, and stress subscales (Cronbach's α ranged between 0.82 and 0.93, McDonald's ω ranged between 0.83 and 0.93).

2.3. Procedure

The socio-demographic data form and the Turkish version of the GSES, DBAS-16, PSQI, ISI, and DASS-21 were designed online using Google Forms. Researchers contacted university students from various faculties of the Karamanoğlu Mehmetbey University randomly. Then, we shared the online link of the survey with the participants via WhatsApp.

All volunteers read and signed an informed consent form before completing the socio-demographic data form and the psychological instruments.

2.4. Sample size of the study

The study was conducted online using a university population. We collected data online due to the COVID-19 pandemic. Online data collection is being used increasingly, especially in sleep medicine [38]. Despite some limitations, large amounts of data were accessed quickly and at a low cost. Online data collection is as valid and reliable as traditional data collection methods [39,40]. The total number of study participants was 747. The calculated minimum sample size was 10 participants for each scale item [41]. Regardless of the number of items on a scale, at least 200–300 participants are recommended for factor analysis [42,43]. Comrey and Lee recommended at least 500 participants for scale development and adaptation studies [44]. The sample size of our study was sufficient according to the ideal ratio of respondents to items (10:1) or other sample size propositions.

2.5. Statistical analysis

The data were analyzed using SPSS 23.0 (IBM Corp., Armonk, USA), Jamovi 2.2, and Rstudio. Descriptive statistics identified means, standard deviations, and frequencies. The skewness-kurtosis value was used to determine the normality of the data. The factor structure was assessed by both the exploratory factor analysis (EFA) [estimation method: maximum likelihood] and the confirmatory factor analysis (CFA) [estimation method: DWLS]. The EFA and CFA were analyzed using different samples [45,46]. Therefore, we randomly divided the data into two groups: one group ($n = 374$) for EFA and the other ($n = 373$) for CFA. The psychometric properties of the Turkish version of the GSES scale were assessed utilizing the item response theory (IRT) approach. For the IRT model, we utilized the graded response model (GRM). Using the GRM, we estimated the item's fit, slope (α), and threshold parameters (b).

Reliability analyses were assessed with Cronbach's alpha, McDonald's omega, item-total score correlation coefficient, and inter-item correlations. The correlations between the GSES and the DBAS-16, PSQI, ISI, and DASS-21 were analyzed using the Pearson correlation coefficient to determine the convergent validity of the GSES. The independent *t*-test was used for comparing the total score of the GSES between groups derived from the

sociodemographic data. For the predictive validity, we also compared the total score of the GSES between the poor sleeper and good sleeper groups (PSQI for the clinical insomnia group and ISI for the non-clinical insomnia group) using an independent *t*-test. We applied the ROC curve to determine the cut-off score of the GSES in the clinical insomnia group categorized by the ISI and the poor sleeper group categorized by the PSQI. Reliability values above 0.70 and Pearson correlation coefficients greater than 0.30 are accepted [47].

For the model of fit, the criteria of $\chi 2/df$ (chi-square/degree of freedom) less than 3.0, root-mean-square-error of approximation (RMSEA) less than 0.06 [48], comparative fit index (CFI) greater than 0.90 [49,50], Tucker-Lewis index (TLI) greater than 0.95 [43], and a standardized root-mean-square residual (SRMR) close to or below 0.07 [43] were applied. P-values less than 0.05 were considered statistically significant.

3. Results

3.1. Participants

The study included 747 university students (68% female and 32% male). Participants' age ranged from 18 to 56 years (mean age = 22.02 ± 4.19) years. The mean body mass index of the participants was 22.73 ± 6.50. Most participants were not married 96% (n = 717). Nearly half of the participants lived with their family 47.9% (n = 358) or friends 37.1% (n = 277) and few were currently using a hypnotic drug for insomnia 1.7% (n = 13). Most participants 74% (n = 553) had poor sleep quality according to Pittsburg Sleep Quality Index [31] (PSQI ≥5). A few had clinical insomnia 15.9% (n = 119) according to Insomnia Severity Index [34] (ISI ≥15). Table 1 shows the descriptive statistics relating to sociodemographic and sleep characteristics.

Table 1
Sociodemographic and sleep characteristics of the participants.

	Mean *(SD)*
Age	22.02 (4.19)
BMI	22.73 (6.50)
	n (%)
Sex	
Male	239 (32)
Female	508 (68)
Marital status	
Not married	717 (96)
Married	30 (4)
Living	
Alone	112 (15)
with family	358 (47.9)
with friends	277 (37.1)
Chronic disease	
Yes	60 (8)
No	687 (92)
Current use of hypnotic drug	
Yes	13 (1.7)
No	734 (98.3)
History of previous use of hypnotic drug	
Yes	37 (5)
No	710 (95)
Clinical insomnia (ISI ≥15)	
Yes	119 (15.9)
No	628 (84.1)
Poor sleep quality (PSQI ≥5)	
Yes	553 (74)
No	194 (26)

3.2. Structure of the GSES

First, we evaluated the factor structure of the GSES using the EFA. To perform the EFA, correlation coefficients between the items of the scale should be approximately 0.30 and above, the Kaiser-Meyer-Olkin measure of sampling adequacy at least 0.50, and the Barlett sphericity value significant [51,52]. We determined the correlation coefficients of the GSES items to be approximately 0.30 and above (0.22–0.59) (Supplementary Table 1). The Kaiser-Meyer-Olkin sample adequacy was 0.85, and Bartlett's test of sphericity $\chi 2$ was 835.8749 ($p < 0.001$). The EFA based on the eigenvalue revealed a single-factor structure that explains 49.42% (eigenvalue = 3.46) of the total variance. The factor loading of the items ranged from 0.39 to 0.81 under a single factor (Supplementary Table 2).

Second, the CFA outputs showed that the single factor structure has the following model of fits: $\chi 2 = 32.332$, df = 14, $p = 0.004$, $\chi 2/df = 2.309$, CFI = 0.984, TLI = 0.976, RMSEA = 0.0.059, and SRMR = 0.060. These values suggest a good fit [52,53]. Fig. 1 shows the details of these analyses. All analyses were significant at a level of 0.01 in the model. The factor loading of the items tested with CFA was rated from 0.38 to 0.79. Since the factor loading obtained was greater than 0.30, it was considered adequate [54].

3.3. Graded response model

Table 2 presents the GRM outputs. The item fit of the scale was estimated using S-χ^2 and RMSEA. Non-significant p-values of S-χ^2 [adjusted for false discovery rate] and RMSEA suggest that all items belong to the same latent construct assessed by the Turkish version of the GSES. All the items had very high slope parameters, except item 2, which had a moderate slope. Slope parameters ranged between 0.894 and 4.824. Regarding threshold coefficients, items 3 and 6 were more difficult than the rest of the items. For these two items, an above-average latent trait is required to endorse all the response options. For the rest of the items, a higher latent trait or theta is required to endorse the response option 'very much'. The scale information curve (Supplementary Fig. 1) shows that this scale is more efficient and provides reasonable information about individuals between −0.75 and 2.25 theta levels.

3.4. Descriptive item characteristics and reliability of the GSES

The Turkish version of the GSES had good internal consistency reliability (Cronbach's $\alpha = 0.82$, and McDonald's $\omega = 0.83$). Also, the deletion of any items on the scale did not increase internal consistency. The corrected item-total correlation coefficients of all items of the GSES were positive and ranged from 0.36 to 0.70. These corrected item-total correlations were above the recommended cut of ≥ 0.30 [55]. Item skewness values were between −2 and +2 and kurtosis values were between −7 and +7. Taken together, the data were normally distributed [49]. Table 3 displays the descriptive characteristics and reliability of the GSES.

3.5. Convergent validity

Since the scores demonstrated a normal distribution according to the skewness-kurtosis values [56], Pearson correlation analysis was performed. As Table 4 shows, the convergent validity of the GSES was assessed by calculating the Pearson correlation between all of the study's psychological instruments. We found positively significant correlations between the total score of the GSES and the DBAS-16 ($r = 0.43$, $p < 0.001$), ISI ($r = 0.66$, $p < 0.001$), PSQI ($r = 0.58$, $p < 0.001$) DASS depression ($r = 0.42$, $p < 0.001$), DASS anxiety ($r = 0.44$, $p < 0.001$), and DASS stress ($r = 0.43$, $p < 0.001$) in this study. Moreover, we calculated the Pearson product-moment

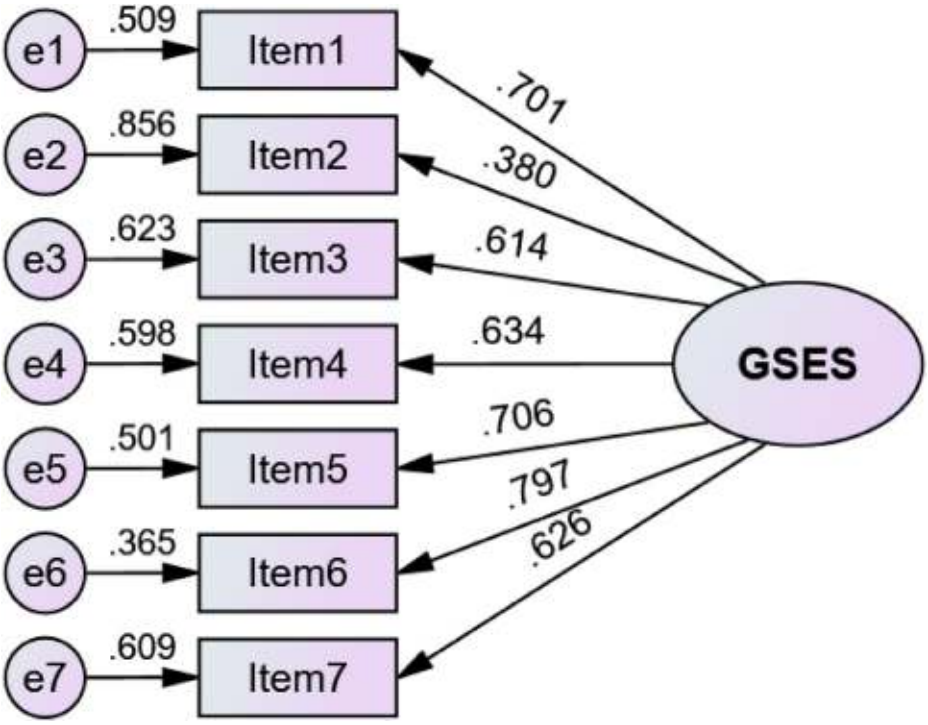

Fig. 1. Results of the CFA model of the Turkish version of the Glasgow Sleep Effort Scale.

Table 2
Item fits and slope and threshold parameters of the Turkish version of the Glasgow Sleep Effort Scale.

Items	Item fits				Slope parameter (a)	Threshold parameter (b)	
	S-χ^2	df	p value	RMSEA		b_1	b_2
Item 1	9.035	14	.829	.000	2.024	−.566	1.555
Item 2	31.210	16	.091	.036	.894	−1.978	1.251
Item 3	16.238	12	.317	.022	2.443	.874	2.108
Item 4	12.506	14	.660	.000	1.877	−.380	1.264
Item 5	21.369	14	.229	.027	2.060	−.166	1.563
Item 6	16.052	10	.229	.028	4.824	.426	1.599
Item 7	14.970	15	.636	.000	1.787	−.298	1.389

Notes: p-values adjusted for false discovery rate (FDR).
RMSEA: Root-Mean-Square-Error of Approximation.

correlation between the seven components of the PSQI and the GSES. A significant positive correlation was found between all PSQI components and the total score of the GSES, and the correlation coefficients ranged from 0.16 to 0.45. The highest correlation values between GSES and PSQI components were between subjective sleep quality and GSES ($r = 0.45$, $p < 0.001$), sleep latency and GSES ($r = 0.44$, $p < 0.001$), and sleep efficiency and GSES ($r = 0.45$, $p < 0.001$) (Supplementary Table 3).

Table 4
Pearson Correlations between psychological instruments.

Variable	1	2	3	4	5	6	7
1. GSES	–						
2. PSQI	583[a]	–					
3. ISI	663[a]	726[a]	–				
4. DBAS-16	432[a]	371[a]	459[a]	–			
5. DASS-21 $_{depression}$	424[a]	467[a]	510[a]	368[a]	–		
6. DASS-21 $_{anxiety}$	442[a]	476[a]	484[a]	365[a]	680[a]	–	
7. DASS-21 $_{stress}$	435[a]	434[a]	475[a]	370[a]	753[a]	719[a]	–

[a] $p < 0.01$ GSES: Glasgow Sleep Effort Scale; PSOI: Pittsburgh Sleep Quality Index; ISI: Insomnia Severity Index; DBAS-16: Dysfunctional Beliefs and Attitudes About Sleep Scale-16; DASS-21: Depression Anxiety Stress Scale-21.

Table 3
Descriptive statistics and reliability analysis of the Turkish version of the Glasgow Sleep Effort Scale.

	Mean	*SD*	Skewness	Kurtosis	Item total-score correlation	If item deleted	
						Cronbach's α	McDonald's ω
Item 1	0.78	0.63	0.21	−0.64	0.59	0.79	0.80
Item 2	1.10	0.66	−0.11	−0.75	0.36	0.82	0.83
Item 3	0.28	0.55	1.79	2.24	0.55	0.80	0.81
Item 4	0.78	0.72	0.34	−1.02	0.59	0.79	0.80
Item 5	0.67	0.67	0.50	−0.76	0.59	0.79	0.80
Item 6	0.41	0.60	1.19	0.36	0.70	0.77	0.78
Item 7	0.74	0.71	0.41	−0.96	0.58	0.79	0.80
GSES	4.79	3.20	0.61	−0.11	–	Cronbach's α = 0.82 McDonald's ω = 0.83	

3.6. Comparison of the means of the total score of the GSES between groups derived from socio-demographic variables

In the comparison analysis, there was no statistically significant difference in the total score of the GSES between male and female (4.79 ± 3.27, 4.78 ± 3.16; p = 0.95, t = 0.06) and married and not married groups (4.78 ± 3.18, 4.83 ± 3.52; p = 0.93, t = −0.07). The total GSES score was significantly higher in participants with chronic disease than in those without chronic disease (6.16 ± 3.96, 4.66 ± 3.09; p < 0.001, t = 3.50). Current use of hypnotic drugs had a higher score than not using hypnotic drugs (7.07 ± 3.54, 4.74 ± 3.18; p = 0.009, t = 2.61), and history of hypnotic drug use had a higher score than no history of hypnotic drug use (6.81 ± 3.48, 4.68 ± 3.15; p < 0.001, t = 3.98). These were statistically significantly high in the total score of the GSES.

3.7. Predictive validity

First, we divided all participants into two groups (poor sleepers vs. good sleepers) according to the PSQI. Second, according to the ISI, we again divided into two groups (clinical insomnia vs. non-insomnia). We compared the total score of the GSES and the PSQI and ISI scores for these groups. The GSES score was significantly higher in the poor sleeper and clinical insomnia groups than in the good sleeper and non-insomnia groups. The details are presented in Table 5.

3.8. Sensitivity and specificity of the GSES

First, we calculated the GSES cut-off for the clinical insomnia group according to the ISI. Second, we calculated the GSES cut-off for the poor sleeper group according to the PSQI. In the first ROC curve analysis, the area under the curve was 0.832 [(95% CI) = 0.79 to 0.86, p < 0.001]. A GSES score of 6 or higher yielded a sensitivity of 81.5% and a specificity of 70.1% in the clinical insomnia group. In the second ROC curve analysis, the area under the curve was 0.824 [(95% CI) = 0.79 to 0.85, p < 0.001]. A GSES score of 3 or higher yielded a sensitivity of 84.3% and a specificity of 64.4% in the poor sleeper group.

4. Discussion

In our study, we adapted the original English version of the GSES for a Turkish population and evaluated the validity and reliability of the Turkish version of the GSES. To the best of our knowledge, the present study is the first to validate a Turkish version of the GSES.

Only using the EFA or the CFA was not adequate for determining the best fit model of the scale [57]. Therefore, we examined the structural validity of the scale using both the EFA and the CFA. Both factor analyses suggested the single factor structure with good model fits. The content validity of the GSES was assessed via principal component analysis (PCA) only in two previous validation studies of the GSES [22,23]. We examined the factor structure in more detail as in another recent study: this is the strength of our study compared to the previous two studies [16,22]. Additionally, the results showed that the Turkish version of the GSES had good internal consistency (Cronbach's α = 0.82, and McDonald's ω = 0.83). These findings are consistent with previous studies that demonstrated good internal consistency of the GSES [16,22,23]. A recent study of four weeks reported a high test-retest reliability (r = 0.70) of the GSES in patients with a diagnosis of insomnia [23].

In the GRM outputs, we observed that items 3 (I put off going to bed at night for fear of not being able to sleep) and 6 (I get anxious about sleeping before I go to bed) were more difficult than the rest of the items. Insomnia patients usually want to go to bed early in the evening to fall asleep easily [13]. However, early bedtime is not so effective in inducing short sleep latency [58]. Item 3 is a question asking whether an individual who has insomnia delays their bedtime. It may not be a usual behavior to advance their bedtime to fall asleep early in the evening. This discrepancy might affect the difficulty of item 3. Item 6 is a question asking whether an individual gets anxious about sleep. However, an individual who has insomnia may have worries about sleeplessness. We can speculate that getting worried about sleeping may be a more difficult question. Of course, the cultural difference might influence the difficulty of items. The scale information curve showing that theta levels ranging from −0.75 to 2.25 reflects that the GSES is efficient and reasonably informative. We can consider that the GSES might be helpful and informative in assessing one's preoccupation with sleep.

The convergent validity of the Turkish GSES was supported by significant correlations between its total score and the related measures in the literature. A positive correlation (r = 0.43) between the Turkish GSES and DBAS-16 revealed a significant relationship between sleep effort and cognitions and behaviors of sleep. A similar correlation between these scales (r = 0.45) was also demonstrated in the study of the Persian version of the GSES [23]. We found a moderately significant correlation between GSES and the PSQI and ISI. This suggests that sleep effort may be associated with sleep quality and the severity of insomnia. The relationship between these scales was not examined in the first two validation studies [16,22]. In contrast, a moderately significant correlation was shown between the GSES and the PSQI and ISI in the Persian GSES study of patients with insomnia. The Pearson correlation coefficients in this study were 0.48 and 0.46, respectively. Similarly, we found a slightly higher (0.58, 0.66) but moderate correlation between these scales in our study. Statistical analysis showed a mildly significant and positive correlation between GSES and the subscales of the DASS-21, indicating that the GSES may correlate with depression, anxiety, or stress. It also suggests that sleep effort may be an indicator of mental health like insomnia. Unlike previous studies [16,22,23], we calculated the correlation of the GSES with seven subcomponents of the PSQI. We detected a moderately significant positive correlation between subjective sleep quality, sleep latency, and sleep efficiency in the Turkish version of the GSES. These results confirmed that sleep effort is associated with subjective sleep quality [59]. Furthermore, the role of sleep effort in psychophysiological insomnia has also been confirmed because sleep-onset difficulties are quite evident in psychophysiological insomnia [21].

The current study examined the discriminant validity of the GSES as in other validation studies [16,22,23]. A cut-off score of 6 correctly identified 81.5% of the clinical insomnia group and 70.1% of good sleepers according to the ISI. A cut-off score of 3 correctly identified 84.3% of poor sleepers and 64.4% of good sleepers according to PSQI. These specificity and sensitivity values were lower than in other studies [22,23]. The difference may have arisen because we made the distinction using only the ISI and PSQI,

Table 5
Comparisons of Glasgow Sleep Effort Scale scores between the groups.

Groups	N	Mean	SD	*p*	*t*
According to PSQI (PSQI ≥5)					
Poor sleeper group	553	5.65	3.06	<0.01	14.03
Good sleeper group	194	2.31	2.12		
According to ISI (ISI ≥15)					
Clinical insomnia group	119	8.13	3.01	<0.01	13.96
Non-clinical insomnia group	628	4.15	2.81		

PSQI: Pittsburgh Sleep Quality Index; ISI: Insomnia Severity Index.

without a clinical interview. However, these cut-off values suggest that the Turkish version of the GSES can distinguish between patients with insomnia and poor sleepers.

4.1. Limitations

This study has several limitations. First, the participants consisted of university students. Most of the participants were female and relatively young. Therefore, our results cannot be generalized to the general Turkish population. Second, we did not conduct a clinical interview and evaluated the participants only with scales. However, the PSQI and ISI, which we used in our research, are as valuable as clinical interviews as they are widely used to determine insomnia, have absolute cut-off values, and are compatible with insomnia diagnostic criteria. Third, we could not perform a retest-test analysis. However, as noted by Tsang et al., test-retest reliability is not valid if the questionnaire measures temporal characteristics such as pain intensity or if there are unstable responses over time [60]. Since sleep effort can be labile, we decided that the test-retest reliability calculation was not essential. Fourth, the reliability of the participants' answers may be problematic because our study was conducted online. However, as the study was conducted during the COVID-19 pandemic, online data collection was the preferable option. Fifth, we did not assess the association between the GSES and objective measure of sleep (for example, Actigraphy) in this study. An association between this subjective measure with an objective measure will provide a more robust validity of the GSES. Sixth, we did not identify the core item of this scale. Further network analysis would be conducted to explore the core item of this scale. Seventh, because there may have been older students among the participants, the age range is extensive. However, the fact that all study participants are university students may render this limitation insignificant. Finally, the proportion of poor sleepers is higher in this study. The proportion of poor sleepers ($\geq$5 in PSQI) is varied with sample characteristics. The study sample was university students. Moreover, we conducted the study during the COVID-19 pandemic. Therefore, both factors (student sample and period of the study conduction) might be the reasons for this higher proportion of poor sleepers.

4.2. Future recommendations

We included a non-clinical population in our study. Future studies should establish the validity and reliability of the scale in clinical groups. Most of the participants in our study were relatively young. Therefore, the lifetime status of sleep effort was not evaluated. Future studies that examine sleep effort in older ages are warranted. In addition, an evaluation of the relations between the GSES and one or more objective measures (e.g., polysomnography and actigraphy) is suggested.

5. Conclusions

This is the first study to evaluate the psychometric properties of the GSES in Turkey. Our study results indicated that the Turkish version of the GSES is a valid and reliable instrument in the university population. The current study validated a simple and practical scale that is useful for investigating sleep effort. The Turkish version of the GSES may help with the identification of patients with insomnia who are suited to psychotherapy. We hope that the simple scale encourages Turkish clinicians dealing with insomnia to include sleep effort in their examinations.

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Declaration of competing interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.sleep.2022.06.022.

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