Abstract

Sleep effort is generally defined as the attempt to force and induce sleep in a voluntary manner. This study aimed to document the psychometric properties of a brief measure of sleep effort - the Glasgow Sleep Effort Scale (GSES), in its European (Portuguese) version \using a large sample ($N = 2995$). The results supported the good internal consistency of the overall scale scores ($\alpha = .79$). Potential construct validity was evaluated with various methods, including criterion validity. There was also a convergent validity indicator. Principal Components Analysis (PCA) revealed a one-dimensional structure which accounted for 45% of the total variance. This preliminary study suggests that this Portugese version of the GSES is a measure of sleep behavior suitable for research and clinical purposes. However, more studies are needed, particularly with clinical groups.

Keywords: sleep, insomnia, GSES, psychometric studies, higher education

When sleep behavior is disturbed the quality of life is seriously compromised (Léger, Morin, Uchiyama, Hakimi, Cure, & Walsh, 2012; Reimar & Flemons, 2003). Higher education students, in particular, are a vulnerable group prone to develop sleep problems that may affect among others their academic performance (Gomes, Tavares, & Azevedo, 2011; Kloss et al., 2011).

Initial insomnia (sleep-onset insomnia) is the most frequent complaint described by students (Kloss et al., 2011). Insomnia is one of the most common sleep disorders both in general population and clinical groups (AASM, 2005). In higher education context, this is the most prevalent sleep disorder (Kloss, Nash, Horsey, & Taylor, 2011). Of note that according to ICSD-2 (AASM, 2005) there are several possible diagnoses of insomnia. For example, sleep-onset difficulties are quite evident in psychophysiological insomnia as well as inadequate sleep hygiene and insomnia due to mental disorder (i.e., anxiety disorders).

Over the past decades, several models have been proposed to explain the pathogenesis and pathophysiology of sleep disorders. The psychobiological inhibition model (Espie, 2002; Espie et al., 2006) is one of the current models on insomnia (Perlis, Shaw, Cano, & Espie, 2011). According to this theoretical perspective, the occurrence of critical incidents or stressors precipitates psychological and physiological activation, promoting selective attention to these life events, and resulting ininsomnia. This model asserts that difficulties concerning initiating or maintaining sleep occur due to a failure of neurobiological mechanisms of wakefulness inhibition. This failure is triggered so that the attentional processes are transferred from the initial stressor event to symptoms of insomnia, initiating consequently the cognitive and behavioral phenomena that the model highlights. Through this process, it is feasible to understand how an acute or transient insomnia becomes chronic (Espie et al., 2006; Perlis et al.

2011). Under normal circumstances, sleep behavior in good sleepers occurs passively and effortless (Frosch, 2010; Perlis et al., 2011). The attention-intention-effort (AIE) pathway model of Espie et al. (2006), a development from psychobiological inhibition general model, puts forward that automaticity of sleep-wake cycle is inhibited through three core processes: selective attention, explicit intention, and sleep effort (Broomfield, Gumley, & Espie, 2005; Espie, 2007). Sleep effort is a key factor in the maintenance of insomnia (Broomfield & Espie, 2005). Given the importance of this component in the perpetuation of insomnia, and its impact on initiating sleep, Espie and colleagues developed the Glasgow Sleep Effort Scale (GSES) (Broomfield & Espie, 2005).

After a thorough analysis of existing scales contents, the authors generated a conceptual model of sleep effort comprising seven main components. Each of these components was assigned an item, thus building the pilot version of GSES (Broomfield & Espie, 2005) used in two previous studies (Broomfield & Espie, 2003; Kohn & Espie, 2005). The GSES consists of 7 items assessed on a 3-point scale severity (Very much = 2 / To some extent = 1 / Not at all = 0), referring to last week's sleep pattern. Total score is obtained by adding up all items, ranging from 0 to 14 points. A higher score indicates greater effort to sleep (Broomfield & Espie, 2005).

Broomfield and Espie (2005) conducted a first validation of GSES using a sample of insomnia patients and a sample of healthy controls. In this study they concluded that GSES had adequate internal consistency (Cronbach's α = .77) and good ability to differentiate clinical group (M = 7.06, SD = 3.58) from control group (M = 1.22, SD = 1.35), with 92.1% sensitivity and 97.3% specificity for a 2 points cut-off. For a cut-off value of 3 points, the GSES identified correctly 82.2% of patients with insomnia, and 92.2% of individuals in the general population. The inter-item correlations were satisfactory and it was verified a statistically significant positive

correlation between GSES and DBAS (Dysfunctional Beliefs and Attitudes about Sleep Scale) for patients with insomnia ($r = .50$; $p < .0001$) suggesting good convergent validity (Morin, Stone, Trinkle, Mercer, & Remsberg, 1993). In another study, a group of insomnia patients with no other comorbidities was compared with a group with insomnia associated with other mental disorders. Obtained GSES scores were higher in the insomnia group compared with control group, confirming the discriminative power of this scale. Nevertheless, sample with insomnia associated with other mental disorders scored higher on GSES than patients with primary insomnia (Kohn & Espie, 2005). Malaffo (2006) also used this scale in study of insomnia patients undergoing behavioral treatments. The sample was divided in 3 subgroups: 1. following "quarter of hour rule" in bed (a stimulus control-based therapy); 2. following "quarter of hour rule" out of bed, and 3. control group with no intervention. Groups were assessed before and after the intervention with GSES scores significantly declined for both of intervention groups. In a study of effects of mindfulness based cognitive-behavioral therapy (CBT) lowering of GSES over time were in a group with primary insomnia (Ong, Shapiro, & Manber, 2009) was observed. Another study based on mindfulness used GSES as measure in a sample of college students (Howell, Digdon, & Buro, 2010). The GSES was also used in a research in a sample of insomnia patients submitted to sleep restriction therapy. After the intervention, GSES scores have significantly decreased (Kyle, Morgan, Spiegelhalder, & Espie, 2011). Espie, Barrie and Forgan (2012) compared patients with primary insomnia with a group of patients with idiopathic insomnia. It was observed that the former group had significantly higher scores on GSES than idiopathic insomnia patientsMore recently, Spiegelhalder et al. (2013) found that insomnia patients scored higher than control sample in GSES.

Despite these studies on the GSES, there is lack of studies on cross-cultural validation and with other populations (e.g., other sleep disorders, non-sleep and psychiatric disorders, normal samples).

The aim of this paper is to describe GSES translation, adaptation, and validation processes in a large sample of higher education students in Portugal. Specific goals: (1) performing the adaptation of GSES into European Portuguese language, ensuring the comprehensibility and clarity of the items, and (2) drawing the first psychometric characterization of the European Portuguese version of GSES, including studies of reliability (internal consistency) and validity (convergent, criterion, and component structure).

METHOD

Participants

In this study we collected a non-probabilistic sample of 2,995 higher education students. Participants were contacted via institutional email or through social networks where they voluntarily acceded to the online questionnaire. Students from public and private universities and polytechnic schools across the country were contacted.

Students were on average 24 years of age and were mostly female (70%). Majority of students were freshmen (71%), full-time students (77%), and about half continued to live with their parents at the time they started higher education (52%) (see Table 1). Inclusion criteria: (1) ≥ 17 years of age (all students), (2) attending a course in higher education, and (3) voluntary participation in research.

INSERT TABLE 1 HERE

Measures

Sleep-Wake Questionnaire for University Student during-the-semester (SWQUS; Adapted from Gomes, 2005; Gomes et al., 2011). This is a self-report questionnaire developed for research with higher education students (cf. Gomes, 2005; Gomes et al., 2011). It aims to characterize some aspects of sleep-wake patterns and some aspects of daytime and academic functioning of the student. The SWQUS includes 3 sections: (1) *"sleep-wake cycle during the semester"* which characterizes sleep-wake patterns and habitual aspects of daytime functioning *"in a typical class week"*, considering the last month ; (2) "other sleep aspects" comprising questions about sleep but not necessarily during the class week or during the last month; and finally (3) a section about other daytime aspects to explore other dimensions of academic functioning and student lifestyle (e.g., substance use). For the current study, we used only the first two sections. Some of the items were used to compute a sleep index measure ($\alpha = .78$) currently named *Basic Scale of Insomnia and Quality of Sleep* (BaSIQS, Gomes, Marques, Tavares, & Azevedo, 2013; Gomes et al., 2014). Calculations were done following instructions in Gomes (2005) and Gomes et al. (2011).

Glasgow Sleep Effort Scale – European Portuguese version (GSES; Marques, Gomes, Meiavia, & Couto, 2012) - is the translation and linguistic adaptation of Glasgow Sleep Effort Scale (Broomfield & Espie, 2005), developed to evaluate the individuals´ effort to sleep (for more details see Introduction).

Glasgow Content of Thoughts Inventory – European Portuguese version (GCTI; Marques, Gomes, Meiavia, & Couto, 2012). It is a translation and linguistic adaptation of Glasgow Content of Thoughts Inventory, developed with the purpose of assessing individuals´ thoughts when they cannot fall sleep. Instrument consists of 25 items, scores range from 25 to 100. Higher scores mean greater intrusiveness and frequency of dysfunctional thoughts interfering with sleep-onset (Harvey & Espie, 2004).

Procedure

Preliminary translation of the scale to European Portuguese was made by four psychology researchers. Two experts in the field of sleep and circadian rhythms (one working in an academic setting and the other has clinical practice in behavioral sleep medicine) were additionally recruited. The aim was to examine the first translated version and provide suggestions in order to make translation more accessible to the Portuguese population and maintaining semantic equivalence. The resulting version of the scale comprising the suggestions made by those experts was tested by "thinking aloud" procedure (Shaughnessy, Zechmeister, & Zechmeister, 2012) in a small but representative group of individuals. The aim was to develop a coherent, comprehensible and reliable version of the scale so that it may be used by individuals from varying socio-demographic and educational backgrounds: higher education students (n = 4); patients attending a university sleep psychology consultation (n = 4), and general population of both genders, different ages (range: 30-70 years), and diverse professional occupations and education levels (n = 6). This step was carried out individually with the participants. Each participant had to read out loud each item and give a response. Than the researcher questioned the individual about the meaning of the items to see how individual interpreted each of the items.

Participants were encouraged to provide any observations/comments about items. This process resulted in minor linguistic adjustments. The resulting version was then submitted to back-translation. This step was completedby a professional with training in Portuguese-English languages and qualification on the English language and culture. The retroversion was developed without prior access to the original scale. Once translation and back-translation of GSES were completed, materials were sent to the main author for approval. According to the main author, there were no discrepancies in content, or between the original version and the translated version. Thus the European Portuguese version of GSES - "Escala de Glasgow sobre o Esforço para Dormir" was developed.

Data collection. GSES and the other measures were available online through Through GoogleDocs platform, The request for disclosure of the study was sent to 13 public universities, including the University of Aveiro, 25 universities, and 19 polytechnics institutes (this was a convenience sample although it covered the majority of higher educations institutions of the country). Study participants were also recruited through social networks. Massive data collection was preceded by a day of data collection to test the correct functioning of the electronic version of the questionnaires. To beincluded in the research, questionnaires had to be completely filled (Meia-Via, 2013).

Statistical Analysis

IBM SPSS Statistics™ Version 19 (IBM, SPSS, Chicago, IL) was used for statistical analysis. Descriptive statistics such as means, standard deviations, and chi-squares (χ^2) for the sociodemographic features of the sample was computed. Despite non-normal sample distribution of some of the variables, parametric statistics (univariate analysis of variance (*ANOVAs*)) was

used since the number of participants was considerably high ($n > 30$). To study internal

consistency of the measures, we calculated Cronbach's alpha, corrected item-total correlations,

alpha coefficients excluding item, and inter-item correlations. Principal components analysis

with varimax rotation was also done.

RESULTS

Table 2 displays the intercorrelation matrix. We found that almost all the items correlate

with each other in a positive and small to moderate way (r range= .19-.41), according to criteria

by Dancey and Reidy (2011).

INSERT TABLE 2 HERE

Reliability

The overall value of the Cronbach's α for GSES was .79 which is considered adequate

(Field, 2005). It was found that the exclusion of any item did not increase the level of internal

consistency obtained, as can be observed in Table 3. The minimum corrected item-total

correlation was .43.

INSERT TABLE 3 HERE

Validity

Convergent validity

In order to assess convergent validity of the Portuguese version of GSES, we computed a

Pearson correlation coefficient between GSES total score and GCTI total score. Moderate

positive correlation between the two scales ($r = .56$; $p < .001$) was found according to criteria by

Dancey and Reidy (2011), suggesting convergent validity of GSES.

Criterion validity

In order to verify criterion validity of GSES, we divided the total sample into three

subgroups (i.e., "no sleep problems"; "insomnia symptoms"; and "other sleep problems")

depending on the answer to the self-report question *"Do you think you have a sleep problem? If*

yes, please specify" which figured in QSVES. This division of groups was based on a qualitative

analysis of primary sleep complaints that the participants reported. The "insomnia symptoms"

group comprised participants whose main sleep difficulty was related to insomnia; the "other

sleep problems" group was constituted by participants whose major sleep concerns were not

related directly to insomnia (e.g., symptoms of bad dreams/nightmares, sleep apnea, circadian

disorders, sleep disturbance caused by depressive or anxiety symptoms). Since the assumption

of homogeneity of variances was not assumed for some items ($p < .001$), we used a more suitable

test, the Welch ANOVA test (Field, 2005). There were significant differences among the groups

regarding total score. Post-Hoc Tests of Games-Howell (Field, 2005) revealed that the three

groups differed significantly ($p < .001$), and the "insomnia symptoms" group had higher scores

on GSES compared to the other groups. Moreover, the group "with other sleep problems" had

higher scores than participants with no sleeping problems (cf. Table 4). Of note that the

prevalence of "insomnia symptoms" in our sample was 7.9 % whereas "other sleep problems" was 7.0 %.

INSERT TABLE 4 HERE

Difference among conditions achieved a large effect size ($\eta^2 = .4$) according to Cohen´s criteria (Cohen, 1992). Figure 1 displays a comparison among the groups.

INSERT FIGURE 1 HERE

Discriminative power of each GSES item was analyzed. There were significant differences among the three groups on all items of the scale ($p < .001$). Through post hoc testing, it was observed that the mean scores of the three groups were significantly different. The "insomnia symptoms" group scored higher than remaining groups in all GSES items (cf. Table 4).

Structure of GSES

To examine the component structure of GSES we followed the analyses of the authors of the instrument - principal component analysis (PCA) followed by Varimax Rotation (Broomfield & Espie, 2005). Since only one component was extracted, no rotation was generated. Kaiser Criterion (eigenvalues > 1) was considered for components extraction, Cattell´s Scree Plot was examined. In general, we found suitable conditions for the implementation of PCA, namely: inter-item correlation coefficients close to or above .30; KMO value (Kaiser-Meyer-Olkin measure of sampling adequacy) = .83, exceeding the recommended minimum value of .50;

significant Bartlett's test of sphericity, and χ^2 (21) = 5163.4 (p < .001) (Field, 2005; Pallant, 2007). A single principal component was found (eigenvalue = 3.13) accounting for 44.8% of total variance (cf. Table 5).

INSERT TABLE 5 HERE

DISCUSSION

The main goal of the present study was translation and linguistic adaptation of GSES to European Portuguese language and to evaluate how robust the GSES is when applied to another language and culture. Furthermore, we wanted to study some of the preliminary psychometric properties of this version in a younger adults´ group.

Statistical analysis suggest that GSES scores are psychometrically sound, at least in the examined sample.

The results of PCA suggest presence of a single component, which explained approximately 45% of the variance. This structure meets the one obtained in the aforementioned study of Broomfield and Espie (2005) encompassing clinical adult sample (n = 159) and a nonclinical sample (n = 120). Likewise, they found only a single component though explaining about 63% of the variance. Although there has been the same component solution, the sample in the original study was small. Through the analysis of the three sub-groups we found that the scale scores are able to discriminate students who think they have insomnia symptoms from those who think they have other sleep problems, and from those who reportedly have no sleep problems. This observation is supported by other findings that GSES is a good tool foridentifying insomnia patients (Broomfield & Espie, 2005). Previous studies showed the power of GSES to discriminate

patients with insomnia from "good sleepers" (Broomfield & Espie, 2005; Spiegelhalder et al., 2013) or patients with other sleep problems (Espie et al., 2012). Even though this study did not include groups clinically identified or diagnosed strictly according clinical or objective criteria, the GSES seems to contribute to the identification of possible clinical insomnia patients.

For the current study, we recruited a sample of Portuguese higher education students, since literature notes the presence of a significant percentage of sleep disturbances, including insomnia, in this group (Gomes et al., 2010; Kloss et al., 2011). The lack of validated psychological scales concerning sleep behavior in Portugal, and the clinical need for instruments which assess specific aspects of insomnia reinforce the importance of this study. This study may become a starting point in developing this measure for other Portuguese speaking countries (e.g., Brazilian Portuguese) in the future. According to our research, none of the few published studies that used GSES recruited specifically higher education students, which makes this study unique. Data was collected through internet survey. This method of data collection has been incresingly used in psychological studies, especially in the behavioral sleep medicine (Gellis & Lichstein, 2009; Gellis & Park, 2013). Despite the inherent limitations, several studies indicate that it is an effective way of collecting large amounts of data fast and at a low cost (Gellis & Lichstein, 2009). It seems to be as valid and reliable as traditional data collection methods (Eysenbach & Wyatt, 2002; Gosling, Vazire, Srivastava, & John, 2004).

Self-selection bias (i.e., students who responded to the questionnaires might have a particular interest in sleep issues compared to the average or typical student) should be acknowledged. Although the sample consisted only of higher education students, Portuguese versions of the instruments were first administered to a small group of diverse Portuguese population with results indicating good comprehension of measures. For future administration of

GSES to the general population and different clinical groups, we worked carefully in the scale´s

translation and adaptation. Another limitation of our study was that our selection criteria did not

include the mandatory presence of any sleep disorders. Nevertheless, through information

obtained by SWQUS it was possible to identify subjects with possible sleep disorders, and more

specifically with insomnia symptoms, allowing to assess the discriminative power of the

instrument. It is necessary to be aware that subgroups division was artificial as it was based on a

self-report measure and not guided by clinical, or other more discriminative criteria. This should

be taken into account in the future studies.

It is important to replicate this study in other samples of Portuguese higher education

students. The joint use of another tool for assessing sleep patterns, including, for instance, the

Pittsburgh Sleep Quality Index (Buysse, Reynolds, Monk, Berman, & Kupfer, 1989) would be

germane since the groups may be constituted according to a more reliable and objective criteria.

Another solution would be to include only individuals clinically diagnosed with

psychophysiological insomnia according to ICSD-2 or insomnia disorder according to DSM-5,

for instance.

In summary, Portuguese version of GSES has good psychometric properties and good

relevance to clinical practice, particularly in the diagnosis and monitoring of insomnia treatment.

GSES appears easy to understand and complete, which reinforces its implementation in clinical

settings. In this sense, it is also worth noting that this scale will be for sure a relevant tool in

university sleep psychology consultations, which deal with students who have sleep

disturbances/disorders, including insomnia complaints (Marques & Gomes, 2012). As insomnia

is the most common sleep complaint in Portuguese higher education students, it is important to

introduce this measure in assessment protocols at the sleep and mental health consultations (Gomes, 2005).

Finally, one should be aware of the potential that GSES might have even for the non-sleep specialist. It is well known that insomnia symptoms are one of the most frequent complaints in health settings (Morin & Espie, 2003). Many times, insomnia symptoms are devalued and are assumed as an epiphenomenon of other clinical conditions (Espie, 2002). Although GSES does not enable a clinical diagnosis of insomnia, it can draw attention to an eventual insomnia disorder (Espie et al., 2006). Insomnia and sleep disturbances are almost always present in all forms of psychopathology and other medical conditions. Having a brief and simple scale available which may assess insomnia complaints may be a relevant key to provide help and improve treatments.

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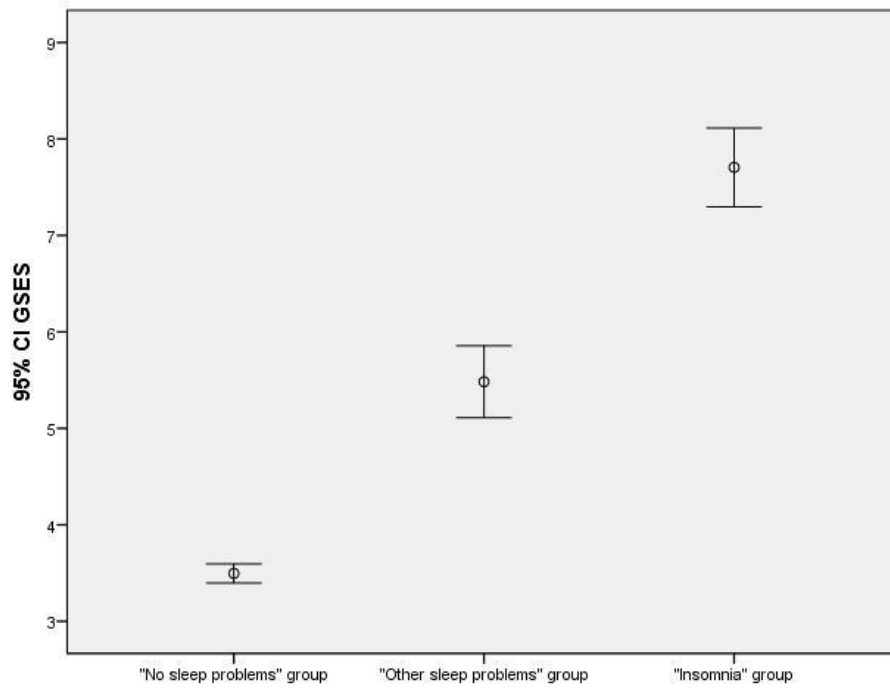*Sleep*, *36*(5), 731-737. doi:10.5665/sleep.2638

Figure 1. Error bar chart showing differences among groups in GSES total score

Table 1.

Demographic and clinical features of the sample

	(*N*=2995)	
	M (*SD*)	Min-Max
Age	23.9 (6,59)	17[a]-62
Attended grade	2.21 (1,1)	1-10
	n (%)	χ^2
Completed enough course credits? [1]		
Pass	2579 (13.9%)	1562.1**
Fail	416 (89.1%)	
Sex		
Female	2089 (69.7%)	467,3**
Male	906 (30.3%)	
Children		
No	2764 (92.3%)	2142.3**
Yes	231 (7.7%)	
Marital status		
Single	2631 (87.8%)	
Married	324 (10.8%)	4045.5**
Divorced	40 (1.3%)	
Degree of study		
B.Sc. / B.A	2117 (70.7%)	
M.Sc / M.A	601 (20.1%)	4202.8**
Ph.D	53 (1.8%)	
Other	6 (0.2%)	
Student status		
Ordinary	2309 (77.1%)	
Student-emplyee	656 (21.9%)	2777.3**
Other	30 (1.0%)	
Left parent´s home to study in Higher Education		
No	1554 (51.9%)	4.3*
Yes	1441 (48.1%)	

[a] excluding an invalid case.
p < .05; ** *p* < .001
[1] Fail means he/she did not complete enough courses credits to progress to a new curricular year;
Pass means he/she completed enough course credits to progress to a new curricular year.

Table 2.

Inter-item correlation matrix

	Items						
	GSES_1	GSES_2	GSES_3	GSES_4	GSES_5	GSES_6	GSES_7
GSES_1	-						
GSES_2	.43	-					
GSES_3	.45	.30	-				
GSES_4	.40	.29	.37	-			
GSES_5	.38	.25	.37	.25	-		
GSES_6	.41	.26	.51	.38	.37	-	
GSES_7	.32	.30	.26	.50	.19	.33	-

Table 3.

Corrected item-total correlations and Cronbach´s alpha if item is excluded

Items	Corrected item-total correlation	Alpha if item deleted
GSES_1	.60	.74
GSES_2	.45	.77
GSES_3	.55	.75
GSES_4	.55	.75
GSES_5	.43	.77
GSES_6	.56	.75
GSES_7	.47	.76

Table 4.

Means, standard deviations, ANOVA and post hoc GSES findings for groups

GSES items	**1** "No sleep problems" group ($n = 2547$) *M* (*SD*)	**2** "Insomnia symptoms" group ($n = 210$) *M* (*SD*)	**3** "Other sleep problems" group ($n = 238$) *M* (*SD*)	test *F* / *Welch*	post hoc testing Tukey HSD / Games-Howell
1. I make too much of an effort to fall asleep, when it should happen naturally	.47 (.59)	1.32 (.64)	.79 (.68)	208.646**	1< 3< 2
2. I feel that I should be able to control my sleep	.83 (.63)	1.36 (.58)	1.16 (.63)	92.826**	1< 3< 2
3. At night, I put off going to bed for fear of not being able to sleep	.29 (.56)	1.01 (.80)	.54 (.71)	93.955**	1< 3< 2
4. If I can't fall asleep I get worried	.69 (.63)	1.24 (.62)	.98 (.61)	93.770**	1< 3< 2
5. I feel like I'm not very good at sleeping	.26 (.51)	.88 (.76)	.53 (.70)	78.084**	1< 3< 2
6. Before going to bed I get anxious about my sleep	.14 (.37)	.63 (.70)	.37 (.56)	68.537**	1< 3< 2
7. I worry about the consequences of not sleeping	.82 (.66)	1.26 (.63)	1.12 (.66)	58.877**	1< 3< 2
GSES total score	3.50 (2.53)	7.70 (2.99)	5.48 (2.91)	235.112**	1< 3< 2

** $p < .001$
Note. In items 3, 4, 5, 6, 7 and GSES total score it was computed an asymptotically *F* test (Welch test), as the homogeneity of variances was not assumed. Consequently, in post hoc comparisons, we calculated Games-Howell test. For the remaining items (1, 2 and 7) it was computed *ANOVA F´*s and Tukey HSD tests.

Table 5.

Component loadings for GSES

Item no.	Item content*	Component I	h^2
1	"I make too much of an effort to fall asleep, when it should happen naturally"	.74	.55
6	"Before going to bed I get anxious about my sleep"	.71	.35
3	"At night, I put off going to bed for fear of not being able to sleep"	.71	.50
4	"If I can't fall asleep I get worried"	.69	.48
7	"I worry about the consequences of not sleeping"	.61	.35
2	"I feel that I should be able to control my sleep"	.59	.51
5	"I feel like I'm not very good at sleeping"	.59	.38

* The item contents refer to the ones achieved after Portuguese retroversion.