**Tittle**

Basic Scale on Insomnia complaints and Quality of Sleep (BaSIQS): reliability, initial validity and normative scores in higher education students

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**Abstract**

Based on successive samples totaling more than 5000 higher education students, we scrutinized the reliability, structure, initial validity, and normative scores of a brief self-report 7-item scale to screen for the continuum of nighttime insomnia complaints / perceived sleep quality, used by our team for more than a decade, henceforth labeled the Basic Scale on Insomnia complaints and Quality of Sleep (BaSIQS). In study/sample 1 (n = 1654), the items were developed based on part of a larger survey on higher education sleep-wake patterns. The test-retest study was conducted in an independent small group (n = 33) with a 2-8 week gap. In study/sample 2 (n = 360), focused mainly on validity, the BaSIQS was completed together with the Pittsburgh Sleep Quality Index (PSQI). In study 3, a large recent sample of students from universities all over the country (n = 2995) answered the BaSIQS items, based on which normative scores were determined, and an additional question on perceived sleep problems in order to further analyze the scale's validity. Regarding reliability, Cronbach alpha coefficients were systematically higher than 0.7, and the test-retest correlation coefficient was greater than 0.8. Structure analyses revealed consistently satisfactory two-factor and single-factor solutions. Concerning validity analyses, BaSIQS scores were significantly correlated to PSQI component scores and overall score (r = 652 corresponding to a large association); mean scores were significantly higher in those students classifying themselves as having sleep problems ($p < .0001$, $d$ = 0.99 corresponding to a large effect size). In conclusion, the BaSIQS is very easy to administer, and appears to be a reliable and valid scale in higher education students. It might be a convenient short tool in research and applied settings to rapidly assess sleep quality or screen for insomnia complaints, and it may be easily used in other populations with minor adaptations.

**Key-words:** self-response questionnaire; sleep quality; psychometric analyses; higher education students.

**Note:**

Partial results from this study have been previously presented at the World Congress on Sleep Medicine in 2013 (WASM-2013) and were published as a congress abstract. The BaSIQS items have been in use by our research team for more than a decade, so Cronbach alpha values have been reported in academic dissertations (cf. references in the text). However, no previous publication has been dedicated to scrutinizing the full psychometric properties of this scale, and until now, the only single value which was previously published in a journal article was the Cronbach alpha coefficient found for the first sample. Therefore, the current paper is dedicated to presenting original research results derived from first-hand psychometric analysis that were not previously addressed or published in any other journal article.

## Introduction

The definition and conceptualization of *sleep quality* varies considerably in the literature, although there are common aspects. In a paper dedicated to sleep quality measurement, Krystal and Edinger (2008) observed that there is still no standard definition, and according to Harvey et al. (2008), sleep quality is still poorly defined despite its ubiquitous use. At least three related meanings of sleep quality are apparent in the literature: 1.) The expression simply to refer to subjective sleep satisfaction or perceived quality of sleep, which is usually assessed through a single question (e.g. Harvey et al., 2008; Hawkins & Shaw, 1992; Tsai & Li, 2004). 2.) In other instances, in addition to items on sleep quality or sleep satisfaction, the expression also encompasses several sleep onset and maintenance aspects related to insomnia complaints such as difficulties falling asleep, frequent or prolonged night awakenings, early morning awakenings, perceived light sleep, and non-restorative sleep (e.g. Alapin et al., 2000; Pilcher et al., 1997). In effect, insomnia symptoms and poor quality of sleep appear in sleep literature as interconnected and intersecting concepts. Sleep quality is usually defined based on a number of items from which an overall score may be determined. 3.) Finally, there are also more comprehensive instruments (e.g. Buysse et al., 1989; Hyeryeon et al., 2006), such as the well-known Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989), which allows for the extraction of seven component scores and a global score concerning not only insomnia or sleep quality questions, but also items regarding other sleep aspects, including the amount of sleep, sleep-wake schedules, sleep breathing difficulties, or even daytime dysfunction aspects.

The present work assumes the second definition of sleep quality, which is focused on the qualitative aspects of sleep with some insomnia symptoms included. Aspects such as sleep amount and sleep schedules are intentionally excluded, since

these dimensions may be independent from each other. For instance, an individual may complain of poor sleep quality in the form of light sleep, even if an adequate amount of sleep is usually obtained. Although the first definition of sleep quality is very specific, single-item measurements may have the disadvantage of capturing a limited range of differentiation within the continuum between good and poor sleepers.

We therefore concentrate on the second definition of sleep quality, which encompasses sleep onset and maintenance aspects related to insomnia symptoms, but our focus is not mainly a clinical one. We are interested in the continuum ranging from good to poor sleep, not exactly in specific issues concerning insomnia measurement or diagnosis through self-response measures, which have been the subject of extensive previous work. Since sleep quality refers fundamentally to subjective/perceived aspects, self-response measures have constituted the privileged way to assess it. However, more than just subjective reports, according to a handful of studies using polysomnography and other objective methodologies, perceived sleep quality appear to be specially related to sleep continuity (Åkerstedt, 2008; Åkerstedt et al., 1994), sleep efficiency (Åkerstedt et al., 1994), and amount of (Åkerstedt, 2008).

Interestingly, in spite of the multiplicity of definitions and subjective nature, sleep quality seems to be of considerable importance given that significant correlations with daytime functioning have been systematically reported. The case of higher-education students appears to be of particular interest when taking into account the predominance of relatively successful and allegedly healthy young adults. However, even in such samples with a majority of reasonably healthy individuals, sleep quality assessed by different methods has been associated with a myriad of daytime correlates, such as academic achievement (Lemma et al., 2013; Tavernier & Willoughby, 2013; Wong et al., 2013), psychosocial functioning (e.g. friendship quality; self-esteem)

(Tavernier & Willoughby, 2013), neuroticism, social support (Cheng et al., 2012), reported health (Cheng et al., 2012; Pilcher et al., 1997; Wong et al., 2013), wellbeing indicators (Pilcher et al., 1997), perceived stress level, and symptoms of depression and anxiety (Lemma et al., 2012; Wong et al., 2013). In addition, complaints of insomnia or poor sleep quality have been consistently reported in higher-education students in a variety of countries from all continents (e.g. Alapin et al., 2000; Allen Gomes et al., 2009; Fernández-Mendoza et al., 2009; Lack, 1986; Lemma et al., 2012; 2013; Lima et al., 2002; Lohsoonthorn, 2013; Machado et al., 1998; Taylor et al., 2013; Wong et al., 2013). Therefore, it seems that insomnia symptoms and poor sleep quality complaints in undergraduate/graduate students deserve more attention.

The present work focuses on a brief 7-item scale developed for higher-education students that may be easily transposed to other populations, in order to parsimoniously measure the continuum ranging from good to poor sleepers by concentrating on the main night symptoms of insomnia and poor sleep quality. Although several useful instruments have been published over the last years with focus on insomnia or sleep quality (e.g. Broman et al., 2008; Espie et al., 2014; Hyeryeon et al., 2006; Kessler et al., 2010; Okun et al., 2009; Pallesen et al., 2008; Soldatos et al., 2000), on the date we started collecting data on a large sample in the academic year of 2001/2002, very few brief tools were then available (e.g. Moul et al., 2004; Shahid et al., 2012). Moreover, at the present time, full psychometric characterization is sporadic or limited in regard to more specific populations such as higher-education students. It seems to be valuable to obtain normative data on this specific population for research and or clinical purposes (e.g. university mental health services). Also, few tools provide norms throughout a continuum ranging from good to poor sleepers. In contrast, the existing tools and published studies are mainly concerned with identifying insomniacs or poor sleepers,

such as through diagnostic criteria or considering clinical samples. Furthermore, sleep quality is frequently measured using the PSQI. Despite being a very useful instrument, this index is not limited to questions directly asking for subjective sleep quality or insomnia symptoms, as it also contains items on sleep duration or about symptoms of other sleep problems such as sleep-breathing disorders, including components relating to sleep quality in a more specific sense. Therefore, although acknowledging the major usefulness of existing instruments in identifying potential patients with insomnia according to sleep disturbance classifications, or poor sleepers in a broader sense, a gap seems to exist in measuring the continuum of subjective sleep quality/insomnia symptoms in a more parsimonious and specific way without restriction to a single item.

We are interested in a tool focused mainly on the nighttime sleep quality and interrelated insomnia aspects, while intentionally leaving out items about the associated daytime dysfunction, other sleep parameters such as sleep amount, and other sleep problems (e.g. sleep breathing disturbances). A measure exclusively devoted to sleep quality in this more specific sense may be useful for research purposes, such as when a researcher wants to assess the effect of sleep quality separately from other sleep dimension effects (such as sleep duration or sleep schedules).

The current work aims to examine in higher-education students the reliability, validity, and normative scores of a short and practical self-report measure intended to assess some insomnia night symptoms and perceived sleep quality, which has been used for more than a decade by our research team members (Gomes, 2005; Gomes et al., 2011; 2013). To avoid overlapping designations with existing measures as much as possible, it is definitively called the Basic Scale on Insomnia symptoms and Quality of Sleep (BaSIQS). The specific aims were to inspect the internal consistency and structure of BaSIQS in student samples; its test-retest stability; its validity using the PSQI and the

perceived presence/description of sleep problems as independent measures; and to obtain normative scores for higher-education students.

## Materials and Methods

***Participants*** . There were 5042 effective participants from three sequential samples of higher-education students and a test-retest group, who participated in sequential studies and returned valid questionnaires. For replication purposes and given the different time points and forms of administration of the BaSIQS, data from successive samples were *not* aggregated. Sample 1 is a cluster sample selected from a public university (located in a city in the littoral center-north region of the country) composed of students from 50% of the existing undergraduate degree programs of the university, from a variety of academic fields (engineering, sciences, education, management, and languages). The eligible participants totaled 1654 full-time students who were 45% men and 17 to 25 years old . (M = 20.0 ± 1.65) Further details about this sample may be found in a previous publication (Gomes et al., 2011).

The test-retest group comprised 33 undergraduate and graduate students (28 female and 5 male) from psychology courses, with age ranging from 18 to 28 years (M = 19.6 ± 2.19). Sample 2 was composed of 360 undergraduate and master degree students (34.3% men, 65.7% women) who were 17 to 47 years old (M= 21.0 ± 2.85) and from the same University in a variety of academic fields. Finally, sample 3 comprised 2995 undergraduate and graduate students (30.25% men, 69.75% women) from numerous public and private universities and polytechnic institutes with an average age of 23.9 (± 6.59) years old and a range of 17 to 62 years. Additional details about these samples will be addressed in the procedures section.

### *Instruments and measures*

- *Basic Scale on Insomnia and Quality of Sleep - BaSIQS* (cf. appendix). Originally written in European Portuguese, BaSIQS consists of seven items covering difficulties with sleep onset and maintenance, as well as subjective assessment of overall quality and depth of sleep in the past month. Each item is rated on a 5-point Likert scale from 0-4, except for the last two items, which are reversed. The total result is obtained by summing the individual items and may range from 0 to 28, with higher scores equating to poorer sleep. This measure has been used by our research team members and is now assuming a definitive designation intended to avoid confusion with other existing tools.

The items were originally conceived as part of a much larger and comprehensive sleep-wake questionnaire developed for a survey of undergraduates. The items were developed by a research team of university teachers combining experience in higher education research with clinical and research expertise in mental health and sleep disturbances, particularly insomnia. Details about the development of this larger questionnaire (Sleep-Wake Questionnaire for University Students [SWQUS] - "during-the-semester" version) have been described earlier (Gomes et al., 2011). It should be emphasized that the BaSIQS is by no means simply a short form of the SWQUS. In fact, SWQUS is a much larger and comprehensive questionnaire meant to assess four main sleep dimensions (among several other aspects such as daytime and academic functioning): sleep *quantity* aspects, sleep *quality* aspects (the 7 items of the BaSIQS described in the current work), sleep *phase* aspects, and *irregularity* aspects of the sleep-wake cycle.

- *Pittsburgh Sleep Quality Index* (Buysse et al., 1989), European Portuguese Translation (PSQI [PT]), 2008, obtained via Mapi Research Institute, authorized by the principal PSQI author. The PSQI consists of 19 questions (plus 5 additional questions applicable only to participants with a roommate or bed partner). Based on these questions, an

overall sleep quality score and seven component scores are extracted to reflect areas in which sleep may or may not be disturbed. Higher scores correspond to greater disturbance. A cut-off global score higher than 5 is used to distinguished between good and poor sleepers (Buysse et al., 1989; Marques et al., 2013). Cronbach alpha was .83 for the original language questionnaire, while it was .65 and .74 in sample 2 when based on components and items, respectively. The mean overall score in this sample was 5.18 (SD= 2.49), with 230 students classified as "good sleepers" (63.9%) and 130 classified as "poor sleepers" (36.1%).

- An additional question asking whether the student considered that they had any sleep problems was also used ("no" / "yes-please specify"). In case of an affirmative answer, the student was asked to briefly describe the sleep problem. Based on the analysis of the students' responses, three groups were formed: "insomnia symptoms" (n = 210, 7.0% of sample 3); "other sleep problems" (n = 238, 7.9% of sample 3); and "no sleep problems" (n = 2547, 85.0% of sample 3).

***Procedures***. The successive studies conformed to international ethical standards for biological rhythm research as described by Portaluppi et al. (2010). First, the 7 items of the BaSIQS scale were developed and answered by sample 1 as part of a larger self-report questionnaire on higher education sleep-wake patterns (full data collection procedures were described by Gomes et al., 2011). The first data on internal consistency and item homogeneity of the scale were then obtained. Test-retest data was based on a small group of university students, with a time interval ranging from 2 to 8 weeks. In sample 2, students completed the BaSIQS together with the PSQI-[PT], which was used to analyze the validity of the scale. Sample 3 replicated and expanded previous analyses on reliability in a national sample of university and polytechnic students and further examined validity through a question on perceived sleep problems. Item discriminative

power was inspected based on both the PSQI cut-off point (study 2) and the question about perceived sleep problems (study 3).

In samples 1 and 3 and in the retest group, the BaSIQS items were presented indistinctly as part of a much larger questionnaire on sleep-wake patterns in higher education (SWQUS "during-the-semester" version, Gomes et al., 2011), either in paper-and-pencil format (sample 1 and the retest group) or in an online format. In study 2, the BaSIQS items were presented as a demarcated paper-printed scale. Data were collected in the academic years of 2001/2002 (sample 1), 2011/12 (test-retest group), and 2012/13 (samples 2 and 3 in different semesters). All participants were recruited as part of broader academic dissertation research projects involving specific sleep variables in higher-education students (Gomes, 2005; A. Meia-Via, 2013; M. Meia-Via, 2013).

The students' participation was voluntary in the sense that participants neither receive extra credit nor any other benefit from participating in the study. The research team was independent from the students' teachers. Depending on the specific research, students answered printed questionnaires at the end of class sessions (sample 1 and the test-retest group), at several places of the university campus (e.g. the library and study rooms in sample 2), or through an online survey hosted on the GoogleDocs platform using a personal computer (sample 3).

Concerning the sample planning procedures and representativeness issues, *sample 1* resulted from a systematic sampling plan designed to represent 50% of the majors of the university (cluster sample). The participation rate was 90.1% of all students in each selected undergraduate course attending class sessions invited to the study. Therefore, this sample appears to be fairly representative of the university's full-time undergraduate population and comprises a variety of common academic fields.

*Sample 2* was collected from several places of the university campus, whereas

the *test-retest group* was collected during psychology courses, and both were convenience samples. The percentages of good/poor sleepers found in sample 2 according to the PSQI and the mean overall PSQI score (see instruments section) were similar but systematically lower compared to those reported in many other studies with university student samples (Carney et al., 2006; Cheng et al., 2011; Clegg-Kraynok et al., 2011; Kabrita et al., 2014; Lemma et al., 2012, 2013; Lund et al., 2010). This suggests that sample 2 does not over represent poor sleepers, so it is not biased in in this sense.

*Sample 3* was recruited via email announcements directed to all 13 public universities of the country, plus 25 private universities/institutes and 19 polytechnic institutes (and in a less systematic way via social networks). Complete questionnaires were obtained from most of the invited universities and institutes, but the data collection procedures do not allow for accurately computing the participation rate. Therefore, in spite of the great participation and dimension of the sample, its representativeness may not be rigorously assumed given the possibility of self-selection: those choosing to answer to an online questionnaire from their personal computer might have higher interest in sleep issues (e.g. due to sleep difficulties) than the average higher education student. On the other hand, the percentages mentioned (see the instruments section) for students perceiving themselves as having no sleep problems (85%), insomnia symptoms (7%), or other sleep problems (8%) seem to agree well with epidemiological data in representative samples of young adults or university students (e.g. Buysse et al., 2008; Coren, 1994; Janson et al., 1995; Taylor et al., 2013). The percentages are also in line with the prevalence of insomnia in population-based studies (e.g. Roth, 2007; Roth et al., 2011) and studies on sleep disorders in general according to the International Classification of Sleep Disorders (American Academy of Sleep Medicine [AASM],

2014). This suggests that sample 3 is not biased regarding the frequency of sleep problems expected in a community sample largely composed of young adults.

*Statistical analyses* were performed using IBM SPSS 19 (Statistical Package for the Social Sciences). Regarding reliability analyses, the Cronbach alpha coefficient was used as a measure of internal consistency. Item homogeneity was analyzed by computing the corrected item-total correlation coefficients and Cronbach alpha changes when excluding each item, while temporal stability was examined through correlation coefficients between scores obtained in the first and second administration (Spearman Rho and Pearson product-moment), and by performing an absolute-agreement-type test-retest intraclass correlation coefficient (ICC) analysis.

The scale structure was explored through principal axis factoring, followed by the direct oblimin rotation method for the number of factors suggested according to eigenvalues and the scree plot. An oblique rotation method was adopted since there was no reason to expect independent factors. For the same reason, a single-factor solution was also examined. All variables of the BaSIQS (total score and item scores) showed distributions close to the normal curve in sample 1 and sample 3 indicated by skewness and kurtosis values between -1 and +1. However, in sample 2, one item of the BaSIQS and three components of the PSQI showed relevant deviations from a normal distribution. Therefore, in validity analyses of sample 2 involving the items of the BaSIQS or the PSQI components, non-parametric statistics were used, and all remaining analyses were carried out using parametric statistics.

ANOVAs were used to compare mean scores between three groups (followed by Tamhane or Tukey HSD post hoc tests), and Eta square values were determined as measures of effect size. A t-test was also used to compare two independent samples (for equal or for non-equal variances, depending on the results of the Levene's test), and

Cohen's *d* was used to measure the respective effect size. ROC analyses were conducted to explore the scale accuracy by obtaining the Area Under the Curve (AUC), specificity, and sensitivity values. Finally, normative scores were determined using percentiles.

## Results

### *Reliability*

Cronbach alpha coefficients were .73 in study 1 and .78 in studies 2 and 3. Corrected item-total correlations ranged from .32 to .57 (study 1), .40 to .60 (study 2), and .34 to .61 (study 3). There were drops in Cronbach alpha values when excluding each item, except for the item about early morning in samples 1 and 3, which do not change the alpha coefficients when excluded. Details are shown in Table 1.

With regard to the temporal stability, mean scores were M = 9.57, SD = 4.09, and M = 9.33, SD = 4.01 for the 1st and 2nd administrations. The absolute-agreement-type test-retest ICC analysis revealed a value of ICC=0.94 [95% CI: 0.89-0.97]; p <.001. The Pearson product-moment correlation coefficient between test and retest BaSIQS scores was .895 ($p < 0.0001$). At the item level, the Spearman Rho test-retest correlations were .788 (sleep latency), .646 (sleep onset difficulty), .797 (number of night awakenings), .702 (early morning awakenings), .705 (night/premature awakenings are a problem), .712 (sleep quality), and .668 (sleep depth). Similar results were found when separate test-retest analyses on each sex were performed, indicating a lack of the Simpson paradox.

### *Scale structure*

Two meaningful factors were found using principal axis factoring followed by direct oblimin rotation for factors showing eigenvalues greater than 1. Minimum primary factor loadings were.32 in sample 1, .43 in sample 2, and .45 in sample 3 (see Table 2, which also shows percentages of explained variance). In sample 2, one item

showed moderate secondary loadings: the item on whether night/early wakening constituted a problem (sample 1). The factorial solutions were very similar in the three samples, given the coincidence of the items loading primarily in factor 1 or in factor 2. Following the items' primary factor loadings, each factor was capable of a sensible interpretation: factor 1 represents *interrupted and light sleep*, whereas factor 2 grouped items pertain to *sleep onset difficulties*.

The inspection of the scree plots (Figure 1) suggests that a single-factor solution would also be appropriate. Therefore, we conducted a second set of analyses, and in all three samples, the one-factor solution was satisfactory, with minimum item loadings being .37 (sample 1), .48 (sample 2), and .39 (sample 3). Table 3 (right columns) shows item loadings and percentages of total variance explained.

***Validity***

The PSQI (sample 2) and one question on self-reported sleep problems (sample 3) were used as independent measures to test whether the BaSIQS assesses the concept of insomnia complaints and sleep quality. The correlation coefficient of r = .65 between the BaSIQS and the PSQI overall score was large (Cohen, 1992). Correlations between BaSIQS scores and each component of the PSQI were all statistically significant (Table 3). As expected given the facial content of the BaSIQS items, the highest correlation coefficients concerned the sleep quality and the sleep latency components of the PSQI. Moderate associations concerned the PSQI components of sleep disturbances and use of sleeping medication. The lowest associations concerned the PSQI components on daytime dysfunction (low to moderate), and especially sleep duration and sleep efficiency (low associations), the last of which was somewhat unexpected.

Then, the PSQI cut-off score of >5 was used to divide the sample into groups with good (n = 230) versus poor (n = 130) sleep quality, and then the BaSIQS

median/mean scores were compared to test whether this scale would be able to differentiate poor and good sleepers defined by an independent measure. The mean total BaSIQS scores were significantly higher in poor sleepers than in good sleepers by 4 points out of 28, $t$ = -9.45, d.f. 208.26, p<.0001, $d$ = 1.09 (t-test values for non-equal variances). This corresponds to a large effect size (Cohen, 1992). Significant differences in median/mean BaSIQS scores between groups were also found in the item-level comparisons (Table 4).

As for the ROC analysis, based on the PSQI cut-off point, the AUC was .78, which indicates moderate accuracy (Pintea & Moldovan, 2009; Swets, 1988) of the BaSIQS in differentiating poor and good sleep groups according to the PSQI. The "optimal threshold," where specificity and sensitivity are the most alike (e.g. Zou et al., 2007), corresponded to a cut-off of 9 or more points in the BaSIQS in order to distinguish good from poor sleepers defined by the PSQI. Using this cut-off point, the sensitivity was .69 (correct identification of 69% of true positives/poor sleepers), and the specificity was .77 (correct non-detection of 77% of true negatives/good sleepers).

Regarding the question asking whether or not the student considered that they had any sleep problems, we first found that those who reported a sleep problem (n = 514) obtained a significantly higher mean BaSIQS score than those who denied having any sleep problem (n = 2481): M = 13.62 (SD = 5.04) versus M = 9.13 (SD = 3.95), $t$ = 19.05, d.f. = 649.47, and p <.0001 (t-test values for non-equal variances), with $d$ = 0.99 indicating a large effect size (Cohen, 1992). Significant differences in BaSIQS scores between groups were also found in the item-level comparisons (p < .0001 in all comparisons). Secondly, mean scores in BaSIQS were compared between participants with self-reported insomnia, participants with other self-reported sleep problems, and participants without perceived sleep problems. As expected, ANOVA showed

statistically significant differences for each BaSIQS item as well as total BaSIQS score, with the group reporting no sleep problems presenting lower scores (Table 5).

Post hoc tests showed that for all items and total BaSIQS scores, significantly lower mean values were found in the group reporting no sleep problems than in the groups admitting to having a sleep problem. Furthermore, the group reporting insomnia showed significantly higher mean values than the group with other sleep problems either for the BaSIQS total score or for the items referring to sleep latency, sleep onset difficulties, sleep depth, and whether night/early morning awakenings were perceived as a problem. For the items concerning night/premature awakenings and perceived sleep quality, mean scores where similar in the two groups reporting sleep problems (irrespective of having insomnia or other sleep problem). Eta square values indicated large or near large effect sizes (Cohen, 1988; 1992) for sleep onset items and total BaSIQS score (the highest association concerned sleep-onset difficulties). The values showed a medium effect size for the sleep quality item and small associations in the remaining items, with the lowest magnitude associated with the item on early morning awakenings. All validity analyses presented in this section were also performed separately in men and women, to check for the Simpson paradox, and the results indicate no evidence for this effect.

***Normative scores***

Normative BaSIQS scores were determined using sample 3, because it was the most recently collected (2012/2013), and it involved the most participants, who were from a large number of public and private universities and polytechnic institutes in the country. There were statistically significant mean differences between men and women, with the latter presenting greater difficulties, $t = -6.733$, d.f. = 1899.29, $p < .0001$ (t-test values for non-equal variances). Therefore, norms were obtained separately for each sex

(Table 6). Given the broader age range in sample 3 and the possibility of age variations in BaSIQS scores, additional norms were also computed for subsamples after eliminating students older than 25 years old. However, results were very similar considering either all participants or younger students exclusively. Significant differences by age in sample 3 were found only for women, with BaSIQS scores being slightly higher in those aged 26 years or older (mean difference = 0.96, t = 3.450, d.f. = 543.84, p<.01 [t-test values for non-equal variances]).

Given the risk of self-selection bias in sample 3, normative scores were also computed for sample 1. Although sample 1 was restricted to one university studied in 2001/2012, it appears to be reasonably representative of the undergraduate population of that university, with the additional advantage of comprising diverse academic fields commonly found in many other universities worldwide. In general, visual comparison of each sex's percentile values between sample 1 and sample 3 indicates equal or higher scores in the latter, usually by 1 and sometimes 2 points. The corresponding mean differences between sample 1 and subsample 3 of comparable age ranges were 0.96 points in men and 0.73 points in women, which again were higher in sample 3.

Although defining a more liberal or conservative percentile to detect potential good or poor sleepers will depend on the goals of the researcher, a practical classification for research purposes based on percentile/quartile values would be as follows: BaSIQS score < P25: good/very good sleep quality; BaSIQS score from P25 to < P50: good to average sleep quality; BaSIQS score from P50 to <P75: average to poor sleep quality; and BaSIQS score > = P75: poor/very poor sleep quality.

**Discussion**

Based on successive samples totaling more than 5000 higher-education students, the present work was dedicated to inspecting the psychometric properties of a 7-item

scale about perceived sleep quality and nighttime insomnia manifestations called BaSIQS. Regarding reliability, Cronbach alpha values were systematically higher than .7, approaching .8 in the latter two samples. These values are indicative of the appropriate internal consistency of the BaSIQS, especially considering the small number of items and the scale's non-redundancy (in fact, increasing the number of items of a scale and its redundancy artificially inflates consistency coefficients, e.g. Almeida & Freire, 2007; Nunnally, 1978). Each item seems to adequately represent the construct measured by the whole scale, as indicated by coefficients higher than the minimum of .3 usually recommended for corrected item-total correlations (Kline, 1992). Furthermore, each item showed a contribution to the internal consistency of the scale, as revealed by drops in the Cronbach alpha values when each item was excluded, with the exception of the item about premature awakenings, which produced irrelevant changes in alpha coefficients upon exclusion. This is not surprising, considering that participants were mostly young adults, for whom insomnia symptoms typically manifest as sleep-onset problems, not exactly as early morning awakenings, which increase with ageing (e.g. Pallessen et al., 2014).

As for the temporal stability of BaSIQS, the absolute-agreement-type test-retest ICC analysis corresponded to a high value of within-subject agreement (Huck, 2012; McGrath, 2011), and a high test-retest correlation coefficient emerged for the total score, surpassing the recommended reference value of .80 (Kline, 1992). At the item score level, all test-retest correlation coefficients were at least .65, meaning that the magnitude of the associations may be considered large according to Cohen's (1992) criteria. However, as limitations, it should be recognized that both the sample size and the time span between administrations were narrow, meaning future test-retest analyses are needed and that the present results should be regarded as preliminary.

Regarding the BaSIQS factor structure, two main factors emerged corresponding to eigenvalues higher than 1, independently from the sample considered. Furthermore, a single-factor solution also proved to be adequate, with factor loadings systematically higher than .37. The two-factor structure seems to agree with diverse manifestations of insomnia and poor sleep quality symptoms: whereas some individuals suffer from trouble initially falling asleep, others may instead experience difficulties staying asleep, which is quite in accordance with the classic descriptive clinical characterizations of insomnia as initial, middle, and terminal (Perlis et al., 2005). Simultaneously, the feasibility of a single-factor solution is in accordance with a common construct underlying different presentations.

We may assume that the psychometric properties of the scale are consistent and robust across various forms of administration given the different modalities of the presentation of the BaSIQS (sample 1: items dispersed in a larger printed-paper questionnaire; sample 2: items presented together as a demarcated section in printed-paper format; sample 3: items dispersed in a larger online questionnaire). The replication of results in samples collected at distinct moments from different universities also supports the consistency.

With regard to validity, the generally large associations found between the BaSIQS, the PSQI relevant scores, and the self-reported sleep problems seem to support the BaSIQS as a valid measure of *self-reported* insomnia and poor sleep quality complaints. Taking into account magnitude criteria (Cohen, 1992), we may conclude that the BaSIQS and the PSQI global scores are highly associated, as are the BaSIQS score and the PSQI components of sleep latency and sleep quality. The remaining coefficients between the BaSIQS and the PSQI components were also significant but of moderate or small magnitude, as expected based on their facial content, except for the

low association of the BaSIQS and the PSQI component of habitual sleep efficiency. This was somewhat unexpected given that in one study, objective sleep efficiency was correlated to subjective sleep quality (Åkerstedt et al., 1994). This overall pattern of associations with the PSQI scores generally seems to support the validity of the BaSIQS as an adequate measure of specifically self-reported sleep onset/maintenance difficulties and perceived poor quality of sleep. Both the total score and each BaSIQS item score were able to differentiate between groups showing poor versus good sleep quality in the PSQI, which further favors the validity of the BaSIQS. In addition, the large magnitude of the effect (Cohen *d*) should again be stressed. In ROC analysis, the AUC value of .78 indicates moderate accuracy (Pintea & Moldovan, 2009; Swets, 1988) of the BaSIQS in differentiating good sleepers and poor sleepers defined by the PSQI.

With regard to the second validity measure, when comparing the BaSIQS total mean score between groups reporting the presence/absence of any sleep problem, significant differences of large magnitude emerged (Cohen, 1992). Then, statistically significant differences were again found upon comparing the BaSIQS scores between participants reporting specifically insomnia, other sleep problems, or no sleep problems. The effect sizes ranged from small to large, with the highest effects found for the BaSIQS sleep-onset difficulty item and total score.

Finally, mean scores, standard deviation, and percentile scores were presented. The accurate applicability of normative scores depends on sample representativeness. Therefore, each sample's advantages and limitations deserve careful consideration. Sample 3 is the largest and most recent one, and it was collected at a national level, but it was also vulnerable to self-selection bias due to the data collection methodology (students participating voluntarily from their personal computer might have more interest in sleep issues than non-respondents due to factors such as sleep problems).

However, the distribution of self-reported "insomnia" or "other sleep problems" in this sample are in line with reports from epidemiological studies on young adults (e.g. Buysse et al., 2008; Coren, 1994; Janson et al., 1995) or college students (Taylor et al., 2013: 9.5% met DSM-V criteria for primary insomnia), as well as population-based estimates (e.g. Roth, 2007; Roth et al., 2011).

Therefore, it seems plausible that the BaSIQS scores found in this sample fairly represent the reality of higher-education students. Nonetheless, as it is not possible to rule out the self-selection bias of sample 3 in absolute terms, normative scores were also computed for sample 1, which was less vulnerable to self-selection bias (response rate = 90%) and may be considered representative of full-time students of a variety of academic fields. On the other hand, the sample excluded working students and was collected more than a decade ago. Normative scores were in some cases slightly higher in sample 3 (usually by 1 and sometimes 2 points) than in sample 1, probably due to a variety of reasons in addition to self-selection. These reasons are related to the differences between samples 3 and 1 (national-level sampling versus one university; data collected in 2012/13 marked by economic austerity in our country versus in 2001/02, respectively). Taking these possible explanations together, it is not strange that scores in sample 3 surpass those in sample 1. In conclusion, the normative scores described for sample 3 are most likely accurate enough to be applicable to contemporary Portuguese higher-education students.

Normative scores in the form of percentiles will allow clinicians and researchers to interpret the total BaSIQS score obtained by a particular higher-education student. Since mean scores were higher in women than in men, separate norms for each sex were determined. The adoption of a more liberal or more conservative percentiles to detect potential good or poor sleepers will depend on the goals of the researcher. A practical

classification for research purposes based on percentile/quartile values is suggested to label four sleep quality levels: good/very good, good to average, average to poor, and poor/very poor. The classification seems to fit relatively well with the "optimal cutoff point" of 9 points in the BaSIQS score found in ROC analysis for distinguishing poor sleepers from good sleepers in the PSQI, as that cut-off corresponds exactly (in men) or very nearly (in women) to the $50^{th}$ percentile scores. More conservative percentiles may be suggestive to identify students with probable sleep disorders. For instance, if a student obtains a score in the 90th percentile, this should be a red flag for the necessity of further assessing the possible presence of any sleep disorder. However, the absence of research data for the moment contrasting clinical samples and controls suggests that high precaution is needed in making this kind of inference. Therefore, it seems precocious to define conservative cut-off points for now.

Lastly, it must be stressed that the BaSIQS should not be used to diagnose insomnia disorders. According to evidence-based guidelines from AASM, insomnia is primarily diagnosed by clinical evaluation considering a thorough sleep history and detailed medical, substance, and psychiatric history as a standard, which reflects a high degree of clinical certainty (e.g. Schutte-Rodin et al., 2008). We should also keep in mind that in addition to insomnia disorders (e.g. paradoxical insomnia or psychophysiological insomnia), some primary sleep disorders (e.g. restless legs syndrome, sleep-related breathing disorders, or circadian rhythm disorders) often present with insomnia symptoms, and that psychiatric disorders (e.g. depressive disorders) may be comorbid with insomnia or produce insomnia symptoms and poor sleep quality (e.g. Roth, 2007). The BaSIQS cannot discern the exact disorder that may be underlying a high score, nor whether or not a sleep disorder is present. Therefore, this scale should not be used for diagnostic purposes. A limitation of the analyses of the

present work is that we did not control for the presence of sleep, psychiatric, or other medical disorders in the samples studied, which might be responsible for a high BaSIQS score.

In conclusion, the BaSIQS is a short scale that is very easy to score and administer in higher education students, and it seems to possess reasonable reliability and validity regarding good and poor sleepers defined by the PSQI or in differentiating self-perceived insomniacs from non-insomniac students. Therefore, it may constitute a convenient tool to screen for insomnia symptoms and complaints of poor sleep in higher-education students, as well as in other populations in the future with minor adaptation (cf. appendix), both for research purposes and in clinical settings. Further reliability, validity, and normative data are now needed in other samples, such as non-students and older adults. Validity studies may also be continued in clinical samples of patients independently diagnosed in sleep clinics/centers. It should be noted that this scale should not be used for diagnostic purposes, but only to screen for complaints of insomnia or poor sleep quality, as well as to position individuals on the continuum ranging from good to poor quality of sleep. The BaSIQS may be useful in the future essentially for epidemiological research in community samples, especially in busy protocols, as it is brief and easy to administer.

Despite its strengths, the present study possesses some limitations in addition to those previously mentioned (e.g. small test-retest sample; an absence of clinical samples; possible self-response bias in some samples; and sleep, psychiatric, and other medical conditions were not controlled for). The participants comprised only students, so the current results or normative scores may not be applicable to other adult populations. The BaSIQS scale is not concerned with meeting diagnostic criteria, so it is of little use for diagnostic purposes. Validity analyses were limited to questionnaire

measures. Thus, further validity studies using objective measures and external informants would seem important.

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**Appendix**

BASIQS – BASIC SCALE ON INSOMNIA COMPLAINTS AND QUALITY OF SLEEP

Please consider the last month, keeping in mind what usually happens in a typical class* week.

(i.) After going to bed, you usually fall asleep within …

☐1-14 min; ☐15-30 min; ☐31-45 min; ☐46-60 min; ☐more than 60 min

(ii.) How often do you have trouble falling asleep?

☐never; ☐rarely; ☐sometimes; ☐3-4 nights a week; ☐almost every night/always

(iii.) How many times do you usually wake up during a night's sleep?

☐none; ☐once; ☐2-3 times per night; ☐4-5 times per night; ☐6 times or more

(iv.) How often do you wake up spontaneously much earlier than needed (i.e., much earlier than your planned waking time)?

☐never; ☐rarely; ☐sometimes; ☐3-4 nights a week; ☐almost every night/always

(v.) Are nocturnal or early morning awakenings a problem for you?

☐not at all; ☐a bit; ☐somewhat; ☐often; ☐very often

(vi.) Regardless of its duration, how would you describe your sleep?

a) sleep quality:

☐very poor; ☐poor; ☐fair; ☐good; ☐very good

b) sleep depth:

☐very light; ☐light; ☐fairly deep; ☐deep; ☐very deep

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* For administration in non-students, simply remove the word "class", keeping "in a typical week".