Title: European Portuguese adaptation of Glasgow Content of Thoughts Inventory (GCTI): Psychometric characterization in higher education students

Authors:

Daniel Ruivo Marques [1] (e-mail: drmarques@ua.pt)

- University of Aveiro, Department of Education, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

- Institute for Biomedical Imaging and Life Sciences, IBILI, Azinhaga de Santa Comba, 3000-548 Coimbra, Portugal

Mariana Soares Meia-Via[1] (e-mail: mariana.soares@live.ua.pt)

- University of Aveiro, Department of Education, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

Colin A. Espie (e-mail: colin.espie@ndcn.ox.ac.uk)

- Nuffield Department of Clinical Neurosciences / Sleep & Circadian Neuroscience Institute, University of Oxford

Carlos Fernandes da Silva (e-mail: csilva@ua.pt)

- University of Aveiro, Department of Education, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

- CINTESIS - Center for Health Technology and Services Research. Centro de Investigação Médica, Faculdade de Medicina do Porto. R. Dr. Plácido Costa, 4200-450 Porto, Portugal.

Ana Allen Gomes (e-mail: ana.allen@ua.pt)

- University of Aveiro, Department of Education, Campus Universitário de Santiago, 3810-193 Aveiro, Portugal

- CINTESIS - Center for Health Technology and Services Research. Centro de Investigação Médica, Faculdade de Medicina do Porto. R. Dr. Plácido Costa, 4200-450 Porto, Portugal.

[1] Both authors contributed equally to this work.

Author's address (Corresponding author):

Daniel Ruivo Marques
Department of Education of University of Aveiro
Campus Universitário de Santiago
3810-193 Aveiro, Portugal
Phone: +351 234 372 428
E-mail: drmarques@ua.pt

Abstract

Persistent cognitive activity is an important factor in disturbing sleep-onset both during bedtime and when attempting to get back to sleep after nocturnal awakenings. One of the most specific self-report measures designed to assess this feature is the Glasgow Content of Thoughts Inventory (GCTI). In this study, we investigated the preliminary psychometric properties of GCTI in a large sample of higher education European Portuguese students (N = 2995). Our results suggest that there is evidence of good internal consistency (α = .93) and validity indicators. Moreover, we found an interpretable factorial structure comprising five correlated factors that needs to be confirmed in future studies. The European Portuguese version of the GCTI appears to be a reliable and valid instrument for measurement of sleep-onset disturbing cognitions.

Keywords: Sleep; Insomnia; GCTI; Psychometric study; Validation

Introduction

Insomnia Disorder (ID) is one of the most prevalent sleep disorders.[1,2] According to the literature and clinical experience, this disorder is characterized by excessive levels of arousal, namely cognitive overactivity.[3,4] This cognitive arousal comprises self-referential thoughts related to ruminations and worries, which most of the time interferes with sleep-onset and sleep maintenance.[5] As this is a major point in insomnia, Harvey and Espie[6] developed a clinical instrument (Glasgow Content of Thoughts Inventory - GCTI) aimed to assess specifically the cognitive contents which tend to occur at bedtime. GCTI is a scale grounded on psychobiological inhibition model of insomnia.[7,8] In broad terms, the psychobiological inhibition model posits a difficulty in disengagement from wakefulness, which in turn leads to difficulties in sleep-onset or sleep re-engaging after night awakenings. Moreover, the increased cognitive activation (i.e., persistent dysfunctional thoughts about sleep difficulties and other life themes as well) will increase further the sleep-onset difficulty.[4]

The GCTI items were generated based on a careful registration of the most frequent thoughts that ID patients normally experience. After a systematic and careful analysis of these cognitive contents, the scholars developed the final version of GCTI.[9]

The instrument is constituted by 25 items comprising a 4-point scale (1 = ‘never’, 2 = ‘sometimes’, 3 = ‘often’, 4 = ‘always’). Scores may range from 25 to 100. Higher scores are associated with higher sleep-onset interfering cognitive activity.

In the original study, it was found a satisfactory internal consistency index (Cronbach α = .87). The scale discriminated the insomnia patients group from the “good sleepers” group. It was observed appropriate construct and convergent validity indicators and good specificity and sensitivity indices as well.[6]

There are some data regarding structure of GCTI; however, the specific methods used to obtain them are not explicitly mentioned. There is an indication of a principal component

analysis performed in GCTI in a textbook by Morin and Espie.[5] That analysis identified 3 subscales: c*ognitive intrusions relating to active problem-solving* (items 1, 3, 8, 12, 14, 15, 19, 21 and 23); *cognitive intrusions relating to sleep and wakefulness* (items 5, 6, 7, 9, 11, 18, 22, 24, and 25); and *cognitive intrusions relating to somatic and sensory engagement* (items 2, 4, 10, 13, 16, 17, and 20). In a study about the "quarter-of-hour rule" intervention efficacy, Malaffo[10] used the GCTI and found the same three factors reported in Morin and Espie.[5] The composition of the factors was identical.

Another study used the GCTI to differentiate individuals with both sleep-onset and sleep maintenance disturbance from individuals having only one of the complaints.[11] The authors considered four factors based on conceptual analysis given the lack of psychometric studies concerning GCTI: *general worries* (1, 3, 6, 10, 12, 14, 19, 21 and 23); *anxiety about anxiety* (4, 5, 7, 8, 15 and 22); *sleep anxiety* (2, 9, 11, 18, 20, 24, and 25); and *thoughts about the environment* (13, 16 and 17). Espie et al.[12] used some selected items from GCTI as an outcome measure in a randomized clinical trial intended to study the efficacy of an online version of cognitive-behavior therapy for insomnia. Some authors posit that GCTI is an important clinical questionnaire to assess key aspects of insomnia theoretical models such as Harvey´s cognitive model[13] with important benefits for assessment and treatment planning.

Beyond psychometric studies, the GCTI has been also used in other researches: comparison of bipolar patients in remission, insomnia patients and healthy-control individuals, discriminating insomnia patients from the other groups[14] or as source of experimental stimuli.[15]

Given the potential utility of the GCTI, we considered of great relevance to develop a Portuguese version of this tool and to examine its psychometric properties. To obtain data for this first psychometric characterization, we decided to consider the relatively accessible population of higher education students which is prone to present sleep disturbances, in

particular insomnia. In fact, in this group, insomnia problems are the most prevalent sleep complaints, particularly concerning sleep-onset.[16-18] At the same time, we were interested in testing the psychometric behavior of the GCTI considering a sample recruited from the general population, instead of a clinical one. It is worth mentioning that insomnia may also be conceptualized from a dimensional perspective allowing differentiating various degrees of insomnia (beyond the categorical / diagnostic perspective: "to have or have not insomnia"). Thus, even in cases of insomnia symptoms (not specifically the disorder), the GCTI might constitute an important tool in identifying problems and in treatment planning.

Therefore, in this study, our goal is to present the initial psychometric properties of GCTI, including internal consistency, convergent and criterion validity, and factorial structure in a large sample of European Portuguese higher education students.

Methods

Participants

In this study participated 2995 higher education students from a variety of public and private universities and polytechnic institutes from all over the country, with a mean age of 24 yrs (23.9 ± 6.59); min=17 max=62. The majority of participants were female (69.7%), attended graduation degree courses (70.7%), and were mostly "full time" students (77.1%). Our inclusion criteria were: (1) being ≥ 17 years, (2) attending a course in higher education, and (3) voluntary participation in the study. Our sample was recruited via email announcements directed to public universities and private universities/institutes of the country, and also polytechnic institutes. In a less systematic way, there were enrolled participants through social networks.

Measures

- *"Sleep–Wake Questionnaire for University Students [SWQUS] – ''during-the-semester'' version" (selected questions adapted from Gomes et al., 2011).* This is a questionnaire intended to assess sleep-wake behaviors in higher education students.[19] For the purposes of this paper, we will report only the data obtained with a self-report question about the presence or absence of sleep problems (yes/no response). In case of positive response, it was requested that participants briefly describe their major sleep difficulties. These data were later used to create subgroups.

- *Glasgow Sleep Effort Scale – European Portuguese version (GSES; Marques, Gomes, Meia-Via, & Couto, 2012)* - Instrument resulting from the translation and linguistic adaptation of Glasgow Sleep Effort Scale, which was built in order to evaluate the effort of people to sleep. Higher score is indicative of more sleep effort. Cronbach alpha in this sample was .79.[20]

- *Glasgow Content of Thoughts Inventory – European Portuguese version (GCTI; Marques, Gomes, Meia-Via, & Couto, 2012).* It is an instrument concerned in evaluating individuals´ thoughts when they cannot fall asleep. It consists of 25 items. Total scores may range from 25 to 100. The higher the score the greater the intrusiveness and frequency of dysfunctional thoughts at bedtime.[6] For more details see Introduction.

Procedure

The study of adaptation and validation of GCTI for European Portuguese Language was included in a wider research project involving adaptation of other self-report sleep scales. The process of translation and adaptation of the GCTI followed the recommendations by Hambleton[21] and ISPOR guidelines.[22] Firstly we ask permission to the author responsible for the original version of GCTI to adapt it to European Portuguese Language. Then, we translate the scale in order to adjust the items to Portuguese cultural context. This step was performed with the contribution of two experts in sleep, insomnia and biological rhythms. We performed a small sample pilot study encompassing individuals from both sexes with different ages, and levels of education. Our aim was to prepare a version suitable to administer to a variety of samples beyond higher education students. After this process is concluded, we carried out the back translation of the scale and sent all the materials (i.e., European Portuguese version, Back translation in English Language and a detailed document describing all the steps carried out and some additional questions) to the original author. We made some adjustments according to suggestions of this author and began data collection. All the data were obtained online through a GoogleDocs platform where participants could complete the questionnaires. Before start to fill in the questionnaires, participants had to read and accept an online informed consent. The questionnaires were available from November 2012 to January 2013. We tested the correct functioning of the electronic version of the questionnaires for one day, and then, we begin data collection. Our study was disseminated across the majority of higher education institutions in Portugal (public and private ones). The higher education institutions which approved the study were encouraged to disseminate the link containing the questionnaires to their students.

Statistical analysis

We calculated descriptive statistics such as means and standard deviations. To check the normality of variables´ distribution we analyzed the skewness and kurtosis indicators ($\left|2\right|$) as the normality tests such as Kolmogorov-Smirnov are not quite informative when there is a large sample size. Moreover, according to the central limit theorem, parametrical statistics can be performed without special concerns when the $N > 30$;[23] For inferential statistical analysis, we computed Pearson product-moment correlations and univariate between-subjects ANOVAs. Eta squared (η^2) was considered as the magnitude effect measure. In order to study internal consistency of the scales we calculated Cronbach's alphas, corrected item-total correlations, alpha coefficients excluding item, and inter-item correlations. To study GCTI factorial composition, we performed an exploratory factor analysis (Principal Axis Factoring) recurring to oblique rotation. This option was based in the fact that there is scarce literature regarding GCTI factorial structure; besides, it was assumed that the items could be explained by latent factors which could be correlated.[24] All the calculations were carried out with support of IBM SPSS (Statistical Package for the Social Sciences) Statistics v.22 software.

Results

Reliability

For reliability purposes we computed the Cronbach´s alpha coefficient. It was obtained an overall value of .93. According to George & Mallery[25] this is an excellent indicator of internal consistency. It was found that the exclusion of any item did not increase the level of internal consistency obtained, as can be observed in Table 1. The minimum corrected item-total correlation achieved was .43 (item 16) and the mean item-total correlation was .33. This

was a good indicator that the items comprising the GCTI were somehow correlated and not redundant. All the items showed relevance to the scale. All items of GCTI were significantly and positively correlated, with coefficients magnitudes indicating small to large associations (*r* range= .15 -.74), according to criteria by Dancey and Reidy[26]. It is worth mentioning that only one correlation was considered large (*r* between item 11: *"thoughts on ways of falling asleep"* and item 25: *"thoughts on things I can do to help me sleep"*).

INSERT TABLE 1 HERE

Validity

Convergent validity

To check for convergent validity, we carried out a Pearson product-moment correlation coefficient between GCTI total score and GSES total score. The obtained result is indicative of a satisfactory convergent validity, $r = .56$; $R^2 = 31\%$, $p < .001$.[24]

Criterion validity

We formed 3 groups (i.e., "no sleep problems"; "insomnia symptoms"; and "other sleep problems") based on the answer to the question "Do you think you have a sleep problem?" which figured in SWQUS. 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). The GCTI Cronbach´s alphas for the groups were .92, .93, and.88, respectively. We computed a unifactorial ANOVA to investigate whether GCTI was able to differentiate the means subgroups [$F_{(2, 2992)} = 116.362$;

p<.001]. We found that “insomnia” group had higher mean scores than “other sleep problems” group and “no sleeping problems” group (cf. Figure 1).

INSERT FIGURE 1 HERE

Additionally, “other sleep problems” group had statistically significant higher mean scores than “no sleeping problems” group. The differences observed in the groups were moderate in magnitude (η^2= .07) according Cohen´s criteria.[27] Moreover, we compared the scores of the three groups for all items independently. Differences were found pertaining to all the items (p < .001). More specifically, we observed that in some of the items (i.e., 5, 8, 9, 11, 12, 15, 18, 22, 23, 24 and 25) “insomnia” group scored higher than the other groups, whereas in other items (i.e., 1, 2, 3, 4, 6, 13, 17, 19, 20 and 21) “insomnia group” and “other sleep problems group” showed no differences between themselves (cf. Table 2).

INSERT TABLE 2 HERE

Structure of GCTI

In order to study the factorial composition of GCTI we performed an exploratory factor analysis (EFA). It were considered components with eigenvalues greater than 1 (Kaiser´s criterion), and Cattell´s Scree plots. The analysis was performed recurring to the method of Principal Axis Factoring followed by Direct Oblimin rotation. We found appropriate conditions for the implementation of factor analysis, namely: inter-item correlation coefficients close to or above .3; KMO value (Kaiser-Meyer-Olkin measure of sampling adequacy) = .95, exceeding the recommended minimum value of .6; significant Bartlett's test of sphericity, and χ^2 (300) = 31003.3.[26] Five correlated factors were found accounting for 48% of total variance (cf. Table 3). Based on the factors´ labels proposed by Suh et al. (2012), we named our factors in the following way: F1=“*Sleep-related anxiety*” (comprising

items related to anxiety about sleep topics); F2="*Reflection and planning*" (comprising items related to concerns on the future or in reviewing the day); F3="*General worries*" (items focused on general and personal worries); F4="*Thoughts about the environment*" (items focused on sources that might disturb sleep-onset); F5="*Negative affect*"(items dedicated to negative affect that are related to physiological sensations). One should note that item 6, 7 and 10 of GCTI were not included in any of the factors.

We tested other possible factorial solutions (3 and 4 factors). However, the 5-factor model seems to be an appropriate one, approaching empirical findings and theoretical background. Notwithstanding, the extraction method based on Scree Plot did not enable a simple or clear-cut decision (cf. Figure 2).

INSERT FIGURE 2 HERE

Discussion

It was our aim in this paper to evaluate the suitability of the GCTI for use in Portuguese language format. Our results indicate that the European Portuguese version of GCTI has sound psychometric properties.

In terms of reliability, we observed excellent internal consistency (α = .93), and found strong evidence also of convergent validity. In relation to the latter, we correlated the GCTI with another sleep scale focused on insomnia (GSES). The resultant association was moderate (r = .56) in magnitude, which is according to our expectations given the conceptual underpinnings of both scales.[26]

Our self-reported "insomnia group" had higher cognitive intrusive thoughts than the other groups. However, when all the items were analyzed independently, it was found that in general, there were no significant differences between the two sleep problems groups (i.e.,

"insomnia" and "non-insomnia"). However, both groups differ from the "no sleeping problems" group. These results are easily understood since dysfunctional cognitive activity, even if a major feature of insomnia, is not entirely specific to it. Other sleep problems groups (e.g., those suffering from nightmares, sleepwalking, sleep problems caused by anxiety or depression) might show a similar pattern of cognitive activity, even if is not so focused on sleep preoccupation per se, as occurs in insomnia. We suggest that the cognitive construct of 'sleep effort' may be a more discriminative feature of insomnia patients.[20,28]

Regarding the structure of the GCTI, we suggest a 5-factor composition. These five factors were labeled as sleep-related anxiety, reflection and planning, general worries, thoughts about the environment and negative affect, respectively. Some items of the original GCTI did not contribute to our factor solution. For example item 10:*"thoughts on my health"* is not included in any of the factors. We think that this might be occurred because the specificity of our sample, mostly composed of young adults. Is seems plausible that the major intrusive cognitive activity might be related with other aspects rather than health. In other samples (e.g., elderly), it is possible that this item might be included in one of the proposed factors. Besides, item 6: *"thoughts on checking the time"* and item 7: *"thoughts on non-important things"* were not included in the factorial structure as well. The exclusion of item 6 from the factorial structure of GCTI might be due to the fact that participants comprising our sample are predominantly non-insomniacs. It is well know that checking the clock and monitoring the hours spent awake is a feature of insomnia patients[29] - perhaps recurring to a well-established clinical sample this item was introduced in one of the factors. For item 7 we do not find an appropriate justification. Even so, it is important to confirm this finding in other studies comprising higher education students. Additionally, it is essential to conduct confirmatory factor analysis in other higher education students to test different factorial solutions since other factorial structures seem feasible (1, 2, 3, 4 and 5 factor-models).

Despite these encouraging results, we must outline some important limitations: Test-retest temporal stability was not studied; the creation of the subgroups was made artificially based on qualitative classification of the participants self-report (thus, not based in a clinical diagnosis); and the data were collected through the internet which may have motivated the people more interested in sleep and insomnia issues to fill in the questionnaires. Nevertheless, if we consider the three groups we created, the proportion of our sample with possible insomnia (7 %) corresponds approximately to the prevalence of insomnia complaints found in higher education.[30] Furthermore, there is evidence showing that collecting online data is a suitable methodology in scientific research.[31]

Conclusion

In summary, the GCTI appears to be a valuable instrument to use in clinical and research settings, including in non-clinical samples. It is a clinical instrument easy to use and it takes approximately five minutes to complete. However, more studies with the Portuguese version are now needed, particularly in clinical samples using stringent diagnosis criteria.

Note: The present paper was based on the research developed for the Master Degree dissertation of Dr. Mariana Meia-Via in psychology (U. Aveiro), with the supervision of the last author and the assistance of the corresponding author.

References

[1] American Psychiatric Association. *Diagnostic and statistical manual of mental disorders*. 5th ed. Washington, DC: American Psychiatric Association; 2013.

[2] AASM. *International Classification of sleep disorders: Diagnostic and coding manual*. 3rd ed. Westchester: American Academy of Sleep Medicine; 2014.

[3] Harvey A. (2005). Unwanted intrusive thoughts in insomnia. In Clark, D (ed.) *Intrusive thoughts in clinical disorders: Theory, research, and treatment*. The Guilford Press, New York, 86-118.

[4] Perlis M, Shaw PJ, Cano G, Espie CA. (2011). Models of insomnia. In Kryger, MH, Roth, T, Dement W (eds.), *Principles and practice of sleep medicine* (5th ed). Elsevier Saunders, Missouri, 850-865.

[5] Morin C, Espie C. *Insomnia: A clinical guide to assessment and treatment*. New York: Kluwer Academic/Plenum Publications; 2003.

[6] Harvey KJ, Espie CA. Development and preliminary validation of the Glasgow Content of Thoughts Inventory (GCTI): A new measure for the assessment of pre-sleep cognitive activity. *Br J Clin Psychol*. 2004;43:409-420.

[7] Espie C. Insomnia: Conceptual issues in the development, persistence, and treatment of sleep disorder in adults. *Annu Rev Psychol*. 2002;53:215-243.

[8] Espie CA, Broomfield NM, MacMahon KM, Macphee LM, Taylor LM. The attention-intention-effort pathway in the development of psychophysiologic insomnia: A theoretical review. *Sleep Med Rev*. 2006;10:215-245.

[9] Wicklow, A., & Espie, C. A. (2000). Intrusive thoughts and their relationship to actigraphic measurement of sleep: Towards a cognitive model of insomnia. *Behav Res Ther*. 2000;38:679-693.

[10] Malaffo M. *The quarter of an hour rule: A simplified cognitive-behavioural intervention for insomnia improves sleep*. Doctoral dissertion, University of Glasgow; 2006.

[11] Suh S, Ong JC, Steidtmann D, Nowakowski S, Dowdle C, Willett E, et al. Cognitions and insomnia subgroups. *Cognitive Ther Res*. 2012:36:120-128.

[12] Espie C, Kyle S, Miller C, Ong J, Hames P, Fleming L. Attribution, cognition and psychopathology in persistent insomnia disorder: Outcome and mediation analysis from a randomized placebo-controlled trial of online cognitive behavioural therapy. *Sleep Med*. 2014;15:913-917.

[13] Hiller R, Johnston A, Dohnt H, Lovato N, Gradisar M. Assessing cognitive processes related to insomnia: A review and measurement guide for Harvey´s cognitive model for the maintenance of insomnia. *Sleep Med Rev*. 2015;23:46-53.

[14] St-Amand J, Provencher MD, Bélanger L, Morin CM. Sleep disturbances in bipolar disorder during remission. *J Affect Disord*. 2012;146:112-119.

[15] Baglioni C, Lombardo C, Bux E, Hansen S, Salveta C, Bielli S, et al. Psychophysiological reactivity to sleep-related emotional stimuli in primary insomnia. *Behav Res Ther*. 2010;48:467-475.

[16] Gellis LA, Park A. Nighttime thought control strategies and insomnia severity. *Cognitive Ther Res*. 2013;37:383-389.

[17] Kloss J, Nash C, Horsey S, Taylor D. The delivery of behavioral sleep medicine to college students. *J Adolescent Health*. 2011;48:553-561.

[18] Taylor D, Zimmerman M, Gardner C, Williams J, Grieser E, Tatum J, et al. A pilot randomized controlled trial of the effects of cognitive-behavioral therapy for insomnia on sleep and daytime functioning in college students. *Behav Ther.* 2014;45:376-89.

[19] Gomes AA, Tavares J, Azevedo MH. Sleep and academic performance in undergraduates: A multi-measure, multi-predictor approach. *Chronobiol Int*. 2011;28:786–801.

[20] Meia-Via M, Marques D, Espie C, Silva C, Gomes A. *Psychometric properties of Glasgow Sleep Effort Scale in Portuguese language*. *Psychol Assess*. 2015;Epub ahead of print.

[21] Hambleton RK. (2005). Issues, designs, and technical guidelines for adapting tests into multiple languages and cultures. In Hambleton RK, Merenda P, & Spielberger C (eds.) *Adapting educational and psychological tests for crosscultural assessment*. Lawrence Erlbaum, NJ Mahwah, 3-38.

[22] Wild D, Grove A, Martin M, Eremenco S, McElroy S, Verjee-Lorrenz A, Erikson P. Principles of good practice for the translation and cultural adaptation process for patient-reported outcomes (PRO) measures: Report of the ISPOR task force for translation and cultural adaptation. *Value Health*. 2005;8:94-104.

[23] Tabachnick BG, Fidell LS. *Using Multivariate Statistics* (6th ed.). Boston, MA: Pearson; 2013.

[24] Field A. *Discovering Statistics using IBM SPSS Statistics* (4th ed.). London: Sage Publications; 2013.

[25] George D, Mallery P. *SPSS for Windows step by step: A simple guide and reference, 11.0 update* (4th ed.). Boston: Allyn & Bacon; 2003.

[26] Dancey C, Reidy J. *Statistics without maths for psychology* (5th ed.). Essex: Pearson Education Limited; 2011.

[27] Sink C, Mvududu N. Statistical power, sampling, and effect sizes: Three keys to research relevancy. *CORE*. 2010;1:1-18.

[28] Broomfield NM, Espie CA. Towards a valid, reliable measure of sleep effort. *J Sleep Res*. 2005; 14:401-407.

[29] Tang N, Schmidt A, Harvey A. Sleeping with the enemy: Clock monitoring in the maintenance of insomnia. *J Behav Ther Exp Psychiatry*. 2007;38:40-55.

[30] Taylor D, Bramoweth A, Grieser E, Tatum J, Roane B. Epidemiology of insomnia in college students: Relationship with mental health, quality of life, and substance use difficulties. *Behav Ther*. 2013;44:339-348.

[31] Gosling DS, Vazire S, Srivastava S, John PO. Should we trust web-based studies? A comparative analysis of 6 preconceptions about internet questionnaires. *Am Psychol*. 2004;59:93-104.

Table 1. Corrected item-total correlations and Cronbach´s alpha if item is excluded

	Alpha if item deleted	Corrected item-total correlation
1. Things about the future	.924	.484
2. How tired / sleepy I am feeling	.923	.518
3. What happened during the day	.923	.530
4. How nervous / anxious I am feeling	.923	.540
5. How awake I am feeling	.923	.555
6. Checking the time	.923	.510
7. Non-important things	.924	.473
8. How I cannot shut off my mind	.921	.637
9. How long I have been awake	.922	.583
10. My health	.924	.498
11. Ways of falling asleep	.922	.591
12. Things I have to do tomorrow	.922	.566
13. How hot / cold I am	.924	.462
14. My work / responsibilities	.923	.560
15. How frustrated / upset I am feeling	.922	.606
16. How bright / dark my room is	.924	.429
17. Noise that I'm hearing	.924	.490
18. To be awake all night	.922	.572
19. Images that I cannot get out of my mind	.922	.618
20. The consequences of not sleeping well	.922	.615
21. My personal life	.922	.591
22. How thinking too much is the problem	.921	.635
23. Things from my past	.922	.572
24. How bad my sleeping is	.922	.602
25. Things I can do to help me sleep	.922	.598

Table 2. Mean differences among groups

	[1] "No sleep problems" group (n = 2547)	[2] "Insomnia symptoms" group (n = 210)	[3] "Other sleep problems" group (n = 238)	test	post hoc testing
	M (SD)	M (SD)	M (SD)	F / Welch	Tukey HSD / Games-Howell
1. Things about the future	2.62 (.82)	2.96 (.75)	2.83 (.80)	25.336**	1<3=2
2. How tired / sleepy I am feeling	1.74 (.71)	2.10 (.82)	2.06 (.83)	42.815**	1<3=2
3. What happened during the day	2.45 (.76)	2.62 (.78)	2.64 (.76)	10.775**	1<3=2
4. How nervous / anxious I am feeling	1.97 (.81)	2.37 (.91)	2.31 (.88)	32.710**	1<3=2
5. How awake I am feeling	1.73 (.74)	2.22 (.88)	2.00 (.82)	39.750**	1<3<2
6. Checking the time	2.04 (.88)	2.31 (.85)	2.18 (.85)	11.540**	1<3=2
7. Non-important things	2.06 (.81)	2.39 (.89)	2.17 (.87)	15.021**	1=3<2
8. How I cannot shut off my mind	2.23 (.94)	3.09 (.88)	2.70 (.96)	110.112**	1<3<2
9. How long I have been awake	1.82 (.84)	2.43 (.94)	2.08 (.92)	47.674**	1<3<2
10. My health	1.76 (.79)	1.97 (.90)	2.10 (.91)	23.625**	1<3=2
11. Ways of falling asleep	1.69 (.83)	2.41 (.93)	1.94 (.90)	64.918**	1<3<2
12. Things I have to do tomorrow	2.68 (.84)	3.01 (.78)	2.87 (.83)	20.334**	1<3<2
13. How hot / cold I am	1.89 (.80)	2.11 (.83)	2.09 (.86)	12.383**	1<3=2
14. My work / responsibilities	2.68 (.87)	2.89 (.82)	2.94 (.81)	16.265**	1<2<3
15. How frustrated / upset I am feeling	1.85 (.82)	2.38 (.90)	2.29 (.95)	54.145**	1<3<2
16. How bright / dark my room is	1.32 (.62)	1.53 (.81)	1.40 (.70)	8.235**	1=3<2
17. Noise that I'm hearing	1.66 (.76)	1.90 (.85)	1.82 (.87)	13.012**	1<3=2
18. To be awake all night	1.41 (.67)	2.12 (.93)	1.71 (.91)	68.976**	1<3<2
19. Images that I cannot get out of my mind	1.93 (.86)	2.42 (.96)	2.25 (.87)	36.745**	1<3=2
20. The consequences of not sleeping well	1.67 (.82)	2.29 (.92)	2.13 (.95)	67.210**	1<3=2
21. My personal life	2.67 (.89)	3.01 (.81)	2.88 (.87)	21.901**	1<3=2
22. How thinking too much is the problem	2.09 (1.00)	2.83 (1.02)	2.47 (1.04)	62.145**	1<3<2
23. Things from my past	2.06 (.87)	2.54 (.96)	2.29 (.88)	29.348**	1<3<2
24. How bad my sleeping is	1.34 (.62)	2.25 (.91)	1.90 (.93)	134.362**	1<3<2
25. Things I can do to help me sleep	1.62 (.79)	2.29 (.93)	1.98 (.91)	64.971**	1<3<2
Factor I	13.50 (4.47)	19.10 (4.99)	16.44 (5.25)	150.663**	1<3<2
Factor II	10.43 (2.59)	11.48 (2.31)	11.28 (2.52)	29.402**	1<3=2
Factor III	8.75 (2.85)	10.80 (2.91)	9.88 (2.92)	62.579**	1<3<2
Factor IV	4.87 (1.67)	5.55 (1.81)	5.31(1.89)	18.572**	1<3=2
Factor V	5.56 (1.82)	6.86 (2.00)	6.66 (2.17)	65.931**	1<3=2
GCTI total	48.9 (12.0)	60.4 (11.5)	56.02 (13.3)	116.362**	1<3<2

** $p < .001$

Note. In items 1, 4, 5, 7, 8, 9, 11, 12, 14, 15, 16, 18, 19, 20, 21, 22, 23, 24 and 25 and in Factors I, II, IV and V, it was computed an asymptotically F test (Welch test), as the homogeneity of variances was not assumed. Consequently, in post hoc comparisons, we calculated the Games-Howell test. For the remaining items/factors it was computed ANOVA F´s and Tukey HSD tests. Factor I=Sleep-related anxiety; Factor II=Reflection and planning; Factor III=General worries; Factor IV=Thoughts about the environment; Factor V=Negative affect.

Table 3. GCTI factorial structure - Rotated pattern matrix

	Factors				
	I	**II**	**III**	**IV**	**V**
11. Ways of falling asleep	**.852**				
25. Things I can do to help me sleep	**.785**				
9. How long I have been awake	**.607**				
8. How I cannot shut off my mind	**.385**		(-.351)		
20. The consequences of not sleeping well	**.380**				(-.315)
24. How bad my sleeping is	**.364**				(-.356)
18. To be awake all night	**.343**				
5. How awake I am feeling	**.302**				
12. Things I have to do tomorrow		**.730**			
14. My work / responsibilities		**.691**			
3. What happened during the day		**.504**			
1. Things about the future		**.463**			
6. Checking the time					
23. Things from my past			**-.617**		
21. My personal life		(.369)	**-.534**		
22. How thinking too much is the problem			**-.506**		
19. Images that I cannot get out of my mind			**-.492**		
7. Non-important things					
16. How bright / dark my room is				**.643**	
17. Noise that I'm hearing				**.635**	
13. How hot / cold I am				**.365**	
10. My health					
4. How nervous / anxious I am feeling					**-.619**
15. How frustrated / upset I am feeling					**-.476**
2. How tired / sleepy I am feeling					**-.434**
Eigenvalues	9.030	1.960	1.208	1.178	1.065
Cronbach α	.87	.80	.79	.62	.69
Explained variance (%)	34.08	5.99	2.73	2.62	2.23
Total explained variance (%)			47.67		

Extraction method: Principal Axis Factoring. Rotation method: Direct Oblimin, for factors with eigenvalues greater than 1. Only factor loadings > .30 are shown. Secondary loadings under parenthesis.

Note. Factor I=Sleep-related anxiety; Factor II=Reflection and planning; Factor III=General worries; Factor IV=Thoughts about the environment; Factor V=Negative affect.

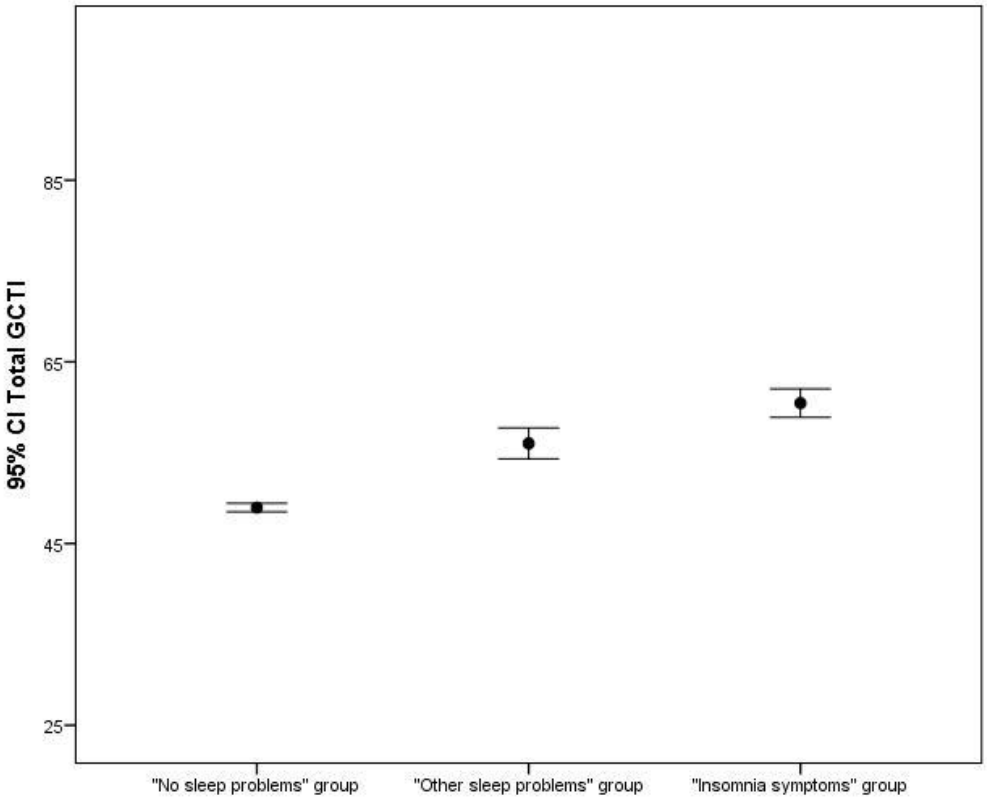

Figure 1. Error bar chart displaying differences among the subgroups regarding GCTI total score. *Note.* GCTI = Glasgow Content of Thought Inventory

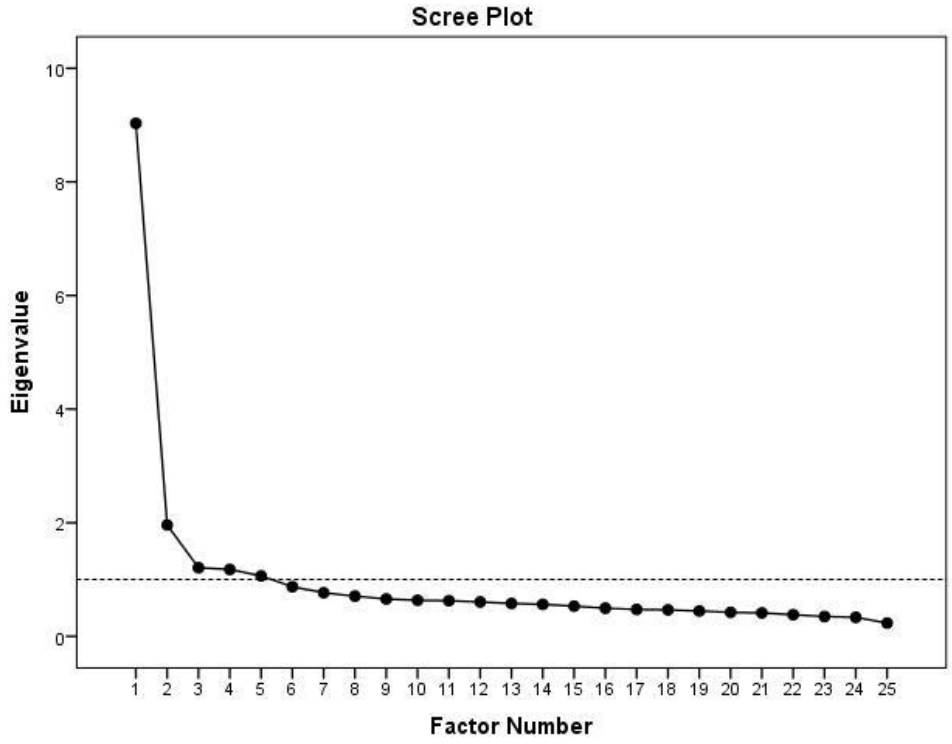

Figure 2. Scree plot for GCTI