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A VALIDATION OF THE CLEVELAND ADOLESCENT SLEEPINESS QUESTIONNAIRE

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This work presents the results of the validation of the Cleveland Adolescent Sleepiness Questionnaire (CASQ), in a cross-sectional sample of Portuguese adolescents. The psychometric properties of the Portuguese version of the CASQ, a multidimensional self-report questionnaire that assesses daytime sleepiness versus day and nighttime alertness, were studied through exploratory (EFA) and confirmatory factor analyses (CFA), in adolescents from 11 to 17 years old (EFA sample: $N = 732$; CFA sample: $N = 726$). Results of the EFA indicate an exploratory factor solution of three factors which explain 53.26% of variance, with good reliability indices in factors (alpha between .83 and .68). Also, the CFA indicated that the three-factor solution proposed in EFA had better fit indices compared with two alternative models ($\chi^2/df = 4.79$; GFI = .93; CFI = .92; RMSEA = .72; ECVI =.662; RMR = .041). The obtained results support acceptable levels of validity and reliability of the Portuguese version of CASQ.

Key words: Sleep deprivation; CASQ; Daytime sleepiness; Day and nighttime alertness; Exploratory and confirmatory factor analysis.

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In modern societies, voluntary sleep deprivation constitutes one of the most dangerous sleep habits, with significant consequences on health, safety, and social behavior (Wolfson & Carskadon, 2003). Also, it is common for sleep quality to be compromised, particularly when sleep disturbances are not treated (Paiva & Penzel, 2011), or when wake activities invade and disrupt sleep with their stimulation. Both of these situations contribute to the development of several sleep problems, such as an increased daytime sleepiness and a reduced functioning in the general population, and especially among adolescents and young adults (Fallone, Owens, & Deane, 2002; Johnson, Roth, Schultz, & Breslau, 2006).

Compared with the beginning of the 20th century, nowadays adolescents sleep on average 1h 30 less (Wolfson, 2007). This situation may be due to high pressure regarding sleep duration, since academic work, social networking, and nightlife are usually competing in this period with adequate sleep duration and promote high levels of daytime sleepiness (Dahl, 1999; Van den Bulck, 2007; Wahlstrom, 2002). During puberty, there are also biological changes in sleep regulation that justify a tendency to a delayed chronotype (Dahl, 1999; Paiva & Rebelo-Pinto, 2014) and even a higher daytime sleepiness with no change in nocturnal sleep (Carskadon, 1990). These variations, combined with lack of parental supervision, early school schedules, and more access to technology at night, frequently increase sleepiness during the day, representing serious difficulties in academic success and all activities during daytime (Halik, Aftar, Xuan, & Jarimal, 2011). Also, when daytime sleepiness is not addressed in adolescents, it could increase the risk of accidents, mood and behavior problems, addictive behaviors, and disorders of the sleep-wake cycle (Carskadon, 1990).

Daytime sleepiness may be associated with an effort to resist sleep, which means the propensity to fall asleep during daytime. It has been recognized as an important sign of insufficient sleep or bad sleep quality (Paiva & Penzel, 2011; Pelayo, 2014). Furthermore, it represents an important symptom of some sleep disturbances, while affecting the ability to perform in wake activities, including learning (BaHammam, Alaseem, Alzakri, Almeneessier, & Sharif, 2012) and socializing (Roeser, Schlarb, & Kubler, 2013). Therefore, daytime sleepiness should be addressed as a main issue in sleep education and prevention (Owens, 2014). The past 20 years have been fruitful in the development of sleep measures (Lewandowski, Toliver-Sokol, & Palermo, 2011), but in general, most medical and psychological questionnaires, including those related to daytime sleepiness, are concerned with adults and not validated for the Portuguese population.

Cleveland Adolescent Sleepiness Questionnaire (CASQ)

Cleveland Adolescent Sleepiness Questionnaire (CASQ) is a questionnaire originally developed by Spilsbury, Drotar, Rosen, and Redline (2007). It is a brief, multidimensional, self-report, and pencil-and-paper measure which assesses the daytime sleepiness versus day and nighttime alertness, in adolescents from 11 to 17 years old. It was developed in a study with a normative sample of American adolescents (N = 411). Initially, the authors generated 46 items, based on previous theoretical and empirical studies, but also taking into account other instruments. From these, six items were eliminated after analysis by a group of four sleep specialists. Subsequently, remaining 40 items were submitted to children and adolescents, and based on their recommendations, a reduction was made to 35 items. An exploratory factor analysis (EFA), using a principal axis extraction and varimax rotation, was conducted to identify the underlying factor structure of the CASQ. EFA revealed a final solution consisting of 16 items, organized in four factors that explained 55% of the total variance. A confirmatory factor analysis (CFA) was conducted, and the goodness-of-fit measures were satisfactory. Cronbach's alpha coefficients were calculated, and CASQ indicated a good internal consistency (.89). Also, CASQ demonstrated correlations with two other measures of daytime sleepiness such as Pediatric Daytime Sleepiness Scale (Drake et al., 2003) and School Sleep Habits Survey (Shahid, Wilkinson, Marcu, & Shapiro, 2011).

This study intends to adapt and validate CASQ for the Portuguese adolescent population. Using two samples, exploratory and confirmatory factor analyses were designed in order to study the psychometric properties of CASQ and to test alternative factor solutions. Specifically, with EFA our objective was to identify the underlying scale structure, and with CFA we aimed to test the scale structure highlighted by EFA.

METHOD

Participants

In the first study, an exploratory factor analysis was conducted to examine the factor structure of the CASQ and to provide evidence of its psychometric properties. Overall, 742 students from Portuguese schools participated in this study. The current sample is representative of the student body enrolled in schools from 7th to 12th grades from all the administrative regions of Portugal, distributed as follows: north (29.4%), centre (49.4%), south (13.2%), and autonomous islands (8.0%). Students' average age was 14.8 years (*SD* = 1.87), and 56.9% were females. Regarding education level, 384 participants were from secondary school (10th to 12th grade; 54.4% females), with age ranging from 15 to 18 years (*M* = 16.4, *SD* = 1.07); 358 participants were from middle school (7th to 9th grade; 59.5% females), with age ranging from 12 to 14 years (*M* = 13.3, *SD* = 1.02).

In the second study, a confirmatory factor analysis was conducted with 730 students from Portuguese schools. Similarly to exploratory factor analysis, this sample is representative of the student body enrolled in 7th to 12th grades from all the administrative regions of Portugal, distributed as follows: north (26.7%), centre (49,5%), south (15.0%), and autonomous islands (8.8%). Their mean age was 14.8 years (*SD* = 1.84), with 388 females and 342 males. Regarding education level, 358 participants were from middle school, similarly distributed in gender, with age ranging from 12 to 14 years (*M* = 13.31, *SD* = 1.01), and 372 (56.5% females) were from secondary school, with age ranging from 15 to 18 years (*M* = 16.3, *SD* = 1.0).

Measure

Cleveland Adolescent Sleepiness Questionnaire is composed by 16 items, organized in four subscales: (i) sleep in school, (ii) alert/awake in school, (iii) sleep during the evening, and (iv) sleep during transport; all items refer to everyday situations in which adolescents might feel sleepy or even fall asleep. Item responses were made on a 5-point scale, ranging from 1 (*never*) to 5 (*almost every day*), indicating the frequency of occurrence of each behavior during a usual week. Participants' responses were summed up to produce an overall score (items related to alertness were reversed), and higher scores reflected greater daytime sleepiness.

Procedure

Permission was requested from the CASQ authors for use of the questionnaire in Portugal. It was then translated into Portuguese, followed by a back-translation to the original language (English), by two independent bilingual researchers. A new version was then developed and delivered to a group of four judges with advanced training in sleep medicine to revise the translated items. Afterward, five adolescents were asked to review this CASQ version, by completing the questionnaire through the thinking-aloud method. A final revised version was developed and the study started to be distributed among the national secondary and middle schools (Rebelo-Pinto et al., 2012).

For the data collection, permission from the nationally selected school boards was requested, and written informed consent from parents and adolescents for their participation was obtained. Participants were asked to answer a brief sociodemographic questionnaire which focused on issues concerning sex, age, and school. Administration of the questionnaire took place in classrooms, by teachers. Adolescents were informed about the study's goals, confidentiality, and voluntary nature of their participation; confidentiality of data collected was assured. Instructions about the questionnaire completion were also given, and the approximate time to fill it out was 10 minutes.

Statistical Analyses

The data collected were keyed into the statistical software — SPSS for Windows, version 21 — by an expert researcher in the sleep field. To assess the factor structure of the scale we performed an exploratory factor analysis; analyses were conducted using principal axis factoring (PAF) method with varimax rotation. To determine the number of factors we employed three criteria: Kaiser criterion with eigenvalues greater than one, Cattell's scree test, and the interpretability of the solution. The cut-off used for factor loadings was .40. Cronbach's alpha was employed as measure of internal consistency; values above .60 were considered as suitable (Hair, Black, Babin, & Anderson, 2009).

Confirmatory factor analyses were performed to replicate the three-factor solution found with Study 1, and to test alternative factor solutions. The estimation method used was maximum likelihood (ML), using the variance-covariance matrix; missing cases were replaced by the mean. First, we tested the fit of a three-factor solution; additionally, we tested three alternative models: (i) a one-factor model; (ii) a two-factor model, with a first dimension including five items about *alertness* and a second dimension including 10 items about *somnolence* (Item 16 was eliminated according to PAF's results); and (iii) one model with four factors, based on EFA. In the latter model, the first factor includes five items concerning *sleep in school*; the second factor includes five items concerning *alert/awake in school*; the third factor includes three items related to *sleep during transport*; and, finally, the fourth factor includes two items related to *sleep during the evening* (Item 16 was excluded according to PAF's results).

We used the following indices to test the general fit of the proposed and alternative models: (i) the ratio of the chi-square to the degrees of freedom (χ^2/df), with values ranging between 2-3 indicating an acceptable fit; (ii) the goodness-of-fit index (GFI) and the comparative fit index (CFI), with values close to .95 or higher indicating a good fit; (iii) the root mean square error of approximation (RMSEA), with values below .06 indicating good fit (Byrne, 2016); and (iv) the root mean square residual (RMR), with values equal to or lower than .08 indicating good fit. Furthermore, values higher than .90, for GFI and CFI, and lower than .08 for RMSEA also indicate an acceptable fit. Further, we used the χ^2 difference ($\Delta\chi^2$) between models and the expected cross-validation index (ECVI) to assess significant improvement over competing models. Significant values of $\Delta\chi^2$ and lower values of ECVI reflect the model with better fit. We also tested the structure and fit of the revised 15-item CASQ. We used AMOS 21 to analyze data.

RESULTS

Descriptive Analyses

Table 1 presents the analysis of the CASQ at an item level. Descriptive analysis of each of the 16 items indicates that all the means were below the mid-point of the scale. Asymmetry and kurtosis results were far from normal for Items 1, 3, 6, 10, and 15. The item-total correlation was greater than .30 for all items, the lowest value being for Item 4 (.336) and the highest value for Item 11 (.581). The alpha for the 16 items was .82; it did not become worse with the elimination of any of the 16 items.

TABLE 1
CASQ: Descriptive results (*N* = 742)

Items – CASQ	*M*(*SD*)	Skewness	Kurtosis	Item-total correlations	Alpha if item deleted
1. Fall asleep morning classes	1.26 (0.631)	2.974	10.116	.39	.82
2. Go through whole school day without feeling tired	2.63 (1.24)	0.199	–0.971	.37	.82
3. Fall asleep last class	1.19 (0.550)	3.500	13.790	.41	.82
4. Feel drowsy in car > 5 minutes	1.92 (1.05)	1.150	0.796	.34	.82
5. Wide-awake whole day	2.01 (1.18)	0.947	–0.190	.43	.81
6. Fall asleep in afternoon classes	1.23 (0.646)	3.520	13.520	.37	82
7. Feel alert during classes	2.19 (1.08)	0.688	0.261	.53	.80
8. Sleepy in evening after school	2.86 (1.23)	0.077	–0.891	.40	.81
9. Feel sleepy on bus trip for school event	1.87 (1.07)	1.200	0.787	.42	.81
10. Fall asleep in morning at school	1.20 (0.569)	3.580	15.180	.44	.81
11. When in class, wide awake	2.26 (1.12)	0.621	0.090	.58	.80
12. Feel sleepy during schoolwork at home in evening	2.61 (1.25)	0.319	0.879	.46	.81
13. Wide awake last class of day	2.20 (1.18)	0.691	–0.418	.54	.80
14. Fall asleep when ride bus, car, train	1.89 (1.03)	1.110	0.693	.43	.81
15. During school day, realize just fell asleep	1.31 (0.703)	2.540	6.740	.50	.81
16. Fall asleep doing schoolwork at home in evening	1.60 (1.02)	1.740	2.300	.45	.81

Exploratory Factor Analysis

Initially, we conducted a PAF with all 16 items without fixing the number of components to extract. The Kaiser-Meyer-Olkin (KMO = .84) and Bartlett's Test of Sphericity, $\chi^2(105) = 3315.4$, $p < 0.001$, indicated the sampling adequacy for the analysis. Four factors with eigenvalues greater than one emerged, explaining 58.5% of the variance. Eigenvalues and percentage of variance accounted by each factor were: Factor 1 (eigenvalue = 4.73; 29.5% of variance), Factor 2 (eigenvalue = 2.02; 12.6% of variance), Factor 3 (eigenvalue = 1.53; 9.6% of variance), Factor 4 (eigenvalue = 1.09; 6.78 % of variance). We removed Item 16, since it had cross loadings in two factors with about equal magnitudes (.32 in Factor 1 and .44 in Factor 4). After inspecting the scree plot, indicating the existence of three factors, we conducted another PAF with 15 items and fixing the number of factors to extract only three. The three factors explained 53.3% of variance. Considering the interpretability of the four- and three-factor solutions, we decided to retain the three-factor solution. EFA analyses were repeated using a direct oblimin rotation, but since the three factors revealed a moderate intercorrelation (F1 and F2, r = .33; F1 and F3, r = .30; F2 and F3, r = .39), we decided to use varimax rotation (Tabachnick & Fidell, 2007).

Factor 1 had an eigenvalue of 4.47 and explained 29.8% of variance; we retained five items with factor loadings ranging from .65 to .72. This factor was named *Sleep in school* because it includes items of daytime sleepiness. Factor 2 had an eigenvalue of 2.02 and explained 13.5% of variance; we retained five items with factor loadings ranging between .43 and .78. This factor was named *Alertness in school,* since items refer to alertness. Factor 3 had an eigenvalue of 1.49 and explained 10% of variance; we retained five items with factor loadings ranging between .46 and .59. This factor was named *Sleep in evening and/or transportation*.

All factors showed good reliability: alphas were .83, .78, and .68, for F1, F2, and F3, respectively. Rotated factor loadings reliabilities are presented in Table 2.

TABLE 2
Rotated factor loadings, communalities, and Cronbach's alpha

		F1	F2	F3	h^2
Item 10	Fall asleep in morning at school	**.72**	.13	.13	.55
Item 3	Fall asleep last class	**.71**	.13	.08	.53
Item 1	Fall asleep morning classes	**.68**	.17	.04	.49
Item 6	Fall asleep in afternoon classes	**.68**	.04	.14	.48
Item 15	During school day, realize just fell asleep	**.65**	.20	.20	.50
Item 7	Feel alert during classes	.11	**.78**	.11	.64
Item 11	When in class, wide awake	.14	**.76**	.21	.64
Item 5	Wide-awake whole day	.12	**.55**	.13	.33
Item 13	Wide awake last class of day	.17	**.54**	.28	.40
Item 2	Go through whole school day without feeling tired	.09	**.43**	.13	.21
Item 9	Feel sleepy on bus trip for school event	.09	.13	**.59**	.37
Item 4	Feel drowsy in car > 5 minutes	.02	.08	**.57**	.33
Item 14	Fall asleep when ride bus, car, train	.19	.14	**.50**	.31
Item 12	Fall asleep during schoolwork at home in evening	.13	.19	**.48**	.28
Item 8	Sleepy in evening after school	.07	.21	**.46**	.26
Alpha		.83	.78	.68	–

Note. h^2 = communalities after factor extraction. In bold higher factor loadings of each item.

Confirmatory Factor Analysis

We aimed to replicate the three-factor structure on an independent sample. Moreover, we tested alternative models with one, two, three, and four factors.

The three-factor solution proposed in Study 1 showed good fit indices, supporting the structural validity of the CASQ. In addition, comparing the fit of alternative models, the three-factor model showed better indices. Table 3 presents fit indices for the test of the one-, two-, three-, and four-factor models. The one-factor model exhibited the poorest fit indices, followed by the two-factor model. Moreover, the comparison of the models using the $\Delta\chi^2$ measure indicated a better fit for the three-factor model compared with the four-factor model, $\Delta\chi^2$ (1) = 117.83, $p < .001$, the two-factor model, $\Delta\chi^2$ (3) = 952.54, $p < .001$, and the one-factor model, $\Delta\chi^2$ (3) = 1558.6, $p < .001$. The prevalence of the three-factor model was confirmed also by the comparison of CFIs (see the method proposed by Cheung & Rensvold, 2002).

TABLE 3
Fit indices for the alternative models

Model	χ^2	*df*	χ^2/df	GFI	CFI	RMSEA [CI 90%]	ECVI	RMR
One-factor	1975.25	90	21.95	.64	.53	.170 [.163, .176]	2.792	.193
Two-factor	1369.20	90	15.21	.78	.68	.140 [.133, .146]	1.961	.162
Three-factor	416.66	87	4.79	.93	.92	.072 [.065, .079]	0.662	.041
Four-factor	534.49	88	6.07	.90	.82	.091 [.075, .097]	0.885	.060

Note. GFI = goodness-of-fit index; CFI = comparative fit index; RMSEA = root mean square error of approximation; CI = confidence interval; ECVI = expected cross-validation index; RMR = root mean square residual.

Reliability was computed for the three-factor model. All factors showed acceptable alphas (F1, alpha = .86; F2, alpha = .82; F3, alpha = .70) and mean inter-item correlations (F1 = .56; F2 = .48; F3 = .32). The standardized loadings and correlations between factors are presented in Figure 1.

DISCUSSION

Exploratory factor analysis (EFA) results indicated an overall satisfactory internal consistency (alpha = .76), with a total of 15 items, organized in three factors, which explained 53.3% of the variance. Comparing these results with the results obtained in other studies, in Spilsbury et al.'s (2007) study the factor structure was articulated in four factors (16 items), explaining 55% of the variance (alpha = .89). Also, in Peña and Agudelo's (2012) study, performed with 324

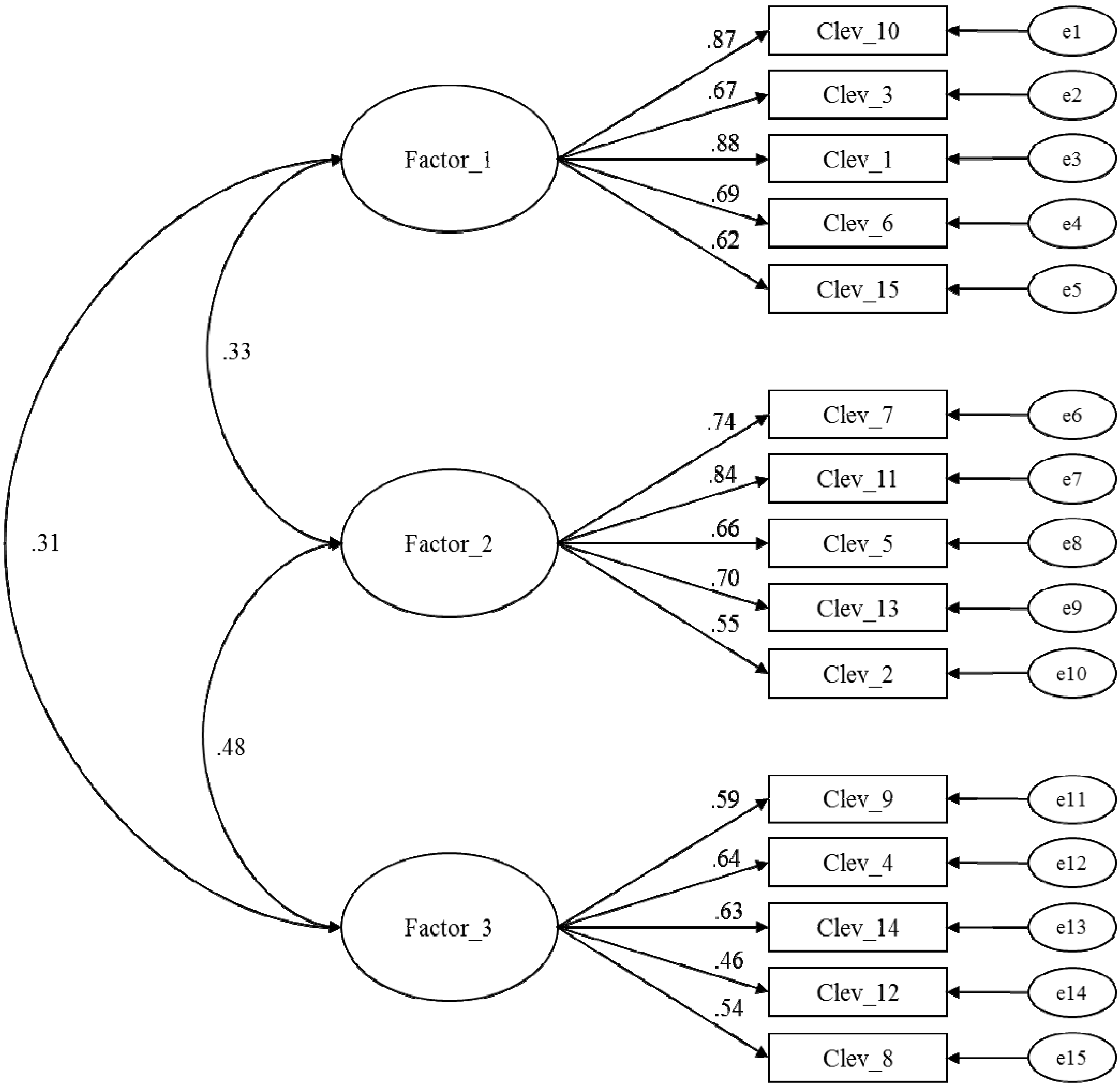

FIGURE 1
Standardized regression weights and correlation coefficients.

students (55.6% males), with a mean age of 13.05 years, EFA indicated four factors, which explained 58.3% of the variance (F1 = 6.1%; F2 = 13.3%; F3 = 11.5%; F4 = 27.4%). In Halik et al.'s (2011) study, performed with 707 university students (437 women), aged between 20 and 24 (alpha = .77), EFA indicated four factors, explaining 55.2% of the variance. These findings suggest that the results obtained with the Portuguese version of CASQ are different from those obtained in previous studies, but they also show that CASQ is a promising measure of daytime sleepiness for students in middle and secondary schools.

Results from confirmatory factor analysis provided further evidence for the three-factor structure. This structure showed better fit indices than the alternative models tested. In addition, alphas and mean inter-item correlations supported its internal reliability. Comparing our results with those obtained by Spilsbury et al. (2007), it is important to refer that the original CASQ structure is composed by four factors with good fit indices (χ^2 = 167.987; CFI = .951; RMSEA = .059). In general, we can state that the psychometric properties of the Portuguese version of CASQ are slightly different from, but comparable to, those reported originally, and also comparable to the other versions that have been developed in other countries, such as Colombia and Malaysia (e.g., Halik et al., 2011; Peña & Agudelo, 2012).

Conclusion

This research aimed to validate the Portuguese version of CASQ, and included two factor analyses, exploratory and confirmatory, with two different samples. In general, CASQ demonstrated a high internal consistency and reliability. The exploratory (EFA) and confirmatory (CFA) factor analyses confirmed the multidimensionality of the construct. Results from EFA evidenced the presence of three factors, moderately correlated, with five items each. On the other hand, CFA confirmed the proper adjustment of the three-factor model, when compared with alternative models, highlighting the usefulness of CASQ to measure excessive daytime sleepiness in Portuguese adolescents. The obtained results support the three-factor structure of the CASQ and its reliability. However, it is important to recognize that this study has some limitations since we did not analyze the discriminant and convergent validity of the measure. As noted by other authors (e.g., Spruyt & Gozal, 2011), it is necessary to proceed with further studies of this version of CASQ adapted to the Portuguese cultural context, with new samples, including participants already diagnosed with sleep disorders. We believe this is a promising resource to be used in Portuguese interventions and research contexts, as it may provide a simple, useful, valid, and reliable assessment of daytime sleepiness in young adolescents.

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