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Translation and Psychometric Properties of Bedtime Procrastination Scale (BPS) in Peruvian College Students

Traducción y propiedades psicométricas de la Bedtime Procrastination Scale (BPS) en universitarios peruanos

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Summary

The purpose of this study was to translate the Bedtime Procrastination Scale (BPS) into Spanish and to evaluate its psychometric properties. A sample of 419 students from three Peruvian universities participated in the study. Confirmatory factor analysis was conducted to evaluate the original model of the scale, which initially showed poor fit indices. Improved fit indices were obtained after removing reverse-scored item, $\chi^2(5) = 9.240$, CFI = .998, RMSEA = .045, TLI = .997, and SRMR = .013. The internal consistency of the scale, examined using the omega coefficient, was found to be satisfactory ($\omega = .86$). Moreover, measurement invariance analysis supported gender invariance, indicating that the scale functions equivalently across male and female participants. Additionally, convergent validity was assessed by examining the correlations between the BPS and insomnia, as measured by the Athens Insomnia Scale (AIS-5), revealing a moderate correlation (r = .44). In summary, the Spanish translation of the BPS demonstrated adequate psychometric properties in Peruvian college students and supported a one-factor structure after the removal of reverse-scored items.

Keywords: Bedtime procrastination; Factor analysis; Reliability; Psychometrics.

Resumen

El objetivo del estudio fue traducir el *Bedtime Procrastination Scale (BPS)* al español y evaluar sus propiedades psicométricas. Participó una muestra de 419 estudiantes de tres universidades peruanas. Se realizó un análisis factorial confirmatorio para evaluar el modelo original de la escala, el cual inicialmente mostró índices de ajuste pobres. Se obtuvieron mejores índices de ajuste después de eliminar los ítems con puntuación inversa, $\chi^2(5) = 9.240$, CFI = .998, RMSEA = .045, TLI = .997, y SRMR = .013. La consistencia interna de la escala, examinada mediante el coeficiente omega, resultó ser satisfactorio ($\omega = .86$). Asimismo, el análisis de invarianza de la medición demostró la invarianza de género, lo que indica que la escala funciona de manera equivalente en participantes masculinos y femeninos. Además, se evaluó la validez convergente examinando las correlaciones entre la BPS y el insomnio, medido por la Escala de Insomnio de Atenas (AIS-5), encontrando una correlación moderada ($r = .44$). En resumen, la traducción al español de la BPS demostró adecuadas propiedades psicométricas en universitarios peruanos y una estructura unifactorial después de la eliminación de los ítems con puntuación inversa.

Palabras claves: Procrastinación a la hora de dormir; Análisis factorial; Fiabilidad; Psicometría.

INTRODUCTION

College students have a particularly high prevalence of sleep problems compared to the general population (Jiang et al., 2015). Insufficient sleep affects multiple areas of health, increasing anxiety levels (Palmer et al., 2024; Pires et al., 2016) and impairing attention span (Lim & Dinges, 2010). In addition, inadequate sleep leads to increased risks of obesity (Cappuccio et al., 2008), hypertension (Gangwisch et al., 2006), cardiovascular problems and diabetes (Itani et al., 2017), as well as increased mortality (Cappuccio et al., 2010). In the academic setting, daytime sleepiness is associated with lower self-efficacy and a greater tendency to procrastination (Edens, 2006). In the Peruvian context, it has been observed that university students also face these problems (Morales et al., 2022; Murrieta-Ruiz et al., 2023). Sleep quality in this population has been related to higher levels of depression, anxiety and excessive internet use (Chui et al., 2023). At the occupational level, sleep also influences the quality of professional life, as has been observed in Peruvian graduate students (Grimaldo & Reyes, 2015).

Bedtime procrastination, first introduced in a study by Kroese et al. (2014), is defined as the act of not going to bed at the scheduled time without external circumstances preventing it. Those who show this behavior tend to do so in order to engage in social or leisure activities such as spending time on digital media, watching television or using the *Smartphone* (Chung et al., 2020). This procrastination can be intentional or unconscious, by losing track of time (Nauts et al., 2019). In recent years, this phenomenon has gained interest for its negative effects on physical and mental health, especially for its link with insufficient sleep and impaired well-being (Guo et al., 2020).

A study by Nauts et al. (2019) explored the reasons why individuals procrastinate bedtime and identified three main reasons: a) Deliberate procrastination: intentionally delaying bedtime because the individual feels that he or she "deserves more personal time"; b) Unconscious procrastination: losing track of time and, as a result, delaying bedtime; c) Strategic procrastination: staying awake a little longer in the belief that this will make it easier to fall asleep later. In addition, Magalhães et al. (2020) proposed two types of bedtime procrastination: delaying going to bed and staying in bed procrastinating sleep, e.g., using a cell phone. These categories help to better understand the behaviors associated with bedtime procrastination and their implications.

In order to adequately assess this phenomenon and its effects, it is important to have measurement instruments as they allow the rapid and practical identification of bedtime procrastination, as well as the evaluation of response to treatments. The *Bedtime Procrastination Scale* (BPS), developed by Kroese et al. (2014), is a brief measure designed to assess this behavior. This scale has been translated and used in several countries, including China (Fang et al., 2022), Korea (An et al., 2019), India (Shukla & Andrade, 2023), Japan (Hazumi et al., 2024) and Spain (Brando-Garrido et al., 2022), demonstrating in such studies adequate internal consistency and evidence of convergent validity with insomnia scales (An et al., 2019), general procrastination and self-control (Brando-Garrido et al., 2022; Hazumi et al., 2024).

Given its international use, it is essential to evaluate its psychometric properties in Peru, considering that various sociocultural factors may influence bedtime procrastination. Lower levels of education, reduced income and precarious working conditions may negatively impact sleep

patterns in Latin American populations (Etindele et al., 2023). Likewise, cultural differences may play a relevant role in how people perceive and manage their sleep habits (Chung et al., 2015). Addressing these differences is crucial to developing effective interventions tailored to this population.

In addition to sociocultural factors, gender also plays a significant role in sleep patterns. Meta-analytic evidence suggests that insomnia is approximately 1.5 times more frequent in women than in men, with a 41% higher risk in the female population (Zhang & Wing, 2006; Suh et al., 2018). This predisposition has been linked to hormonal factors throughout the life cycle, including menstruation, pregnancy and menopause, which significantly affect sleep patterns (Baker et al., 2020). Although women present better objective measures of sleep, such as longer total sleep time and fewer awakenings, they report worse subjective quality (Baker et al., 2020), which could be influenced by the higher prevalence of anxiety and depression in this group (Voderholzer et al., 2003). In this context, this study will analyze measurement invariance by gender in the BPS, in order to ensure equivalence in comparisons between men and women.

A distinctive aspect of the BPS is the inclusion of reverse-worded items. Although its use seeks to reduce acquiescence bias in response styles, research suggests that this approach may not be entirely effective, leading to confusion among participants. (Sonderen et al., 2013). In fact, previous studies have pointed out problems with these items in the BPS (Shukla & Andrade, 2023), especially item 2 (An et al., 2019; Hazumi et al., 2024) and item 3 (An et al., 2019; Fang et al., 2022; Hazumi et al., 2024). Therefore, this study will analyze the relevance of the reverse-worded items within the BPS.

Bedtime procrastination is associated with poor sleep quality (Ma et al., 2022) and insomnia. People with moderate or high levels of bedtime procrastination are twice as likely to develop insomnia (Alshammari et al., 2023). One of the factors that explain this relationship is rumination, which is common to both conditions and involves repetitive thoughts in the person that can generate emotional arousal and interfere with sleep quality (Hairston & Shpitalni, 2016). For this reason, this study will evaluate the convergent validity of the BPS through its correlation with insomnia.

In this regard, the research will analyze the psychometric properties of the BPS in a sample of Peruvian college students. The objectives are to provide additional evidence of its structural validity, convergent validity, measurement invariance by gender and reliability within this specific population.

METHOD

Design

This study followed an instrumental design, given that its purpose was to examine the psychometric properties of a self-reported measurement instrument (Ato et al., 2013).

Participants

The sample consisted of 419 students from three Peruvian universities located in the city of Ica, two private and one public. The participants completed the questionnaires online. The sample consisted of 277 women (66.11%) and 142 men (33.89%), whose ages ranged from 18 to 41 (*M* = 21.68; *DE* = 3.26). Academically, 33.2% were studying psychology, 11.5% engineering, 8.8% management, 8.1% education, 5.7% biology, and 32.7% other majors. Individuals were excluded if they were not currently enrolled in one of the specified universities, were under 18 years of age, or had incomplete responses on the questionnaires. Convenience sampling was used, as participants were those who were available and accessible (Kerlinger & Lee, 2002).

Instruments

Bedtime Procrastination Scale (BPS).

Bedtime procrastination was assessed using the 9-item *Bedtime Procrastination Scale* (BPS) de 9 items developed by Kroese et al. (2014), which includes items such as *"I go to bed later than planned"* and *"I am often still doing other things when it is already time for me to go to bed."* Responses to the items were recorded using a 5-point scale ranging from 1 (never) to 5 (always). Items 2, 3, 7 and 9 were reverse scored. A higher score reflected a greater predisposition to delay bedtime. The original instrument presented high internal consistency (α = .92) and a unifactorial structure (Kroese et al., 2014). The instrument was translated into Spanish and administered to participants.

Athens Insomnia Scale-5 (AIS-5).

Symptoms of insomnia were evaluated using the *Athens Insomnia Scale*, developed by (Soldatos et al., 2000). This scale includes four response options with values ranging from 0 to 3 (where 0 indicates no problem and 3 indicates a severe problem) and assesses insomnia symptoms experienced during the last month. In its 5-item version, scores can range from 0 to 15 points. Higher scores indicate a greater presence of non-organic insomnia symptoms. In Peruvian adults, the scale demonstrated adequate psychometric properties, with an internal consistency measured by an omega coefficient of .83 (Baños-Chaparro et al., 2021), using the Spanish version of the instrument translated by Gómez-Benito et al. (2011). The same adaptation was used in this study, obtaining an adequate omega coefficient (ω = .78).

Procedure

The original scale was linguistically and culturally translated following the guidelines of Muñiz et al. (2013). Initially, two bilingual experts independently performed direct translations of the scale. Subsequently, a committee of four specialists in clinical psychology reviewed the evaluations. After extensive deliberation, the committee reached consensus on the Spanish version of the instrument.

To ensure the comprehensibility of the translated items, a pilot study was conducted with 32 university students between 18 and 27 years of age. The scale was administered online, and at the

end, they were asked directly if they had had difficulty understanding any item. None of the participants reported interpretation problems, which indicated that the translated version was clear and understandable. Therefore, no additional modifications to the scale were considered necessary.

Data Analysis

A data cleaning process was carried out to identify and eliminate extreme cases, ensuring the quality of the information analyzed. These cases represented approximately 2% of the sample.

Data processing and psychometric analysis was performed using R software, version 4.1.2 (R Core Team, 2021) together with the Lavaan package (Rosseel et al., 2012). Polychoric correlations were used to analyze the relationship between items, considering their ordinal nature to provide more precise estimates in the factor analysis (Pendergast et al., 2017).

Confirmatory factor analysis (CFA) was also carried out to evaluate the correspondence between the proposed factor structure and the data, using the weighted least squares method adjusted for mean and variance (WLSMV). Goodness-of-fit indices (RMSEA, SRMR, CFI and TLI) were evaluated, considering an adequate model fit with RMSEA $\leq .06$, CFI/TLI $\geq .90$ and SRMR $\leq .10$ (Hu & Bentler, 1999; Mehmetoglu & Jakobsen, 2016). Given that the instrument includes reverse-scored items, the possible influence of a method factor associated with this type of scores was explored. For this purpose, four models were compared: (1) the original one-factor model (2) a two-factor model differentiating direct and inverse-scored items, (3) a two-factor model with specific adjustments and (4) a one-factor model excluding all inverse-scored items.

The measurement invariance analysis was performed following the guidelines proposed by Wu and Estabrook (2016) and Svetina et al. (2020). The analysis focused on the review of three criteria between gender groups: configural invariance, equality of thresholds and the combination of equality of thresholds and factor loadings. The WLSMV estimator, suitable for ordinal data, was used for these models. The model fit was evaluated by considering variances in CFI $< .010$, RMSEA $< .015$ or SRMR $< .005$ (Chen, 2007). These cutoff points allow us to determine whether the restrictions imposed on the parameters significantly affect the model fit. Thus, they indicate whether the invariance between groups is maintained or whether there are significant differences.

Convergent validity was analyzed using Pearson correlations between the BPS and the Athens Insomnia Scale. Construct reliability was estimated using both coefficient alpha and coefficient omega (McDonald, 1999), the latter considered a more robust alternative due to the limitations of coefficient alpha, such as the tau-equivalence assumption (Cho, 2016; Sijtsma, 2009).

RESULTS

Table 1 presents the polychoric correlations of the BPS items. It is notable that the items with inverse scores show correlations below .40 with the other items. These reverse-scored items are Item 2, "*I go to bed early if I have to get up early in the morning*"; item 3, "*If it is time to turn off the lights at night I do it immediately*"; item 7, "*I have a regular bedtime which I keep to*"; and item 9, "*I can easily stop with my activities when it is time to go to bed*".

Table 1.
Matrix of polychoric correlations of the BPS.

	1	2	3	4	5	6	7	8	9
1	-								
2	.08	-							
3	.05	.41	-						
4	.57	.02	.00	-					
5	.56	-.02	-.05	.62	-				
6	.64	.03	.06	.63	.62	-			
7	.27	.31	.41	.12	.16	.27	-		
8	.56	.07	.09	.60	.56	.65	.18		
9	.14	.32	.30	.10	.15	.07	.44	.08	

The original model was initially evaluated, although its fit indices were poor. Subsequently, a two-factor model differentiating positive and negative items was tested, but it did not show a satisfactory fit either. In view of this, a variant of the two-factor model was explored excluding item 3, due to its low correlations with the other items. Although the latter model presented good fit indices, the internal consistency of the factor composed only of negative items was low. Finally, a model consisting exclusively of the positive items was tested and showed an adequate fit and satisfactory internal consistency (ω = .86; α = .86). Table 2 shows the detailed results of these analyses.

Table 2.
Fit and internal consistency indices of four factor models of the BPS.

Models	χ^2	gl	CFI	TLI	RMSEA	SRMR	ω direct and reverse scoring items	ω direct scoring items	ω reverse scoring items
Original model	646.363	27	.774	.699	.234	.132	.74	-	-
Model of two unspecified correlated factors	103.479	26	.972	.961	.084	.053	-	.86	.66
Re-specified correlated two-factor model	53.657	19	.987	.981	.068	.040	-	.86	.58
Model with only directly scored items	9.240	5	.998	.997	.045	.013	-	.86	-

Table 3 presents the factor loadings of the instrument after eliminating items with reverse or negative scores. All factor loadings are above .70, indicating adequate loadings.

Table 3.
Standardized factor loadings of the BPS items.

Item	Factor
1. *I go to bed later than I had intended*.	.75
4. *Often, I am still doing other things when it is time to go to bed*.	.78
5. *I easily get distracted by things when I actually would like to go to bed*.	.76
6. *I do not go to bed on time*.	.83
8. *I want to go to bed on time but I just don´t.*.	.76

A measurement invariance analysis was performed between two groups, categorized by sex, as presented in Table 4. The fit indices indicated good model fit at each stage evaluated. Configural invariance was confirmed and, when imposing the threshold equivalence constraint, the RMSEA showed a considerable decrease (ΔRMSEA = .043), with the other fit indices reflecting no significant deterioration. Similarly, the joint restriction of thresholds and factor loadings presented an adequate fit according to the criteria of Chen (2007), confirming the invariance at all levels evaluated.

Table 4.
Invariance of the final model measurement according to sex.

Model	χ2(df)	CFI	RMSEA	SRMR	ΔCFI	ΔRMSEA	ΔSRMR
Configural	18.212(10)	.997	.063	.014			
Equivalence of thresholds	21.697(20)	.999	.020	.014	.002	.043	.000
Equivalence of loads and thresholds	25.602(24)	.999	.018	.017	.000	.002	.003

Finally, evidence of convergent validity of the BPS was analyzed by correlating it with the AIS-5. A moderate correlation of .44 was found, indicating satisfactory convergent validity.

DISCUSSION

The objective of this study was to examine the psychometric properties of the *Bedtime Procrastination Scale* (BPS) in a sample of 419 Peruvian university students.

The results indicate that the inversely worded items (2, 3, 7 and 9) have low correlations with the other items of the scale. This is consistent with previous psychometric research that also identified problems with these items. Specifically, low factor loadings, below 0.50, were reported for item 2 (An et al., 2019; Hazumi et al., 2024) and item 3 (An et al., 2019; Fang et al., 2022; Hazumi et al., 2024). Similarly, previous studies identified factor loadings lower than the optimum of 0.70 (Rodriguez et al., 2015) for item 7 (An et al., 2019; Hazumi et al., 2024) and item 9 (Hazumi

et al., 2024). These consistent findings across different studies suggest that reverse-worded items may contribute systematically less to the overall construct being measured, thus affecting the reliability and validity of the scale.

Research indicates that the inclusion of both positively and negatively worded items in psychometric tests, although intended to mitigate response styles, may not be effective (Sonderen et al., 2013). Rather than reducing acquiescence bias, incorporating reverse-worded items often leads to greater confusion and inattention among respondents, potentially making the practice counterproductive (Solis, 2015). The results of this study support these findings, suggesting that the removal of negatively worded items may improve BPS fit indices in this population. Given the problems with reverse-scored items, future research could focus on refining these items or developing alternative methods to mitigate response biases without compromising the validity of the scale.

After elimination of the reverse items, the instrument showed good fit indices. The BPS demonstrated good internal consistency. This suggests that the scale items reliably measure the construct of bedtime procrastination among the Peruvian university students evaluated.

The analysis of invariance of the BPS according to gender confirmed the configural invariance, threshold invariance, and threshold invariance and factor loadings, indicating that the factor structure is consistent in both groups. Although the ΔRMSEA presented an increase in the threshold restriction (ΔRMSEA = .043), the other fit indices remained within acceptable ranges (Chen, 2007). This finding is relevant, as previous studies have reported a higher prevalence of bedtime procrastination in university women (Alshammari et al., 2023). In addition, this behavior has been found to be closely related to anxiety (Campbell & Bridges, 2023), a factor that shows higher prevalence in women (Farhane-Medina et al., 2022). Considering that anxiety could influence bedtime procrastination, confirming measurement invariance allows valid comparisons between genders and accurately assessing this phenomenon in university populations exposed to multiple sources of stress, such as exams and academic load.

Additionally, the instrument showed a positive and moderate correlation with insomnia as measured by the AIS-5, supporting its convergent validity. This finding suggests that individuals who report higher levels of bedtime procrastination also tend to experience greater difficulty falling asleep. This is to be expected, as both phenomena share a central cognitive mechanism: cognitive rumination, a repetitive thought pattern that interferes with the ability to relax and sleep (Alshammari et al., 2023). In addition, delaying bedtime contributes to poor sleep quality (Ma et al., 2022).

The translation and validation of the BPS in Peru allows the accurate measurement of bedtime procrastination in Peruvian university students, facilitating comparative and epidemiological studies. Likewise, its application contributes to the identification of vulnerable populations and the development of intervention strategies, especially in students, where it has been found that this behavior can affect academic performance (Azwar et al., 2024). While this adaptation represents a significant advance, its use in clinical settings still requires further study. Future research could explore its applicability in the detection and management of difficulties related to delaying bedtime.

Despite the relevant findings, the study has limitations. Although participants from private and public universities were included, the use of a convenience sampling method limits the generalizability of the findings to other populations. In addition, the sample was composed of students from only three universities in a specific region of Peru, further restricting the applicability of the results to other regions of Latin America. The cross-sectional design of the study represents another limitation, as it precludes assessment of BPS stability over time and makes it difficult to assess how changes in bedtime procrastination behaviors might relate to changes in sleep quality or other outcomes. Also, reliance on self-report questionnaires may introduce response biases, such as social desirability bias or recall bias, potentially affecting the accuracy and reliability of the data. Future research should address these limitations by employing longitudinal designs, expanding the sample to include a more diverse population, and incorporating objective measures along with self-report questionnaires to improve the validity and generalizability of the findings.

In conclusion, the Spanish translation of the BPS showed adequate psychometric properties and supported a one-factor structure after the elimination of the reverse-scored items. The scale presented good internal consistency and invariance according to gender. The results suggest that the BPS, without reverse-scored items, is a robust tool for research. Moreover, its applicability makes it a valuable resource for the study and understanding of sleep habits.

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