DOI: 10.1590/1413-812320202511.34162018

DOI: 10.1590/1413-812320202511.34162018

Cross-cultural adaptation and validation of the *Self-efficacy Scale to Brush Teeth at Night*

Adaptação transcultural e validação da escala de autoeficácia para a escovação dentária noturna

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Abstract *This study aims to perform cross-cultural adaptation and validation of the "Self-efficacy scale to brush teeth at night" with a Brazilian adult population. Translation and cross-cultural adaptation to the Brazilian-Portuguese language were done according to the stages recommended in the literature. Construct validity was carried out by mean of exploratory and confirmatory factorial analysis in a sample of 198 adult subjects. The reliability of the instrument was measured by Alpha and Omega indices. The model was observed to have been established as one-dimensional for all indicators, with explained variance of 85.7%; factorial loads between 0.85 and 0.91; and with communalities between 0.72 and 0.83. The goodness of fit of the model shown by the confirmatory model were between 0.98 and 0.99; with factorial loads between 0.85 and 0.93, and regression values between 0.69 and 0.84, all above the minimum indices established for instrument quality. For reliability, the Alpha and Omega values had identical indices of 0.95 showing high levels of reliability of the model. The G-H index replicability was 0.96, indicating the stability of solution in other contexts and samples. We concluded that all indicators represented excellent evidence of scale validity to measure self-efficacy to brush teeth at night.*

Key words *Self-efficacy, Oral health, Psychometrics, Behavioral medicine*

Resumo *O objetivo deste estudo foi realizar a adaptação transcultural e validação da "Escala de Autoeficácia para escovação dentária noturna" em uma população de adultos brasileiros. A tradução e a adaptação transcultural para a língua portuguesa foram realizadas de acordo com padrões recomendados na literatura. A validade de construto foi realizada por meio de análises fatoriais exploratória e confirmatória em uma amostra de 198 adultos. A confiabilidade do instrumento foi aferida pelos índices Alpha e Ômega. O modelo foi observado como unidimensional para todos os indicadores, com variância explicada de 85,7%, cargas fatoriais entre 0,85 e 0,91 e comunalidades entre 0,72 e 0,83. Os índices de ajuste do modelo apresentados pela análise confirmatória estiveram entre 0,98 e 0,99, com cargas fatoriais entre 0,85 e 0,93 e valores de regressão entre 0,69 e 0,84, indicando a qualidade do instrumento. Para a confiabilidade do instrumento, os valores de Alpha e Ômega apresentaram índices idênticos de 0,95, mostrando altos níveis de confiabilidade do modelo. O índice de replicabilidade G-H foi de 0,96, indicando a estabilidade da solução em outros contextos e amostras. Concluímos que todos os indicadores representaram excelentes evidências de validade da "Escala de Autoeficácia para Escovação Dentária Noturna".*

Palavras-chave *Autoeficácia, Saúde bucal, Psicometria, Medicina do comportamento*

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Introduction

According to the American Dental Association, people should brush their teeth, floss daily and receive regular preventive measures to avoid oral diseases[1]. The nocturnal period is especially critical for the development of caries lesions, because "during sleep, salivary flow levels and buffering capacity are reduced. It is therefore appropriate to brush just before going to bed to reduce the plaque load in the oral cavity and boost fluoride levels"[2]. In the same way, denture stomatitis is strongly associated with nocturnal denture wearing and the presence of denture biofilm (as a result of not brushing before sleeping); and this is also associated with denture staining and malodor[3].

However, brushing and flossing teeth are behaviors highly influenced by self-efficacy, a psychological construct that determines the amount of confidence, engagement, effort, time spent and the emotional reaction triggered by the behavior[4].

Self-efficacy is one of the Cognitive Social Theory constructs, developed by Albert Bandura, who stated that human behavior is mediated by three variables, i.e., expectations of the consequences of individuals' actions (outcome expectations); their ability to perform the action (self-efficacy); and their beliefs that the action will achieve a desired outcome (response efficacy)[5,6].

In the health context, self-efficacy is considered an important predictor of behaviors such as smoking cessation, weight control, exercise and nutritional behaviors, alcohol and contraceptive use, among others[7].

In the dentistry field, studies have indicated that self-efficacy was an important predictor variable associated with diverse behaviors relevant to oral health, such as brushing, flossing and frequency of dental appointments[4,8,9]. In recent years, instruments have been developed in different languages, such as English and Japanese, for the purpose of measuring this construct for dental outcomes[9-11].

In the Brazilian Portuguese language, Souza et al.[12] adapted a self-efficacy scale for tooth brushing and flossing and applied it to 94 adults patients of a university dental clinic. However, this scale has not undergone a validation process.

Therefore, in view of the scarcity of instruments in the Portuguese language, which assess the self-efficacy levels for dental outcomes, and the importance of this construct for the development of more effective actions in the oral health context, the aim of the present study was to perform the cross-cultural adaptation and validation of the *Self-efficacy scale to brush teeth at night* (SESBN) with a Brazilian adult population. The study hypothesis was that the instrument presents good psychometric properties when applied in the Brazilian adult population.

Methods

This study was approved by the Human Research Ethics Committee of the Piracicaba Dental School, University of Campinas, Brazil. All participants signed a term of free and informed consent.

Description of self-efficacy scale

SESBN was developed by Jamieson et al.[9] and validated by Jones et al.[13] and was based on an instrument developed by Finlayson et al.[14].

The instrument aims to measure the self-efficacy levels of individuals to brush their teeth at night, before going to sleep, when they find themselves in the following conditions: a) under a lot of stress, b) depressed c) anxious, d) feeling very busy, e) tired or f) worried about other things in life. The four response options ranged from 'very confident' to 'not at all confident'. The possible score range is 0 to 24, with high scores indicating high self-efficacy.

Translation and cross-cultural adaptation

Before the study began, the author of the original study (Lisa Jamieson) was contacted to request her authorization to translate the instrument into the Brazilian Portuguese language, and validate it.

Figure 1 shows the cross-cultural translation and validation steps of the Brazilian version of SESBN.

For cross-cultural adaptation of the instrument, researchers followed the recommendations of Guillemin et al.[15], who developed guidelines and a scoring method to assess the quality of cross-cultural adaptations of instruments. The guidelines include five steps: (1) translation with semantic, idiomatic and experimental (empirical), and conceptual equivalence; (2) back-translation by qualified persons; (3) a panel of experts or a committee that reviews all translations and back translations; (4) pre-test for equivalence us-

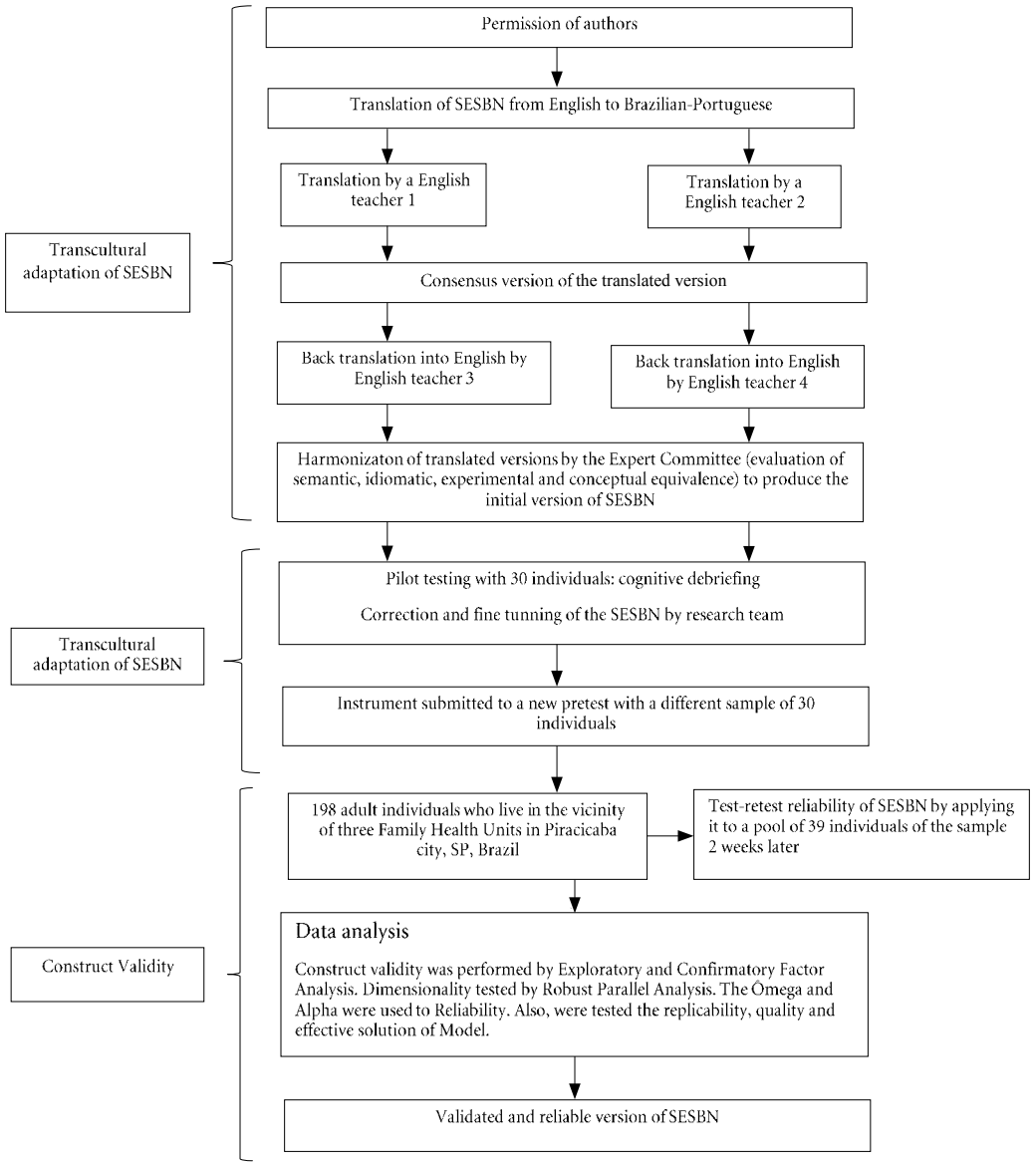

Figure 1. Flowchart demonstrating the cross-cultural translation and validation steps of the Brazilian version of *Self-efficacy Scale to Brush Teeth at Night (SESBN)*.

ing appropriate techniques; and (5) re-weighing the weights of the scores, if necessary.

The original version of the questionnaire in English was translated into the Brazilian Portuguese language by two English teachers whose mother tongue was the same of the target language, and performed in an independent manner. The consensus version was then retranslated into English (back-translation) by two native English-speaking translators (original language), who did not participate in the first stage of translation, were unaware about the intent of the material and who did not have access to the original instrument. The purpose of the reverse translation was to compare the re-translated version with the original instrument in the English language.

A committee, comprising the principal investigator and three researchers with expertise

in self-efficacy evaluated all stages of the process, from the original to the final version. By consensus, the differences found in the translations were reduced; the best terms and words for all questions were selected and adapted to the linguistic cultural universe of the Portuguese language of Brazil. These steps consisted of aspects of semantic, idiomatic, experimental and conceptual equivalence[15].

When the two initial translations by two Brazilian English-speaking teachers were compared, the introductory phrase of the instrument, "How confident you are" was translated by the first translator as "How much you feel confident", and the second as "How much you feel safe." The committee opted for the use of "How much do you feel confident" because it was more faithful to the original version. Subsequently, the expert committee elected the final version of the instrument to be submitted to the pre-test phase after evaluating the translations, by reaching consensus and comparing the retranslations (Chart 1).

The consolidated version of the self-efficacy scale was initially applied to a convenience sample of 30 adult users of three Family Health Units located in the city of Piracicaba, SP, Brazil. The majority of the participants were female (65%), with a mean age of 45.7 years (sd ± 15.23), and a mean of 11.25 (sd ± 3.9) years of study. They were asked to answer "I did not understand" if they did not understand any word / phrase of the instrument, including instructions for applying the questionnaire.

According to Souza and Rojjanasrirat[16] the percentage of answers "I do not understand" must be lower than 20% for the tool to be considered culturally adapted. If the percentage is higher than this, the process must undergo a new adaptation process until no items were considered misunderstood by more than 20% of participants[16].

There were more than 20% of misunderstandings relative to the word "confident", which was replaced by "capable". The committee chose to use "How capable are you" because of the fact that self-efficacy is defined as belief in the capability to learn, organize and perform health behaviors in different coercive situations[5] and capable has also been used for translation of the English word confident into other instruments of self-efficacy for Brazilian Portuguese language. The same thing happened with the answer options. The following five options: "very confident, "fairly confident", "occasionally confident", "hardly ever confident", "not at all confident" were replaced with five new, more suitable options, as follows: "fully capable", "quite capable" , "capable", "a little capable" and "not capable" so that all response alternatives could be answered in response to the initial question and indicate intensity.

The tool was then submitted to a new pretest with a different sample of 30 individuals, 63.3% female, with a mean age of 44.5 (sd ± 3.7) years and a mean of 11.2 years of schooling. At this stage, the researchers observed that all words were appropriate to the items and were well understood.

With the results of the final pretest, a final Brazilian Portuguese version of the Self-efficacy Scale for brushing at night (Chart 1) was submitted to the validation phase.

Validity and reliability of Self-efficacy scale to brush teeth at night

For the validity and reliability of the self-efficacy scale, 198 adult individuals who had Brazilian-Portuguese as their native language were randomly selected from three Family Health Units in Piracicaba city, SP. Individuals over the age of 18, literate, with no obvious signs of cognitive dis-

Chart 1. Original and final version of the instrument, translated and adapted culturally. Brazil, 2017.

Original version	Brazilian Portuguese version
How confident do you feel about your ability to brush your teeth or false teeth at night when you are:	*O quanto você se sente capaz de escovar seus dentes ou suas próteses à noite quando você está:*
Under a lot of stress	Muito estressado
Depressed	Deprimido
Anxious	Ansioso
Feeling that you do not have time (too busy)	Se sentindo sem tempo (muito ocupado)
Tired	Cansado
Worried about other things in your life	Preocupado com outras coisas da sua vida

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turbances and who were not under the influence of alcohol or drugs were invited to participate in the study. The questionnaires were applied in the individuals' by the self-completion method after the researcher had explained the aims and methodology of the study.

The means with confidence interval, standard deviation and medians were analyzed. The descriptive analysis that preceded the factorial analyses was recommended in the literature[17] as a way to better understand the nature of the data and because it was crucial for the choice of techniques to be used during the factorial analysis[17]. The Kolmogorov-Smirnov Test (K-S) and the Mardia Multivariate Normality Test were used to test normality of the data distribution by asymmetry and flattening[18]. The normality or violation of data determines which extraction technique should be used. In case of violation, polychoric/tetrachoric correlations should be used instead of Pearson's correlation[19,20]. The literature has shown that in cases where there is a violation of normality in data distribution, the polychoric correlation is more precise and robust[21,22].

The exploratory factorial analysis requires the accomplishment of several steps, such as: data inspection, the methods of factor analysis; techniques of factor retention; techniques of factor rotation and cutoff points for the factorial loads[23]. These steps will be systematically presented for construct validation. The dimensionality testing was performed using Robust Parallel Analysis (RPA) through the *Optimal implementation of Parallel Analysis (PA)* with minimum rank factor analysis that minimizes the common variance of residuals[24]. The robustness test was determined from the association of a *bootstrap* with sample extrapolation to 5000. For testing the instrument dimensionality RPA was associated with the latent root (eigenvalues)[25]. UNICO (Unidimensional Congruence > 0.95), ECV (Explained Common Variance > 0.80) and MIREAL (Mean of Item Residual Absolute Loadings < 0.30) were used as indicators of evaluating unidimensionality[26].

Parallel Analysis is considered one of the most robust and accurate techniques for dimensionality testing[21,23,27,28]. Factor extraction was done initially with Robust Unweighted Least Squares (RULS), which reduces the matrix of residuals[29]. If the instrument pointed out more than 1 dimension, a non-orthogonal Promax rotation technique was adopted.

Sample/item ratio: Usually the sample size in psychometric studies is calculated by the ratio between the number of participants and number of items[30,31]. The golden standard recommended a ratio of 20:1 or above. This ratio decreases the errors in factor analysis[32]. The sample of 198 participants for the 6 initial items of the instrument, allowed a ratio of 1:33 that was above the acceptable minimum.

Parameters of quality and adjustment of the instrument, for the exploratory factorial analysis in this study, the criteria adopted for adequacy of the instrument were stipulated, taking into account the number of participants and the levels of parameters that indicated excellent explanation of the model. Thus, the explained variance should be above 60%[32,33]. For the factorial loads, a minimum index of at least 0.40 was established, but as a criterion of superior quality, factorial loads of between 0.50 and 0.70 were sought[32,33] ; and communalities had to have values above 0.40[23,32,34].

For the Confirmatory Factor Analysis (CFA) the decision was to adopt the parameters established by Sivo et al.[35] who considered the number of participants and controls of the model as requirements for indicating the adjustment parameters, which were stricter, and met the aims of this article. Although we had 198 participants in the study, the CFA extraction technique was also robust (bootstrap = 5000). The following parameters were established as minimum indexes for the adequacy of the model: Robust Mean-Scaled Chi Square / df (X2 / df < 5)[36]; NNFI (Non-Normed Fit Index> 0.93); CFI (Comparative Fit Index > 0.94); GFI (Goodness Fit Index > 0.95); AGFI (Adjusted Goodness Fit Index > 0.93); RMSEA (Root Mean Square Error of Approximation < 0.07) and RMSR (Root Mean Square of Residuals < 0.08). The factorial loads in the confirmatory analysis should be higher than 0.50[32].

Internal consistency of the data was evaluated by two indicators, namely: the Cronbach alpha[37] and Omega of McDonald[38]. The adoption of two indicators sought to increase the reliability of interpretation.

The indices of replicability, quality and effectiveness of the solution were used as a way to increase the security of the solution of the proposed model[26,39]. For the construct replicability we used the Generalized G-H Index with a minimum index of 0.80[40] and for the factor Quality and Effectiveness estimation we used the Factor Determinacy Index higher than 0.90 (FDI > 0.90), EAP marginal reliability (> 0.80), sensitivity ratio (SR > 2) and Expected percentage of true differences (EPTD > 90%)[41,42].

Test-retest reliability was assessed by calculating the intraclass correlation coefficient (ICC), with data from the reapplication of the instrument to 39 individuals of the sample, randomly selected two weeks the first interview

The analyses were carried out with the programs SPSS 23, AMOS 23 and Factor 10.8.

Results

The mean value for all items was higher than 2 points with standard deviations representing about 50% of the mean values, indicating a trend of normal data distribution and homogeneity (Table 1). The medians were 2 and 3, which represented a tendency of response to the center of the scale and a point below the center. The asymmetry ranged from 0.72 to 2.47, and there were no acute violations of normality when the items were individually analyzed. The Mardia index (56) = 1587.50, showed that the data did not violate the asymmetry, but there was violation of the Mardia kurtosis (56) = 67.30; $p < 0.0001$. The non-violation of asymmetry allowed the analyses to be based on Pearson's correlation and not on polychoric correlations.

Adequacy levels of the sample were satisfactory with the Kaiser-Meyer-Olkin index (0.82), the Bartlett sphericity (15) = 1505.7; $p < 0.0001$ and the matrix determinant = 0.004, which allowed continuation and adequacy of the analyses. The correlations between the items could also be considered strong and ranged from 0.70 to 0.93.

The dimensionality testing performed through robust parallel analysis indicated the existence of a one-dimensional model with explained variance of 85.7%. The eigenvalue criterion also defined only one dimension with a value of 4.93 and an explained variance of 82.2%, both above the established minimum of 60%. These indices resulted from adequate factor loads and communalities. The indicators that evaluated the unidimensionality of the model confirmed the solution in a single dimension, the UNICO (0.99), the ECV (0.90) and the MIREAL (0.25). Therefore, there was no other feasible solution to this data set than a one-dimensional model.

The analysis of factorial loads and commonalities (Table 2) indicated that all items had factorial loads ranging from 0.85 to 0.91 above the minimum criterion (> 0.40) and established quality indexes (> 0.50). For communalities that ranged from 0.72 to 0.83, values above the established minimum (> 0.40) were also found.

Table 3 allows the visualization of all quality indicators of the exploratory model adjustment, confirmatory analyses and the indexes of reliability and quality of the model adopted. In the same way as the exploratory analysis, the confirmatory analysis pointed out a satisfactory solution with good levels for all indexes of the model. These values were higher than the criteria initially established in the study and recommended by Sivo et al.[35].

The Alpha and Omega had identical indexes of 0.95 showing high levels of model reliability.

The replicability of the construct was measured by the G-H index (ranging from 0 to 1) and evaluated how well a factor was represented by the set of items; that is, how well the items represented the common factor. It also allowed the researchers to be sure that the model would maintain its properties in other data sets and populations. In the model in question the index was 0.959, above the cut-off of 0.80. In addition, the analysis of test-retest reliability demonstrated excellent reproducibility [ICC = 0.89 (95% CI: 0.83 to 0.93)].

With reference to the measures of quality and effectiveness of the model, the FDI presented a high and adequate level (0.97) in evaluating the

Table 1. Descriptive statistics and sample distribution.

	Mean	sd	CI 95%		Median	Sample distribution			
			LL	HL		K-S[a]	sig	Curtose	Asymmetries
Estressado	2.35	1.12	2.19	2.51	2.00	0.18	0.001	-2.52	1.97
Deprimido	2.45	1.23	2.28	2.63	2.00	0.19	0.001	-2.43	2.47
Ansioso	2.33	1.13	2.17	2.49	2.00	0.18	0.001	-2.52	2.14
Sem Tempo	2.55	1.12	2.39	2.70	3.00	0.21	0.001	-2.24	0.72
Cansado	2.56	1.22	2.39	2.73	3.00	0.18	0.001	-2.54	1.38
Preocupado	2.41	1.15	2.25	2.57	2.00	0.18	0.001	-2.03	2.29

[a] Lilliefors Correction ; sd – Standard Deviation ; CI –Confidence Interval ; LL – Low Limit; HL – High Limit; KS - Kolmogorov-Smirnov

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relationship between estimating the scores of the solution and the latent variable that they estimated. The EAP (0.95), SR (4.83) and EPTD (96%) also indicated the quality and effectiveness of the model solution.

Table 2. Factorial Load (λ), Confidence Interval and Communalities (h2)

Item	λ	CI 95% λ	h2
Estressado	0.88	0.76-0.94	0.78
Deprimido	0.85	0.74-0.91	0.72
Ansioso	0.91	0.96-0.94	0.83
Sem Tempo	0.86	0.78-0.91	0.74
Cansado	0.89	0.81-0.93	0.79
Preocupado	0.87	0.87-0.94	0.83

λ – factor load; CI95% - Confidence interval; h2 – communalities

In the path diagram of the confirmatory factor analysis, shown in Figure 2, it is possible to verify the factor loads (λ) and the regression indexes (W). The factor loads were between 0.83 and 0.93 higher than the minimum required (0.50). The values of the regression indexes ranged from 0.68 to 0.83 indicating the satisfactory level of items to predict the latent variable.

Figure 2. The path diagram of the confirmatory factor analysis (factor loads - λ and the regression indexes – W)

Discussion

The present study intended to show psychometric properties of the *Self-efficacy scale to brush teeth at night* in Brazilian adult population.

The expectations of self-efficacy, according to Bandura[43], refer to particular domains of realiza-

Table 3. Adjustment model for Exploratory, Confirmatory and Reliability analysis

	Index	Technique	Self-Efficacy
Exploratory	Adequacy of correlation matrix	Determinant of the matrix	0.0004
		Bartlett	1505 (df = 15)*
		KMO (Kaiser-Meyer-Olkin)	0.82
	Explained Variance (PA)		85%
	Pearson correlation (r =)		0.70 to 0.93
Confirmatory	Robust Mean-Scaled Chi Square (X^2/df = 56)		30.28*
	Non-Normed Fit Index (NNFI)		0.98
	Comparative fit index (CFI)		0.98
	Goodness of Fit Index (GFI)		0.99
	Adjusted Goodness of Fit Index (AGFI)		0.99
	Root Mean Square Error of Approximation (RMSEA)		0.11
	Root Mean Square of Residuals (RMSR)		0.06
Reliability	Standardized Cronbach's Alpha		0.95
	McDonald's Omega		0.95
Unidimensionalidade	Unidimensional Congruence (UNICO)		0.99
	Explained Common Variance (ECV)		0.91
	Mean of item residual absolute loading (MIREAL)		0.25
Quality and Effectiveness	Factor Determinacy Index (FDI)		0.97
	EAP Marginal Reliability		0.95
	Sensitivity Ratio (SR)		4.83
	Expected percentage of true differences (EPTD)		96%

* p = 0.0001

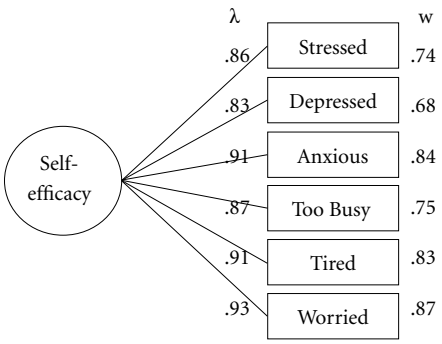

Figure 2. The path diagram of the confirmatory factor analysis (factor loads - λ and the regression indexes – W).

tion, and therefore, their evaluation must be specific for each type of phenomenon investigated. This implies the need to construct instruments adapted to each of them, such as oral health outcomes.

In the dental field, the recommendation is that tooth brushing must be performed at least twice a day to disorganize the oral biofilm and prevent dental caries and periodontal problems[1]. Since saliva is an important elemental tooth cleaning fluid, and as there is a marked reduction in salivary flow during sleep, nocturnal tooth brushing is considered the most important task of the day and should be performed with care[2]. Therefore, the development of instruments that emphasize self-efficacy in performing this task is of extreme relevance, since irregular dental tooth brushing at night is strongly associated with a higher level of dental caries experience[44].

Thus, given the scarcity of specific oral health instruments in the Portuguese language, the present study has made important contributions to the development of future investigations related to the impact of self-efficacy on dental outcomes, and an important alternative for exploring the theme.

The translation and adaptation of instruments previously validated in other languages and countries are procedures considered valid in the scientific field, because in addition to reducing development costs and facilitating the exchange between researchers within the scope of international interchange, these instruments allow the comparisons of results. However, adapting an instrument to another language is a complex process that involves technical, linguistic and semantic aspects that must be taken into account[15,16]. In the case of the present study, these characteristics were evaluated by the committee of experts composed of doctors with expertise in processes of cross-cultural adaptation and validation of instruments of self-efficacy in Brazilian Portuguese, thus guaranteeing an instrument adapted to the Brazilian context.

The exploratory and confirmatory analyses showed the adequacy of items in measuring the instrument construct with adequate levels of factorial loads, communalities, variance explained by the EFA, as well as the factorial loads in the CFA, good levels of the regression values and the adequacy index models. The instrument reliability was measured by the Alpha and Omega indexes, both indicating high levels of reliability. The Cronbach's Alpha obtained in this study was 0.95, identical to that found in the validation study of Jones et al.[13] with Australian homeless people and very close to the value found in the study of Ohara et al.[11] for the development of an oral health-related self-rated self-efficacy scale for use in Japanese older adults (0.924). Moreover this was higher than the value of 0.82 found in the study of Kakudate et. al.[10], for the development of a self-efficacy scale for maternal oral care. The high level of replicability of the scale demonstrated that the instrument was stable for use in other populations and samples; in synthesis, the model would preliminarily maintain its psychometric properties in other conditions[40].

As observed in the present study, the use of precise and robust techniques is mandatory in psychometric studies, both in testing the instrument dimensionality and in the adequacy of the various indicators that demonstrate the instrument validity[23]. In this way, we follow a course with a contemporary psychometric approach that showed indicators that adequately and satisfactorily explained the measured construct, including all the indicators of the exploratory, confirmatory factorial solutions, as well as those of reliability, quality and effectiveness of the model, which demonstrated evidence of the instrument validity.

The limitation of this study was the use of the instrument in a convenience sample, composed of users of primary health care in a city in the interior of the state São Paulo, and was therefore not representative of all adults in the municipality and/or in Brazil. Therefore, it is recommended that the instrument be replicated in populations with different characteristics to those of the present study, for the purpose of either confirming, or not confirming maintenance of the psychometric properties observed in the present study.

Conclusions

The self-efficacy scale to brush teeth at night demonstrated psychometric properties with excellent reliability and validity and can be used as an important resource for planning interventions with the aim of improving the oral health of Brazilians adults.

Collaborations

FMR Bado worked on the research, design, article writing and final editing. F Rebustini worked on statistical analysis and article writing. RG Azzi, LCM Ferreira, GA Souza and L Jamieson worked on article writing and final editing. FL Mialhe worked on the design, article writing and final editing.

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Article submitted 18/09/2018
Approved 17/02/2019
Final version submitted 19/02/2019