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# Psychometric Properties of the Brazilian Version of the Adolescent Health Promotion Scale (AHPS)

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**Abstract** *This study aimed to translate into Portuguese, perform the cross-cultural adaptation and verify the psychometric properties of the Adolescent Health Promotion Scale (AHPS) for use in Brazilian adolescents. The original version was translated following international recommendations. The final version of the translated scale was administered to a sample of 1,949 adolescents of both genders aged 12-18 years. An exploratory factor analysis and then a confirmatory factor analysis were completed to identify the baseline psychometric properties. After minor changes identified in the translation process, the committee of experts considered that the Portuguese version of the AHPS showed semantic, idiomatic, cultural and conceptual equivalence. The factor analysis confirmed the structure of six subscales originally proposed, by statistical indicators equivalent to χ2/df=1.83, CFI=0.948, GFI=0.969, AGFI=0.956 and RMSR=0.052. Factor validity and reliability were confirmed by suitable factor loadings and desirable realms of composite reliability (>0.7) average variance extracted (>0.5). In conclusion, translation, cross-cultural adaptation and psychometric properties of the AHPS were satisfactory, thus enabling its application in future Brazilian studies.*

**Key words** *Questionnaire, Psychometrics, Health Promotion, Adolescent Behavior*

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## Introduction

Reconciling the technological advances and the modernity of the present day with the adoption of health promotion-oriented behaviors is one of the significant challenges of contemporary society[1]. Evidence available in literature shows that the leading causes of morbidity and premature death are directly related to modifiable risk behaviors, such as inadequate eating habits[2], insufficient physical activity[3], tobacco use[4], alcohol consumption[5], among others[6].

Most risk behaviors start at an early age, especially during adolescence[7]. As a result, experimentation and consolidation of risk behaviors in this development period strongly compromise the health of young people, with severe repercussions throughout life and with low possibility of reversing their harmful effects[8]. In this regard, adolescence is marked by profound physical, cognitive and emotional transformations as a consequence of the biological maturation process. Young people still experience a set of stressful situations and abrupt changes in behavior resulting from the interaction between social context, relationship with peers and living environment, which calls for special consideration[9].

Based on the assumption that the promotion of healthy behaviors in young populations can help reduce the emergence and development of noncommunicable diseases in adulthood[1,7,9], valid and reliable measurement tools capable of identifying and monitoring health promotion behaviors among adolescents are required. In this perspective, the most commonly used measures proposed to meet this purpose are the *Health-Promoting Lifestyle Profile*[10], the *Adolescent Lifestyle Questionnaire*[11], the *Teenage Lifestyle Profile*[12] and the *Adolescent Health Promotion Scale (AHPS)*[13]. In this regard, the *Adolescent Health Promotion Scale* (AHPS) has been prominent worldwide, translated into several languages and used in different cultures[14,15], as well as employed to monitor the effects of health education programs[16].

The AHPS consists of 40 items designed to detect self-reported healthy practices, where the respondent indicates the level that most applies to his case, using a five-point Likert scale (1 = "Never"; 2 = "Rarely"; 3 = "Sometimes"; 4 = "Usually"; 5 = "Always"). Then, after handling the scores assigned to each item, one can identify, measure and sort six subscales associated with health promotion specifically for adolescents: (a) nutrition behavior; (b) social support; (c) health responsibility; (d) life appreciation; (e) exercise behavior; and (f) stress management.

The AHPS content is based on findings from previous studies and observations from a panel of 14 behaviors studied and examined by experts. Initially, its content validity and its psychometric properties were examined in a sample of Asian adolescents, where it was defined as a highly reliable scale, which, a priori, suggests its use in other regions of the world. However, previous studies involving Asian and North American adolescents identified relevant cultural diversities that influence the standing of young people from different countries in the face of health promotion behaviors[14].

Thus, considering that the practical and easy use of the AHPS can promote themes of interest to the academic and professional communities in the area of health education, and the possibility of making a significant contribution to the acquisition and dissemination of useful knowledge in the formulation of new studies aimed at promoting health at young ages, this study aimed to translate and perform a transcultural (semantic, idiomatic, cultural and conceptual equivalence) adaptation and then to verify the psychometric properties (factor validity and reliability) of AHPS for use in Brazilian adolescents.

## Methods

### Translation and cross-cultural adaptation

The translation and transcultural adaptation protocols followed internationally-suggested procedures[17]. The initial translation of the original language into English was carried out independently by two researchers with a detailed understanding of AHPS. The two researchers were Portuguese native speakers, mastered the English language, and were experienced translators of academic texts. Besides the translation, they were asked to record expressions that could cause a dubious interpretation.

A bilingual group of three health researchers compared the translated texts, standardizing the use of different expressions, and a single version of the questionnaire that synthesized the two previous versions was produced. Then, the back-translation of the scale was performed by two other translators independently. The translators chosen for this stage were English native speakers, mastered the Portuguese language and worked as university professors at a Brazilian

institution. Translators were asked to record expressions that might cause dubious interpretation in the back-translation process. The bilingual group compared both back-translated texts and produced a single version.

A committee reviewed the translation process and the results achieved in previous steps. The committee consisted of eight members, including the authors of the study, the translators who participated in the translation/back-translation process, and two university health professors, all Portuguese-English bilingual. The committee reviewed the seven versions of AHPS available: the original English version, two versions translated into Portuguese, the synthesis version of both Portuguese translations, two versions of back-translation and the synthesis version of both back-translations.

The committee assessed the types of equivalence between the original instrument and the Portuguese language version. The members received written guidelines on the purpose of the study and the definitions adopted for equivalence. Each one responded individually to an analysis form that compared each item of the original scale, the synthesis version translated into Portuguese and the back-translation synthesis version, regarding the semantic, idiomatic, cultural and conceptual equivalence. The analysis form was structured using differential scaling with discrete alternatives: "*not modified*", "*slightly modified*", "*substantially modified*" and "*completely modified*".

**Population and sample**

The next step of the study was to perform the AHPS test translated into Portuguese to identify indicators of its psychometric properties. The study target population consisted of students of both genders, aged 12-18 years, were 6$^{th}$ to 12$^{th}$ graders in schools of Londrina, Paraná. According to information from the Secretariat of Education of the State of Paraná, this population was estimated at approximately 90 thousand students in the 2016 school year. A representative sample was obtained through a probabilistic process by clusters, taking as reference the number of students considered by administrative office (public and private), gender, year of schooling and the shift of those enrolled in each school.

The sample size was established assuming a 95% confidence interval, a sampling error of three percentage points and 10% increase to cater for cases of data collection losses. Since sample planning involved conglomerates, a design effect (*deff*) of 1.5 was defined, and, thus, a minimum sample of 1,900 schoolchildren was initially estimated. However, the final sample used in data processing consisted of 1,949 schoolchildren (1,032 girls and 917 boys).

**Instrument and procedures**

Besides the AHPS translated and adapted for use with Brazilian adolescents, a brief sociodemographic questionnaire, which included questions about gender, age, schooling year, school shift enrollment, and family economic class, was employed. The study was approved by the Human Research Ethics Committee of the University of North Paraná – *Plataforma Brasil*.

Data collection was performed from February to June 2017 by a team of researchers who were knowledgeable about the instrument and trained in its procedures. The classroom chosen for the study was visited, and the objectives of the research, the principles of confidentiality, non-identification in the study and non-influence on school performance were explained to the students. The students were invited to participate in the study and received instructions on how to complete the Informed Consent Form.

The classroom was revisited after a week and the students received a copy of the sociodemographic questionnaire and the AHPS with instructions and recommendations for their self-completion, for which no time limit was set. Any concerns by the respondents were promptly clarified by the researchers who followed the application of the scale.

The criteria adopted to exclude some students of the selected classroom were: (a) absence from classes on the scheduled date for the application of the scale; (b) refusal to participate in the study; (c) non-authorization of parents or guardians; (d) inadequate completion of scale items (more than one response to one item or unanswered item); and (e) age under 12 years or over 18 years.

**Data analysis**

Initially, involving the entire selected sample, mean and standard deviation values were calculated, accompanied by the symmetry and kurtosis indications of each AHPS item to verify the univariate normality behavior of the distribution. The multivariate normality was analyzed employing the Mardia's test assuming a boot-

strapping procedure. Then, the total sample was randomly divided into two independent equally sized subsets to identify the psychometric properties, ensuring a proportional representation of the distribution of the participants in the strata related to the gender, age and schools' administrative structure.

The exploratory factor analysis (EFA) was used in the first subset ($n_1 = 975$), adopting the technique of principal components with orthogonal rotation (Varimax). The suitability of the subset of data for EFA procedures was verified using Kaiser-Meyers-Olkin (KMO) and Bartlett sphericity tests. The factor matrix of scores derived from the 40 items were observed by items-factor saturation analysis. Thus, we used bivariate correlations using Pearson's correlation coefficient. In this case, items with factor saturation lower than $\lambda = 0.40$ or that were represented in more than one factor with factor saturation $\lambda \geq 0.40$ were assumed as an exclusion criterion. The Cronbach's alpha calculations were used for internal consistency analysis, followed by mean, standard deviation and inter-factor bivariate correlations.

The procedures of hierarchical confirmatory factor analysis (CFA) using the Maximum Likelihood estimation method were conducted with the data collected in the second subset of the sample ($n_2 = 974$) to test the factor structure extracted through the EFA and verify the validity of convergent and discriminant constructs. The fit between the proposed theoretical model and the data matrix was tested using multiple criteria: chi-square and degrees of freedom ($\chi^2$/df), Comparative Fit Index (CFI), Goodness-of-Fit Index (GFI), Adjusted Goodness-of-Fit Index (AGFI) and Root Mean Square Residual (RMSR). In this case, $1 < \chi^2/df < 3$, CFI, GFI and AGFI $\geq 0.9$, along with RMSR values $\leq 0.08$ suggest a good model fit[18]. The convergent validity of the factor model was analyzed by the Composite Reliability (CR) and the Average of Variance Extracted (AVE) for each factor, with CR > 0.7 and AVE > 0.5[19] expected. The discriminant validity of the factor model was verified by comparing the AVE of each factor with the shared variance (Pearson's correlation coefficient squared) among all pairs of factors. AVEs greater than the respective shared variances were suggestive of discriminant validity[19].

Additionally, a multi-group analysis was conducted, setting factor loadings, variance/covariance, and residuals to estimate the factor invariance of the adjusted model for the use of the AHPS in students of both genders and different ages. Differences between chi-square ($\Delta\chi^2$) values, respective degrees of freedom ($\Delta df$) and CFI ($\Delta CFI$) were considered to identify any significant differences between the sub-models extracted separately by gender (girls versus boys) and age (12-13 years versus 14-15 years versus 16-18 years). Values of $p > 0.05$ for $\Delta\chi^2$ and $\Delta CFI \leq 0.01$ were the criteria assumed to define factor invariance[20]. Data were processed using *SPSS* and *AMOS* computerized statistical packages, version 22.

## Results

Discrete divergences in the use of expressions were observed in the stages of the translation process. Any divergence was discussed in the review committee, and expressions of easier understanding and frequent use prevailed to facilitate understanding. Of the 40 items in the translated version of the AHPS, 28 (70%) were labeled as "not modified" regarding the semantic, idiomatic, cultural and conceptual equivalence by the members of the analysis committee. The remaining 12 (30%) were considered "slightly modified" in at least one equivalence by the committee members. No item from the translated version of AHPS was "substantially modified" or "completely modified" compared to the original version.

Mean and standard deviation values followed by asymmetry and kurtosis indexes for each item individually (n = 1,949) are shown in Table 1. The scores equivalent to the 40 items had normal data distribution (asymmetry and kurtosis in the interval ± 1) and mean values ranging from 2.48 to 4.44, with associated standard deviations between 0.63 and 1.57. The multivariate data normality was confirmed with the Mardia index = 3.17.

Regarding the adequacy of the first subset of data for the use of EFA procedures, the KMO test value was equivalent to 0.954 and the Bartlett sphericity test $\chi^2_{(1254)} = 9281.6$ ($p < 0.001$), pointing to the legitimacy of the factor analysis. Information available from the EFA can be observed in Table 2. A detailed analysis of the factor matrix revealed that all "r" values associated with factor weight showed statistical significance ($p < 0.001$). However, six items were removed because they did not meet the previously established criteria for permanence in the factor structure. In this case, we excluded items 6 (*I have breakfast*

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**Table 1.** Descriptive statistics equivalent to the Adolescent Health Promotion Scale (AHPS) items translated and applied to students of both genders.

| Item | Mean | Standard deviation | Asymmetry | Kurtosis |
|---|---|---|---|---|
| 1 – Has three daily meals | 3.31 | 1.13 | -0.59 | -0.82 |
| 2 – Prefers low-fat foods | 3.23 | 1.41 | -0.81 | -0.43 |
| 3 – Includes fiber-rich foods in the diet | 3.62 | 1.28 | -0.46 | -0.77 |
| 4 – Drinks at least 1.5 liters of water per day | 3.35 | 1.05 | -0.33 | -0.81 |
| 5 – Includes five food groups at meals | 3.30 | 0.99 | -0.31 | -0.68 |
| 6 – Has breakfast every day | 3.83 | 1.10 | -0.57 | -0.89 |
| 7 – Shares his/her feelings with other people | 3.11 | 1.36 | 0.23 | -0.44 |
| 8 – Cares about other people | 3.67 | 1.15 | -0.64 | -0.82 |
| 9 – Talks about his/her concerns with other people | 3.19 | 1.29 | 0.41 | -0.36 |
| 10 – Smiles every day | 4.02 | 0.78 | -0.98 | -0.78 |
| 11 – Likes to relate to relatives | 4.28 | 0.63 | -0.95 | 0.80 |
| 12 – Seeks to have good friendships | 4.44 | 0.84 | -1.12 | 0.67 |
| 13 – Talks about his/her problems with other people | 3.10 | 1.57 | 0.34 | -0.54 |
| 14 – Reads packaging labels when purchasing food | 2.72 | 1.42 | 0.84 | -0.83 |
| 15 – Is concerned with maintaining body weight | 3.48 | 1.26 | -0.21 | -0.37 |
| 16 – Discusses with professionals about his/her health | 2.48 | 1.44 | 0.49 | -0.21 |
| 17 – Observes/analyzes his/her body at least once a month | 3.11 | 1.03 | -0.17 | -0.17 |
| 18 – Brushes his/her teeth and flosses after meals | 3.92 | 1.24 | -0.48 | -0.55 |
| 19 – Washes his/her hands before meals | 4.06 | 0.92 | -1.05 | 0.95 |
| 20 – Reads health information | 3.15 | 1.29 | 0.54 | -0.43 |
| 21 – Selects food without preservatives | 3.02 | 1.42 | 0.47 | -0.64 |
| 22 – Likes himself/herself | 4.17 | 0.89 | -1.03 | 0.88 |
| 23 – Feels happy and satisfied | 4.29 | 0.96 | -0.92 | 0.45 |
| 24 – Usually thinks positively | 4.11 | 0.72 | -0.86 | -0.79 |
| 25 – Understands and accepts his/her strengths and weaknesses | 3.85 | 1.04 | -0.35 | -0.42 |
| 26 – Tries to correct his/her faults | 3.96 | 1.11 | -0.99 | -0.59 |
| 27 – Seeks to identify what is important to him/her | 4.06 | 1.02 | -1.11 | 1.02 |
| 28 – Feels interested and challenged every day | 3.84 | 1.38 | -0.73 | -0.66 |
| 29 – Believes that life has a purpose | 4.21 | 0.80 | -1.00 | 0.89 |
| 30 – Performs stretching exercises every day | 3.13 | 1.38 | 0.62 | -0.17 |
| 31 – Performs 30 minutes of vigorous exercise three times a week | 3.49 | 1.32 | 0.37 | -0.21 |
| 32 – Participates in physical education classes at school | 4.39 | 0.78 | -0.93 | 0.76 |
| 33 – Warms up before vigorous exercise | 3.98 | 1.32 | -0.96 | -0.83 |
| 34 – Adopts proper posture when standing or sitting | 3.24 | 1.48 | 0.85 | -0.64 |
| 35 – Spends some time daily to relax | 3.75 | 1.22 | -0.79 | -0.81 |
| 36 – Tries to identify the causes of his/her stress | 3.72 | 1.26 | -0.73 | -0.51 |
| 37 – Pays attention to mood swings | 3.84 | 1.09 | -0.63 | -0.75 |
| 38 – Sleeps 6 to 8 hours per night | 4.04 | 1.00 | -0.71 | -0.83 |
| 39 – Plans and establishes priorities | 3.68 | 1.37 | -0.70 | -0.41 |
| 40 – Tries not to lose control when something unfair happens to him/her | 3.74 | 1.40 | -0.81 | -0.94 |

*every day*), 10 (*I try to smile or laugh every day*), 12 (*I try to have good friends*), 18 (*I brush my teeth and floss after meals*), 19 (*I wash my hands before meals*) and 34 (*I try to assume a proper posture when standing or sitting*) because they have insufficient saturation ($\lambda < 0.40$). The factor solution of the data matrix defined six factors with *eigenvalues* greater than one unit, contributing to

**Table 2.** Exploratory factor analysis of the Adolescent Health Promotion Scale (AHPS) translated and applied in students of both genders.

| Item | Factor 1 | Factor 2 | Factor 3 | Factor 4 | Factor 5 | Factor 6 |
|---|---|---|---|---|---|---|
| 22 | 0.84 | | | | | |
| 23 | 0.92 | | | | | |
| 24 | 0.91 | | | | | |
| 25 | 0.82 | | | | | |
| 26 | 0.78 | | | | | |
| 27 | 0.79 | | | | | |
| 28 | 0.80 | | | | | |
| 29 | 0.86 | | | | | |
| 35 | | 0.70 | | | | |
| 36 | | 0.80 | | | | |
| 37 | | 0.83 | | | | |
| 38 | | 0.71 | | | | |
| 39 | | 0.76 | | | | |
| 40 | | 0.71 | | | | |
| 7 | | | 0.78 | | | |
| 8 | | | 0.65 | | | |
| 9 | | | 0.80 | | | |
| 11 | | | 0.72 | | | |
| 13 | | | 0.77 | | | |
| 1 | | | | 0.67 | | |
| 2 | | | | 0.73 | | |
| 3 | | | | 0.81 | | |
| 4 | | | | 0.65 | | |
| 5 | | | | 0.72 | | |
| 14 | | | | | 0.66 | |
| 15 | | | | | 0.72 | |
| 16 | | | | | 0.77 | |
| 17 | | | | | 0.74 | |
| 20 | | | | | 0.71 | |
| 21 | | | | | 0.79 | |
| 30 | | | | | | 0.74 |
| 31 | | | | | | 0.79 |
| 32 | | | | | | 0.69 |
| 33 | | | | | | 0.67 |
| *Eigenvalues* | 12.52 | 7.48 | 3.75 | 2.13 | 1.40 | 1.08 |
| % Variance | 21.08 | 11.84 | 10.48 | 9.11 | 7.74 | 4.93 |
| | | 32.92 | 43.40 | 52.51 | 60.25 | 65.18 |

Factor 1: Life Appreciation; Factor 2: Stress Management; Factor 3: Social Support; Factor 4: Nutrition Behavior; Factor 5: Health Responsibility; Factor 6: Exercise Behavior.

explain jointly about 65% of the total variance and commonalities higher than 0.52. The definition of the six factors confirms the original proposal of the AHPS, thus recommending the use of identical names: life appreciation (factor 1), stress management (factor 2), social support (factor 3), nutrition behavior (factor 4), health responsibility (factor 5) and exercise behavior (factor 6).

Regarding the magnitude of the internal consistency rates of the six subscales pointed out by the factor structure, preliminary statistics that underpin their estimates were performed before the calculations of the Cronbach's alpha coefficients (Table 3). The mean values found ranged from 3.14 to 4.14, with standard deviations between 0.92 and 1.30. At first, these findings concerning descriptive statistics strongly support the reliability of the internal consistency estimates, considering that none of the mean value of the subscales, in isolation, neared the possible extreme scores (1 or 5). It is also important to note that the variability of the individual scores was restricted, thus denoting some homogeneity in their dispersion, regardless of the factor considered. Bivariate correlations between subscales showed values between 0.52 and 0.78. When calculating Cronbach's alpha coefficients, dimensions ranging from 0.74 (exercise behavior) to 0.87 (life appreciation) were identified, which points to desirable internal consistency rates for the format of the translated and adapted version of the AHPS.

Once the factor structure was defined using EFA procedures, the indicators associated with the validation of the proposed model were analyzed. Thus, CFA procedures were used in the second subset of the sample. Initially, with the help of the Box Plot chart, we verified the lack of outlier cases, thus meeting an important assumption for the CFA procedures. Figure 1 shows information equivalent to the factor structure of the proposed model. We immediately note that the CFA supports the hypothesis of the presence of six subscales, as shown by the adjustment indexes equivalent to $\chi^2 = 1385.17$, df = 757, $\chi^2/df = 1.83$, CFI = 0.948, GFI = 0.969, AGFI = 0.956 and RMSR = 0.052 [95%CI: 0.054 – 0.061]. Furthermore, the factor loadings ranged between 0.65 and 0.92, with satisfactory residual variances.

Table 4 provides information for the analysis of convergent and discriminant validities. In this respect, the convergent validity is supported by dimensions equivalent to CR ranging from 0.79 (exercise behavior) to 0.90 (stress management) and to the AVE between 0.72 (exercise behavior) and 0.82 (life appreciation). Regarding the discriminant validity, it is verified that the dimensions of the shared variances are inferior to the AVEs of each subscale, which allows us to

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**Table 3.** Descriptive statistics, Cronbach's alpha coefficient and bivariate correlations between subscales of the Adolescent Health Promotion Scale (AHPS) translated and applied in students of both genders.

| | Mean | Standard deviation | Cronbach's alpha | Nutrition | S_Social | R_Health | A_Life | Exercise |
|---|---|---|---|---|---|---|---|---|
| Nutrition | 3.41 | 1.26 | 0.80 | - | - | - | - | - |
| S_Social | 3.51 | 1.30 | 0.84 | 0.68 | - | - | - | - |
| R_Health | 3.14 | 1.18 | 0.81 | 0.53 | 0.56 | - | - | - |
| A_Life | 4.14 | 0.92 | 0.87 | 0.71 | 0.69 | 0.52 | - | - |
| Exercise | 3.72 | 1.19 | 0.74 | 0.69 | 0.78 | 0.61 | 0.68 | - |
| M_Stress | 3.84 | 1.22 | 0.85 | 0.77 | 0.76 | 0.54 | 0.63 | 0.69 |

Nutrition: Nutrition Behavior; S_Social: Social Support; R_Health: Health Responsibility; A_Life: Life Appreciation; Exercise: Exercise Behavior; M_Stress: Stress Management.

assume, by the CFA bias, adequate factor validity and reliability of the translated and adjusted AHPS version for use with the adolescents.

Indicators related to the factor invariance tests between different gender and age strata are shown in Table 5. The multi-group analysis conducted for gender showed values of $\Delta\chi^2$ and $\Delta CFI$ that reveal the existence of invariance between girls and boys in the factor structure of the model considered. Likewise, we found indicators that suggest proper adjustments for the models that fixed factor loadings, variance/covariance and residuals in the three age groups (12-13 years versus 14-15 years versus 16-18 years). However, it should be noted that, even if adequate, adjustments were improved when comparing gender-related strata than when comparing age-related strata.

## Discussion

This study aimed to translate, transculturally adapt and verify the psychometric properties for use in the Brazilian context of AHPS, directed to the analysis of the adolescent health promotion behaviors. The implementation of the stages of the translation process of the measurement scale was not harder due to the methods adopted and the objective and straightforward structure of the AHPS items formulation. The initial translation performed by the two translators suffered few changes in subsequent steps. When compared to the original version, the back-translation showed few discrepancies resulting from adjustments made to meet the specifics of certain items. The analysis of semantic, idiomatic, cultural and conceptual equivalence, in other words, transcultural adaptation, such as the translation stage, evidenced that the instrument was easy to translate.

The equivalence analysis showed that the AHPS subscales are adequate and the attributes used in the original version of the scale are equally valid for the target culture, which meets the cultural equivalence. The conceptual equivalence showed that few items required adjustment. The items could be considered in a similar way to the original format, indicating, once again, that the formulation structure of the AHPS was well elaborated. As far as language equivalence is concerned, the translated version showed that almost all of the items were not modified and no item required significant changes when comparing the original, translated and back-translated versions of the instruments.

Concerning the factor structure of AHPS translated and adapted to the Portuguese language, we verified that the criteria for EFA adequacy were similar to those found in the original version, with KMO = 0.954, compared to KMO = 0.940 observed by Chen et al.[13], and a Bartlett's sphericity test was significant ($p < 0.001$) in both cases. All 40 items behaved as per expectations of understanding the subscales and their answers; however, six items (items 6, 10, 12, 18, 19 and 34) were removed due to poor factor saturation ($\lambda < 0.40$). Thus, a model with an identical number of factors (six subscales) was pointed out; however, gathering no more than 34 items.

Several reasons justify the lower factor saturation observed between each of the removed items and the respective theoretical subscales. For

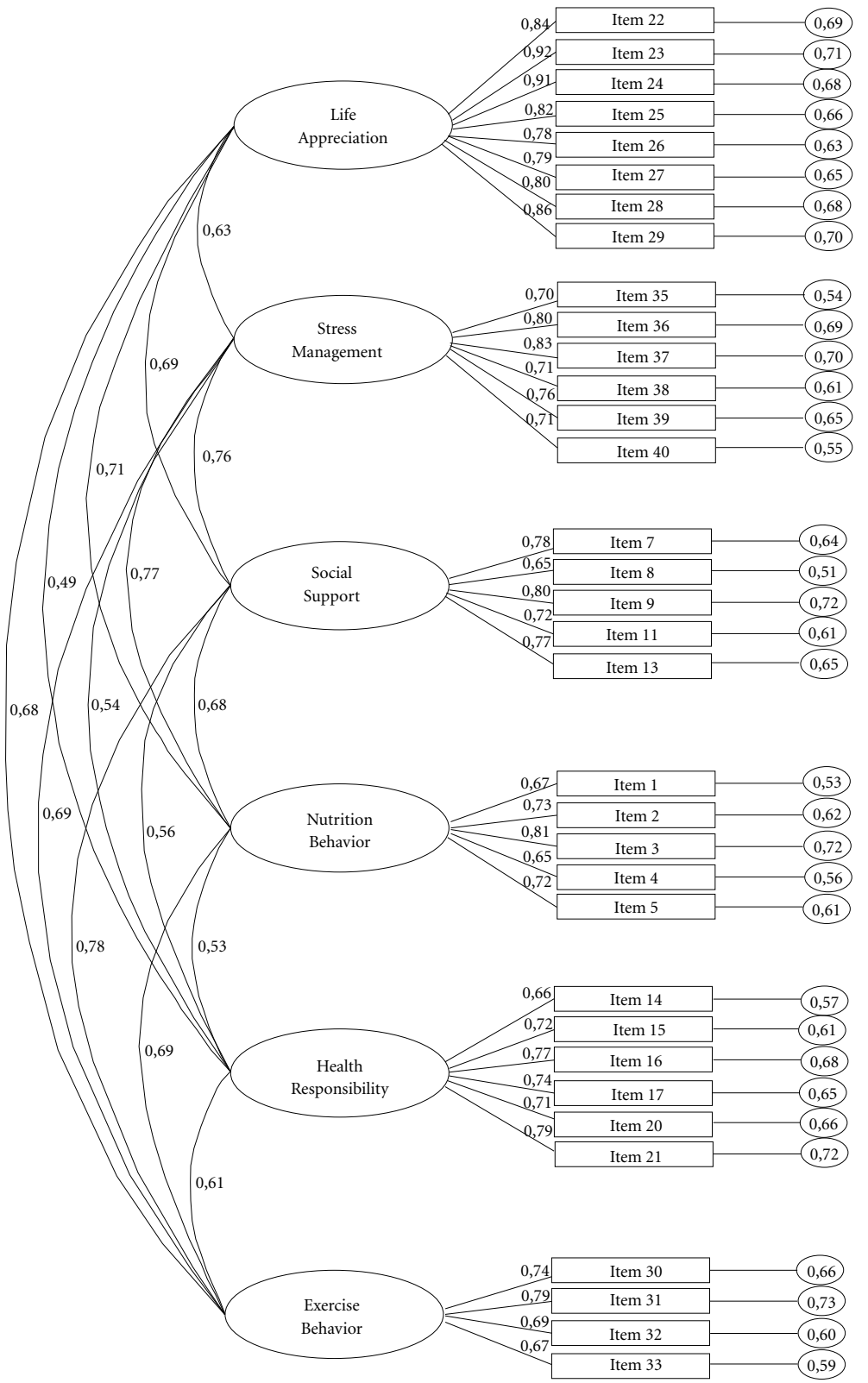


**Figure 1.** Factor structure of the Adolescent Health Promotion Scale (AHPS) translated and applied in adolescents. The ellipses represent the subscales, and the rectangles, the scale items. Residual variances are shown in smaller circles.

**Table 4.** Composite reliability (CR) average variance extracted (AVE) and shared variances of the Adolescent Health Promotion Scale (AHPS) subscales translated and applied in students of both genders.

| | CR | AVE | Shared variances[1] | | | | |
|---|---|---|---|---|---|---|---|
| | | | Nutrition | S_Social | R_Health | A_Life | Exercise |
| Nutrition | 0.82 | 0.73 | - | - | - | - | - |
| S_Social | 0.85 | 0.77 | 0.46 | - | - | - | - |
| R_Health | 0.84 | 0.75 | 0.28 | 0.31 | - | - | - |
| A_Life | 0.89 | 0.82 | 0.50 | 0.48 | 0.27 | - | - |
| Exercise | 0.79 | 0.72 | 0.48 | 0.61 | 0.37 | 0.46 | - |
| M_Stress | 0.90 | 0.80 | 0.59 | 0.58 | 0.29 | 0.40 | 0.48 |

[1] Square of the correlation coefficient between each pair of subscales. Nutrition: Nutrition Behavior; S_Social: Social Support; R_Health: Health Responsibility; A_Life: Life Appreciation; Exercise: Exercise Behavior; M_Stress: Stress Management.

**Table 5.** Indicators produced by multi-group confirmatory factor analysis for factor invariance tests between different strata related to gender and age.

| | $\chi^2$ | df | $\Delta\chi^2$ | Δdf | p-value | CFI | ΔCFI |
|---|---|---|---|---|---|---|---|
| **Gender** | | | | | | | |
| Model 1 | 821.82 | 310 | - | - | - | 0.926 | - |
| Model 2 | 831.90 | 324 | 10.08 | 14 | > 0.05 | 0.923 | 0.003 |
| Model 3 | 837.27 | 326 | 15.45 | 16 | > 0.05 | 0.921 | 0.006 |
| Model 4 | 846.67 | 338 | 24.85 | 28 | > 0.05 | 0.919 | 0.007 |
| **Age** | | | | | | | |
| Model 1 | 834.65 | 310 | - | - | - | 0.920 | - |
| Model 2 | 846.83 | 324 | 12.18 | 14 | > 0.05 | 0.913 | 0.007 |
| Model 3 | 855.45 | 326 | 20.80 | 16 | > 0.05 | 0.910 | 0.010 |
| Model 4 | 865.65 | 338 | 31.04 | 28 | > 0.05 | 0.905 | 0.015 |

χ2: chi-square; df: degrees of freedom; Δχ2: differences between chi-square values; Δdf: differences between degrees of freedom; CFI: Comparative Fit Index; ΔCFI: differences between Comparative Fit Index values. Model 1: Configuration model (all parameters are free to be estimated); Model 2: Model in which factor loadings are contrasted; Model 3: Model in which variance/covariance are contrasted; Model 4: Model in which residuals are contrasted.

example, in the case of item 6 of the nutritional subscale "Having breakfast every day", it may not have integrated this subscale considering that a significant proportion of Brazilian adolescents do not know that breakfast is an important meal for health promotion. Regarding items 10 and 12, which underlie the social support subscale (item 10: "I try to smile or laugh every day"; item 12: "I try to have good friends"), a probable reason may be associated with the fact that these two items do not indicate actual actions to the respondent like the other items, but a proposed initiative ("try") to perform both actions. It is worth noting the need to analyze further the attempt to reformulate the statement of both items since previous studies conducted in other cultures have also identified very low factor saturations[15,21]. The opposite may be the case of items 18 and 19, which are originally covered in the health responsibility subscale (item 18: "I brush my teeth and floss after meals"; item 19: "I wash my hands before meals"), since they are the only items that refer to specific and daily actions. Moreover, in Brazilian culture, both actions are considered basic behavior habits that are learned from a very early age and, therefore, may not be considered by the adolescents as attributes of health responsibility, but rather as questions of manners. In the case of item 34, in the original measurement instrument of the exercise behavior subscale ("I try to adopt an adequate posture when standing or sitting"), adolescents may have shown some difficulty in making a connection

between paying attention to posture and exercise behavior, suggesting perhaps that this item can be defined as an isolated factor, which is supported by the variability of its factor saturation, as shown in several previous studies[15,22,23].

Another essential difference to be highlighted between the original AHPS model and the model resulting in this study refers to the explained variance proportion. The AHPS was initially proposed with 40 items distributed in six latent factors and explained variance of around 51%, while after removing six items and keeping the same six factors in their translated version, the explanatory capacity of the model hiked to a rate close to 65%. When reviewing information available in the literature, we found that few studies have explored the original structure of the items that underlie the AHPS. For example, in Portugal, the factor analysis of the scale confirmed a structure of six factors and 40 items with a total variance of 45.6%[21]. However, when factor saturations were examined, it was found that, although they were not removed from the factor structure, 13 of these items were loaded on the factors with $\lambda < 0.40$. Another study involving adolescents from Chile chose to remove eight items with insufficient factor saturation. In this case, the remaining 32 items distributed over the six AHPS factors explained variance of 62%[15]. Interestingly, five of the six items removed in this study also evidenced low factor saturations in the Portuguese and Chilean studies, suggesting that these items have a weak performance in other configurations, which justifies their removal.

Previous studies carried out in other regions of the world indicate that the order of the factors considered in the AHPS, defined by the dimensions of the variances explained by each subscale, may differ from one another. This is justified because adolescents from different cultures assign different levels of importance to the same health promotion behaviors. In the original study of AHPS proposal, involving Asian adolescents[13], the main subscale was social support (28.8%) and the least important subscale was exercise behavior (3.5%). In Portugal[21], life appreciation (10.1%) and nutrition behavior (4.3%) were the most and least important subscales, respectively; similar to that found in Turkey[24], with a ratio equivalent to 17% (life appreciation) and 3.4% (nutrition behavior). In Chile[15] and in this study, the subscale of life appreciation (19% and 21.1%, respectively) was confirmed as the most prominent; however, the subscale exercise behavior (6% and 4.9%, respectively) ranked as the least important. These findings refer to the position that, when designing intervention actions geared to health promotion, an important consideration to be taken into account is adapting their contents according to the importance that the adolescents to be benefited assign to the different behaviors in the health promotion concept. Also, it should be emphasized that, in all of the localized studies, and this study, the subscale life appreciation explained a high proportion of the total variance, which makes it essential for health promotion regardless of the culture of adolescents.

With values equivalent to Cronbach's alpha greater than 0.70 in all subscales extracted from the factor structure, it is assumed that the translated version of AHPS adjusted for 34 items had acceptable internal consistency, which points out its reliability for the analysis of health promotion behaviors of adolescents in the Brazilian context. However, it was observed that, in comparison with the original version, in general, the internal consistency of each subscale was slightly higher in the factor structure of the AHPS translated into the Portuguese language. Yet the amplitude of variation between the highest (0.87) and the lowest (0.74) score was identical to that shown by the original version (0.88 and 0.75, respectively), suggesting an equal balance between the subscales in both versions of AHPS.

In the set of six subscales of health promotion behavior identified in the translated version of AHPS, even considering the statistical requirement of acceptance (Cronbach's alpha $\geq 0.70$)[25], exercise behavior was the one with the lowest internal consistency (0.74). The possible justification for this finding may be associated with the fact of gathering the least amount of items (4 items), which may lead to greater difficulty for adolescents to position themselves in this attribute. It should be noted that, in the study proposing the AHPS, the exercise behavior subscale was also defined as the one with the greatest difficulty in achieving adequate internal consistency[13].

When verifying the convergent validity, the favorable dimensions of CR are highlighted, revealing that the subscale indicators contribute substantially to the description of the latent construct (health promotion behavior). Also, the dimensions equivalent to the AVE translated proportions of variance of the items that are explained by the subscale to which they belong as extremely satisfactory. In the case of discriminant validity, the results indicated that the entire set of shared variances were lower than the respective AVEs of each subscale, which meets the desired

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validation requirements. It is worth mentioning that CR and AVE analyses related to the psychometric structure of AHPS may be impaired since previous studies that have considered both validation criteria have not been found in the literature, which justifies the importance of approaching convergent and discriminant validities in the current study. Another important finding was the confirmation of the factorial invariance, showing that there is strong evidence that the treated version of AHPS can identically identify health promotion behaviors in both genders, regardless of the age between 12 and 18 years.

To the best of our knowledge, this is the first study conducted in Brazil with the purpose of reporting the proposal and verifying the psychometric properties of a parsimonious scale in order to identify health promotion behaviors in adolescents. Some of the strengths of the study worth highlighting are the robust protocols used for translation and transcultural adaptation of the measurement scale and that data used to define the psychometric properties have been collected in a random sample representative of a population of adolescents. An additional strength was the use of two independent sets of data involving various analysis procedures directed to the AHPS factor validity and reliability estimates.

On the other hand, one possible limitation of the study refers to the lack of analysis of the concurrent validity of AHPS. However, the lack of Brazilian data from other scales regarding adolescent health promotion behaviors hindered efforts to address this essential validation criterion. Also, the test-retest reproducibility of AHPS was not verified in the study. Thus, considering the importance of identifying the susceptibility of the scale to external influences when applied at different times, other investigations must be carried out in an attempt to assess its stability in application replications. Another aspect to be observed is that the study sample gathers adolescents from the school population of a medium-sized city located in the southern region of the country. Therefore, although careful procedure of sample definition and selection of adolescents has been employed, future investigations are required to extend the psychometric properties of AHPS identified in this study to other Brazilian geographic regions.

In conclusion, the AHPS translated and adapted to the Portuguese language achieved a good psychometric performance compared to the study sample, extracting a factor structure similar to the original version. The factor solution generated through the EFA and validated through CFA indicators consisted of 34 items and six subscales with factor invariance confirmation for gender and age. The factor validity and reliability were confirmed by satisfactory factor loadings and desired dimensions of CR and AVE. As a result, the version of AHPS available shows to be promising for use in future interventions to perform diagnoses and follow-up actions geared to health promotion behaviors in the Brazilian context. At the same time, providing a validated and reliable international measurement scale facilitates the development of comparative studies.

## Collaborations

DP Guedes and MA Zuppa participated in the design and outline of the study, data analysis and interpretation and the drafting of the manuscript.

## References

1. World Health Organization (WHO). *Milestones in Health Promotion Statements from Global Conferences*. Geneva, Switzerland: WHO; 2009.
2. Han JC, Lawlor DA, Kimm SY. Childhood obesity. *Lancet* 2010; 375(9727):1737-1748.
3. Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT, Lancet Physical Activity Series Working Group. Effect of physical inactivity on major non-communicable diseases worldwide: An analysis of burden of disease and life expectancy. *Lancet* 2012; 380(9838):219-229.
4. Wu F, Chen Y, Parvez F, Segers S, Argos M, Islam T, Ahmed A, Rakibuz-Zaman M, Hasan R, Sarwar G, Ahsan H. A Prospective Study of Tobacco Smoking and Mortality in Bangladesh. *PlosOne* 2013; 8(3):e58516.
5. Fuller TD. Moderate alcohol consumption and the risk of mortality. *Demography* 2011; 48(3):1105-1125.
6. GBD 2015 SDG Collaborators. Measuring the health-related Sustainable Development Goals in 188 countries: a baseline analysis from the Global Burden of Disease Study 2015. *Lancet* 2016; 388(10053):1813-1850.
7. Blum RW, McNeely C, Nonnemaker J. Vulnerability, risk, and protection. *J Adolesc Health* 2001; 31(Supl.1):28-39.
8. Te Velde SJ, Twisk JW, Brug J. Tracking of fruit and vegetable consumption from adolescence into adulthood and its longitudinal association with overweight. *Br J Nutr* 2007; 98(2):431-438.
9. Sawyer SM, Afifi RA, Bearinger LH, Blakemore SJ, Dick B, Ezeh AC, Patton GC. Adolescence: A foundation for future health. *Lancet* 2012; 379(9826):1630-1640.
10. Walker SN, Sechrist KR, Pender NJ. The Health-Promoting Lifestyle Profile: Development and psychometric characteristics. *Nurs Res* 1987; 36(2):76-81.
11. Gillis AJ. The Adolescent Lifestyle Questionnaire: Development and psychometric testing. *Can J Nurs Res* 1997; 29(1):29-46.
12. Hendricks C, Murdaugh C, Pender N. The Adolescent Lifestyle Profile: Development and psychometric characteristics. *J Natl Black Nurses Assoc* 2006; 17(2):1-5.
13. Chen MY, Wang EK, Yang RJ, Liou YM. Adolescent health promotion scale: Development and psychometric testing. *Public Health Nurs* 2003; 20(2):104-110.
14. Chen MY, James K, Wang EK. Comparison of health -promoting behavior between Taiwanese and American adolescents: A cross-sectional questionnaire survey. *Int J Nurs Stud* 2007; 44(1):59-69.
15. Rojas-Barahona CA, Gaete J, Olivares E, Förster CE, Chandia E, Chen MY. Psychometric Evaluation of the adolescent Health Promotion Scale in Chile: Differences by Socioeconomic Status and Gender. *J Nurs Res* 2017; 25(6):471-480.
16. Hsiao YC, Chen MY, Gau YM, Hung LL, Chang SH, Tsai HM. Short-term effects of a health promotion course for Taiwanese nursing students. *Public Health Nurs* 2005; 22(1):74-81.
17. Hambleton RK. Issues, design and technical guidelines for adapting tests into multiple languages and cultures. In: Hambleton RK, Merenda PF, Spielberger CD, editores. *Adapting Psychological and Educational Tests for Cross-Cultural Assessment*. Mahwah: Lawrence Erlbaum; 2005. p. 3-38.
18. Hu L, Bentler P. Cutoff criteria for fit indexes in covariance structure analysis: conventional criteria versus new alternatives. *Struct Equ Modeling* 1999; 6(1):1-55.
19. Hair JF, Hult GTM, Rigle C. *A primer on partial least squares structural equation modeling (PLS-SEM)*. Los Angeles: Sage; 2014.
20. Byrne BM. *Structural Equation Modeling with AMOS: Basic Concepts, Applications, and Programming*. Mahwah: Lawrence Erlbaum Associates, Inc.; 2010.
21. Tomás CC, Queirós PJP, Ferreira TDJR. Health-promoting behaviors: Psychometric properties of an assessment tool. *Texto Contexto Enferm* 2015; 24(1):22-29.
22. Temel AB, Basalan F, Yildiz S, Yetim D. The reliability and validity of adolescent health promotion scale in Turkish community. *J Curr Pediatr* 2011; 9(1):14-22.
23. Aghamolaei T, Tavafian SS. Health behaviors of a sample of adolescents in Bandar Abbas, Iran. *Int J High Risk Behav Addict* 2013; 2(1):34-38.
24. Ortabag T, Ozdemir S, Bakir B, Tosun N. Health promotion and risk behaviors among adolescents in Turkey. *J Sch Nurs* 2011; 27(4):304-315.
25. Hogan T. *Psychological testing: A practical introduction*. New York: Wiley; 2013.

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