Validity and reliability analysis of the Portuguese version of the healthy lifestyle questionnaire - EVS IV

Análisis de validez y fiabilidad de la versión portuguesa del cuestionario de estilo de vida saludable - EVS IV

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Abstract

Introduction and Objective. The primary objective of this study was to validate the Healthy Lifestyle Questionnaire – EVS IV using Exploratory Structural Equation Modeling (ESEM).
Methodology. A total of 1,668 Portuguese participants (aged 18 to 70 years; M = 39.71, SD = 15.68) took part in the study, comprising 856 men (51.3%) and 812 women (48.7%).
Results. The findings confirmed the adequacy of the factorial structure of the Healthy Lifestyle Questionnaire – EVS IV (8 factors / 29 items), demonstrating strong psychometric properties and good fit indices: χ^2 = 253.499, df = 189, p = .001; χ^2/df = 1.34; CFI = .97; TLI = .93; RMSEA = .01 (95% CI: .01, .02); SRMR = .02. The instrument evaluates eight distinct dimensions: balanced diet, adherence to meal schedules, tobacco use, alcohol consumption, use of other drugs, rest habits, physical activity habits, and sedentary behavior.
Conclusions. The Portuguese version of the Healthy Lifestyle Questionnaire – EVS IV shows robust psychometric validity and can be confidently applied to assess healthy lifestyle behaviors.

Keywords

Factor analysis; health; healthy lifestyles; psychometrics; sedentary behavior.

Resumen

Introducción y Objetivo. El objetivo principal de este estudio fue validar el Cuestionario de Estilos de Vida Saludables – EVS IV, utilizando un Modelo de Ecuaciones Estructurales Exploratorio (ESEM).
Metodología. Participaron en el estudio un total de 1,668 individuos portugueses de ambos sexos, con edades comprendidas entre 18 y 70 años (M = 39.71, SD = 15.68), de los cuales 856 eran hombres (51.3%) y 812 mujeres (48.7%).
Resultados. Los hallazgos confirmaron la adecuación de la estructura factorial del Cuestionario de Estilos de Vida Saludables – EVS IV (8 factores / 29 ítems), mostrando sólidas propiedades psicométricas e índices de ajuste satisfactorios: χ^2 = 253.499, df = 189, p = .001; χ^2/df = 1.34; CFI = .97; TLI = .93; RMSEA = .01 (IC 95%: .01, .02); SRMR = .02. El instrumento evalúa ocho dimensiones específicas: dieta equilibrada, cumplimiento de los horarios de comida, consumo de tabaco, consumo de alcohol, consumo de otras drogas, hábitos de descanso, hábitos de actividad física y comportamiento sedentario.
Conclusiones. La versión portuguesa del Cuestionario de Estilos de Vida Saludables – EVS IV presenta una validez psicométrica sólida y puede utilizarse con plena confianza para la evaluación de conductas relacionadas con un estilo de vida saludable.

Palabras clave

Análisis factorial; conducta sedentaria; estilos de vida saludables; psicometría; salud.

Introduction

Insert Healthy lifestyle practices represent a significant barrier to the manifestation of diseases (Odgen & Carroll, 2010; Telama et al., 2014). These lifestyles include preventive health practices, good nutrition, weight control, leisure, regular physical activity, periods of rest and relaxation, as well as the ability to cope with adverse conditions and establish supportive, civic relationships. Adopting a conscious stance regarding our presence in the world aims to promote a healthy and satisfying life (WHO, 2002).

On the other hand, harmful lifestyle habits, such as sedentary behavior, an unbalanced diet, lack of rest, and the consumption of harmful substances, are associated with long-term diseases such as overweight, type II diabetes, hyperlipidemia, and even cancer, contributing to premature increases in morbidity (Dunton, 2018; Ezzati & Riboli, 2013). In light of this reality, the importance of cultivating a healthy lifestyle from an early age becomes evident (Arriscado et al., 2017). In this context, habits that promote balanced nutrition, such as adopting appropriate eating habits and respecting meal times (Aparicio-Ugarriza et al., 2019), as well as regular physical exercise (Jakicic et al., 2018) and adequate rest (Onambele-Pearson et al., 2019), are fundamental. In contrast, behaviors such as sedentary behavior, lack of rest, smoking, drug use, and excessive alcohol consumption are detrimental to health (Meredith et al., 2018).

Additionally, a particularly relevant aspect in the analysis of health-harming behaviors is sedentary behavior (Hermassi et al., 2024; Lavie et al., 2019). This term refers to activities performed in a lying or seated position that do not increase energy expenditure above resting levels, defined as ≤1.5 metabolic equivalents (METs). When examining the physiological implications of these behaviors on health, a reduction and cessation of muscular contractility stand out. This decrease triggers a process that results in reduced glucose utilization by muscles, increased insulin levels, and promotion of lipid production, which is preferentially stored in the central adipose tissue of the body. The accumulation of this adipose tissue, in turn, produces inflammatory molecules that are precursors to non-communicable chronic diseases (Meneguci et al., 2015). The same authors emphasize the need to distinguish between physical inactivity and prolonged exposure to sedentary behaviors, respecting the theoretical foundations of each construct (Meneguci et al., 2015).

The WHO (2020) presented the Guidelines on Physical Activity and Sedentary Behaviour for various age and fitness strata of the population, highlighting the importance of limiting time spent in sedentary behavior across all these strata. Indeed, every individual can meet or even exceed the minimum indicators of physical activity; however, attention must be paid to the sedentary behavior that occurs within the same weekly time frame, as excessive sedentary behavior can be detrimental to health (WHO, 2020).

In assessing the time spent engaged in sedentary behaviors, it is crucial to distinguish between activities performed on weekends and those during weekdays. Additionally, the time spent in sedentary behaviors across different domains, such as work, leisure, domestic activities, or transportation, as well as the interruptions occurring during these behaviors, must be considered (Clark et al., 2011; Marshall et al., 2010).

It is increasingly necessary for various health promoters, such as doctors, physiotherapists, physical activity professionals, and social agents, to be able to measure Healthy Lifestyle (HL) practices. A growing number of studies advocate for the need to describe and improve HL in its various facets (Arriscado et al., 2017; Llorent-Bedmar & Cobano-Delgado, 2019). Thus, developing accessible and user-friendly instruments for health professionals and social agents to measure HL in the population is fundamental. This approach will not only allow for the diagnosis of problems but also enable the creation of individualized and/or collective programs aimed at promoting healthy behaviors.

Most previous research considers motivation a key element for adherence to a healthy lifestyle. The Self-Determination Theory (Deci & Ryan, 1980; Ryan & Deci, 2020) has frequently been utilized as a theoretical model to explain this adherence. According to SDT, motivation can be placed on a continuum with three levels (Ryan & Deci, 2012): intrinsic motivation, which is the most self-determined and refers to engaging in an activity for its own sake; extrinsic motivation, which varies from more to less self-determined and includes integrated, identified, introjected, and external regulation, often associated with external rewards or recognition; and amotivation, which represents the least self-determined form, characterized by a lack of intention to act (Deci & Ryan, 2000).

Some studies have also shown that intrinsic motivation regarding physical activity is associated with the maintenance of the intention to continue practicing over time (Kang et al., 2019; Lee, 2018). Furthermore, regular physical activity can trigger the acquisition of other healthy habits (Carbó-Carreté et al., 2016; Chacón-Cuberos et al., 2018; Rodrigues et al., 2018). Researchers such as Leyton et al. (2020), Scoffier-Mériaux et al. (2020), and Vancampfort et al. (2018) have assessed motivation using the Behavioral Regulation in Exercise Questionnaire (BREQ-3) (Wilson et al., 2006) and tested its association with health behaviors, including the intention to be physically active, dietary habits, and the consumption of harmful substances. For example, Jimenez et al. (2019) and Leyton et al. (2020) found significant relationships between motivation and the intention to be physically active, utilizing structural equation modeling of the BREQ-3 questionnaire alongside a Measure of Intentionality to be Physically Active (Hein et al., 2004). According to the theoretical conceptual framework of the Theory of Planned Behavior (Ajzen, 1991, 2014), as well as the Transcontextual Model (Hagger et al., 2007), the variable intention is recognized in the literature as a significant predictor of lifestyle behaviors (Batista et al., 2019).

The present study aims to validate the Healthy Lifestyle Questionnaire - EVS IV for the Portuguese language. The application of this questionnaire will allow for the characterization of healthy habits and lifestyles in the general population, regardless of the levels of activity or sedentary behavior that define them. This new questionnaire is more comprehensive, as the validation of EVS III conducted by Batista et al. (2022) had already included a factor aimed at measuring sedentary behavior, in line with the future perspective of the aforementioned research.

Method

The study carried out is a methodological study, aimed at evaluating the validity and reliability of an instrument (Montero & Leon, 2007) in the portuguese population.

Participants

The study involved a sample of 1,668 Portuguese citizens from the general population of Mainland Portugal, as well as the Madeira and Azores islands. Participants included both males and females, aged between 18 and 70 years (M=39.71, SD=15.68), comprising 856 males (51.3%) and 812 females (48.7%). Participants reported a variety of primary activities, including students, active professionals across various categories of the national workforce, unemployed individuals, and retirees. Academic qualifications among respondents varied from basic education to doctoral degrees, with a significant proportion holding higher education degrees. Regarding regular physical activity, 458 participants (27.5%) indicated they did not engage in this habit, 140 (8.4%) reported participating for less than six months, while 1,070 (64.1%) had been active for over six months. The sampling method employed in this study was random (Cubo-Delgado et al., 2011), as it was not built on a probabilistic basis; rather, it relied on a participatory approach essential for collecting data from the general population.

Procedure

The study received approval from the Bioethics and Biosafety Committee of the University of Extremadura (Spain), in accordance with the guidelines of the Declaration of Helsinki. All participants were treated in accordance with the ethical standards of the American Psychological Association regarding informed consent, confidentiality, and anonymity. Written informed consent was obtained from all participants.

In the process of validating instruments such as scales and questionnaires, it is common to use semantic saturation to ensure that the items adequately reflect the intended content, typically through interviews or focus groups (Guest et al., 2006). However, this was not an initial or cross-cultural validation process, but rather an extension of the already validated Portuguese version of the *Healthy Lifestyle Questionnaire – EVS III* (Batista et al., 2022). The aim was to expand the instrument by incorporating an additional dimension—sedentary behavior—ensuring a qualitative approach to support conceptual coverage of the construct.

Given the existence of several literature reviews on sedentary behavior, the present study adopted the conceptual categories proposed in the literature as a basis for evaluating this construct. A review was

conducted focusing on the definition, physiological implications, and assessment methods characterizing sedentary behavior (Meneguci et al., 2015). This process led to the development of six items designed by the authors to assess the construct. These items were subsequently evaluated by three native Portuguese language experts, following the recommendations of Cubo-Delgado et al. (2011), who confirmed the linguistic adequacy of the items for assessing the intended construct.

To ensure the content validity of the instrument designed to assess sedentary behavior, the Item-Level Content Validity Index (I-CVI) and the Scale-Level Content Validity Index (S-CVI) were calculated, following the procedures described by Polit and Beck (2006) and Polit, Beck, and Owen (2007).

Six subject-matter experts, each with at least a decade of experience in the fields of exercise, health, and sedentary behavior, served as judges for evaluating the six newly developed items. The relevance of each item was rated using a 4-point ordinal scale: 1 (not relevant), 2 (somewhat relevant), 3 (relevant), and 4 (highly relevant). For the I-CVI calculation, only scores of 3 and 4 were considered. The I-CVI for each item was calculated as the proportion of experts rating the item as 3 or 4, divided by the total number of experts (n = 6). According to the criteria proposed by Polit and colleagues, I-CVI values equal to or greater than 0.78 are deemed acceptable when between six and ten experts are involved (Polit & Beck, 2006; Polit et al., 2007).

All six items showed I-CVI values ranging from 0.83 to 1.00, indicating satisfactory semantic and conceptual adequacy. The S-CVI, calculated as the arithmetic mean of the I-CVI values, was 0.92, exceeding the recommended threshold of 0.90 and indicating high overall content validity for the set of items (Polit & Beck, 2006; Polit et al., 2007).

Following the content validity analysis, the six sedentary behavior items were incorporated into the *Healthy Lifestyle Questionnaire – EVS III* (Batista et al., 2022), resulting in the updated *Healthy Lifestyle Questionnaire – EVS IV*, which now includes 41 items.

Once the instrument was finalized, a pilot study was conducted with a small group of 30 adults (M = 30.21, SD = 9.42), in line with the target study population, to ensure clarity and comprehension. No participants reported difficulties in understanding the items or in selecting appropriate response options.

Subsequently, a battery of questionnaires was compiled, which included sociodemographic items such as gender, age, educational background, profession/occupation, place of residence, and regular physical activity habits. The questionnaires were digitized using the Google Forms platform for online completion and disseminated through various channels (WhatsApp, Facebook, and email). The average completion time was approximately 15 minutes.

Instrument

Article The resulting instrument is called the Healthy Lifestyles Questionnaire (Questionário de Estilos de Vida Saudáveis - EVS IV). This questionnaire is more comprehensive and complete than the validation of the EVS II conducted by Batista et al. (2020), the EVS III (Batista et al., 2022), or the Healthy Lifestyles Questionnaire (EVS2) developed by Leyton et al. (2021). It incorporates the future research perspective that highlighted the need to include a factor measuring sedentary behavior.

The EVS IV comprises 41 items, utilizing a Likert-type scale that ranges from strongly disagree (1) to strongly agree (5). All questions are categorized into four domains: eating habits, substance use, resting habits, physical activity habits and sedentary behavior. These domains are further divided into eight factors:

- Eating habits, which include a) balanced diet and b) adherence to mealtime.

- Substance use, which encompasses c) tobacco use, d) alcohol consumption, and e) use of other drugs.

- Three additional dimensions, with a single designated factor each for f) resting habits, g) physical activity habits, and h) sedentary behavior.

Regarding the measurement of eating habits in a total of 11 items, specifically balanced diet (e.g., “I usually eat fish two or more times a week.”) – six items; respect for meal times (e.g., “I usually respect meal times.”) – five items; in the consumption of harmful substances in a total of 15 items, tobacco consumption (eg, “I smoke regularly.”) – five items, alcohol consumption (eg, “I drink alcoholic

beverages regularly on weekends (beer , liquors, wines, combined drinks…).” – five items, the consumption of other drugs (eg, “I've ever tried drugs (joints, marijuana, cocaine, stimulants,…)” – five items, rest habits (eg, I normally sleep 7-8 hours a day.”) – four items, physical activity habits (eg, I consider myself a physically active person.) – five items, and sedentary behavior (e.g., I usually spend more than 3 hours a day sitting during my work/studies.) – six items.

To determine concurrent validity, we used the Validation of the Intentionality Scale of being physically active in a Portuguese population (Jimenez et al, 2019). The questionnaire consists of five items, which evaluates a single factor, the intention to be physically active (e.g. "I am interested in the development of my physical form"), according to a five-level Likert-type scale, which varies between one (completely disagree) and five (completely agree).

Data analysis

The statistical analysis of the data was done through the statistical software SPSS (version 23.0 for Windows, SPSS, Inc., Chicago, IL, USA). Firstly, we filtered the data to make sure there was no missing data. Then, having no missing data, we observed the existence of normal data obtained. For the univariate analyses of normality, the asymmetry and kurtosis indicators of each item that composed the EVS IV were used first. The author (Pestana & Gageiro, 2005) also proposed the limits, in absolute value, and considered values up to 2 for asymmetry and 7 for kurtosis for a behaviour like normal; between 2 and 3 for asymmetry and between 7 and 21 for kurtosis for moderately normal behaviour; and values greater than 7 in asymmetry and 21 in kurtosis for extremely normal behaviour.

Later, in order to perform the confirmatory factor analysis (CFA), the construct validity was estimated, respecting the criterion of eliminating those items whose regression weight does not have an adequate value (greater than 0.40), and the factorial loads of each item should be significant. We also determined the internal consistency of each of the factors resulting from the factorial analysis Omega coefficient (ω), which expresses that the coefficient of reliability must be above 0.70 (Gignac & Kretzschmar, 2017).

Composite reliability (degree of consistency between latent construct indicators) and mean extracted variance (the amount of variance of indicators, captured by the construct, compared with that obtained by the measurement error) was estimated. Given the composite reliability, the minimum level is 0.70, and the mean variance extracted should be greater than 0.50, to conclude that a substantial amount of the variance is captured by the construct (Gignac & Kretzschmar, 2017).

To analyse the factor structure of the Portuguese Version of the Healthy Lifestyle Questionnaire - EVS IV, the statistical software Mplus 7.3 (Muthén & Muthén, 1998-2017) was used. The factor structure was estimated from the perspective of exploratory structural equation modelling (ESEM; Marsh et al., 2009; see Figure 1) using an oblique target rotation, in which the main loadings were freely estimated, while the cross-loadings were estimated to be close to 0 (Asparouhov & Muthén, 2009). Exploratory Structural Equation Modeling (ESEM) can be considered within structural equation modelling as a combination of the best features of exploratory factor analysis (EFA) and confirmatory factor analysis (CFA) (Marsh et al., 2014). In this regard, one of the fundamental advantages of this model is that it enables cross-loadings of items on multiple factors, providing a more flexible, natural and valid structure (Asparouhov & Muthén, 2009; Marsh et al., 2014). Moreover, according to these authors, it is a fascinating perspective when assessing the psychometric properties of multidimensional scales where factors are correlated. The following fit indices were considered to analyse model agreement: chi-square ($\chi 2$), degrees of freedom (gl), comparative fit index (CFI), Tucker Lewis index (TLI), root mean square error of approximation per degree of freedom (RMSEA) and root mean standardised residual (SRMR).

The $\chi 2$ indicates a similarity of the covariates observed with those that are predicted in the hypothetical model, with values for a good fit $0 \leq \chi 2 \leq 2df$ and an acceptable fit $2df < \chi 2 \leq 3df$. However, it is very sensitive to the size of the sample, so it is recommended to complete with $\chi 2/df$, whose values below 2 indicate a very good fit of the model, although values below 3 are considered acceptable (Schermelleh-Engel, Moosbrugger & Müller, 2003).

Thus, the CFI and TLI indices can be acceptable when their scores are above 0.90 and excellent when their values are above 0.95 (Hu & Bentler, 1999). Furthermore, following Hu and Bentler (1999), the RMSEA and SRMR should be less than 0.06 for the model to have a good fit.

A descriptive analysis was carried out by the determination of means and standard deviations of each extracted factor, and the concurrent validity was evaluated through a bivariate correlation analysis. This assessment of concurrent validity is justified because, according to the theoretical conceptual framework of the Theory of Planned Behavior (Ajzen, 1991, 2014), as well as the Transcontextual Model (Hagger et al., 2007), the variable intention is recognized in the literature as a significant predictor of lifestyle behaviors (Batista et al., 2019). In this context, we utilized the Portuguese Intentionality Scale of Being Physically Active (Jimenez et al., 2019), which indicates that higher intentionality is positively correlated with healthy behaviors and negatively correlated with unhealthy behaviors.

Results

Analysis of internal consistency, discriminant and convergent validity

In this study, we decided to remove certain items that did not achieve a factorial loading of 0.40 or higher, as recommended by Revelle (2014). This was done to avoid redundancy in the questions presented and to streamline the instrument, both in terms of form and structure, as well as in relation to the assessment's objectives.

The internal consistency for each factor identified through factor analysis, measured by McDonald's Omega (ω) coefficient—a more robust indicator—yielded the following results: (.85) for balanced diet, (.88) for adherence to meal times, (.91) for tobacco use, (.90) for alcohol consumption, (.85) for the use of other substances, (.78) for resting habits, (.91) for physical activity habits, and (.85) for sedentary behavior.

The average variance extracted and the composite reliability for each factor were 0.58 and 0.85 for balanced diet, 0.65 and 0.88 for adherence to meal times, 0.73 and 0.91 for tobacco use, 0.68 and 0.90 for alcohol consumption, 0.58 and 0.85 for the use of other substances, 0.54 and 0.78 for resting habits, 0.71 and 0.91 for physical activity habits, and 0.60 and 0.85 for sedentary behavior, meeting all the criteria set by Arias (2008).

Table 1. Internal consistency values, discriminant and convergent validity of EVS III

Variável	item	FL	Skew	Kurt	Ω	VME	FC
Balanced Diet	EVS 21	0.739	-0.24	-0.67	0.85	0.58	0.85
	EVS 26	0.767					
	EVS 39	0.833					
Respect for Meal Time	EVS 5	0.775	-0.48	-0.46	0.88	0.65	0.88
	EVS 23	0.807					
	EVS 37	0.843					
Tobacco Consumption	EVS 2	0.848	2.03	3.07	0.91	0.73	0.91
	EVS 13	0.917					
	EVS 19	0.782					
	EVS 34	0.833					
Alcohol Consumption	EVS 8	0.829	1.51	1.92	0.90	0.68	0.90
	EVS 14	0.832					
	EVS 15	0.743					
	EVS 17	0.807					
	EVS 22	0.779					
Consumption of Other Drugs	EVS 25	0.728	1.95	3.23	0.85	0.58	0.85
	EVS 27	0.722					
	EVS 32	0.856					
	EVS 38	0.761					
Resting Habits	EVS 3	0.833	-0.11	-0.72	0.78	0.54	0.78
	EVS 9	0.887					
	EVS 33	0.829					
Physical Activity Habits	EVS 1	0.818	-0.13	-1.03	0.91	0.71	0.91
	EVS 10	0.851					
	EVS 20	0.836					
	EVS 29	0.875					
Sedentary Behavior	EVS 6	0.778	-0.15	-1.09	0.85	0.60	0.85
	EVS 12	0.829					
	EVS 18	0.810					

Note: FL – Factor Loading: Correlation between item and factor; *Skew* – Skewness; *Kurt* – Kurtosis; *Ω* – McDonald's Omega; VME – Average variance extracted; *FC* – Composite reliability.

According to the descriptive perspective (table two), values consistent with a healthy lifestyle were obtained, with higher means in balanced diet behaviors ($\bar{x}$= *3.47 ± 0.93*), respect for mealtime ($\bar{x}$= *3.39 ± 1.01*), resting habits ($\bar{x}$= *3.28 ± 1.05*) and physical activity habits ($\bar{x}$= *3.33 ± 1.09*), and lower means of tobacco consumption ($\bar{x}$= *1.40 ± 0.79*), alcohol consumption ($\bar{x}$= *1.65 ± 0.80*) and consumption of other drugs ($\bar{x}$= *1.48 ± 0.81*). Regarding the intention to be physically active, respondents demonstrated high values ($\bar{x}$= *3.65 ± 1.04*).

The evaluation of concurrent validity, conducted through bivariate correlation analysis, revealed that most correlations between the EVS IV and the Physical Activity Intention Questionnaire were significant and aligned with expectations. The intention to be physically active showed a positive correlation with balanced diet, respect for mealtimes, resting habits, and physical activity habits. Conversely, it exhibited a negative correlation with tobacco consumption, along with positive residual correlations concerning alcohol consumption, use of other drugs, and sedentary behavior.

Table 2. Descriptive statistics and bivariate correlation between EVS IV and Intention Physically Active Questionnaire

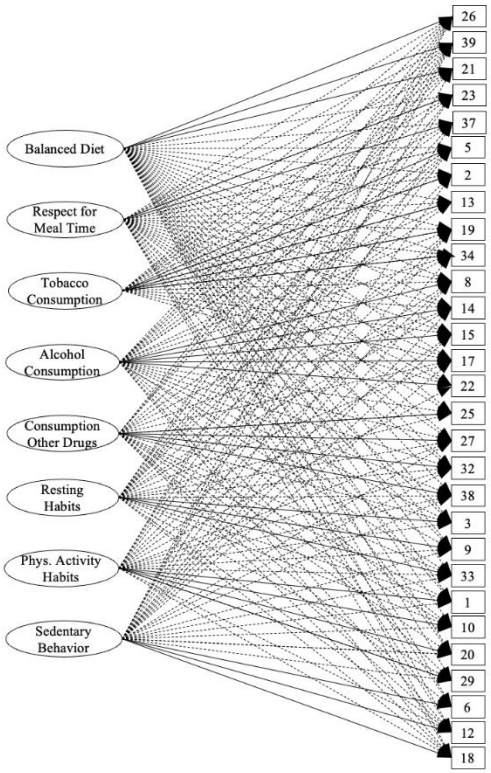
Variável	Média	DP	1	2	3	4	5	6	7	8	9
1. Balanced Diet	3.47	0.93	-	0.55**	-0.19**	-0.24**	-0.18**	0.44**	0.35**	0.02	0.24**
2. Respect for Meal Time	3.39	1.01		-	-0.03	-0.23**	-0.06*	0.50**	0.30**	0.07**	0.13**
3. Tobacco Consumption	1.40	0.79			-	0.31**	0.49**	-0.09**	-0.08**	0.24**	-0.12**
4. Alcohol Consumption	1.65	0.80				-	0.38**	-0.17**	0.04	0.08*	0.06*
5. Consumption of Other Drugs	1.48	0.81					-	-0.10**	0.06*	0.31**	0.02
6. Resting Habits	3.28	1.05						-	0.41**	0.07**	0.35**
7. Physical Activity Habits	3.33	1.09							-	0.11**	0.72**
8. Sedentary Behavior	2.99	1.14								-	0.05*
9. Intention Physically Active	3.65	1.04									-

Note: *p < .05; **p < .01

Exploratory Structural Equation Modeling

The Exploratory Structural Equation Modeling used to assess the eight-factor model of the Healthy Lifestyles Questionnaire - EVS IV version showed that the 29 items were grouped into eight factors, namely: balanced diet (three items), respect for mealtime (three items), tobacco consumption (four items), alcohol consumption (five items), consumption of other drugs (four items), resting habits (three items), physical activity habits (four items), and sedentary behavior (three items). The graphical structure obtained from the Exploratory Structural Equation Modeling is observable in Figure 1 and the tested model indicated a reasonable fit of the Healthy Lifestyle Questionnaire - EVS IV: χ^2 = 253.499, df = 189, p = .001, X^2/df = 1.34, CFI = .97, TLI = .93, RMSEA = .01 (95% CI: .01, .02), SRMR = .02.

Figure 1. Exploratory Structural Equation Modeling of the Healthy Lifestyles Questionnaire (EVS IV)



The item grouping described earlier into the eight dimensions is presented in Table 3, where we can see the textual structure of each statement and the respective factor loading of the item, which varied from .50 as the minimum value to .99 as the highest.

Table 3. Factor analysis of EVS IV

Items	Factor							
	1	2	3	4	5	6	7	8
Eating habits balanced diet								
21. Considero que tenho uma alimentação equilibrada e sã.	.50	-.03	.01	-.08	-.12	.29	.20	.05
26. Normalmente bebo mais de um litro de água por dia.	.76	.11	-.06	.04	-.01	-.03	-.02	-.10
39. Normalmente, como hortaliças, verduras e fruta todos os días.	.63	.08	.03	.01	.68	-.11	.08	.13
Eating habits respect for meal times								
5. Respeito o horário das refeições principais do dia.	-.05	.69	.00	-.04	-.03	.20	.11	.09
23. Normalmente tomo o pequeno almoço, almoço e jantar sempre à mesma hora.	-.05	.86	.07	-.04	-.11	-.09	.07	.03
37. Normalmente respeito os horários das refeições.	.26	.73	-.07	-.01	.12	.05	-.04	-.05
Tobacco consumption								
2. Sinto-me bem quando fumo.	-.15	-.02	.67	.12	-.01	.18	-.11	-.01
13. Fumo de forma habitual.	-.01	.03	.99	.01	-.12	.00	.05	.01
19. Se me falta tabaco fico nervoso, irritável,...	.11	.01	.72	-.06	.04	-.07	-.07	-.03
34. Às vezes tenho necessidade de fumar.	.08	-.04	.69	-.02	.27	-.01	.03	-.03
Alcohol consumption								
8. Considero que o álcool me faz sentir bem.	.04	.03	.04	.78	.04	-.01	.01	.22
14. Tomo bebidas alcoólicas de forma habitual aos fins de semana (cerveja, licores, vinhos, bebidas combinadas...).	-.05	-.02	.08	.69	-.00	-.15	.09	.06
15. Às vezes tomo álcool inclusivamente nos dias de semana.	-.12	.08	-.03	.69	-.01	.07	-.10	-.23
17. O álcool faz com que passe melhor.	.21	-.06	-.07	.88	.08	.01	-.01	-.02
22. Tenho a sensação de que cada vez consumo mais álcool.	-.07	-.06	.02	.74	-.09	.06	.06	-.03
Consumption of other drugs								
25. Alguma vez, os meus amigos já me incitaram a provar alguma droga	.11	-.06	.08	-.05	.56	.08	-.04	.02
27. Gosto como me sinto quando tomo alguna droga.	-.22	.05	-.04	.11	.65	.09	-.01	.01
32. Já provei droga alguma vez (charros, marijuana, cocaína, estimulantes,...)	.05	.02	.16	.09	.63	-.01	.05	.04
38. É-me fácil conseguir alguma droga.	-.10	.05	.02	-.02	.67	.10	.01	.06
Resting habits								
3. Durmo o número de horas suficientes para que o meu corpo esteja descansado	-.07	-.06	.01	-.02	.06	.79	.10	.07
9. Normalmente durmo 7-8 horas diárias	.16	-.02	-.05	-.03	.08	.80	-.04	-.07
33. Respeito os horários de descanso	.14	.25	.03	-.03	-.11	.50	.05	.04
Physical Activity Habits								
1. Realizo atividade física de intensidade moderada cinco dias da semana (subir escadas, andar 5 km, bailar) durante pelo menos 30 minutos.	-.05	-.04	.04	.05	-.02	-.02	.77	.05
10. Considero-me uma pessoa físicamente activa	-.04	.16	.03	.02	-.10	.14	.76	-.13

20. Quando faço atividade física, no mínimo faço-o durante 150 minutos por semana, acumulando blocos de pelo menos 10 minutos	.03	.02	-.11	.03	.09	-.08	.79	-.01
29. Pratico atividade física de intensidade vigorosa, no mínimo quatro dias por semana, durante 20 minutos	.09	-.04	.02	-.04	.08	-.02	.89	.01
Sedentary behavior								
6. Normalmente, na minha atividade laboral/estudos permaneço mais de 3 horas diárias na posição de sentado	.06	-.16	-.02	-.02	.00	.08	.04	.83
12. Durante a semana, nos meus tempos libres passo mais de 3 horas diárias na osição de sentado ou deitado (ver televisão, estudar, ler, jogar, ao telemóvel, ao computador, a descansar).	-.01	.16	.01	.03	.06	.03	-.08	.60
18. Ao fim de semana, passo mais de 3 horas diárias na posição de sentado ou deitado (ver televisão, ler, jogar, ao telemóvel, ao computador, a descansar).	-.05	.12	.01	.03	.07	-.13	-.08	.58

If we take a retrospective look at the various versions and respective validations of the Healthy Lifestyles Questionnaire – EVS, as presented in Table 4, since 2015, starting with the preliminary Portuguese version by Aspano (2015), more complete and refined versions of the EVS have emerged over the past decade, both in Portuguese (Batista et al., 2016; Batista et al., 2020; Batista et al., 2022), in Spanish (Leyton et al., 2018; Leyton et al., 2021), and a cultural adaptation in Ecuadorian Spanish (Alvarez-Alvarez et al., 2021).

Table 4. Fit indices model to the Healthy Lifestyle Questionnaires (EVS)

	EVS vp	EVS	EVS sp	EVS II	EVSspII	EVS eq	EVS III	EVS IV
X^2	632.68	172.117	-	305.925			644.6828	253.499
Sig X^2	(p=.000)	(p=.000)	(p=.000)	(p=.000)			(p=.000)	(p=.001)
df	157.775	41.078	-	120.017			168	189
X^2/df	4.01	4.19	4.2	2.55	3.76	9.02	3.84	1.34
TLI	-	.96	-	.92			.90	.93
CFI	.94	.97	.94	.94	.97	.96	.92	.97
SRMR	.06	.04	.04	.05	.06	.03	.06	.02
RMSEA	.07	.07	.06	.06	.05	.06	.06	.01
90% CI RMSEA	-	(.058 - .076)	-	(.056 - .072)	(.046 - .052)		(.054 - .064)	(.01 - .02)

EVS vp – Portuguese preliminary version of Aspano (2015); EVS – Portuguese version of Batista et al. (2016); EVS sp – Castilian version of Leyton et al. (2018); EVS II – Portuguese version of Batista et al. (2020); EVS II sp – Castilian version of Leyton, Mesquita & Jiménez-Castuera (2021); EVS eq – Ecuadorian version of Alvarez-Alvarez, et al. (2021); EVS III - Portuguese version of Batista et al. (2022); EVS IV – Present version of the Portuguese validation.

With these results, the analyzed structural model demonstrated a satisfactory overall fit, just as models with good fit were achieved in previous versions of the EVS, although they had fewer dimensions of analysis compared to the Healthy Lifestyles Questionnaire - EVS IV.

Discussion

The primary objective of this study was to deepen previous investigations into healthy lifestyles by validating the Lifestyle Questionnaire - EVS IV for the general Portuguese population. Considering that each new application of a measurement instrument represents a significant contribution to the theoretical enrichment of the research area (Pestana & Gageiro, 2005), this study expands existing knowledge by confirming the validity of the EVS IV in a more comprehensive version, while also broadening the understanding of healthy practices and health indicators in the population.

After analyzing the internal consistency coefficients of each factor, for which we employed McDonald's Omega, we obtained values equal to or greater than 0.70 across all dimensions, as indicated by Gignac and Kretzschmar (2017). By estimating the composite reliability and average variance extracted for each factor, we found that the obtained values meet the criteria established by Gignac & Kretzschmar (2017), concluding that a substantial portion of the variance is explained by the construct. The composite reliability should present a minimum value of 0.70, while the average variance extracted should exceed 0.50.

Exploratory Structural Equation Modeling – ESEM (Asparouhov & Muthén, 2009; Marsh et al., 2014) demonstrated that the 29 items grouped into eight factors: balanced diet (three items), respect for meal

times (three items), tobacco consumption (four items), alcohol consumption (five items), use of other substances (four items), rest habits (three items), physical activity habits (four items), and sedentary behavior (three items). The tested model exhibited a satisfactory overall fit, as did other previous models with adequate fit (Asparouhov & Muthén, 2009; Marsh et al., 2014), although all of them had fewer factors for analysis than the Lifestyle Questionnaire - EVS IV (Alvarez-Alvarez et al., 2021; Batista et al., 2016; Batista et al., 2020; Batista et al., 2022; Leyton et al., 2018; Leyton et al., 2021).

The results obtained through the psychometric quality indices indicated a very good fit with a value of $\chi^2/df < 2$ (Schermelleh-Engel, Moosbrugger & Müller, 2003), as well as in the incremental indices of TLI, NFI, SRMR, and RMSEA, respecting the cutoff values proposed by Hu and Bentler (1999) or Schumacker and Lomax (2010).

These results are consistent with previous investigations that utilized the EVS (Aspano, 2015; Batista et al., 2016; Leyton et al., 2018; Batista et al., 2020; Alvarez-Alvarez et al., 2021; Leyton et al., 2021) and reaffirm the relevance of each of the eight dimensions in understanding healthy lifestyles. When comparing the results of the preliminary validation of the EVS (Aspano, 2015) or the studies by Batista et al. (2016), Leyton et al. (2018), Batista et al. (2021), Alvarez-Alvarez et al. (2021), or Leyton et al. (2021), all demonstrated good psychometric properties, adhering to the recommendations of various prominent authors in the specialized literature (Nunnally, 1978; Browne & Cudeck, 1993; Hu & Bentler, 1999; Byrne, 2006; Schumacker & Lomax, 2010; Gignac & Kretzschmar, 2017), suggesting that the Lifestyle Questionnaire is a reliable instrument for assessing healthy lifestyles.

It is important to emphasize that the validation of the EVS IV is one of the versions that most closely aligns with the original model of the questionnaire proposed by Wold (1995), now with eight extracted factors, making it more comprehensive than the EVS III by Batista et al. (2022), which has seven factors, or the Lifestyle Questionnaire – EVS 2 by Leyton et al. (2021) and the EVS II by Batista et al. (2020), both of which have six factors.

The previously validated versions faced challenges with some items that had factor loadings below 0.40 (Revelle, 2014), resulting in the elimination of certain extracted factors, such as the rest habits in Aspano (2015) study, or the merging of the factors of balanced diet and respect for meal times, which in Batista et al. (2016) work culminated in the creation of a single factor for eating habits. In the current version of EVS IV, this phenomenon was also partially observed, where of the 41 proposed items for the eight dimensions, we eliminated several whose factor loadings, although higher, were marginally close to 0.40, or due to structural repetition of the content of the statements. Through the tested ESEM model, the EVS IV was structured into a more concise version with 29 items, reducing the number of latent variables per assessed dimension and thus avoiding an overly lengthy instrument (Yong et al., 2013). However, this instrument retains potential for refinement as new contributions regarding healthy lifestyles may emerge.

In the descriptive analysis, the results indicated that the study participants tend to value the items in the questionnaire, evidenced by moderate to high mean scores in the dimensions of balanced diet, respect for meal times, rest habits, and physical activity, while the mean scores in the dimensions of tobacco consumption, alcohol consumption, and use of other drugs were low. These trends highlight the theoretical importance underlying the construct of healthy lifestyles, already evidenced in the validation of the EVS III (Batista et al., 2022). Also noteworthy is the moderately high value of sedentary behavior, which is concerning for the health of the population, as it is a predictor of cardiovascular problems, type II diabetes, oncological diseases, and mental health issues, among others (Hermassi et al., 2024; Lavie et al., 2019; Meneguci et al., 2015).

Similar descriptive trends have been observed in the works of Aspano (2015), Batista et al. (2016), Leyton et al. (2018), Batista et al. (2020), Alvarez-Alvarez et al. (2021), and Leyton et al. (2021), as well as in the results of these studies regarding concurrent validity, through the analysis of bivariate correlations in relation to the motivation continuum (Ryan & Deci, 2020).

In the present work, concurrent validity was assessed using the variable intention, employing the Portuguese Scale of Intent to Be Physically Active (Jimenez et al., 2019). Most correlations between the EVS IV variables and the intention to be physically active showed significant associations in the expected direction. This confirms the concurrent validity of the instrument, aligning with the theoretical framework of the Theory of Planned Behavior (Ajzen, 1991, 2014) and the Transcontextual Model

(Hagger et al., 2007). These theories emphasize the importance of intention in human behavioral conduct, especially in promoting healthy behaviors and inhibiting behaviors harmful to health. Thus, we can consider that the questionnaire presents adequate concurrent validity regarding the intention to be physically active, according to the theoretical references (Ajzen, 1991; Hagger et al., 2007).

Although the results obtained allow for the validation of the EVS IV Questionnaire for a broad age population ranging from 18 to 70 years, some limitations must be considered. While the questionnaire was administered to a large sample, it is recommended, as suggested by Leyton et al. (2021), that it be applied to groups with specific pathologies, such as cancer, hypertension, and obesity. This would not only determine the validity of the questionnaire in these contexts but also utilize it as an effective tool for assessing the lifestyles of these groups, especially after the initiation of an intervention program, following surgical interventions, or for the initial diagnosis of the patient.

It would also be interesting to explore, based on the eight factors of the EVS IV, other psychological variables (e.g., emotions, depression, among others) that could help develop strategies aimed at promoting healthier lifestyles. Another limitation concerns the diversity of areas and ages of the participants, who are from mainland Portugal, which may imply significant differences. Therefore, it would be valuable to determine the psychometric properties and invariance of the questionnaire in specific areas and age groups, as well as in other countries or cultural contexts.

Future perspectives may include the development of studies grounded in the transtheoretical model of motivation (Prochaska & DiClemente, 1982) or in the theory of planned behavior (Ajzen, 1991), the self-determination theory (Ryan & Deci, 2020), or the transcontextual model (Hagger et al., 2007), which could subsequently evaluate the adoption of healthy lifestyles across different strata of the population.

Conclusions

Concluding the purpose of our research, we find that the adaptation of the Portuguese version of the Healthy Lifestyles Questionnaire (EVS IV), which includes eight relevant factors, can be used with confidence in assessing healthy lifestyles, encompassing eating habits, consumption of harmful substances, rest habits, physical activity habits, and sedentary behavior. The results also indicated that the factorial validity and reliability of the Portuguese version of the Healthy Lifestyles Questionnaire (EVS IV) are acceptable for the general population aged between 18 and 70 years.

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