

## Validation and Psychometric Properties of the Visual Analogical Fitness Perception Scale for Adolescents

### Validación y Propiedades Psicométricas de la Escala Analógica Visual de Percepción de la Condición Física para Adolescentes

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**Abstract.** Physical fitness (PF) is considered a highly relevant indicator for the healthy growth and development of children and adolescents, crucial stages where lifestyles and behaviors are established. Self-perceived fitness scales are quick and easy to use tools, allowing students to know and monitor fitness. The aim of the study was to show the factor structure and validity of the *Visual Analogical Fitness Perception Scale for Adolescents (FP VAS A)*, a scale aimed at assessing self-perception of PF in adolescents. Reliability tests were used, as well as exploratory and confirmatory factor analyses. The results show a single-factor structure for the scale with high reliability (Cronbach's alpha = 0.80-0.90) and good and exceptional goodness-of-fit indices, composed of 4 items, eliminating the item of self-perception of flexibility for not meeting the criteria of factor loading ( $>0.60$ ) and communality ( $>0.30$ ). In conclusion, a cheap, simple and fast tool is shown. Applicable to the educational field in relation to Physical Education (PE), for the self-monitoring of PF by students and to encourage self-elaboration of physical activity (PA) plans.

**Keywords:** physical fitness; physical activity; *FP VAS A*; validation; reliability; adolescents; physical education.

**Resumen.** La condición física (PF) se considera un indicador de gran relevancia para el crecimiento y desarrollo saludable de niños y adolescentes, etapas cruciales donde se establecen estilos de vida y comportamientos. Las escalas de aptitud física autopercebida son herramientas rápidas y fáciles de utilizar, que permiten conocer y monitorizar la aptitud física. El objetivo del estudio fue mostrar la estructura factorial y la validez de la *Escala Analógica Visual de Percepción de la Condición Física para Adolescentes (FP VAS A)*, una escala dirigida a evaluar la autopercepción de la PF en adolescentes. Se utilizaron pruebas de fiabilidad, así como análisis factoriales exploratorios y confirmatorios. Los resultados muestran una estructura mono factorial para la escala con alta fiabilidad (alfa de Cronbach = 0,80-0,90) e índices de bondad de ajuste buenos y excepcionales, compuesta por 4 ítems, eliminando el ítem de autopercepción de flexibilidad por no cumplir los criterios de carga factorial ( $>0,60$ ) y comunalidad ( $>0,30$ ). En conclusión, se muestra una herramienta barata, sencilla y rápida. Aplicable al ámbito educativo en relación con la Educación Física (EF), para el autocontrol de la PF por parte de los alumnos y para fomentar la auto elaboración de planes de actividad física.

**Palabras clave:** condición física; actividad física; *FP VAS A*; validación; fiabilidad; adolescentes; educación física.

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## Introduction

Physical inactivity stands out as the fourth leading risk factor for mortality and one of the main risk factors for non-communicable diseases. It is a behavior that should be avoided to achieve adequate cardiovascular health and reduce the risk of suffering cardiovascular pathologies in the future (World Health Organization 2022). In this sense, the degree of physical activity (PA) declines throughout adolescence, according to scientific research (Marques et al., 2020), and it is estimated that 77.6% of boys and 84.7% of girls between the ages of 11 and 17 are physically inactive (Guthold et al., 2020).

According to "Corbin and Le Masurier (2014)", physical fitness (PF) is the ability of the organism to engage in a variety of PAs effectively and under control. In addition, it is viewed as a highly relevant indicator for the normal growth and development of children and adolescents (Ke et al., 2022). On the other hand, it has been demonstrated that having low levels of PF during adolescence increases the risk of developing type 2 diabetes, cardiovascular disease and all-cause mortality (World Health Organization 2022). In contrast, high PF levels during adolescence and childhood are linked to better health outcomes over the course of the life cycle (Mateo-Orcajada et al., 2022). Since many physiological and psychological changes that will last throughout a person's lifetime occur

during childhood and adolescence, it is crucial to work on PF during these years. Additionally, during these years, lifestyles and behaviors are established that will affect a person's health and quality of life in later years (True et al., 2021).

As a result of the connection between PF and an individual's health status, public health agencies have a keen interest in assessing PF (García-Hermoso et al., 2022) and in order to identify early low levels of PF associated with the potential future development of some pathologies and to develop the necessary strategies to improve their PF (Cvejic et al., 2013).

Individuals can currently be assessed for their PF in a variety of ways, but laboratory and field tests, along with the associated use of particular equipment and instruments, are the most objective way to obtain precise parameters of the various capabilities that make up PF (Kolimechko 2017). However, due to the projected time needed to complete a PF evaluation in 20 children/adolescents, which equates to three 55-minute PE classes, its usefulness in the school context is constrained (Ruiz et al., 2011). For students to understand and manage their PF values, field tests like the *PA Level Assessment Battery (ALPHA-Fitness)* (Ruiz et al., 2011) have been shown to be valid and reliable (España-Romero et al., 2010). However, due to time, space, and material constraints, other options are now available (Ortega et al., 2011).

Self-reported physical perception using survey-based techniques may therefore be more appropriate for PF

assessment in epidemiological investigations and its use in educational settings. By including too many items or items and focusing on particular subgroups of the population, some questionnaires or scales, like *The Physical Self-perception Profile (PSPP)* (Fox & Corbin 1989) or *the Self-Reported Fitness (SRFit) scale* (Keith et al., 2014), fail to address the aforementioned issue (Bao et al., 2022). There are a number of scales in this field, such *the Visual Analogical Fitness Perception Scale for Adolescents (FP VAS A)* (Mendoza-Muñoz et al., 2021) (scale employed in the current study), *the International Fitness Scale (IFIS)* (Ortega et al., 2011) and *the FP self-perception questionnaire* (Delignières et al., 1994), which evaluates PF self-perception and takes only a few minutes to complete, was slightly modified by "Jürimäe and Saar (2003)". This questionnaire is a very helpful tool for large classes in the educational setting where students receive background information about their deficiencies in various physical abilities. Additionally, adolescent self-perception of PF is crucial because it is directly related to a higher level of PA practice, which in turn affects the health and wellbeing of adolescents (Palacios-Cartagena et al., 2022; Pastor-Cisneros et al., 2021; Shi et al., 2022).

*The IFIS scale*, which has been translated into nine languages and consists of five parts to assess general fitness, cardiorespiratory fitness, muscular fitness, speed/agility, and flexibility, is the most popular and widely used scale in the self-perception of PF. It has shown acceptable reliability and construct validity in European and South American countries in children and adolescents (De Moraes et al., 2019; Sánchez-Toledo et al., 2017; Ortega et al., 2011; Ramírez-Vélez et al., 2017). *The IFIS scale*, on the other hand, is based on five questions presented as a 5-Likert scale. This scale has a lot of categories; too many can make it difficult to make a decision, while too few can result in the wrong option (Svensson 2001). In light of this, *visual analog scales (VAS)* are distinguished by being simple to use and comprehend, especially by participants and raters with less education (Murray et al., 2002). As previously mentioned, the *FP VAS A scale*, a visual analog scale to assess adolescents' self-perception of PF, has only recently been developed. However, because of this, there aren't many studies that have used it, and those that have used it have used rather small sample sizes, which increases the statistical power of the results (Mendoza-Muñoz et al., 2021; Pastor-Cisneros et al., 2021).

Therefore, the aim of the present research will be to analyze the psychometric properties, as well as the validity and reliability of a scale aimed at assessing the self-perception of PF in adolescents (*FP VAS A*), in this case, in secondary school students in the Autonomous Community of Extremadura (Spain), checking whether this instrument is safe and reliable for assessing PF in adolescents.

## Materials and methods

### Participants

One thousand one hundred and fifty-five students from public secondary schools in the Autonomous Community of

Extremadura (Spain) made up the sample of this research. These students were selected using a non-probabilistic convenience sampling method (Salkind et al., 1999). Table 1 shows the sociodemographic characteristics of the sample.

Table 1.  
Sample characterization (N = 1155)

Variable	Categories	N	%
Gender	Male	564	48.8
	Female	591	51.2
Grade	First	221	19.1
	Second	213	18.4
	Third	166	14.4
	Fourth	277	24.0
	Fifth	247	21.4
	Sixth	31	2.7
Province of the School	Cáceres	627	54.3
	Badajoz	528	45.7
School Environment	Urban	787	68.1
	Rural	368	31.9

Notes: N: number, %: percentage

### Procedure

Contact information was chosen of the schools where secondary education is taught by using the database of public schools in the Autonomous Community of Extremadura that belongs to the Department of Education and Employment of the Regional Government of Extremadura (available at: [http://estadisticaeducativa.educarex.es/?centros/enseanzas/&curso=17&enseanza\\_centro=101200001](http://estadisticaeducativa.educarex.es/?centros/enseanzas/&curso=17&enseanza_centro=101200001) accessed on September 2022). Then, the secondary education teachers were informed about the project and asked to work with it via email. The informed consent form and questionnaires were distributed to the schools that expressed interest in taking part via URL.

It was chosen to create the sociodemographic and *FP VAS A* data surveys using the Google Forms program. This made it possible to reduce costs and make it easier to transmit the questionnaires to participants and record their responses in the same database (Anderson & Kanuka 2003). The data was gathered between September and December of 2022.

Likewise, the use of these data did not require approval from an accredited ethics committee, as they are not covered by data protection principles, i.e., they are non-identifiable, anonymous data collected through an anonymous survey for teachers. In addition, based on Regulation (EU) 2016/679 of the European Parliament and of the Council on 27 April 2016 on the protection of individuals concerning the processing of personal data and on the free movement of such data (which entered into force on 25 May 2016 and has been compulsory since 25 May 2018), data protection principles do not need to be applied to anonymous information (i.e., information related to an identifiable natural person, nor to data of a subject that is not, or is no longer, identifiable). Consequently, the Regulation does not affect the processing of our information. Even for statistical or research purposes, its use does not require the approval of an accredited ethics committee. Figure 1 exhibits the procedure used for data collection.

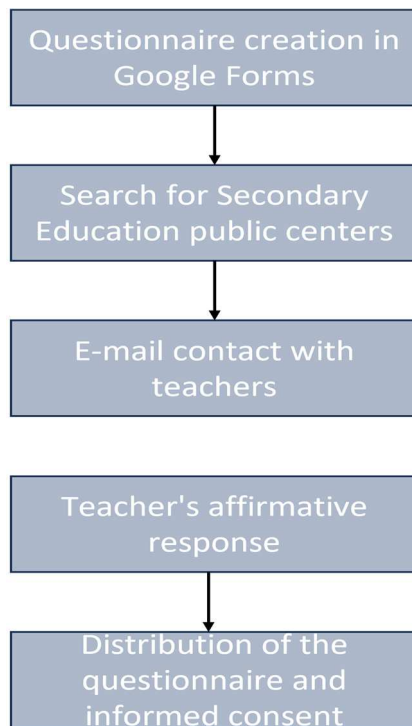


Figure 1. Flow chart

### Instruments

First, a sociodemographic questionnaire composed of 4 questions was designed to determine the characteristics of the participants. Questions about gender, grade, province in which the center was located, and the center's environment were included.

Later, they were administered *the FP VAS A*. This instrument consists of a visual analog scale that assesses the participants' perception of their own level of PF based on 5 different items (general fitness, cardiorespiratory fitness, muscular strength, speed-agility and flexibility). Each item ranges from 0 "very poor level" to 10 "excellent level". This scale has shown excellent concurrent validity and reliability values in its original study (Mendoza-Muñoz et al., 2021).

### Statistical Analysis

Given that the data were ordinal in nature (10-point Likert scale), exploratory analyses were carried out using the free statistical tool FACTOR v.10.10.02 (Rovira I Virgili University: Tarragona, Spain) (Ferrando & Lorenzo-Seva 2017). The entire sample was split into two equal subsamples using the Solomon method (Lorenzo-Seva 2022), one for the exploratory factor analysis (EFA) and the other for the confirmatory factor analysis (CFA). With the assumption that there is a relationship between them, the robust unweighted least squares (RULS) approach with Promin rotation (Lorenzo-Seva & Ferrando 2019) was used to extract the factors. Due to the nature of the data, a polychoric correlation matrix (Holgado-Tello et al., 2010) was used, and parallel analysis (Hayton, Allen, & Scarpello 2004) was used to establish the ideal number of dimensions.

The Kaiser-Meyer-Olkin (KMO) and Bartlett tests of sphericity were used as sampling adequacy measures (Beavers et al., 2013).

The AMOS v.26.0.0 software was then used to conduct the CFA (IBM Corporation, Wexford, PA, USA). Cross loads greater than 0.40, communalities less than 0.30, and loads less than 0.60 were eliminated from the structure (Hair, 2010). The model's goodness of fit was assessed using the following metrics: the non-significant values ( $p > 0.05$ ) for the chi-squared probability calculation (Witkov & Zengel 2019), the chi-square per degree of freedom ratio (CMIN/DF) (Yaşlıoğlu & Toplu Yaşlıoğlu 2020), the root means square error of approximation (RMSEA) (Kenny et al., 2015), the root mean square of residuals (RMSR) (Shi et al., 2018), the comparative fit index (CFI) (Xia & Yang 2019), the non-normed fit index (NNFI) (Bentler 1990). In addition, McDonald's Omega and Cronbach's Alpha were used as indicators of scale reliability (Dunn et al., 2014).

### Results

Table 2 shows the descriptive results on the different items by participants. Regarding the different items, participants show ratings that can be considered good, except for flexibility where scores are lower and vary more widely throughout the sample.

Table 2.  
Descriptive results of the responses

Items	M	SD	Variance
My overall physical fitness is...	6.87	1.97	3.87
My cardiorespiratory endurance (ability to do physical activities for a long time) is...	6.81	2.33	5.44
My overall muscle strength is...	6.60	2.07	4.31
My travel speed (the ability to run very fast) is...	6.97	2.24	5.02
My overall flexibility is...	5.92	2.46	6.05

Notes: M: Mean, SD: Standard Deviation

Through the explained variance based on eigenvalues (Larsen & Warne 2010) and the reliability of expected a posteriori scores (EAP) (Ferrando Piera & Lorenzo Seva 2016) (Table 3), the RULS approach was able to identify a monofactorial structure for the questionnaire.

Table 3.  
Eigenvalues and variance proportion of items

Items	Eigenvalues	Proportion of Variance
My overall physical fitness is...	2.89	.58
My cardiorespiratory endurance (ability to do physical activities for a long time) is...	0.89	.18
My overall muscle strength is...	0.51	.10
My travel speed (the ability to run very fast) is...	0.38	.08
My overall flexibility is...	0.34	.07

Due to the one-dimensional nature, no rotation mechanism was chosen. The sampling adequacy indicators that produced positive results (KMO test = 0.82850 and Bartlett test = 1025.3;  $df = 10$ ;  $p = 0.000$ ) were used to examine the feasibility of the EFA. The loading matrix for five items and one factor is shown in Table 4.

Table 4.

Items	Load	Communality
My overall physical fitness is...	.824	.679
My cardiorespiratory endurance (ability to do physical activities for a long time) is...	.794	.630
My overall muscle strength is...	.690	.476
My travel speed (the ability to run very fast) is...	.754	.569
My overall flexibility is...	.290	.084

After the EFA, item 5 was eliminated as it did not meet the criteria of factor load ( $>0.60$ ) and communality ( $>0.30$ ). As a result, a factor structure was created with four components bundled into one dimension. The polychoric correlation matrix that describes the make-up of the questionnaire is shown in Table 5.

Table 5.

Item	1	2	3	4
1	1			
2	.635	1		
3	.613	.533	1	
4	.617	.621	.516	1

Once the EFA was carried out and the structure of the scale was defined, the CFA was conducted to assess the characteristics of the model (Figure 2).

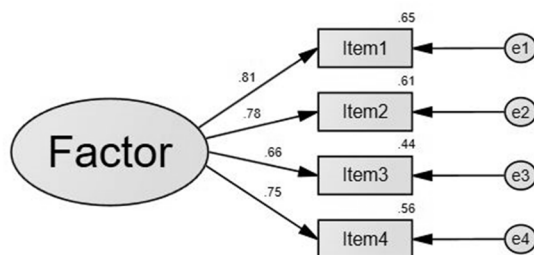


Figure 2. Factorial model of the instrument

After creating the CFA from the structure discovered in the EFA, the goodness-of-fit indices are shown in Table 6. The results showed that the model and data had an incredibly good fit (Bentler 1990). Both the CMIN/DF index, which must be below 2 for a proper model fit, and the chi-squared probability exhibit great results because of non-significant values. A nearly perfect fit to the model is shown by NNFI and CFI over 0.9. The RMSEA is within the pre-determined range (0.010-0.050), and an RMSR of less than 0.08 can be considered extraordinary.

Table 6.

Indices	Value
P ( $\chi^2$ )	0.433
CMIN/DF	1.288
RMSEA	0.016
RMSR	0.036
CFI	0.999
NNFI	0.998

Notes: P ( $\chi^2$ ): chi-squared probability; CMIN/DF: minimum discrepancy per degree of freedom; RMSEA: root mean square error of approximation; RMSR: root mean square of residuals; CFI: comparative fit index; NNFI: non-normed fit index.

Finally, Table 7 displays McDonald's Omega and Cronbach's Alpha reliability indicators for the single-dimensional structure of four items.

Table 7.

McDonald's Omega and Cronbach's Alpha reliability indicators for the single-dimensional structure of four items

Indices	Value
McDonald's Omega	0.838
Cronbach's Alpha	0.836
Explained Variance	2.461

Cronbach's alpha and McDonald's omega scores, for each of the factors, were satisfactory because they were greater than 0.7 (Nunnally & Bernstein 1994).

## Discussion

The aim of the present study was to analyze the psychometric properties, as well as the validity and reliability of a scale aimed at assessing the self-perception of PF in adolescents, in this case, in secondary school students from the Autonomous Community of Extremadura (Spain). Therefore, this study aims to test whether this instrument is safe and reliable for assessing PF in adolescents.

The findings of this study demonstrate that *the FP VAS A scale* is built of a monofactorial structure made up of 4 items with very high goodness-of-fit indices. Although the original *FP VAS A scale* likewise had a single-factor structure, it included five questions instead, with the fifth one measuring the respondent's impression of their own global flexibility (Mendoza-Muñoz et al., 2021). This item was eliminated from *the FP VAS A scale* because it failed to meet the criteria for factor loading ( $>0.60$ ) and communality ( $>0.30$ ) in this study. In this regard, the number of participants in this study ( $n = 1155$ ) is significantly higher than that of the original study ( $n = 67$ ; boys 38.8% and girls 61.2%) (Mendoza-Muñoz et al., 2021), and the proportion of boys and girls is more evenly distributed (boys 48.8% and females 51.2%). In addition, *the FP VAS scale* in the original study, revealed a link between actual fitness level and self-perception of fitness. Self-perception of flexibility, was the skill that had the lowest link with participants' actual levels of fitness (Mendoza-Muñoz et al., 2021). Flexibility was also the ability that obtained the lowest correlation in the study by "Palacios-Cartagena et al. (2022)" which examined the relationship between self-perceived PF, measured using *the IFIS*, and the level of PA, and in the study by "Gatti et al. (2022)" which examined the relationship between self-reported PA level and self-reported PF.

The factorial loading criterion (0.290) was one of the criteria in this study that led to the deletion of the item linked to self-perception of flexibility because the value obtained was less than 0.6. This finding is consistent with findings from earlier research, where self-reported flexibility was the sole skill with factor loadings that were less than 0.6 and did not demonstrate acceptable values (Bao et al., 2022; Español-Moya & Ramírez-Vélez 2014). With factor loadings for self-reported flexibility of 0.43 and 0.448,

respectively, these studies intended to test the psychometric features of the *IFIS scale* in Chinese children and adolescents (Bao et al., 2022) and Colombian youth (Español-Moya & Ramírez-Vélez 2014). In light of this, self-perceived flexibility was the only skill in several studies that examined gender differences in relation to self-perceived PF in children and adolescents (Mendoza-Muñoz et al., 2021; Sánchez-Toledo et al., 2017; Ortega et al., 2011; Palacios-Cartagena et al., 2022; Sánchez-López et al., 2015).

In this study, the mean self-perceived flexibility scores were the lowest and displayed the highest variation. This could be because the teenagers had an inaccurate idea of their own flexibility. This false self-perception might be caused by the fact that flexibility, particularly in boys, declines as puberty progresses if it is not worked on or trained (De Moraes et al., 2019). It is common for flexibility to start declining after puberty if it is not consistently worked on (Greydanus & Patel 2002), with genetics, lifestyle, nutrition, and level of PA also influencing this reduction (Klomsten et al., 2005; Klomsten et al., 2004). In this sense, there is no set age at which flexibility starts to decline. "Jürimäe and Saar's study (2003)", which demonstrates how boys' self-perceptions of flexibility decline between the ages of 14 and 15, while girls' self-perceptions of flexibility improve starting at the age of 17 and remain stable throughout adolescence, supports this. Additionally, it's possible that some adolescents' incorrect self-perceptions of flexibility are influenced by their ignorance of the broad definition of flexibility, which leads them to associate flexibility only with the ability to perform particular postures or extreme movements rather than with the capacity of muscles and joints to move through their full range of motion (Sands & McNeal 2013).

On the other hand, although there are no PF self-perception questionnaires or scales that do not take flexibility into account as an item to support one of the main findings of this study, such as the elimination of the global flexibility item from the *FP VAS A scale*, there are some physical self-perception questionnaires, such as the *PSPP questionnaire*, that do not include a specific item or dimension for flexibility (Fox & Corbin 1989). Thirty items make up the questionnaire, which is divided into five scales to arrange the instrument's components: perceived sport skill, physical beauty, physical strength, PF, and overall perception of physical competence. Additionally, this is related to findings from several studies where self-rated health and self-reported fitness were linked, suggesting that adolescents report their overall fitness and health status based on muscular strength and cardiorespiratory endurance, as the relationship between self-perceived flexibility and perceived health condition was not significant (Bermejo-Cantarero et al., 2021; Marques et al., 2017; Shi et al., 2022).

Finally, Cronbach's alpha and McDonald's omega values showed high levels of consistency. In this sense, the overall internal consistency of the scale was high, showing the existence of a reliable scale. Furthermore, in line with the results of the original study (Mendoza-Muñoz et al., 2021),

the results of the CFA of our research showed good and exceptional reliability values (Nunnally & Bernstein 1994).

### Practical Implications

In general, this scale *FP VAS A* has shown to be a reliable and useful instrument to assess the perception that adolescents have about their own PF, and it can be an alternative to field tests and specific devices to measure different physical abilities. This scale provides fewer objective data to adolescents; however, it is more economical and requires less time to be completed by the adolescent, and it is also a very applicable tool in PE classes, which have a large number of students.

As it has been demonstrated, perceptions of general fitness are related to self-reported health status, life satisfaction, and health-related quality of life, suggesting that improving general fitness could favor a better self-perception of health. On the other hand, this tool could be very useful in improving the health, well-being, and PF of adolescents, especially those who perceive a low level of fitness (Bermejo-Cantarero et al., 2021; Marques et al., 2017; Shi et al., 2022). Additionally, PE instructors should promote the use of this *FP VAS A scale* among their student body by relating it to the effects of PA on PF and assisting teenagers in making connections between health-related fitness and current and future health status, thereby enhancing their actual and perceived fitness levels (Babic et al., 2014). This scale will be a good adjuvant for the practice of PA in out-of-school hours, being an interesting method to identify the skills where students need to improve and thus design PA routines to achieve improvements.

Along the same lines, this scale has certain advantages over the *IFIS scale*, such as, for example, which is based on 5 questions in the form of a 5-Likert scale (Murray et al., 2002; Price et al., 1994), its ease of use and comprehension, particularly by less educated raters and participants. The Likert scale, on the other hand, has a lot of categories, and too many can make it difficult to make a decision, while too few might result in a lack of options or sensitivity. Therefore, the respondent could be pressured to select a response that does not accurately reflect his or her genuine intention (Svensson 2001).

### Limitations and future lines of research

The study was only carried out in the Community of Extremadura, and the sample consisted of adolescents from secondary schools in Extremadura, so the results may have been influenced by sociocultural variables. Additionally, because participants were chosen using a convenience sample technique, the selection process was prone to subjectivity and researcher bias (Etikan 2016). In this sense, it would be interesting to carry out this type of study in other autonomous communities of Spain or in other countries and compare the results with those of this research, thus demonstrating the consistency of the findings shown or checking

whether sociocultural influences influence adolescents' self-perception of PF.

In addition, it would be interesting to evaluate the convergent validity of *the FP VAS A scale* with other instruments that estimate fitness level with standard measures such as the use of accelerometers, dynamometers, cardiopulmonary tests and strength platforms. It would also be innovative to use this scale, originally created for adolescents, in older populations and to compare the results of self-perceived PF between different age ranges.

On the other hand, an online form was utilized to collect the responses. In this sense, when compared to a face-to-face interview, some studies show that respondents may have trouble completing the questionnaire because they don't fully understand some of the questions, which may lead them to choose an ambiguous response or leave the question unanswered (Heerwegh, 2009; Heerwegh & Loosveldt, 2008).

## Conclusions

The present study showed for *the FP VAS A scale* a monofactorial structure composed of 4 items (general PF, cardiorespiratory fitness, muscular strength and speed-agility), as well as consistent goodness-of-fit indicators. With respect to the original *FP VAS A scale*, item number 5 corresponding to the self-perception of global flexibility was eliminated because it did not meet the factorial loading and communality criteria. In general, the internal consistency of the scale was high, with the confirmatory factor analysis (CFA) showing exceptional reliability values. Therefore, the use of this quick and easy-to-use tool is encouraged in the educational environment, especially in PE classes, for the self-monitoring of PF by students so that they can design PA plans to improve the abilities whose self-perceptions are more negative.

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