

Cross-cultural adaptation and validity evidence of the Brazilian version of the State Mindfulness Scale for Physical Activity (SMS-PA)

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Abstract

The objective of this study was to perform a cross-cultural adaptation to the Brazilian Portuguese language and to estimate validity evidence of the State Mindfulness Scale for Physical Activity (SMS-PA) in the Brazilian context. The sample consisted of 288 subjects participating in physical and sports activities (mean age: 21.1±4.8; 56.6% women). Exploratory and Confirmatory Factor Analyzes were conducted to assess the internal structure and the invariance of the factorial model between men and women. Cronbach's alpha was employed to assess internal consistency, and the Pearson correlation to assess the pattern of correlation between the SMS-PA and the intrinsic motivation/ amotivation measures, and between the SMS-PA and the Reason for Exercise scale. The results showed adequacy of the bi-factor structure with two specific factors (mental and body mindfulness), and one general factor (state mindfulness for physical activity), as per the theoretical hypothesis (WLSMV $\chi^2=95.951$; $df=33$; $\chi^2/df=2.91$; CFI= .997; TLI= .962; RMSEA= .072 CI-90% .053-.091); desirable internal consistency indices for all factors ($.882 \leq \alpha \leq .887$), and invariance of the SMS-PA's internal structure to assess men and women. Moreover, positive correlation of the SMS-PA was observed with intrinsic motivation and internal reasons for exercise, with negative correlations for amotivation, as per the theoretical hypothesis. It can be concluded from this study that the Brazilian version of the SMS-PA is a suitable measurement tool for assessing state mindfulness in Brazilians who practice physical activities and sports.

Key-words: sport psychology, psychometric, exercise, intrinsic motivation, bi-factor model.

Introduction

Physical inactivity is currently a worldwide problem, considered to be the fourth main risk factor for mortality, causing approximately 3.2 million deaths around the world (World Health Organization - WHO, 2010; Kohl 3rd et al., 2012). On the other hand, the literature has demonstrated the benefits of practicing sports and physical exercise on a regular basis, in terms of both mental and physical health, and in different stages of human development: childhood, adolescence, adulthood and old age (Oliveira, Monteiro, Jácome, Afreixo & Marques, 2016; WHO, 2010). A positive impact on social, emotional and cognitive aspects, as well as in well-being promoted by engaging in sports and physical exercise, has been demonstrated (Standage, Gillison, Ntoumanis, & Treasure, 2012). However, in order to sustain the benefits associated with regular physical and sporting activities, long-term adherence is important (Marcus et al., 2000).

Researchers from the sports and health sciences have faced the challenge of understanding the variables that contribute to engagement in sport and physical exercise, as well as those that contribute to maintaining these practices throughout one's lifetime (Ullrich-French, Hernández, & Montesinos, 2017). In fact, specialized literature demonstrates a greater likelihood of engagement in those practices on a long-term basis if the activity is chosen by a self-determined behavior (Cox, Ullrich-French, Cole, & D'Hondt-Taylor, 2016; Ryan & Deci, 2007; Ullrich-French, Hernández, & Montesinos, 2017). The self-determination theory (SDT) proposed by Ryan and Deci (2007) states that a self-determined action is driven by a subject's own volition, that is, engagement in the activity due to the pleasure, satisfaction and self-knowledge it provides. On the other hand, when practice is driven by extrinsic motivation, that is, by motives such as physical appearance, medical recommendation or the relief of negative feelings, there is less chance of long-term adherence.

Cox et al. (2016) took an important step towards improving the understanding of the process of engagement in physical activity and sports. They have demonstrated that an intrinsically motivated person can be distinguished from an extrinsically motivated person by the degree of their mental engagement in the activity, with the latter directing their attention to external factors, such as anticipated results (*i.e.* to lose weight), distraction elements (*i.e.* music) and even irrelevant thoughts. The literature has shown that mindfulness theory corroborates this hypothesis.

Mindfulness has been defined as an awareness state in which thoughts, sensations and feelings perceived by the individual are acknowledged and accepted as they are at the present moment, without further elaboration or judgment. Mindfulness reflects the consciousness of stimuli, such as mental states (thoughts and feelings) and physical sensations (muscle tension or body posture) at the moment they occur, without becoming attached to them (Bishop et al, 2004; Grecucci, Pappaianni, Siugzdaite, Theuninck, & Job, 2014; Cox et al., 2016).

However, although there was evidence of a positive association between mindfulness and autonomous motivation (Brown & Ryan, 2003), this relationship in the context of physical exercise and sports only began to be explored very recently, probably due to a lack of assessment tools to conduct studies. Cox, Ullrich-French and French (2016) contributed to filling this gap by developing the State Mindfulness Scale for Physical Activity (SMS-PA), which aims to assess state mindfulness during the practice of physical exercise and sports. The SMS-PA was adapted from the State Mindfulness Scale (SMS) (Tanay & Bernstein, 2013), which was developed to assess mindfulness, both in physical and mental events, as well as the quality of mindfulness, namely attention, awareness and openness. Tanay & Bernstein (2013) intended to fill the gaps that existed at the time associated with the lack of measuring instruments, such as assessing mindfulness of physical sensations; however, they did not address the issue in a sporting context. The SMS showed a two-factor structure reflecting the factors of mental and body mindfulness, in addition to an overall, higher-order factor indicating an overall state mindfulness. Additionally, Cox, Ullrich-French and French (2016) noticed that the original scale (SMS) failed to address the full contents of one's experience during the practice of physical activity. Accordingly, they have included items that address the attention to physical exertion, muscular engagement and body movement. Studies into the internal structure of the SMS-PA showed that the items were grouped into two specific factors (bi-factor structure), one including items that reflect state mindfulness in physical or bodily aspects, and the other reflecting mental aspects experienced when practicing physical activity and sports, as well a global factor. Thus, these results support the use of each subscale score (mental and body) separately, or a global score, corroborating the theoretical hypothesis. Additionally, the SMS-PA showed good internal consistency, with Cronbach's alpha indices greater than 0.80, as well as moderate positive associations with autonomous motivations, intrinsic reasons for practicing physical exercise and a lack of association with external reasons for physical exercise, corroborating the theoretical hypothesis (Cox, Ullrich-French, & French, 2016). The SMS-PA (Cox, Ullrich-French, & French, 2016) was adapted for Spanish youngsters by Ullrich-French, Hernández, & Montesinos (2017). The psychometric analysis showed a higher-order factor structure with a higher-order general factor, and two lower-order specific factors (mental/body state mindfulness). Although this is a similar structure to that presented by Cox, Ullrich-French and French (2016), the higher-order factor model does not support the use of the three different scores simultaneously as unique constructs. The Spanish version of the SMS-PA also showed good internal consistency (Cronbach's $\alpha > .80$) for specific and global factors.

Taking into account the relevance of this construct for professionals and researchers in the fields of health and sports sciences, and the lack of instruments for assessment, the objectives of this study are: a) to perform a cross-cultural adaptation of the SMS-PA to the Brazilian Portuguese language and, b) to estimate validity evidence of the Brazilian version of the SMS-PA. It is hypothesized that the Brazilian Portuguese version of the SMS-PA would demonstrate a bi-factor structure, with two specific factors (mental and body), and one global factor.

Material and Methods

Participants

The sample comprised 288 participants of both sexes ranging in age from 18 to 47 years (mean = 21.1 ± 4.8 years; 56.6% males). The highest percentage of participants (30.5%) reported being involved in practicing sports for fun, with no competitive purpose. Of the remaining participants, 21.9% reported competing at a regional level, 4.2% at the national level and 1.4% at the international level. With regard to the level of education, 47.7% of participants reported not having finished an undergraduate course, 34.4% reported having finished an undergraduate course, 12.5% reported having finished high school and 9% reported having finished elementary school.

Instruments

The State Mindfulness Scale for Physical Activity (SMS-PA) (Cox, Ullrich-French, & French, 2016) aims to assess state mindfulness during the practice of sports and physical exercise. It has 12 items rated on a 5-point Likert scale with responses ranging from "1 = not at all" to "5" = very much", organized in a bi-factor structure: two specific factors, mental mindfulness and body mindfulness, and an overall factor, mindfulness. Studies concerning the psychometric properties of SMS-PA found empirical evidence which supports the measurement model's suitability in its different versions, as well as good reliability levels, with Cronbach's alpha above 0.80 (Cox, Ullrich-French, & French, 2016; Ullrich -French, Hernández, & Montesinos, 2017). Intrinsic motivation was assessed using the Sport Motivation Scale (SMS) (Pelletier et al., 1995). This instrument has the objective of assessing motivational aspects linked to practicing sport: intrinsic and extrinsic

motivation, as well as amotivation, by means of 28 items with a Likert scale response system. The response options ranged from 1 = does not correspond at all, to 7 = corresponds completely. The characteristics of motivation are assessed through three specific intrinsic motivation (IM) factors (IM to increase knowledge, IM to achieve goals and IM for stimulating experiences); and through three factors for assessing extrinsic motivation (internal regulation, introjected regulation and identified regulation). There is only one factor for assessing amotivation. Bara-Filho et al. (2011) adapted and assessed validity evidence of this instrument for the Brazilian context, indicating adequacy of the theoretical model through the CFA method, as well as good reliability indices, with Cronbach's alpha ranging from .70 to .81.

The Reasons for Exercise Inventory (Silberstein, Striegel-Moore, Timko, & Rodin, 1988) aims to assess internal and external reasons for engagement in physical exercise. This 24-item inventory uses a 7-point Likert scale with responses ranging from 1= strongly disagree to 7 = strongly agree. Psychometric properties of this instrument support its use in assessing three overall dimensions concerning the reasons for exercising (appearance, health/fitness and mood/enjoyment), both with good reliability levels, Cronbach's alpha being higher than .7 (Cox et al., 2016; Strelan, Mehaffey, & Tiggemann 2003).

The Sociodemographic questionnaire was developed by this study's researchers with the objective of assessing sample characteristics, such as age, sex, category of sport practiced, competitive level, level of education, etc.

Procedures

Scale adaptation

Initially, one of the authors of the original Scale, Dr. Anne E. Cox (Cox et al., 2016) was contacted to request permission to use the SMS-PA in the transcultural translation and adaptation process. Afterwards, the instrument was translated into Brazilian Portuguese by three bilingual researchers fluent in Portuguese and English. No difficulties were found in the summarization of the three translations, given that SMS-PA is composed of clear and objectively written items.

In a subsequent back-translation, a professional translated the summarized version back to the English language. A multidisciplinary expert group composed of three PhDs from the field of sport psychology and psychological assessment evaluated the equivalence between the back-translated version and the summarized version. The final version was then presented to 10 subjects who practice physical and sports activities. They evaluated the clarity and comprehensibility of the items, which showed good levels of understanding and no further need for adjustment.

For the content validity analysis, the 12 items of the adapted version of the SMS-PA were submitted to the analysis of four independent judges (academics with experience in sport psychology and knowledge of literature on sports-related mindfulness), which led to content validity (Hernández-Nieto, 2002), adequacy of the item in the factors for which they were originally developed, as well as to the analysis of clarity of language and practical relevance to assess the construct of interest. The findings suggest adequacy of the Brazilian version of the SMS-PA with good agreement among experts, who indicated that the items should remain in their original factors (mental and body mindfulness), as per the theoretical hypothesized. The results showed good levels of clarity of language and practical relevance with CVC coefficients above .80 (range= .85 to 1) (Hernández-Nieto, 2002), thus showing the scale's theoretical adequacy. This supported the performance of an empirical study for the gathering of validity evidence, such as internal structure and reliability.

Ethical procedure

Participants were recruited from sports venues, parks and places of physical activity in Garanhuns, a rural town in the state of Pernambuco, northeastern Brazil. All participants signed the Free and Informed Consent Form, which included a description of the study, in accordance with ethical standards. Data collection was conducted collectively. Participants' rights of being informed of the objectives and procedures of the study, to have their data kept confidential, and to cease their participation at any time, were guaranteed, in accordance with the National Health Council (*Conselho Nacional de Saúde*) Resolution 510/2016, which regulates research on human beings in Brazil.

Statistical Analysis

In order to accomplish the objectives of this study, the analysis was performed in several steps. Firstly, an Exploratory Factor Analysis (EFA) was employed to examine the internal structure using estimation methods based on a polychoric correlation matrix (Unweighted Least Squares ULS and Promax rotation), which is a suitable procedure for the assessment of instruments with ordinal response systems, such as Likert scales, for example, and non-normal distribution.

The second step consisted of comparing two measurement models through Confirmatory Factor Analysis (CFA). The adjustment indices of the models composed of two correlated factors, a higher order and a bi-factor model, were compared, as proposed by Cox et al. (2016) and Ullrich -French, Hernández and Montesinos (2017) in the American and Spanish versions of the scale, respectively. The Confirmatory Factor Analyses were estimated based on polychoric correlation matrices with the Weighted Least Squares Mean and Variance-adjusted (WLSMV) method. Indices commonly adopted in the literature were used in the assessment

of the model, namely the WLSMV χ^2 , df, χ^2 /df, RMSEA, CFI and TLI, with the following reference values: χ^2 /df < 3, RMSEA < .06, CFI and TLI > .95 (Muthén & Muthén, 2012). Once validity evidence based on internal structure was obtained, the invariance of the measurement model was evaluated between female and male participants (Milfont & Fisher, 2010).

Once the internal structure of the Brazilian version of the SMS-PA had been estimated, an internal consistency analysis was performed using Cronbach's alpha, having values higher than .70 as a reference. Lastly, convergent and divergent validity evidence was estimated. Pearson correlation coefficients were used to verify the association between the different factors that make up the SMS-PA and intrinsic motivation/amativation for sports practice variables, as well as between the SMS-PA factors and the reasons for exercising.

Results

Exploratory Factor Analysis

Results prior to the EFA indicated data adequacy and thus possible factorability of the variables analyzed, the Kaiser-Meyer-Olkin KMO = 0.80394 and Bartlett χ^2 and the Bartlett sphericity test = (66) 1329.3 $p < .001$. Retention factor analysis (Kaiser-Guttman and PA) indicated adequacy for extracting the first two factors, which presented Eigenvalues higher than 1 (4.291 and 3.207, respectively), and real data explained variance (42.033 and 32.327, respectively) higher than that of the mean values (22.531 and 19.840, respectively) and of those allocated on the 95th percentile (28.089 and 23.662, respectively) of the random matrices. Based on these results, an EFA was conducted forcing a factorial solution into two factors. Table 1 presents the item factor loadings, commonalities, the percentage of explained variance and the correlation indices between factors.

Table 1: Exploratory Factor model to SPM-PA

| Items | F1 | F2 | h ² |
|---|-------|-------|----------------|
| 1. I was aware of different emotions that arose in me/ <i>Estava ciente das diferentes emoções que surgiam em mim.</i> | .393 | | .252 |
| 2. I noticed pleasant and unpleasant emotions/ <i>Notei emoções agradáveis e desagradáveis.</i> | | .649 | .419 |
| 3. I noticed pleasant and unpleasant thoughts/ <i>Notei pensamentos agradáveis e desagradáveis.</i> | | .797 | .637 |
| 4. I noticed emotions come and go/ <i>Notei as emoções irem e virem.</i> | | .870 | .758 |
| 5. I noticed thoughts come and go/ <i>Notei pensamentos irem e virem.</i> | | .894 | .794 |
| 6. It was interesting to see the patterns of my thinking/ <i>Foi interessante perceber os padrões do meu pensamento.</i> | | .528 | .449 |
| 7. I focused on the movement of my body/ <i>Concentrei-me no movimento do meu corpo.</i> | .680 | | .461 |
| 8. I felt present in my body/ <i>Senti-me presente no meu corpo.</i> | .782 | | .612 |
| 9. I listened to what my body was telling me/ <i>Ouvi o que o meu corpo estava me dizendo.</i> | .763 | | .585 |
| 10. I was aware of how my body felt/ <i>Estava ciente de como o meu corpo se sentia.</i> | .812 | | .659 |
| 11. I noticed the sensations in my body/ <i>Notei as sensações que surgiam no meu corpo.</i> | .776 | | .632 |
| 12. I was in tune with how hard my muscles were working/ <i>Estava em sintonia com quão forte os meus músculos estavam trabalhando.</i> | .666 | | .442 |
| Exp. Var. | 35.77 | 26.68 | |
| Total | 62.5 | | |
| <i>r</i> | .103 | | |

Notes: h²= Commonality; Exp. Var.= % of Explained Variance; Total= % of Total Explained Variance; *r*= Inter-Factors Correlation

As noted in Table 1, the items comprising factor 1 are primarily the items developed to assess mental mindfulness (items 7 to 12). However, item 1 presented factor loading on the mental mindfulness factor, although they were theoretically developed to assess body mindfulness. In addition, this item had the lowest factor loading in factor 1 (.393) in comparison with those developed to assess the target construct (between .666 and .812, items 12 and 8, respectively).

The items developed to assess mental mindfulness are allocated in factor 2, showing factorial loads higher than .528 (item 6). All items showed good indices of commonality (between .419 and .794 - items 2 and 5, respectively), except for item 1. The two-factor structure explained 62.5% of the total data variance. Lastly, a

low magnitude correlation was observed among the scale factors. Considering the EFA and internal consistency results, item 1 was excluded from subsequent analysis, since it was not developed for assessment of mental mindfulness, and as it slightly penalized the internal consistency factor.

Confirmatory Factor Analysis

As the first psychometric properties of this Brazilian version of the SMS-PA were estimated through EFA, three factorial models of the data were compared: two correlated factors, second-order and bi-factor. The results are presented in Table 2, where the adjustment indices of the different models are shown.

Table 2 - Confirmatory factor analysis and invariance test fit

| Model Test | WLSMV χ^2 | df | χ^2/df | CFI | TLI | RMSEA (I.C. 90%) |
|---|----------------|-----|-------------|------|------|--------------------|
| Two correlated factors | 279.057 | 43 | 6.49 | .914 | .889 | .139 (.124 - .155) |
| High-Order | 279.057 | 43 | 6.49 | .914 | .889 | .139 (.124 - .155) |
| Bifactor | 95.951 | 33 | 2.91 | .977 | .962 | .072 (.053 - .091) |
| Invariance Test (Bifactor model) | | | | | | |
| Configural invariance | 154.566 | 118 | 1.31 | .990 | .991 | .047 (.022 - .066) |
| Threshold invariance | 165.910 | 115 | 1.44 | .987 | .987 | .056 (.036 - .074) |

Notes: WLSMV χ^2 = weighted least square mean and variance-adjusted chi-square statistic test; df= degrees of freedom; χ^2/df = chi square/degrees of freedom ratio; CFI= comparative fit index; TLI= Tucker-Lewis fit index; RMSEA= root mean square error of approximation. All models were significant at $p < .01$.

The results of the CFA (Table 2) indicate that the two correlated factors and the second-order models showed inadequate adjustment indices. On the other hand, the bi-factor model showed a significantly better fit, indicating a good model fit. The bi-factor model is presented in Table 3. The factor loadings estimated by the bi-factor model were all statistically significant and varied from moderate to high for all factors, ranging from .451 to .897 for the mind mindfulness specific factor, from .605 to .789 for the body mindfulness specific factor and from .243 to .873 for the general factor.

Table 3 – Bi-factor model of the Brazilian version of the SMS-PA

| Items | Specific factors | | General Factor |
|----------|------------------|------|----------------|
| | 1 | 2 | |
| 2 | .682 | | .290 |
| 3 | .822 | | .262 |
| 4 | .860 | | .351 |
| 5 | .897 | | .325 |
| 6 | .451 | | .873 |
| 7 | | .630 | .265 |
| 8 | | .717 | .320 |
| 9 | | .655 | .408 |
| 10 | | .786 | .243 |
| 11 | | .622 | .509 |
| 12 | | .605 | .319 |
| α | .887 | .867 | .882 |

Note: α = Cronbach's alpha.

The last step to verifying the internal structure of the SMS-PA in the Brazilian context was the analysis of the measurement's invariance between female and male participants; these results are shown in Table 2. As for the evaluation of invariance in the model, the results demonstrate an equivalence of the configural model between groups, indicating similarities between the overall internal structure proposed for the measurement model, the number of latent variables and observed variables (items) related to the latent variables (factor). Moreover, an invariance of the scalar model is observed, which assesses the equivalence of the item thresholds between groups. These findings allow the inference of full measurement invariance for the bi-factor model between female and male participants, given that ΔCFI between the two models is less than .01 (Rios & Wells, 2014). It is worth noting that it is not possible to assess the metric model invariance via Mplus software when using the WLSMV estimator for polytomous data.

Reliability analysis

Cronbach's alpha coefficients demonstrated good levels of internal consistency for the specific and general factors, all of them higher than .8, as shown in Table 3.

Validity evidence based on relationship with external variables

The final objective of this study was to estimate possible associations between SMS-PA and indices of intrinsic motivation for practicing sports, between SMS-PA and amotivation and between SMS-PA and reasons for practicing physical exercise. The results are presented in Table 4.

Table 4- Correlation coefficients between SMS-PA and SMS and Reasons for Exercise.

| Motivation | Mindfulness | | |
|-----------------------------|----------------|----------------|---------------|
| | Mental | Physical | Overall |
| Amotivation | .070 | -.239* | -.12 |
| IM - accomplishment | .022 | .233* | .171 |
| IM - knowledge | .006 | .290** | .199 |
| IM- experience stimulation | .020 | .336*** | .236* |
| Total intrinsic motivation | .018 | .321** | .227* |
| Reasons for Exercise | | | |
| Appearance | .135 | .058 | .138 |
| Health/Fitness | .187* | .102 | .197** |
| Mood/enjoyment | .350*** | .033 | .277** |

Notes: * = $p < .05$; ** = $p < .01$; *** = $p < .001$; IM = intrinsic motivation

In the top part of Table 4, the correlation coefficients of moderate and negative magnitudes between the specific factor body mindfulness and the amotivation variable, as well as the correlation coefficients of moderate and positive magnitudes with the factor body mindfulness and the intrinsic motivation indices are highlighted. In this regard, similar magnitude correlations are observed between the global factor and the IM to experience stimulation, and between the global factor and the sum of intrinsic motivation indices. In the lower part of table 4, the positive correlation coefficients of weak and moderate magnitude between the specific factor body mindfulness and the Health/Fitness and mood/enjoyment reasons, and also between the global factor and the Health/Fitness and mood/enjoyment reasons for exercise are highlighted.

Discussion

The objective of this study was to perform a cross-cultural adaptation of the State Mindfulness Scale for Physical Activity to the Brazilian Portuguese language and to estimate its validity evidence. Psychometric analysis provided support for the adapted version of the instrument, demonstrating validity evidence based on the internal structure, which corroborates the initial hypothesis, a bi-factor model with one global factor representing the state of mindfulness, and two specific factors representing the mental and bodily aspects of experiencing physical activity (Cox et al., 2016; Ullrich-French, Hernández, & Montesinos, 2017). These results suggest the adequacy and potentiality of the Brazilian version of the SMS-PA.

Although the Brazilian version of the SMS-PA has presented a similar factorial structure to that of the original instrument's proposal, EFA demonstrated unexpected behavior in respect of item 1. This item's content (1- *Estava ciente das diferentes emoções que surgiam em mim* / I was aware of different emotions that arose in me) was theoretically expected to be associated with the specific factor mental mindfulness. Taking into consideration that, for the participants of this study, emotions cited in the item could have been understood as physical sensations or body experiences, item 1 was excluded from subsequent analysis.

In order to properly assess the construct and to enable intercultural studies based on instruments with similar psychometric property indices, the performance of a new study with the SMS-PA is suggested, aimed at adapting the content of item 1 through a redrafting of the sentence, in addition to a new analysis of validity evidence. As an alternative, more emphasis should be placed on the mental aspects of the emotions referred to in the item in question (Example: 1- *Estava consciente das diferentes emoções que surgiam em minha mente* / I was aware of different emotions that arose in my mind).

Results have shown the internal structure to be adequate, as in the original American version of the SMS-PA (Cox et al., 2016), a bi-factor model, despite the exclusion of one item. It is worth noting that the Spanish version showed a better fit with a higher-order factor model (Ullrich-French, Hernández, & Montesinos, 2017). There has been discussion in the literature about the differences between the bi-factor and the higher-order models (Chen, West & Sousa, 2006; DeMars, 2013; Reise, 2012; Rios & Wells, 2014). The bi-factor model specifies a general factor measured by all of the scale items, as well as two or more specific factors measured by smaller groups of the same scale items. In this case, the specific factors are orthogonal to the general factor and to the other specific factors and, as a result, it is possible to interpret them separately. On the other hand, the second-order model presents a hierarchical structure in which a general factor explains the commonality among the first-order factors.

According to Chen, West and Sousa (2006), the bi-factor model should be chosen when: (a) there is a hypothesis that there is a general factor accounting for the items' commonality; (b) there are specific factors of multiple domains that are hypothesized to exert individual influence beyond the general factor; and (c)

researchers are interested in both the specific factors and the general factor. On the other hand, a second-order model shows greater potential for use when: (a) the lower-order factors present strong correlations with each other, and (b) there is a higher-order factor thought to account for the relationship among the lower-order factors.

Therefore, the better adjustment indices for the bi-factor model, when compared to the two-correlated factor and the higher-order factor models, can be explained by the fact that the factors did not correlate with each other ($r = .103$), as observed in the EFA. In addition, in the original version, Cox et al. (2016) observed the bi-factor model's potential, when they estimated the adequacy of the general factor in explaining part of the item variance. Furthermore, studies have shown advantages of bi-factor models over higher-order models (Brown, 2015; Reise, 2012; Rios & Wells, 2014), such as the possibility of using the different SMS-PA scores simultaneously, representing individual constructs, namely: mental mindfulness, body mindfulness and state mindfulness for physical activity (Cox et al., 2016).

Indicators of invariance of the measurement model proposed for the instrument were estimated in this study as well. The results support the scalar invariance between the groups of male and female athletes. The invariance test has been increasingly important for Psychology in general and Sport Psychology in particular, since psychological constructs are assessed through the answers to the observed variables (items) (Urbina, 2014). By finding empirical evidence that these observed variables are related to the latent constructs in the same way for the different groups, it is possible to compare them with the raw results of a psychological instrument. From these results, the first evidence of how the observed variables (the items that comprise the subscales of the SMS-PA) relate to the latent constructs, considering the assessment of men and women, demonstrates the possibility that this scale can compare these groups through the raw results (Borsboom, 2006; Milfont & Fisher, 2010). In summary, the results of the EFA, the CFA and the multigroup CFA corroborate the initial hypothesis related to the internal structure of the SMS-PA and, therefore, satisfactorily meet the objective of estimating the first validity evidence based on the internal structure of the instrument in the Brazilian context (American Educational Research Association, American Psychological Association, & National Council on Measurement in Education, 2014).

Concerning the reliability indices of the Brazilian version of the SMS-PA, the results presented in this study, Cronbach's alpha between .867 and .887, indicate good levels of internal consistency for the measurement model (Tabachnick & Fidell, 2012). This corroborates results of studies with other versions of the scale, such as the American version proposed by Cox et al. (2016), which have an estimated Cronbach's alpha coefficient higher than .8 for the different specific factors and the global factor, and the Spanish version proposed by Ullrich-French, Hernández and Montesinos (2017), that have also estimated Cronbach's alpha coefficient to be higher than .8 for the subscales of this version. In this way, the results presented here acknowledge support for the objective of estimating the reliability of the Brazilian version of the SMS-PA (AERA, APA, & NCME, 2014).

Validity evidence based on a relationship with other variables, for the Brazilian version of the SMS-PA, were supported by significant correlations with the intrinsic motivation subscales of the Sports Motivation Scale (Peretier et al., 1995), especially with the mindfulness of the body factor and the subscales of intrinsic motivation. These results corroborate the initial hypothesis of positive associations between mindfulness and intrinsic motivation (Cox et al., 2016). Furthermore, increases were observed in the magnitude of association with the increasing degree of autonomy/self-determination of assessed variables (intrinsic motivation for accomplishment, for knowledge and to experience stimulation). This suggests that the level and regulation of self-determination for sports activities show a tendency to increase with the increasing demand of mindfulness experienced by the subject. Similar results were observed by Ullrich-French, Hernández and Montesinos (2017), who showed the same association growth pattern depending on the degree of autonomy/self-determination (i.e. identified and introjected regulation subscales), as well as negative association between mindfulness indices and amotivation. Similar patterns were observed by Cox et al. (2016) and also Brown and Ryan (2003).

Positive associations between the specific factor mental mindfulness and reasons for exercise (Health reasons and Mood reasons), as well as between the global factors and the reasons for exercise, were also observed. These results partially replicate those of Cox et al. (2016), who found a positive association with both specific factors (mental and body mindfulness). On the other hand, the results presented in this study are consistent with the fact that the reasons for exercise (Health reasons and Mood reasons) are internal, and thus are in line with intrinsic goals (Cox et al., 2016; Vansteenkiste, Soenens, & Lens, 2007). The results of this research provide new support for the initial hypothesis that the mindfulness construct may be an important variable for continuing to practice physical activity given the main role of intrinsic motivation in this regard (Ryan & Deci, 2007). Therefore, it may be inferred that the results found ensure the first validity evidence based on the relationship to other variables for the Brazilian version of the SMS-PA (AERA, APA, & NCME, 2014).

Conclusions

The present study enabled the adaptation of SMS-PA to Brazilian Portuguese and the estimation of its psychometric properties for the population of Brazilians who practice sports and physical activities. The results

indicated the adequacy of this version and suggest the potential of this scale to be a part of the set of instruments for researchers whose objective is to investigate the role of the state of mindfulness in the practice of physical and sports activities. Finally, some limitations of this research are pointed out, such as the fact that analyses were based on a convenience sample from a specific region of the country (northeast region). Therefore, caution is advised in the generalization of data for the Brazilian population, given the territorial size of the country and the wide cultural differences between regions. In this sense, further studies with larger and more diversified samples, with regard to geographical representation, are recommended. In addition, further studies are needed in order to investigate the internal structure of SMS-PA using item 1 re-edited from the results obtained in the present research.

Conflicts of interest

The authors declare that there was no conflict of interests.

References

- American Educational Research Association, American Psychological Association, & National Council on Measurement in Education. (2014). *Standards for educational and psychological testing*. Washington, DC: American Educational Research Association.
- Bara Filho, M. G., Andrade, D., Miranda, R., Nuñez, J. L., Martin-Albo, J., & Ribas, P. R. (2011). Preliminary validation of a Brazilian version of the sport motivation scale. *Universitas Psychologica*, 10(2), 363-372.
- Bishop, S. R., Lau, M., Shapiro, S., Carlson, L., Anderson, N. D., Carmody, J., Segal, Z. V., Abbey, S., Speca, M., Velting, D., & Devins, G. (2004). Mindfulness: A proposed operational definition. *Clinical Psychology: Science and Practice*, 11(3), 230–241. doi: 10.1093/clipsy.bph077
- Borsboom, D. The attack of the psychometricians. *Psychometrika*, 71(3), 425-440. doi: 10.1007/s11336-006-1447-6
- Brown, K. W., & Ryan, R. M. (2003). The benefits of being present: Mindfulness and its role in psychological wellbeing. *Journal of Personality and Social Psychology*, 84, 822–848. doi: 10.1037/0022-3514.84.4.822
- Brown, T. A. (2015). *Methodology in the social sciences. Confirmatory factor analysis for applied research* (2nd ed.). New York: Guilford Press.
- Chen, F. F., West, S., & Sousa, K. (2006). A Comparison of Bifactor and Second-Order Models of Quality of Life. *Multivariate Behavioral Research*, 41(2), 189–225. doi:10.1207/s15327906mbr4102_5
- Cox, A., Ullrich-French, S. & French, B. (2016). Validity evidence for state mindfulness scale scores in a physical activity context. *Measurement in Physical Education and Exercise Science*, 20, 38-49. doi: 10.1080/1091367X.2015.1089404
- Cox, A. E., Ullrich-French, S., Cole, A. N., & D’Hondt-Taylor, M. (2016). The role of state mindfulness during yoga in predicting self-objectification and reasons for exercise. *Psychology of Sport and Exercise*, 22, 321–327. doi: 10.1016/j.psychsport.2015.10.001
- De Mars, C.E. (2013). A tutorial on interpreting bifactor model scores. *International Journal of Testing*. 13(4), 354-378. doi: 10.1080/15305058.2013.799067
- Grecucci, A., Pappaianni, E., Siugzdaite, R., Theuninck, A., & Job, R. (2015). Mindful emotion regulation: Exploring the neurocognitive mechanisms behind mindfulness. *BioMed Research International*, 2015, 1–9. doi: 10.1155/2015/670724
- Hernández-Nieto, R. A. (2002). Contributions to statistical analysis. Mérida: Universidad de Los Andes.
- Kohl 3rd, H.W., Craig, C.L., Lambert, E.V., Inoue, S., Alkandari, J.R., Leetongin, G., & Kahlmeier, S. (2012). The pandemic of physical inactivity: global action for public health. *Lancet*, 380(9838), 294-305. doi: 10.1016/S0140-6736(12)60898-8
- Marcus, B. H., Forsyth, L. H., Stone, E. J., Dubbert, P. M., McKenzie, T. L., Dunn, A. L., & Blair, S. N. (2000). Physical activity behavior change: Issues in adoption and maintenance. *Health Psychology*, 19(1, Suppl), 32–41. doi: 10.1037/0278-6133.19.Suppl1.32
- Milfont, T.L. & Fischer, R. (2010). Testing measurement invariance across groups: Applications in cross-cultural research. *International Journal of Psychological Research*, 3(1), 2010, 111-121. doi: 10.21500/20112084.857
- Muthen, L. K., & Muthen, B. (2012). 1998-2012. Mplus User’s Guide (7th ed.). Los Angeles, CA: Muthen & Muthen.
- Oliveira, A., Monteiro, Â., Jácome, C., Afreixo, V., & Marques, A. (2016). Effects of group sports on health-related physical fitness of overweight youth: A systematic review and meta-analysis. *Scandinavian Journal of Medicine and Science in Sports*, 27(6), 604–611. doi: 10.1111/sms.12784
- Pelletier, L. G., Fortier, M. S., Valleraud, R. J., Tuson, K. M., Brière, N. M., & Blais, M. R. (1995). Toward a New Measure of Intrinsic Motivation, Extrinsic Motivation, and Amotivation in Sports: The Sport Motivation Scale (SMS). *Journal of Sport & Exercise Psychology*, 17(1), 35-53. doi: 10.1123/jsep.17.1.35
- Rios, J. & Wells, C. (2014). Validity evidence based on internal structure. *Psicothema*, 26(1), 108-116.

- Reise, S.P. (2012). Invited paper: The rediscovery of bifactor measurement models. *Multivariate Behavioral Research*, 47(5), 667-696. doi: 10.1080/00273171.2012.715555
- Ryan, R. M., & Deci, E. L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise, and health. In M. S. Hagger & N. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1–19). Champaign, IL: Human Kinetics.
- Silberstein, L.R., Striegel-Moore, R.H., Timko, C., & Rodin, J. (1988). Behavioral and psychological implications of body dissatisfaction: do men and women differ? *Sex Roles*, 19(3/4), 219-232. doi: 10.1007/BF00290156
- Standage, M., Gillison, F. B., Ntoumanis, N., & Treasure, G. C. (2012). Predicting students' physical activity and health-related well-being: A prospective cross-domain investigation of motivation across school physical education and exercise settings. *Journal of Sport & Exercise Psychology*, 34(1), 37-60. doi: 10.1123/jsep.34.1.37.
- Strelan, P., Mehafeey, S.J. & Tiggemann, M. (2003). Self-Objectification and Esteem in Young Women: The Mediating Role of Reasons for Exercise. *Sex Roles*, 48(1 and 2), 89-95. doi: 10.1023/A:1022300930307.
- Tabachnick, B. G., & Fidell, L. S. (2012). *Using multivariate statistics*. Boston: Pearson Education.
- Tanay, G., & Bernstein, A. (2013). State Mindfulness Scale (SMS): Development and initial validation. *Psychological Assessment*, 25, 1286–1299. doi: 10.1037/a0034044
- Ullrich- French, S., Hernández, J., & Montesinos, M. D. H. (2017). Validity evidence for the adaptation of the State Mindfulness Scale for Physical Activity (SMS-PA) in Spanish youth. *Psicothema*, 29(1), 119-125.
- Urbina, S. (2014). *Essentials of psychological testing* (2nd ed.). Hoboken: Wiley.
- Vansteenkiste, M., Soenens, B., & Lens, W. (2007). Intrinsic versus extrinsic goal promotion in exercise and sport: Understanding the differential impacts on performance and persistence. In M. S. Hagger & N. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 167–180). Champaign, IL: Human Kinetics.
- World Health Organization – WHO. (2010). Global recommendations on physical activity for health. Disponível em: http://www.who.int/dietphysicalactivity/factsheet_recommendations/en/