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Article

The State Mindfulness Scale for Physical Activity: Further Psychometrics Properties

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Abstract: Mindfulness has been defined as attention and awareness to the present with an attitude of openness, non-judgment, and acceptance. It is suggested that mindfulness can positively influence experiences in sports and physical activity, increasing adherence to these activities. This study aimed to examine new psychometric properties of the State Mindfulness Scale for Physical Activity (SMS-PA) using classical and modern testing theories among Brazilian sport and exercise practitioners. Two studies were conducted. In the first, with 617 Brazilian sports practitioners, confirmatory factor analysis supported the bifactor structure of the SMS-PA composed of two specific (mental and body mindfulness) and one general factor (state mindfulness), which did not vary among genders. The Rasch Rating Scale Model (RSM) supported essential one-dimensionality indicated by the general factor with good item fit statistics (infit/outfit 0.62–1.27). The model presented a good level of Rasch reliability (0.85), and the items difficulty estimation provided an understanding of the continuum represented by their content. In the second study, with 249 Brazilian exercise practitioners, the structural equation modeling showed that Body Mindfulness was associated with positive outcomes (positive affect and satisfaction with practice). The mediation analysis showed that people with higher levels of Body mindfulness tend to experience greater levels of Positive Affect and, consequently, greater Satisfaction with exercises. The results suggest that the Brazilian version of the SMS-PA is an appropriate measure of the state of mindfulness.

Key words: Sport Psychology, Physical Exercise, Psychometrics, Assessment, Mindfulness.

Escala de Estado de Mindfulness para Atividade Física: Novas Propriedades Psicométricas

Resumo: *Mindfulness* pode ser definido como atenção e consciência no momento presente com uma atitude de abertura, não julgamento e aceitação. A literatura sugere que o *mindfulness* pode influenciar positivamente experiências no esporte e atividade física e pode exercer um papel na adesão a essas atividades. Este estudo teve como objetivo investigar novas propriedades psicométricas da *State Mindulness Sacale for Physical Activity* (SMS-PA) utilizando as teorias clássicas e modernas dos testes em praticantes de exercício físico e esporte brasileiros. Dois estudos foram conduzidos. No primeiro, com 617 brasileiros praticantes de esporte, a Análise Fatorial Confirmatória (AFC) demonstrou adequação à estrutura bifatorial da SMS-PA composta por dois fatores específicos (*mindfulness* mental e físico) e um fator geral (estado de *mindfulness*), que apresentou invariância entre sexos. A *Rasch Rating Scale Model* (RSM) corroborou a unidimensionalidade essencial indicada pelo fator geral com bons índices de ajustes (*infit/outfit* 0.62 -1.27). O modelo apresentou bom nível de precisão Rasch (.85), e a

estimação de dificuldade dos itens possibilitou compreensão do *continuum* representado pelo conteúdo dos itens. No segundo estudo, com 249 brasileiros praticantes de esporte, a Modelagem de Equações Estruturais demonstrou que o *mindfulness* físico esteve associado a afetos positivos e satisfação com a prática. A análise de mediação mostrou que pessoas com níveis altos de *mindfulness* físico tendem a apresentar níveis mais elevados de afeto positivo e, consequentemente, níveis mais elevados de satisfação com a prática. Os resultados sugerem que a versão brasileira do SMS-PA é uma medida apropriada do estado de *mindfulness* para atividades físicas.

Palavras-chave: Psicologia do Esporte, Exercício Físico, Psicometria, Avaliação, Mindfulness.

Escala de Mindfulness en la Actividad Física: Nuevas Propiedades Psicométricas

Resumen: La atención plena puede definirse como la atención y la conciencia en el momento presente con una actitud de apertura, no juicio y aceptación. La literatura sugiere que el mindfulness puede influir positivamente en las experiencias en el deporte y en la actividad física, además de desempeñar un papel en la adherencia a estas actividades. Este estudio tuvo como objetivo investigar nuevas propiedades psicométricas de la State Mindfulness Scale for Physical Activity (SMS-PA) utilizando las teorías clásicas y modernas de las pruebas en practicantes de ejercicio físico y de deporte en Brasil. Para ello, se realizaron dos estudios. En el primer, participaron 617 practicantes de deporte brasileños, y el análisis factorial confirmatorio (AFC) demostró adecuación en la estructura bifactorial de la SMS-PA, compuesta por dos factores específicos (mindfulness mental y físico) y un factor general (estado de mindfulness), que mostró invarianza entre sexos. El Rasch Rating Scale Model (RSM) corroboró la unidimensionalidad esencial indicada por el factor general con buenos índices de ajuste (infit/outfit 0,62-1,27). El modelo mostró un buen nivel de precisión de Rasch (.85), y la estimación de la dificultad de los ítems permitió comprender el continuo representado por el contenido de estos. En el segundo estudio, con 249 practicantes de deporte, el modelo de ecuaciones estructurales mostró que el mindfulness físico estaba asociado a resultados positivos (afecto positivo y satisfacción con la práctica). El análisis de mediación reveló que las personas con altos niveles de mindfulness físico tendían a tener mayores niveles de afecto positivo y, en consecuencia, mayores niveles de satisfacción con la práctica. Los resultados sugieren que la versión brasileña de la SMS-PA es una medida adecuada de mindfulness.

Palabras clave: Psicología del Deporte, Ejercicio, Psicometría, Evaluación, Movimiento Mindfulness.

Introduction

Mindfulness has been defined as attention and awareness to the present moment with an attitude of openness, non-judgement, and acceptance. There is an intentional component to mindfulness, that is, it can be intentionally trained, and, in experienced practitioners, can occur spontaneously, as it becomes easier to access the tools to practice mindfulness (K. W. Brown & Ryan, 2003; Tanay & Bernstein, 2013; Kabat-Zinn, 2015). It is suggested that mindfulness can positively influence experiences in sport and physical activity and may play a role in increasing adherence (Yang & Conroy, 2020). Although information on the health benefits of regular physical activity is widely disseminated, levels of inactivity are increasing worldwide (World Health Organization [WHO], 2018; Ullrich-French & Cox, 2020). This was exacerbated by restrictions imposed by the COVID-19 pandemic, which resulted in increased levels of physical inactivity (Amini, Habibi, Islamoglu, Isanejad, & Daniyari, 2021). Therefore, efforts will have to be made to reverse this situation. Understanding psychological constructs that support engagement in physical activity may be important to

the development of interventions aimed at improving people's adherence to active lifestyles, increasing indicators of health and quality of life.

Mindfulness can be characterized as an individual's relatively stable feature (i.e. trait mindfulness), as well as context-dependent transient experiences, which vary according to the environment and person in a moment or particular situation (i.e. state mindfulness) (Yang & Conroy, 2020). People with high levels of trait mindfulness show a tendency to be aware in a variety of situations across the day, while state mindfulness is experienced in a specific moment (Tanay & Bernstein, 2013; Ullrich-French & Cox, 2020). State mindfulness may vary across contexts regardless of trait mindfulness levels (K. W. Brown & Ryan, 2003). Nevertheless, people showing higher levels of trait mindfulness tend to experience state mindfulness more often. On other hand, training mindfulness in different contexts can contribute to people developing more stable skills to be aware of the present moment. Regular physical exercise can be one of these contexts in that training mindfulness can increase the mindfulness trait (Yang & Conroy, 2020). However, most of the research and instruments assess mindfulness as a trait (Ullrich-French & Cox, 2020).

Mindfulness has been studied in movement-based contexts such as yoga (Beddoe et al., 2009), and the literature suggests that it may promote adaptive physical activity and exercise experiences (Cox, Ullrich-French, & French, 2016; Peixoto, Palma, Campos, Oliveira, & Oliveira, in press; Ullrich-French, Hernández, & Montesinos, 2017). However, it was not until recently that an assessment tool specific to physical activity was developed by Cox, Ullrich-French and French (2016), the State Mindfulness Scale for Physical Activity (SMS-PA). The SMS-PA was based on the instrument developed by Tanay and Bernstein (2013), which already included the assessment of mindfulness of physical sensations. The authors proposed this dimension to meet the demands of assessing mindfulness in physical and mental events, but the instrument was not developed for the physical exercise and sports context, and it did not achieve sufficient validity evidence. Cox et al. (2016) developed an instrument specific to this context, with items to assess attention to physical exertion and movement of the body, for example. Thus, Cox et al. (2016) version, the SMS-PA, assesses both mental and body state mindfulness during the practice of physical exercise and sports. The instrument's internal structure shows items grouped in a bifactor structure.

The premise for a bifactor model is that an instrument's items show two variance sources, one originating from a general factor to which all items relate, and another one originating from specific orthogonal factors that group the items according to content specificity (Dunn & McCray, 2020). Thus, the SMS-PA shows a general state mindfulness factor and two specific factors, one with items reflecting state mindfulness of bodily aspects (i.e., physical sensations), and the other reflecting mental aspects (e.g., thoughts). The mind and body subscales and the general factor of mindfulness showed good internal consistency (Cronbach's alpha indices greater than 0.86; Cox et al., 2016).

The State of Mindfulness Scale development allowed important progress in this field. However, as pointed by Ullrich-French e Cox, (2020), the field of mindfulness and exercise still needs investments in theoretical foundations to understand the mechanisms explaining the relationship between these two variables. In Brazil, the SMS-PA was cross-culturally adapted by Peixoto et al. (2019). The scale showed adequacy of the bifactor structure with one general factor (state mindfulness for physical activity), and two specific factors (mental and body mindfulness), similar to the original scale, with desirable internal consistency indices, as well as invariance of the internal structure to assess men and women. However, one item of this scale that was theoretically expected to be associated with the specific factor mental mindfulness was actually associated with body mindfulness. The authors' hypothesis was that the participants understood the content of the item ("I was aware of different emotions that arose in me") as a physical sensation. Therefore, the authors suggested a new study, using a re-edited item ("I was aware of different emotions that arose in my mind"), which would better represent the construct. This is one of the gaps the present study intends to fill.

Mindfulness has been linked to other constructs related to engagement and positive experiences in sports and physical exercise. Positive affect (PA) and negative affect (NA) may have a role in this context (Ullrich-French & Cox, 2020). PA represents how much the individual experiences pleasurable engagement with the activity or the environment, while NA represents a subjective distress and unpleasurable engagement with the activity or the environment (Watson &

Clark, 1984). When practicing a physical exercise, it is common to experience both positive and negative feelings and sensations, in the mind and body. For those practicing for the first time, for example, negative feelings may be the trigger to stop the practice. Mindfulness can help the practitioner to cope with these feelings, either being not judgmental about them, or experiencing less negative affect during practice (Yang & Conroy, 2020; Ullrich-French & Cox, 2020).

In addition, the psychological and physiological benefits of physical exercise practice will be perceived when this behavior becomes a habit, as it can improve mood, metabolism, and health, for example. Therefore, it is important to understand what makes people keep engaged in physical exercises. Mindfulness and satisfaction with the practice of physical exercises can influence adherence to this practice, so that the more aware and satisfied, the more chances the person has to make physical activity part of their life (Tsafou, De Ridder, Van Ee, & Lacroix, 2013). However, in Brazil the SMS-PA is the first instrument specifically designed for the physical activity and exercise context, and it is the first scale to consider a bifactor structure (body and mental mindfulness, and a general factor), raising the need for studies with this instrument in the Brazilian context.

It is expected a negative association between mindfulness and psychological distress (Coffey, Hartman, & Fredrickson, 2010). Mindfulness and physical exercise practice have also been linked to reductions in psychological distress, which can also be a positive result related to physical exercise habits (McDonald et al., 2016; Perales, Pozo-Cruz, & Pozo-Cruz, 2014). The mechanisms through which it occurs are related to emotional regulation, managing negative affect, to reductions in ruminations (i.e. repetitive and negative thoughts about past or future), and to non-attachment to good or bad things.

The SMS-PA has been adapted to specific cultures and has estimations of the validity evidence regarding its potential to assess state mindfulness in the context of various types of sports and physical activities. However, the fact that these validity evidence studies are based on Classical Test Theory (CTC) must be highlighted, along with the gap due to the lack of studies using Item Response Theory (IRT) models for evaluating the properties of the SMS-PA items. It has been suggested that IRT is a psychometric model that complements the classical model, which allows new responses to the process of validation and refinement of instruments for psychological measurement (Edelen & Reeve, 2007). This is because while the CTC will look at the scales more globally, the IRT will look at the scale at the level of the items and the importance of each of them. This makes it possible to identify the main qualities and weaknesses of the scale, levels of difficulty, levels of latent trait, among other aspects (Nakano, Primi, & Nunes, 2015).

To address the identified shortcomings, this study aimed to estimate new validity evidence based on internal structure, to assess the properties of the items of the Brazilian version of the SMS-PA using the IRT, and to estimate validity evidence based on the relation with external variables. This research was based on the following theoretical hypotheses: 1) the bifactor model with two specific factors (Mental and Body mindfulness) and one general factor (Mindfulness) will better represent the data when compared to the models with one or with two factors (Cox et al., 2016; Peixoto et al., 2019); 2) the items will show adjustment indices adequate to the RSM and the estimation of the items difficulty parameters will allow better understanding about the disposition of the continuum that represent the psychological construct of interest (mindfulness); 3) the specific and general factors will present good reliability indices; 4) the indicators of mindfulness, the affect (positive and/or negative) experienced when exercising, and the satisfaction with exercise will show moderate associations; 5) body mindfulness will show positive association with positive affect and negative association with negative affect; 6) mental mindfulness will show positive association with positive and negative affects; 7) body mindfulness and positive affect will show positive association with satisfaction with exercises.

Two studies have been proposed to operationalize this research. The objective of study 1 was to test the hypothesis 1, 2, 3, and 4. In study 2, an independent sample was assessed to test the hypotheses 5, 6 and 7.

Study 1

Methods

Participants

Study 1 sample was composed of 617 Brazilian recreational sportspersons and physical exercise practitioners, most female (54.4%), with age ranging from 18 to 70 (M_{age} = 33.22; SD = 11.79). The

sportspersons (n = 413) practiced different sports, such as basketball, futsal, volleyball, Brazilian jiu-jitsu, swimming, and handball. Regarding the competitive level, 82.0% participated in a regional level, 16.3% in a state level, and 1.7% in a national level. Physical exercise practitioners (n = 204) were involved in cross fit training, strength training, and running). This first study was conducted before the COVID-19 pandemic. In addition, it was advised that the SMS-PA should be answered while remembering the last sports/exercise experience carried out.

Instruments

Sociodemographic questionnaire – Elaborated for this study for sample characterization containing questions about sex, age, and type of sport or exercise.

State Mindfulness Scale for Physical Activity (SMS-PA): (Cox et al., 2016, adapted by Peixoto et al., 2019) – Composed of 12 items divided into two factors to evaluate state mindfulness: Body (e.g. I focused on the movement of my body) with six items, and Mental (e.g. I was aware of different emotions that arose in me) also with six items. The response scale ranges from 0 (not at all) to 4 (very much). The Brazilian version of the SMS-PA (used in this study) presented Cronbach's alpha between .867 and .887 and indicated that the bi-factor model was more adequate in a previous study (Peixoto et al., 2019).

Procedure

After the research was approved by the Research Ethics Committee, (Omitted Information), the instruments were made available on Google Forms®, an online data collection platform, with the link being posted on the researchers' and the research group's social networks. The sample comprised the participants who agreed with the information contained in the Informed Consent Form (ICF), declaring themselves as over 18 years old. After accepting the topics contained in the ICF, the subjects responded to the instruments with an estimated time of up to 15 minutes to be completed.

Data analysis

To estimate the evidence based on the internal structure, a Confirmatory Factor Analysis (CFA) with a Variance-adjusted Weighted Least Squares (WLSMV) estimator was employed. Three different factorial models were tested: one-factor; two correlated factors and bifactor (for more information about the models refer to Reise, Morizot, & Hays, 2007). The adjustments of the models were tested considering the Chi-square and degrees of freedom ratio ($\chi 2/df < 3$), Root Mean Square Error of Approximation (RMSEA < .05), Standardized Root Mean Square Residual (SRMR < .08), Confirmatory Fit Index (CFI > .90), and Tucker-Lewis Index (TLI > .90) (T. A. Brown, 2015; Hox & Bechger, 1998). Cronbach Alpha and McDonald's Omega were employed to estimate reliability. To this end, the Mplus 7.4 statistical software was used.

Additionally, an analysis of invariance between sexes was performed considering the levels: configural, loadings, intercepts, and means. The fit indices considered for invariance were: $\Delta\chi^2/df < 2$; ΔRMSEA < .015; ΔCFI < .010; ΔMc < .015 and ΔGamma hat < .008 (Chen, 2007; Cheung & Rensvold, 2002).

The Item Response Theory (IRT) thought the Andrich-Rasch Rating Scale Model RSM (Andrich, 1978) was used to estimate the item's proprieties. This is an extension of the One-parameter Rasch logistic model to polytomous items. This model suggests that a person's response to the item is a function of their ability level (theta, θ) and the item's difficulty (δ). Thus, the model estimates, in an independent fashion, the location of a person in terms of the latent trait and the difficulty of the item, which allows the evaluation of the probability of the person endorsing each point on the item's response scale (Likert scale). In this scenario, the adjustment indicators (Infit and Outfit indices) refer to a summary of the residual between responses expected by the model and the responses empirically observed. The Infit and Outfit values can go from 0 to infinity, with values closer to 1 indicating a good fit. According to Linacre (2015), values between 0.5 and 1.5 indicate productive items. However, more conservative proposals suggest benchmark values between 0.7 and 1.3 (Bond, Yan, & Heene, 2020), in this study the more conservative indexes were adopted.

The model was estimated by the estimator methods Joint Maximum Likelihood. To this end, the Winsteps 3.7 statistical software was used. To assess the item's parameters the indices of difficulty, infit and outfit, and item-theta correlation (Linacre, 2015) were assessed. Lastly, the association between an item's difficulty and the theta level presented by the subjects was assessed by the Item-persons Map (Embretson & Reise, 2000).

Results

When comparing the three factorial models tested, the bifactor model presented the best fit to the data (Table 1). This suggests that considering one general factor of Mindfulness and two specific factors (Body mindfulness and Mental mindfulness) is the most indicated to represent the construct in the scale, thus confirming the first hypotheses. Although the two correlated factors model also presented adequate indices, the bifactor model showed better fit indices, confirming this was the best model to represent the SMS-PA. None of the indices of the one-factor model were adequate, indicating that this model does not represent well the construct.

Table 1
Comparison of the confirmatory factor analysis of the three models

Model Test	WLSMV χ^2	df	$\chi^{2\,/df}$	CFI	TLI	SRMR	RMSEA (I.C. 90%)
1.349,498		54	24,991	.752	.697	.188	.197(.188–.207)
348,173		53	6,569	.944	.930	.095	.095 (.086–.105)
58,002		42	1,381	.997	.995	.040	.025 (.00–.039)

Notes: WLSMV χ^2 = Variance-adjusted weighted least squares statistic test; df= degrees of freedom; $\chi^{2\,/df}$ = chi square/degrees of freedom ratio; CFI = comparative fit index; TLI = Tucker-Lewis fit index; SRMR = Standardized root mean squared residual) RMSEA = root mean square error of approximation. All models were significant at $p < .01$.

Most items had a factorial load above .30 in the general factor, except for items 2, 3, 4, 5. However, these same items showed high loads (> .70) in the specific factor Mental mindfulness (Table 2). The reliability, measured through Cronbach's Alpha and McDonald's Omega, demonstrated good indices of precision for the General Factor and for the two specific factors (Mental and Body mindfulness).

Evidence of measure invariance between sexes on three (Configural, Metric, and Scalar) of four types of invariance measured was observed. The Means' invariance fits, although good, did not reflect the expected variation. Table 3 shows the indices for each model.

Table 2
Bi-factor model of the Brazilian version of the SMS-PA

Items	Specific factors		General Factor
	Mental	Body	
1	.346		.475
2	.713		.230
3	.793		.127
4	.818		.277
5	.782		.286
6	.368		.557
7		.580	.474
8		.622	.571
9		.572	.613
10		.603	.634
11		.305	.813
12		.619	.497
ω	.855	.921	.877
α	.847	.920	.872

Note: ω = McDonald's omega; α = Cronbach's alpha.

Table 3
Invariance models between sexes for the Brazilian version of the SMS-PA

Model	$\chi^2(df)$	χ^2/df	RMSEA	CFI	Mc	GH
Configural	80.441(126)	.638	.000	1.000	1.037	1.012
Metric	138.596 (168)	.824	.000	1.000	1.024	1.008
Scalar	159.911 (186)	.859	.000	1.000	1.021	1.007
Means	392.872 (192)	2.046	.071	.962	.849	.948

Note: χ^2 = Chi-square; *df* = degrees of freedom; CFI = Comparative Fit Index; RMSEA = Root Mean Square Error Approximation; Mc = McDonald; GH = Gamma hat.

The second group of analyses was performed with the Rating Scale IRT-Rasch model showed that all items presented good fits in the model, with Infit and Outfit values ranging between 0.62 and 1.27. There was also a good correlation between item scores and the person's level of mindfulness (theta) estimated by the model, with moderate and high magnitudes ranging from .53 to .67 (Table 4), suggesting the items' capacity to recover the respondent' trait levels.

Table 4
Items' proprieties using the Rating Scale IRT-Rasch model

Items	Difficulty (b)	Infit	Outfit	Item-theta correlation
4	.26	1.05	.97	.60
6	.20	.93	.95	.62
3	.20	1.26	1.22	.53
5	.17	1.05	.95	.60
1	.02	1.17	1.27	.53
2	.02	1.10	1.10	.55
9	.01	.86	.80	.65
12	-.02	1.14	1.12	.58
7	-.15	1.06	1.08	.58
10	-.19	.79	.73	.65
8	-.24	.89	.82	.63
11	-.27	.69	.62	.67
Mean	.00	1.00	.97	-
SD	.17	.16	.19	-

Note: SD = standard deviation; the items are presented in order of difficulty.

Based on Table 4, for the Brazilian version of the SMS-PA the most difficult items were: 3 (I noticed pleasant and unpleasant thoughts), 4 (I noticed emotions come and go), and 6 (It was interesting to see the patterns of my thinking). The easiest items were: 11 (I noticed the sensations in my body) and 8 (I felt present in my body). These results highlight that, in this sample, the items related to the Mental Mindfulness factor were more difficult to endorse than the items of Body Mindfulness. Finally, it was observed that the model presented good level of Rasch-reliability, .85. These results satisfactorily address the first goal of this research: obtaining validity evidence based on the internal structure of the SMS-PA in its Brazilian version (American Educational Research Association et al, 2014). Additionally, the results from RSM provide a description of the parameters of the items (difficulty/adjustment) and understanding about the disposition of the continuum that represents the state of mindfulness in Physical Activity (items content), thus confirming the hypotheses 2 and 3.

The association between items' properties and the respondents' characteristics are presented in Figure 1. in the map, it is observed an absence of items in the theta range varying from –5 to –.5, which represents a gap in the instrument to cover a wide range of theta in which the participants are allocated.

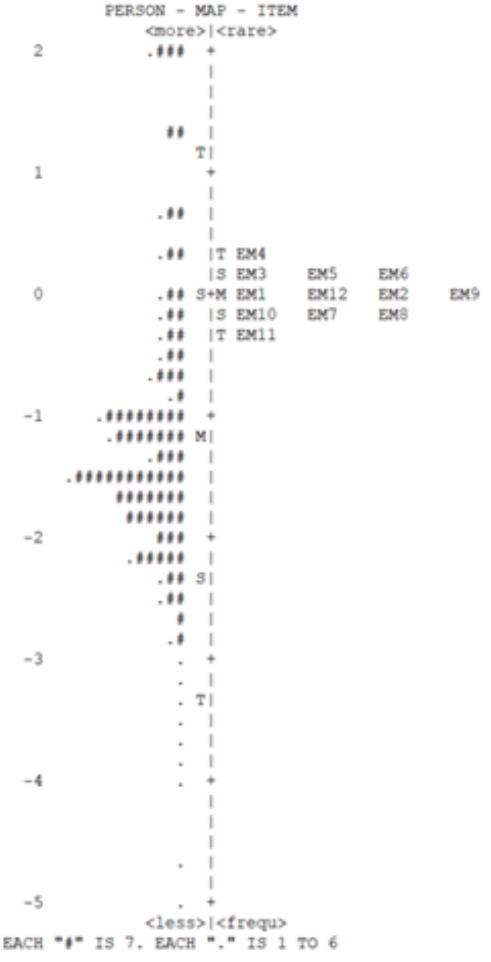

Figure 1
Person-Map-Item estimate by Rating Scale Model for SMS-PA

Notes: In the map, on the horizontal plane, the numeric representation of the latent trait scale (between –5 and 2) is shown, as well as the symbols "#" and ".", which represent the number of individuals allocated to the different latent trait levels. Each "#" is equivalent to seven persons and each "." is equivalent from one to six persons. The symbols "M", "S" and "T" correspond to mean, one and two standard deviations, respectively. Lastly, on the right of the dashed vertical line it is observed the position of the items on the estimated latent trait spectrum.

Study 2

Methods

Participants

The sample consisted of 249 subjects, aged between 18 to 70 years (M = 36.60; SD = 11.90), most of them were female (67.4%), single (51%), and from the Southeast of Brazil (70.2%). As for the modalities of exercises regularly practiced, the participants reported more frequently walking (n = 70) and strength training (n = 51). The survey was answered during the pandemic and the participants adapted their practices to the restrictions imposed for this context. It was advised that SMS-PA should be answered remembering the latest exercise practices performed.

Instruments

State Mindfulness Scale for Physical Activity (SMS-PA) (Cox et al., 2016, adapted by Peixoto, Palma, França-Torres et al., 2019) – This instrument was described on Study 1.

Positive and Negative Affect Schedule (PANAS) (Watson, Clark, & Tellegen, 1988, translated and validated to Brazilian population by Giacomoni & Hutz, 1997, and reviewed by Zanon & Hutz, 2014) – Composed of 20 items to evaluate the affective dimensions of the subjective well-being. The scale has two factors: Positive Affect, with 10 items (e.g. Excited) and Negative Affect, also with 10 items (e.g. Upset). The scores for each factor are calculated separately and can be compared. The responses are given on a five-point Likert Scale, ranging from 1 (Very Slightly or Not at all) to 5 (Extremely). In this study's sample the indices of reliability were α = .910 and ω = .910 for Negative Affect, and α = .854 and ω = .863 for Positive Affect. More recently, validity evidence studies have tested and compared several factorial models for the PANAS, however, the oblique two-factor model has remained better in terms of understanding and remains the preferred model in the evaluation of affects. The reliabilities had indices, including for Brazilians samples, (Cronbach's alpha) greater than 0.80 for each factor (Carvalho et al., 2013; Heubeck & Wilkinson, 2019; Nunes, Lemos, Ribas, Behar, & Santos, 2018).

Satisfaction with the Practice of Physical Exercise Scale (SPPE-S) – The *SPPE-S* was developed specifically for this study to measure the Satisfaction with Exercises (SWE), as an adaptation of the Brazilian version of the *Satisfaction With Life Scale* (*SWLS*) (Diener, Emmons, Larsen, & Griffin, 1985). As proposed in the international literature (Marcatto, Di Blas, & Ferrante, 2021; Gillet, Fouquereau, Vallerand, Abraham, & Colombat, 2018), three of the general items were rewritten, changing the world "life" to the expression "practice of physical activity" so that they could represent aspects of satisfaction with the practice. These three items were answered on a Likert scale (1 = strongly disagree to 7 = strongly agree). The items were: "1. My practice of physical activity is close to my ideal"; "2. My conditions for practicing physical activities are excellent", and "3. I am satisfied with my physical activity". Three researchers with experience in both psychometrics and sport psychology evaluated the items' content and attested their relevance. Parallel Analysis (AP) and Exploratory Factor Analysis (EFA) were employed to assess the internal structure, and they indicated the adequacy of a single factor structure, with factor loads between .789 and .959, explaining 78.6% of the data variability. An excellent indicator of internal consistency was observed in the present study (α = .913 and ω = .916).

Procedures

After the research was approved by the Research Ethics Committee, (Omitted Information), the instruments were made available on the Google Forms®, an online data collection platform, with the link being posted on the researchers' and the research group's social networks. The sample comprised the participants who agreed with the information contained in the Informed Consent Form (ICF), declaring themselves as over 18 years old. After accepting the topics contained in the ICF, the subjects responded to the instruments with an estimated time of up to 15 minutes to be completed. Data were collected from May 29, 2020 to June 8, 2020.

Data Analysis

The descriptive and inferential statistical analysis were performed first. Means, standard deviation, correlation between the scale factors and reliability (McDonald Omega) were performed. The Structural Equation Modeling (SEM), performed in the Mplus 7.4 statistical software, was applied to test the adequacy of the hypothesized model. The significance level adopted was $p < .05$. The 95% confidence interval was calculated as well, a procedure that allows

more robust estimation for the confidence limits of direct and indirect effects, as well as for estimates of the standard errors associated with these statistics. All correlation magnitudes were interpreted according to Cohen (1988) conceptions.

Results

The estimation of descriptive statistics (mean, standard deviation, and reliability) for each factor of the instruments employed on this research and the correlation indices among them are presented in Table 5.

Table 5
Correlations and descriptive statistics of the constructs measured

	Mean(SD)	ω	Mental M.	Body M.	Mind Total.	Positive Af.	Negative Af.
Mental M.	3.56 (.95)	.897					
Body M.	3.61 (1.06)	.937	.188**				
Mind. Total	3.58 (.81)	.893	.740**	.800**			
Positive Af.	2.80 (.74)	.863	,118	.474**	.396**		
Negative Af.	2.45 (.89)	.910	.147*	–.312**	–,124	–.350**	
SWE	3.53 (1.76)	.916	.005	.359**	.249**	.471**	–.197**

Notes: ***p < 0.001; **p < 0.01.; *p < 0.05; ω = McDonald's omega; Mental M. = Mental Mindfulness; Body M. = Body Mindfulness; Mind. Total= Total Mindfulness; Positive Af. = Positive Affect; Negative Af. = Negative Affect; SWE= Satisfaction with exercises; SD= standard deviation.

The correlation between Mental Mindfulness and Body Mindfulness was significant, with a weak magnitude and a positive tendency. Mental Mindfulness showed a positive association with Negative Affect and no significant correlations with Positive Affect and Satisfaction with exercises, which partially confirms the hypothesis 4 and 6. Body Mindfulness, on the other hand, showed a positive association with Positive Affect and Satisfaction with exercises, while being negatively associated with Negative Affect, all with moderate magnitudes. This corroborates the hypothesis 5. Satisfaction with exercise showed a positive and moderate association with Positive Affect and a negative and weak association with Negative Affect, which confirms the hypothesis 7.

Considering SEM analysis, the results suggested very good fit indices of the model (Figure 2) to the available data: χ^2 = 1163.982, df = 550, p < .001; CFI = .952; TLI = .948; and RMSEA = .074 (90% Confidence Interval:.068 to .080).

The SEM model demonstrated that the factor Body mindfulness showed a positive association with Positive Affect (β = .67; 95% CI .58 to .76) and negative association with Negative Affect (β = –.54; 95% CI –.64 to –.43, p < .001), while Mental mindfulness showeda negative association with Positive Affect (β = –.17; 95% CI –.301 –.054, p < .001) and positive association with Negative Affect (β = .38; 95% CI .26 to .49, p < .001). The direct effect of Body mindfulness on satisfaction with exercises was positive (β = .16; 95% CI .04 to .40, p < .05), while the effect of Mental mindfulness on Satisfaction with exercises was very small (β = –.05; 95% CI –.18 to .08). The mediation of Positive and Negative Affect showed that people with higher levels of Body mindfulness tend to experience greater levels of Positive Affect and, consequentially, greater Satisfaction with exercises (β = .43; 95% CI .28 to .59, p < .001). Results indicated that the relationship between Body mindfulness and Satisfaction with exercises was significant, but partially mediated by Positive Affect (β = .29; 95% CI .15 to .42, p < .01). Additionally, the relationship between Mental mindfulness and Satisfaction with exercises was significantly, but also partially, mediated by Positive Affect (β = –.08; 95% CI –.13 to –.02, p < .03). It should be noted that the indirect effect is significant at p < .05 if the 95% confidence intervals do not include the value of zero. On the other hand, people with higher levels of Mental Mindfulness can also experience Negative Affect, since they have a high level of perception of all emotions and feelings, whether they are good or bad. Lastly, the effects of mental mindfulness on satisfaction with exercises were very small.

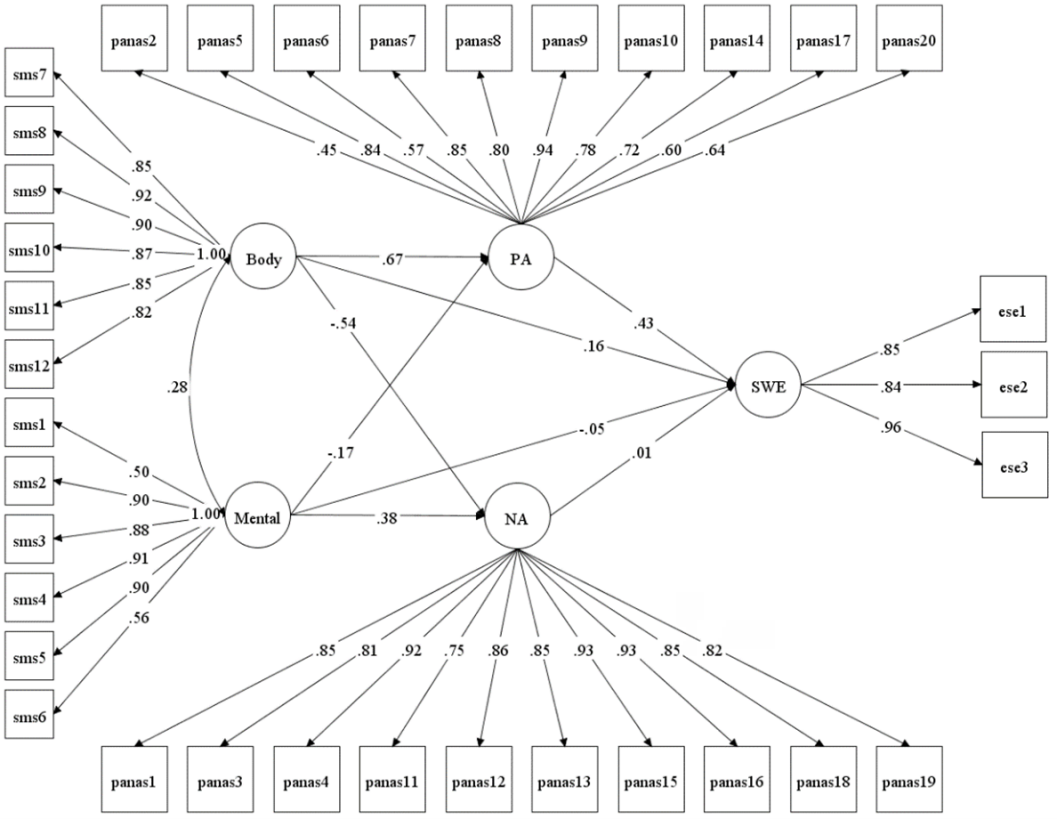

Figure 2
Exploratory Structural Equation Modeling: Mindfulness predicting Affect and Satisfaction with exercises

Note: Body = Body Mindfulness; Mental = Mental Mindfulness; PA = Positive Affect; NA = Negative Affect; SWE = Satisfaction with exercises.

Discussion

This research aimed to estimate new validity evidence based on the internal structure of the Brazilian version of the SMS-PA, to evaluate the properties of the items through IRT, and to assess validity evidence based on the relationship with external variables. The results of the first study showed that the bifactor model presented the best fit, consistent with the original version of the SMS-PA (Cox et al., 2016), and with the State Mindfulness Scale (SMS) developed by Tanay and Bernstein (2013), from which the SMS-PA was derived. This structure also converges with other versions of the SMS-PA (i.e., Spanish version: Ullrich-French et al., 2017; Youth version: Ullrich-French, Cox. et al., 2017).

Configural, metric, and scalar invariance were obtained to the SMS-PA. However, the mean invariance showed greater variation than expected, exceeding the limits established by Chen (2007) and Cheung and Rensvold (2002). Considering the definitions and understandings punctuated by Damásio (2013), the scale presented configural invariance, thus we can assume that the same theoretical model is valid for the groups compared (in this case, for both sexes). That is, the factor structure is the same for both groups. The metric invariance presented demonstrates that the measured variables (items) are related to their latent construct (General, Mental and Body mindfulness) in the same way between sexes. That is, the items have the same importance (factor loading) for their respective constructs, indicating that there are no biases in response to any item. Finally, the scalar invariance indicates that any differences observed in the measured variables means correspond to differences in the latent constructs means alone, and, therefore, allows the researcher to compare group differences in the intercepts of the latent constructs directly. Finding invariance at these levels adds to validity evidence for the scale, mainly showing its consistency and quality in measuring the construct.

Considering that in psychology different groups are often compared, and that this can be important in several interventions, having a stable scale, and ensuring that the differences that can be found are related to specific characteristics of the groups and not to limitations in the measurement instrument is very important (Milfont & Fischer, 2010; Wang, Chen, Dai, & Richardson, 2017). In this direction, Boer, Hanke and He (2018) stated that verifying the invariance of assessment tools can prevent professionals from committing injustices, since it aims to verify and guarantee, or even correct, possible systematic errors accordingly.

Regarding the SMS-PA not having presented invariance of means, this type of invariance assesses whether subjects from different groups show not significant means difference in the factor scores. This result indicates that men and women show different levels of physical and mental mindfulness. However, this result does not put the scale ability to assess the construct similarly between both groups in question (Damásio, 2013), it only means that there is a difference between groups.

The IRT analysis showed that the items parameters were adequate (Bond et al., 2020), since the infit and outfit values did not exceed the limits. The correlation Item-Theta and reliability index demonstrated the ability of the items to recover people's skill level. The evaluation of the items' difficulty levels indicates that they are allocated close to the average. However, when comparing the items' difficulty levels with the theta level estimated for the respondents through the item-map procedure, it is observed that the items in general were relatively difficult to be endorsed, given that the sample presented an average level of theta

From a statistical point of view, those results indicate a greater potential of the scale to identify people with higher levels in the construct. However, from a theoretical point of view, they indicate that the content of the items expresses high levels of state of mindfulness, what may not be experienced by many practitioners. This represents a gap in the instrument that can be filled in future versions.

The interpretation of the results from the IRT provided a better understanding of the continuum represented by the content of the items comprising the SMS-PA. It was observed that items that were more easily endorsed were related to perception of physiological sensations during the exercise practice (items 11, 08, 10). Moving forward on the continuum, it is possible to observe the items that represent the ability to maintain attention on these sensations, which represent that there is greater intensity on their content (items 7, 12 and 9). The most difficult extension of the continuum is represented by the Mental mindfulness items, theoretically focused on assessing the perception of emotions, thoughts, as well as thoughts patterns during exercise practice. These results are consistent with the suggestions of Ullrich-French and Cox (2020) about physical sensations associated with movement. According to the authors, movement provides a dynamic and potentially more engaging focus of attention.

The results of Study 2 suggests that people with higher awareness of their own body during exercise practice have greater chance to experience good feelings and emotions. These results are consistent with K. W. Brown and Ryan (2003), who also found positive associations between mindfulness and positive affect, and negative associations between mindfulness and negative affect. These authors consider that being present when performing physical activities benefits psychological well-being, and reduces the risks of developing depression, anxiety, and experiencing bad feelings. Few studies had proposed differentiating body and mental mindfulness when Cox et al. (2016) suggested this differentiation during yoga practice. The results of Cox et al. (2016) study mindfulness was the only significant positive predictor of the mood/enjoyment-related reasons for exercise, while Body mindfulness predicted decreases in the self-objectification and an increase in the health/fitness reasons for exercise constructs.

Regarding the model, it is possible to identify effects that follow a similar direction of the correlations since Body mindfulness was more associated with positive outcomes than Mental mindfulness. Thus, it is important to highlight that body awareness is more linked to physical sensations (Tanay & Bernstein, 2013), therefore, when one presents high levels of Body mindfulness the perception of her or his own body can be heightened. This can increase the satisfaction with exercise since physical exercise practitioners will be more able to identify results and/or body and health changes (usually positive), and feel more vitality, energy, and mobility (Hyde, Conroy, Pincus, & Ram, 2011; Liao, Shonkoff, & Dunton, 2015).

Mental awareness, on the other hand, will not necessarily lead to a positive perception. Tanay and

Bernstein (2013) consider that Mental mindfulness includes all mental events, such as patterns of thoughts and emotions. Thus, when in contact with one's own emotions and thoughts, a person may become aware of negative aspects (e.g. worries, sadness), something that will not necessarily be considered pleasurable or that will bring satisfaction. Baroni, Nerini, Matera and Stefanile (2016) showed that, of the mindfulness aspects, describing and acting with awareness is not enough to prevent emotional distress, this will happen when people succeed in attention monitoring and accepting feelings and emotions during practice, which are skills that can be trained and may reduce negative affective reactivity, as suggested by the Monitor and Acceptance Theory – MAT (Lindsay & Creswell, 2017).

Ruffault, Bernier, Thiénot, Fournier and Flahault (2017) study showed that combining mindfulness and physical activity can be an important protective factor against various mood disorders, such as depression and anxiety. Considering the context of the COVID-19 pandemic in which this study was conducted, physical activity practices have undergone adaptations, such as training at home, due to the closing of sports centers, gyms and other spaces dedicated to this purpose. Additionally, a meta-analysis carried out by Salari et al. (2020) showed that levels of anxiety, stress, depression, and other disorders increased in just a few months after the spread of the virus in several population groups. Green, Huberty, Puzia and Stecher (2020) also pointed out the negative impacts of COVID-19 on mental health, but they emphasize that the practice of physical activity and conscious meditation, as well as other health behaviors, can prevent the worsening of mental health due to the pandemic.

Stănescu and Vasile (2014) stated that the interest in the impact of physical exercises on physical and mental well-being and health has grown. Physical activity, according to these authors, has been used to assist medicine, treatment, and prevention in mental health. Even in the context of the pandemic, several studies have encouraged and demonstrated better results for physical and mental well-being to the detriment of these activities (Amatriain-Fernández et al., 2020; Moreira et al., 2021).

This study's SEM results show an inverse pattern of association between mental mindfulness and positive affect or negative affect when compared with other studies (Schumer et al., 2018; Cox, Ullrich-French, Howe, & Cole, 2017). This may be explained by the fact that the data collection occurred during an acute phase of the COVID-19 pandemic, when people were more prone to experience negative affect. Therefore, although participants maintained and/or adapted their physical exercise practices, which is something positive and may help to maintain mental and physical health in times like this, they are not immune to the negative feelings and concerns that a phenomenon like a pandemic can cause, such as concerns with family members, job loss, social isolation, fears of contamination, among other concerns (Newby, O'Moore, Tang, Christensen, & Faasse, 2020; Rothe, Buse, Uhlmann, Bluschke, & Roessner, 2021). Thus, experiencing mindfulness may have meant acknowledging these negative affects.

The current configuration of the SMS-PA does not intend to assess the quality of the perception of mindfulness, but rather, how much the person is able or not to perceive their mind and body in the present moment during exercise practice. This means that the instrument was not designed to gauge if this perception is positive or negative. It takes more than just noticing to reap the benefits of being mindful when exercising. Indeed, the magnitude of the Mental mindfulness effect on negative affect was higher than the magnitude on positive affect. In addition, there was no association between Mental mindfulness and satisfaction with exercise. Thus, the expansion of the instrument by developing new items that address the quality of mindfulness involvement with physical exercise, such as acceptance, will reach an important piece of mindfulness (Ullrich-French & Cox, 2020).

Knowing the quality of the perception of mindfulness may help physical education and sports psychology professionals on intervention design. For example, experiencing more positive than negative affect during exercise practice may contribute to long term adherence (Ullrich-French, Cox, & Huong, 2021) and the increase of practitioner's perception of subjective well-being (Ruseski et al., 2014). Positive and negative affects are part of the emotional/affective dimensions of subjective well-being (Zanon & Hutz, 2014). Therefore, those experiencing frequent episodes of intense positive affect consider themselves joyful, confident, and enthusiastic. On the other hand, people who experience frequent episodes of negative affect perceive themselves as worried, discouraged, and sad. The frequency with which one experience

these affects has a direct effect on how they perceive and understand happiness or unhappiness (Kansky & Diener, 2021). Thus, state mindfulness in physical exercise is a relevant construct for positive sports psychology because it contributes to the experience of more positive than negative affect while exercising, increasing practitioners' perception of well-being (Peixoto, Palma, Campos et al., in press; Grenville-Cleave, & Brady, 2018).

Conclusions

This research enabled the assessment of further validity evidence based on the internal structure and reliability of the SMS-PA for a Brazilian sample. The results show that the instrument is an adequate measurement of the state mindfulness on physical exercise and sport, confirming the theoretical hypothesis about the bifactor structure of scales composed two specific factors, mental and body mindfulness and a general factor, state mindfulness. It is worth noting that the use of the TRI enabled an assessment of the scale characteristics not verified in previous studies (level of difficulty and adjustment of items), as well as the interpretation of the continuum that represents the state of mindfulness. It was also estimated in this study new validity evidence based on relations with other variables, once the hypothesis of an association of mindfulness status levels with positive, negative effects, and satisfaction with exercise practice were confirmed. Thus, it is concluded that the objectives initially established were satisfactorily achieved.

Limitations of the present study include the fact that analyses are based on convenience samples. In this regard, caution is recommended in generalizing the results of this study. Additionally, data was accessed electronically, thus there was no control over the environment of data collection. Future studies may access the invariance between electronic and paper and pencil versions of the SMS-PA, as well as develop interpretative norms. This will allow the use of this instrument by psychologists in professional practice and by researchers, in studies comparing different groups, for example. Furthermore, studies dedicated to the expansion of the scale are suggested to address aspects related to the quality of mindfulness people experience during involvement with physical exercises, as well as the development of items with lower intensity levels in the construct, capable of covering lower regions in the latent trait.

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