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Otava mental skill for sports 3 - validation and gender invariance for the portuguese version
Otava mental skill for sports 3 - validación e invariancia de género para la versión portuguesa

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Abstract. The aim of the study was to validate the Portuguese version of the Ottawa Mental Skills Assessment Tool (OMSAT 3p) through confirmatory factor analyses of the measurement model, and gender invariance. A total of 524 Portuguese athletes (male and female) aged between 12 and 42 years old, participated in this study (M = 19.21; SD = 5.46). The main results show that the psychometric qualities of the 48-item OMSAT 3 are adequate and that it has acceptable validity, allowing it to assess Foundation Skills (*SRMR* = 0.042, *CFI* = 0.999, *TLI* = 0.998, *RMSEA* = 0.008 and $\chi 2$ */df* = 1.46), Psychosomatic Skills (*SRMR* = 0.056, *CFI* = 0.979, *TLI* = 0.975, *RMSEA* = 0.042 and $\chi 2$ */df* = 1.93) and Cognitive Skills (*SRMR* = 0.058, *CFI* = 0.973, *TLI* = 0.968, *RMSEA* = 0.044 and $\chi 2$ */df* =1.99). This version also showed adequate values for configural, metric and scalar invariance by gender ($\Delta CFI < 0.01$) ($\Delta RMSEA$ <0,01). The Portuguese version of the OMSAT 3 can be used with reasonable confidence to assess psychological skills in a sports context.
Keywords: Confirmatory Factor Analysis; OMSAT 3; Psychological Skills, Foundation Skills; Psychosomatic Skills; Cognitive Skills

Resumen. El objetivo del estudio fue validar la versión portuguesa del Ottawa Mental Skills Assessment Tool (OMSAT 3p) mediante análisis factorial confirmatorios del modelo de medición e invarianza de género. Participaron en este estudio un total de 524 deportistas portugueses (masculinos y femeninos) con edades comprendidas entre 12 y 42 años (M = 19,21; DE = 5,46). Los principales resultados muestran que las cualidades psicométricas del OMSAT 3 de 48 ítems son adecuadas y que tiene una validez aceptable, permitiéndole evaluar Foundation Skills (*SRMR* = 0,042, *CFI* = 0,999, *TLI* = 0,998, *RMSEA* = 0,008 y $\chi 2$ */df* = 1,46), Habilidades Psicosomáticas (*SRMR* = 0,056, *CFI* = 0,979, *TLI* = 0,975, *RMSEA* = 0,042 y $\chi 2$ */df* = 1,93) y Habilidades Cognitivas (*SRMR* = 0,058, *CFI* = 0,973, *TLI* = 0,968, *RMSEA* = 0,044 y $\chi 2$ /gl = 1,99). Esta versión también mostró valores adecuados de invariancia configural, métrica y escalar por género (ΔCFI <0,01) ($\Delta RMSEA$ <0,01). La versión portuguesa del OMSAT 3 se puede utilizar con razonable confianza para evaluar habilidades psicológicas en un contexto deportivo.
Palabras clave: Análisis Factorial Confirmatorio; OMSAT 3; Habilidades Psicológicas, Habilidades Básicas; Habilidades Psicosomáticas; Habilidades cognitivas.

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Introduction

Sport psychology has been deeply interested in researching the interaction between mind and body. Therefore, over the last few decades, most empirical research in sports psychology has focused on understanding the psychological skills (Noômen et al., 2015; Gould et al., 2002; Vealey, 1994). Subsequently, this trend of assessing psychological skills and their perception spread to other domains of physical activities, such as youth sports (Putra et al., 2024), education (Correa-Bautista et al., 2024; Gomes Gonçalves et al., 2024) or fitness perception (Rojo-Ramos et al., 2024).

In the past, Seiler (1992) proposed that researchers should develop universal terminology and concepts to the area of mental skill training. In response, researchers from the University of Ottawa, analyzed previous works and assessment tools, designed to measure mental aspects of athletic performance, such as: The Athletic Motivation Inventory; Test of Attention and Interpersonal Style; Sport Competition Anxiety Test; Competitive State Anxiety Inventory; The Pressure Checklist; and The Psychological Skills Inventory for Sports (Salmela et al.,1992). The group of researchers concluded that there were 14 mental components addressed frequently in those instruments (Salmela et al., 1992). Those mental components were used to make up the framework of a new instrument named Ottawa Mental Skills Assessment Tool (OMSAT). The final form of the OMSAT was developed through an extensive literature review (Bota, 1993; Salmela, 1992; Orlick, 1992), based on research about stress and fear (Smith & Smoll, 2004; Rotella & Lerner, 1993), relaxation (Williams & Harris, 1998) and activation/excitement (Zaichkowski & Takenaka, 1993). Through the validation process, the questionnaire was submitted to various analysis of the psychometric variables (Draper et al., 1995; Durand-Bush, 1995), which led to the creation of other versions with more consistency and accuracy, such as the OMSAT-3 (Durand-Bush et al., 2001).

Given the various skills required to achieve outstanding performance, the OMSAT-3 aims to facilitate interventions by coaches and technicians, allowing them to assess and develop a holistic approach (Durand-Bush et al., 2001). As the name suggests, this instrument includes only three groups of skills or competences: a) Foundation; b) Psychosomatic; c) Cognitive (Durand-Bush, et al., 2001).

Regarding Foundation Skills, these refer to goal setting, which allows athletes to correctly direct their effort and motivation (Jeong et al., 2022); self-confidence, which consists of believing in oneself and one's abilities (Lochbaum, et al., 2022); and commitment, which involves dedication, discipline, and persistence (Zahariadi et al., 2006). As identified in previous research, it is known that commitment and goal setting, as well as motivation, are considered

differentiating factors in elite athletes compared to others (Znazen et al., 2017; Sotoodeh et al., 2012).

Another important skill is the Psychosomatic, which are directly associated with the regulation of emotions, specifically the intensity during a particular sport's practice (Hanin, 2007). In addition, levels of activation/excitement have also been consistently associated with performance (Frame & Reichin, 2018; Landers & Boutcher, 1998).

Cognitive skills are also essential in the pursuit of sport's excellence (Simonsmeier et al., 2021). Consequently, the OMSAT-3 includes the conceptual component of Cognitive Skills, which includes variables like concentration, attention, and mental visualization (imagery). According to Nideffer (2002), concentration is known to be a decisive factor in competition. In sequence, athletes must not only be able to maintain their concentration and focus, but also reorient their attention when they are distracted by internal or external stimulus (Nideffer, 2002). However, Orlick (1996) noted that although refocusing is an extremely important skill, it is often under-practiced by athletes.

In general, it is believed that it is based on psychological competences that other mental capacities are developed, being crucial for achieving success in sports (Macnamara & Collins, 2013; Ghasemi et al., 2012). Consequently, several studies have been carried out to assess the mental capacity of athletes in individual and team sports (Nahaj & Rejeb, 2016; Taher, 2013; Kruger, 2010; Salmela et al., 2009). Kruger's research (2010) used the OMSAT-3 questionnaire and the Psychological Skills in Sport Inventory (PSIS) to compare university hockey players and concluded that the group that obtained the best results had psychological characteristics that distinguished them from novice and younger players. They also found a significant difference between players in the following factors: level of motivation; stress reaction; fear control; and self-confidence (Kruger, 2010). Similarly, it was applied to football players, where it was found that psychological characteristics differ according to age and, consequently, at different levels (Nahaj & Rejeb, 2016; Taher et al., 2013). In the study of Sotoodeh et al., (2012), it was also identified a difference in the activation skill between males and females, concluding that a gender factor should be considered when presenting mental skills to the taekwondo athletes.

Given the instrument's applicability in the sports context, it has been translated into other languages, like Arabic and Romanian (Noômen et al., 2015; Craciun et al., 2011). The study by Craciun et al. (2011) validated the Romanian version of the OMSAT-3 through a Confirmatory Factor Analysis (CFA) of the 12-dimensional structure proposed for the original scale, using the *Robust Maximum Likelihood* method. This analysis is based on the notion that measurable and observable variables can be reduced to a smaller number of latent variables that share a common variance and are not observable, which is known as dimensionality reduction (Yong et al., 2013). As far as the results are concerned, they indicate that the factorial validity and reliability of the Romanian version of the OMSAT-3 are acceptable and that it can be used to assess the psychological competence of the athletes (Craciun et al., 2011).

The relevance of the present study is that sports performance increasingly depends on the psychological dimension. Athletes often attribute their failures or successes to various psychological aspects that influence performance. Coaches and sports psychologists are therefore interested in developing the psychological resources of athletes/players through mental skills training interventions (Craciun et al., 2011). To do this, it is necessary to use valid and reliable instruments to assess the population, and gender.

Thus, this study aims to determine the extent to which the OMSAT 3p was valid, reliable and equivalent (i.e. invariant) across athlete's genders.

Methods

Sample

The sample comprised of 524 athletes of both genders (88% men and 12% women) competing in national (77%) and regional (23%) Portuguese football, swimming, basketball and volleyball leagues. The training experience of the athletes varied from 1 to 28 years (M = 8.61; SD = 5.49). The ages ranged from 12 to 42 years old (M = 19.21; SD = 5.46), with 45% of the athletes at senior level and 55% at junior and younger levels. The type of sample carried out was purposive (Montero & León, 2007).

Instruments

The instrument used was the Ottawa Mental Skills for Sports (OMSAT 3) (Durand-Bush, et al., 2001) consist in 48 items on a seven-level Likert scale, ranging from totally disagree to totally agree. These items are grouped into factors of psychological skills, namely Foundation Skills, Psychosomatic Skills, and Cognitive Skills:

-The Foundation Skills are grouped into the following variables: Goal Setting, 4 items (e.g. "*I set difficult but achievable goals*"); Self-Confidence, 4 items (e.g. "*I am confident in most aspects of my performance*"); Commitment, 4 items (e.g. "*I am determined not to give up in my sport*").

-Psychosomatic Skills are grouped into: Stress Reactions, 4 items (e.g. "*I experience performance problems because I'm very nervous*"); Fear Control, 4 items (e.g. "I'm afraid of losing"); Relaxation, 4 items (e.g. "I find it easy to relax"); and Activation, 4 items (e.g. "I can easily activate myself to an optimum level so that my performance is at its best").

-Cognitive Skills are grouped into Focusing, 4 items (e.g. "During important competitions I often lose concentration"); Refocusing, 4 items (e.g. "I find it difficult to regain control after being disturbed during a performance"); Mental Visualization or Imagery, 4 items (e.g. "I can create very clear mental images"); Mental Practice, 4 items (e.g. "I mentally practice my sport every day"); and Competition Planning, 4 items (e.g. "I define a set of things to do before each competition").

Procedures

Translation

The OMSAT translation process was conducted in 6 steps. The first step consisted in the original translation by 3 translators. After that (second step), the questionnaire was subjected to review by 4 specialists, all of them knowledgeable in the area and fluent in the English language, who were in charge of evaluating the translation and adaptation of the terms into Portuguese. The third step consisted of a new review session by other 4 specialists. To check for clarity (fifth step), the translated questionnaire was applied in a pilot study with 30 athletes who were asked to point out if the question was not clear or if they had difficulties identifying a response option. The next step counted with a participation of a portuguese teacher to evaluate the instrument, in order to finish the translation process and iniate the validation.

Data Collection

After obtaining authorization from the clubs and informed consent from the participants (regarding underage athletes, authorization was obtained from their legal guardians), all data treated in accordance with the American Psychological Association's ethical guidelines regarding participant consent, parent/guardian consent, confidentiality, and anonymity.

The athletes were selected randomly and voluntarily filled up OMSAT-3 as well as socio-demographic questions. The questionnaire took approximately 10 minutes to complete, and it was filled up on-site, without other people in the room.

Data Analysis

Descriptive, asymmetry and kurtosis analyses were carried out, as well as reliability analyses using the *Omega Coefficient* (ω) (McDonald, 1999), which also serves to check the internal consistency of the variables used in the research and, according to some authors (Revelle & Zinbarg, 2009), has shown evidence of greater precision. In McDonald's *Omega Coefficient* the established range is between 0 and 1, with higher values giving us more reliable measures (Revelle & Zinbarg, 2009; Gignac & Kretzschmar, 2017). The convergent validity of the measurement model was assessed by the standardized factor loadings, the composite reliability and the average variance extracted for each factor, taking 0.500, 0.600 and 0.400 as minimum cutoff limits respectively (Bagozzi & Yi, 1988). The correlation between each item and its factor was also calculated.

The internal validity was analyzed using a *Confirmatory Factor Analysis* (*CFA*). The *CFA* was carried out using the Lavaan package (Rosseel, 2012) inserted into the JASP software version 0.18.1 to test the model. Because the model was twelve factors long, we chose to run three models, one for each group of skills: Foundation, Psychosomatic and Cognitive. As the variables being analyzed were ordinal categorical (classified on a Likert type scale), we used the *Robust Diagonally Weighted Least Squares* (*RDWLS*) estimator, designed specifically for ordinal data (DiStefano & Morgan, 2014; Li, 2016). For each latent factor, item loadings were restricted to 1. Standardized estimates were reported despite using unstandardized values in the model. To assess the good fit of this model, (a) *Normalized Chi-Square* (χ^2/df) was used, whose values of $\chi^2/df < 3.0$ indicate reasonable adjustment (Arbuckle, 2013; Hair et al., 2019); (b) the *Comparative Fit Index (CFI)* and the *Non-Normal Fit Index* (*NNFI*), also known as *Tucker-Lewis Index* (*TLI*), whose values ≥ 0.95 indicate a good fit (Hu & Bentler, 1999), but values equal to or greater than 0.90 are acceptable; (c) the *Root Mean Square Error of Approximation* (*RMSEA*), whose values ≤ 0.06 indicate an adequacy of the model (Hu & Bentler, 1999), but normally the most used cutoff values are: ≤ 0.05 good fit, ≤ 0.08 acceptable it, ≤ 0.10 indicate a mediocre fit and > 0.10 a poor (unacceptable) fit (Brown, 2015; Byrne, 2016; Kline, 2016); (d) the *Standardized Root Mean Square Residual (SRMR),* which represents the value of the residual mean that derives from the adjustment values between the correlation matrices (from the model and from the one observed in the data), values of $SRMR \leq 0.08$ indicate good fit (Hu & Bentler, 1999), but values up to 0.10 may be considered acceptable (Worthington and Whittaker, 2006; Kline, 2016).

Three Confirmatory Factor Multigroup Analyses were also carried out to investigate the invariance of the three groups of competences that make up the Ottawa Mental Skills for Sports (OMSAT 3) for men and women. The analysis was implemented using the same *RDWLS* estimation method (DiStefano & Morgan, 2014; Li, 2016). The Multigroup Analyses assessed the invariance of the measure in three models: Configural, Metric and Scalar invariance.

Model 1 (Configural Invariance) assessed whether the configuration of the scale (number of factors and items per factor) was acceptable for both groups (male and female). If the model is not supported, the factor structure of the instrument cannot be considered equivalent for the groups evaluated. Model 2 (Metric Invariance) analyzed whether the factor loadings of the items could be considered equivalent between the groups. Model 3 (Scalar Invariance) investigated whether the level of latent trait needed to endorse the item categories (*thresholds*) were equivalent between the groups and strict invariance (equality for residual variances or uniqueness) (Cheung & Rensvold, 2002).

To assess the Configural Invariance model, the indexes used were the same as those mentioned above (*CFI, TLI, RMSEA and SRMR*), for the cut-off values proposed by Brown (2015). Metric invariance was assessed using the *CFI* difference test (ΔCFI) and *RMSEA* difference test ($\Delta RMSEA$) (Cheung & Rensvold, 2002). If, when setting a parameter, a significant reduction is found in the CFI ($\Delta CFI > 0.01$) and RMSEA ($\Delta RMSEA > 0.01$), the invariance of the measure cannot be accepted (Cheung & Rensvold, 2002).

The statistical program SPSS 21.0 and JASP software version 0.18.1 were used for the different analyses.

Results

Descriptive statistics, asymmetry, brevity, and reliability analysis

As can be seen in Table 1, the highest mean is observed in the self-confidence variable and the lowest in the fear control variable. According to the normality rules proposed by Curran, West and Finch (1996), all the variables comply with univariate normality, since the Skewness values were below 2 and the Kurtosis values were below 7. In relation to the reliability analysis, the McDonald's *Omega Coefficient*, all the indexes are within the established range, between 0 and 1, with higher values conferring more reliable measures (Revelle & Zinbarg, 2009), with values between .60 and .84.

Furthermore, as illustrated in Table 2, the *Standardized Factor Loadings* (SFL) for each item on the scale ranged from 0.500 to 0.781, all exceeding the 0.500 threshold. Additionally, the *Composite Reliability* (*CR*) values for each factor ranged from 0.64 to 0.74, all exceeding the minimum requirement of 0.600.

Furthermore, the *Average Variance Extracted* (*AVE*) for each factor ranged from 0.40 to 0.43, all exceeding the 0.400 threshold. These findings indicate that the measurement model has satisfactory convergent validity (Bagozzi & Yi, 1988). The Correlations (C) between the item and the respective factor showed moderate to strong values, between 0.589 and 0.864.

Table 1.
Descriptive statistics, asymmetry, kurtosis and reliability analysis of the OMSAT 3 variables.

OMSAT 3	Item	SFL	CF	M	SD	Skew	Curt	ω	AVE	CR
Goal-setting	1	.500	.732*	5.67	.92	-.84	1.19	.75	.40	.64
	10	.540	.724*							
	23	.605	.795*							
	41	.583	.769*							
Self-confidence	2	.623	.760*	5.81	.92	-.89	.81	.78	.42	.74
	12	.612	.780*							
	28	.682	.773*							
	48	.660	.798*							
Commitment	7	.632	.645*	5.43	1.16	-.83	.58	.74	.43	.74
	17	.671	.780*							
	30	.678	.811*							
	39	.640	.743*							
Stress Reactions	6	.653	.820*	4.36	1.49	-.29	-.90	.79	.42	.75
	14	.578	.750*							
	32	.710	.864*							
	36	.653	.589*							
Fear Control	4	.562	.638*	3.99	1.68	-.15	-1.01	.77	.40	.73
	16	.781	.837*							
	24	.560	.735*							
	43	.651	.815*							
Relaxation	3	.631	.730*	4.77	1.05	-.44	.36	.73	.42	.74
	19	.609	.652*							
	29	.708	.814*							
	42	.581	.746*							
Activation	5	.610	.629*	4.74	.90	.03	.04	.60	.40	.73
	20	.684	.702*							
	37	.588	.609*							
	46	.702	.689*							
Focusing	8	.698	.836*	4.08	1.63	-.19	-.88	.84	.42	.74
	15	.704	.849*							
	31	.705	.776*							
	38	.635	.820*							
Refocusing	22	.608	.690*	4.05	1.23	-.27	-.18	.61	.40	.73
	27	.640	.773*							
	34	.589	.656*							
	44	.682	.632*							
Imagery	9	.689	.744*	4.81	1.16	-.39	.43	.77	.42	.74
	18	.617	.728*							
	26	.709	.828*							
	33	.577	.768*							
Mental Practice	13	.677	.754*	4.86	1.15	-.40	-.18	.69	.40	.71
	21	.635	.715*							
	35	.610	.757*							
	45	.540	.760*							
Competition Planning	11	.569	.745*	4.63	1.22	-.22	-.24	.74	.40	.71
	25	.700	.808*							
	40	.646	.763*							
	47	.529	.663*							

Notes: SFL – *Standardized Factor Loading; Correlation between item and factor;* CF – *Factor loading of the item in the factor* *p < 0,01; M – Mean; SD – *Standard Deviation;* Skew – *Skewness*; Kurt – *Kurtosis*; *ω* – McDonald's Omega; AVE – *Average Variance Extracted*; CR – *Composite Reliability*. * p < 0.01.

Confirmatory Factor Analysis

According to the goodness-of-fit of the model, the Three-Factor tested if Foundation Skills had an optimal fit: *SRMR* (0.042), *CFI* (0.999), *TLI* (0.998), *RMSEA* (0.008 CI 90% [0.001, 0.020]) and $\chi 2$ */df* (1.46). As can be seen in Figure 1, the standardized factor loadings showed moderate to strong values, ranging from 0.50 to 0.80. Most of the first-order latent factor correlations were strong, ranging from 0.78 to 0.86 between the three variables.

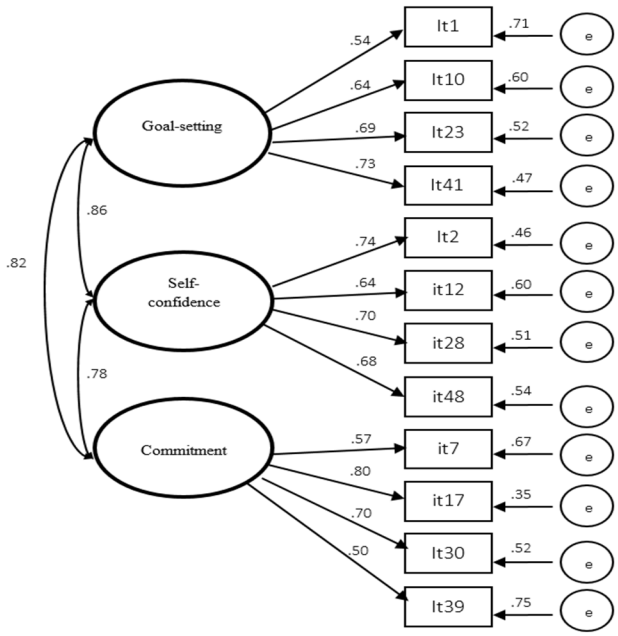

Figure 1. Confirmatory Factor Analysis for Foundation Skills

According to the goodness-of-fit indexes, the four-factor model tested for Psychosomatic skills had an acceptable fit: *SRMR* (0.056), *CFI* (0.979), *TLI* (0.975), *RMSEA* (0.042 CI 90% [0.033, 0.051]) and $\chi 2$ */df* (1.93). As can be seen in Figure 2, the standardized factor loadings showed moderate to strong values, ranging from 0.39 to 0.81. Most of the first-order latent factor correlations ranged from -0.30 to 0.98 between the four variables.

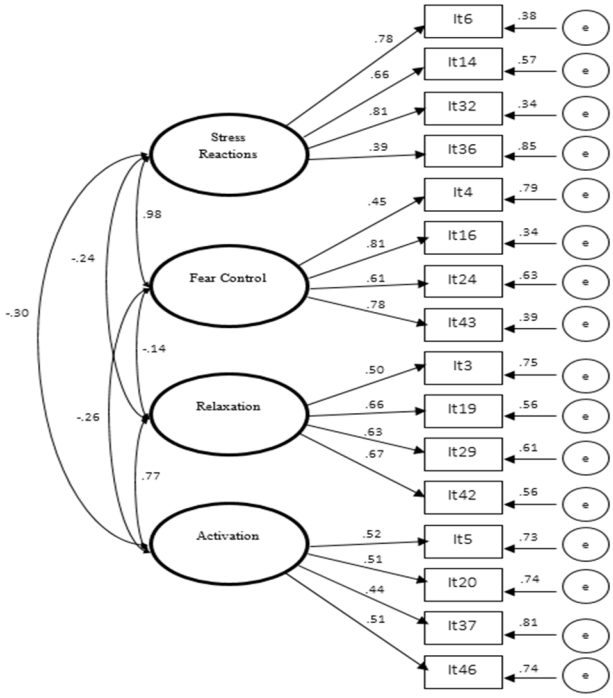

Figure 2. Confirmatory Factor Analysis for Psychosomatic Skills

According to the goodness-of-fit indexes, the five-factor model tested for Cognitive skills had an acceptable fit: *SRMR* (0.058), *CFI* (0.973), *TLI* (0.968), *RMSEA* (0.044 CI 90% [0.037, 0.051]) and $\chi 2$ */df* (1.99). As can be seen in Figure 3, the standardized factor loadings showed moderate to strong values, ranging from 0.35 to 0.78. Most of the first-order latent factor correlations ranged from -0.26 to 0.82 between the four variables.

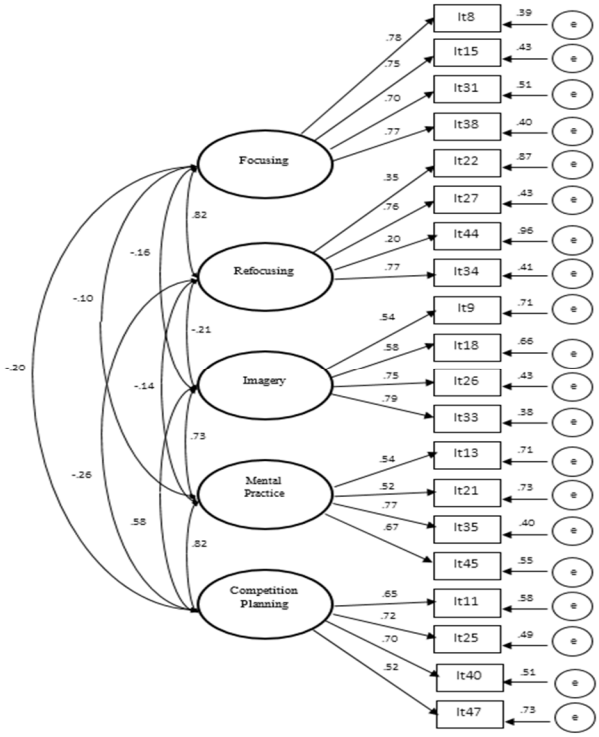

Figure 3. Confirmatory Factor Analysis for Cognitive Skills

Table 2 shows the invariance values for the gender variable of the variables that make up Foundation Skills, Psychosomatic Skills, and Cognitive Skills.

Configural invariance showed that the configuration of the scale was acceptable for both groups. Metric invariance indicated that the factor loadings of the items could be considered equivalent between the groups, as $\Delta CFI < 0.01$. In the same logic, Scalar invariance showed that the level of latent trait needed to endorse the item categories was equivalent between the male and female groups, as $\Delta CFI < 0.01$.

Table 2.
Analysis of invariance by gender for Foundation Skills, Psychosomatic Skills, and Cognitive Skills.

Foundation		Goodness-of-fit indexes				
ISB	RMSEA (90% IC)	ΔRMSEA	SRMR	TLI	CFI	ΔCFI
Configural Invariance	0.008 (0.001-0.020)	-	0.042	0.999	0.999	-
Metric Invariance	0.012 (0.001–0.027)	0.004	0.049	0.999	0.998	0.001
Scalar Invariance	0.012 (0.001-0.027)	0.000	0.049	0.999	0.998	0.000

Psychosomatic		Goodness-of-fit indexes			
ISB	*RMSEA (90% IC)*	Δ*RMSEA*	*SRMR*	*TLI*	*CFI*	Δ*CFI*
		-				
		0.001				
		0.003				
Configural Invariance	0.036 (0.023-0.047)		0.062	0.982	0.985	-
Metric Invariance	0.037 (0.025–0.048)		0.063	0.981	0.983	0.002
Scalar Invariance	0.040 (0.030-0.050)		0.062	0.977	0.979	0.004

Cognitives		Goodness-of-fit indexes				
ISB	*RMSEA (90% IC)*	Δ*RMSEA*	*SRMR*	*TLI*	*CFI*	Δ*CFI*
Configural Invariance	0.043 (0,034-0,051)	-	0.063	0.969	0.974	-
Metric Invariance	0.050 (0,042–0,058)	0.007	0.066	0.956	0.964	0.010
Scalar Invariance	0.048 (0,040-0,056)	0.002	0.063	0.960	0.962	0.002

Notes: ISB – Item Selection Bias; RMSEA (90% IC) – Root Mean Square Error of Approximation; SRMR – Standardized Root Mean Square Residual; TLI – Tucker-Lewis's Index; CFI – Comparative Fit Index; ΔCFI - Measurement invariance using the CFI difference test; Δ RMSEA - Measurement invariance using the RMSEA difference test.

As can be seen in Table 1, the results comply with Configural, Metric and Scalar invariance, demonstrating that the OMSAT 3 is an equivalent measure for men and women, which allows the groups to be compared.

Discussion

The aim of this study was to expand research about the psychological skills in sports by validating the OMSAT 3 questionnaire for the Portuguese population. The application of the measuring instrument represents a contribution to improving the theoretical value of the research domain (Pestana & Gajeiro, 2005), but also expands the body of knowledge by confirming the validity of the OMSAT 3 instrument in a new study, as well as by expanding knowledge towards understanding the psychological abilities of the athletes in Portugal.

After assessing the internal consistency with four items for each of the calculated variables, using McDonald's omega, we obtained a majority of values greater than or equal to 0.70, as recommended by Gignac and Kretzschmar (2017), which was not met in the activation and refocusing variables, and was tangential (0.60) in the mental practice variable, which due to the small number of items that make up the factor, its internal consistency can be marginally accepted (Hair, Anderson, Tatham, & Black, 1998).

We estimated the composite reliability and the average variance extracted for each variable and observed that the values obtained correspond to the indicators proposed by Bagozzi and Yi (1988) for satisfactory convergent validity.

The confirmatory factor analyses showed that the 48 items were grouped into twelve factors, with four items each, respectively: foundation skills (goal-setting, commitment and self-confidence) $SRMR = 0.042$, $CFI = 0.999$, $TLI = 0.998$, $RMSEA = 0.008$ and $\chi 2 / df = 1.46$; psychosomatic abilities (stress reaction, fear control, relaxation, activation) $SRMR = 0.056$, CFI = 0.979, $TLI = 0.975$, $RMSEA = 0.042$ and $\chi 2 / df = 1.93$ and cognitive abilities (focusing, refocusing, imagery, mental practice, competition planning) $SRMR = 0.058$, $CFI = 0.973$, $TLI = 0.968$, $RMSEA = 0.044$ and $\chi 2 / df = 1.99$.

The results obtained through the psychometric quality index revealed a very good fit in the $\chi 2/df$ value, whose recommended value is ≤ 5 (Schumaker & Lomax, 2010). The *CFI* and *TLI* comparative fit index revealed a very good

fit, as we obtained values above ≥ 0.95, as ideally recommended by Brown (2015). The *RMSEA* and the *SRMR* showed acceptable index overall (< 0.08), with the majority also showing a very good fit (< 0.05) (Brown, 2015).

These results are consistent with previous research using OMSAT 3 (Craciun et al., 2011; Durand-Bush, Salmela, & Green-Demers, 2001) and confirm the importance of each of the twelve variables in understanding psychological skills. If we look at the results of the research using the OMSAT 3 (Craciun et al., 2011; Durand-Bush, Salmela, & Green-Demers, 2001) with those obtained in our study, they all present adequate psychometric properties, as guided by the literature (Brown, 2015; Hu & Bentler,1999; Schumaker & Lomax, 2010), apparently presenting the OMSAT 3 in these studies as a reliable instrument for assessing psychological skills.

This version also showed adequate configural invariance values, where the fit index used *CFI, TLI, RMSEA* and *SRMR*, respected the cutoff values proposed by Brown (2015). The Metric and Scalar invariance by gender ($\Delta CFI < 0.01$ and $\Delta RMSEA < 0.01$) complied with the invariance assumptions proposed by Cheung and Rensvold (2002).

The instrument has the potential to become more refined as new contributions on psychological skills emerge using the same instrument.

In terms of limitations, the sample size between men and women showed an imbalance, which could make it interesting to see new invariance tests in other studies. We also refer to limitation, the data used was obtained exclusively from self-reports provided by football players. It is important that future approaches include athletes from different sports in the sample, or even that future validations can be made in the specific context of other sports. Another limitation, is the lack of concurrent validity with another's scales that could assess similar constructs, like PPI-A (Golby et al., 2007) or MTI (Gucciardi et al., 2014) for example, or any theoretical assumption of a relationship between predictive variables or consequences of the psychological skills assessed, such as the use of the transtheoretical model of motivation (Prochaska & DiClemente, 1982), the theory of planned behavior (Ajzen, 1991) or the theory of self-determination (Deci, & Ryan, 1985; Ryan & Deci, 2020) in different strata of the population.

Conclusion

We can conclude that the twelve-factor adaptation of the Portuguese version of the OMSAT 3 can be safely used to assess the psychological skills of athletes.

The results indicate that the factorial validity and reliability of the Portuguese version of the OMSAT 3 are acceptable for the general population of both genders (male and female), aged between 12 and 42 years old.

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