ESTUDOS DE PSICOLOGIA
Psychological Studies

REVIEW ARTICLE

Psychological Assessment

Editor
Tatiana de Cassia Nakano

Conflict of interest
The authors declare that there is no conflicts of interest.

Received
February 5, 2022

Version final
June 12, 2023

Approved
August 1, 2024

Validity and reliability of the Sport Motivation Scale-II (SMS-II): a systematic review

Validade e confiabilidade do questionário Sport Motivation Scale-II (SMS-II): revisão sistemática

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How to cite this article: Amaro, A.S., Barreira, J., & Fernandes, P. T. (2025). Validity and reliability of the Sport Motivation Scale-II (SMS-II): a systematic review. *Estudos de Psicologia* (Campinas), *42*, e220001. https://doi.org/10.1590/1982-0275202542e220001

Abstract

Objective
To analyze the validity and reliability of the Sport Motivation Scale-II in studies that used its original or translated versions.

Method
Systematic review was carried out in PubMed, Web of Science, Scientific Electronic Library Online, *Literatura Latino-Americana e do Caribe em Ciências da Saúde*, Psychnfo, SportDiscuss, and Periódico CAPES databases following Prisma recommendation.

Results
The twenty-eight studies included in this review show that the instrument is well accepted by the scientific community. The translation and adaptation showed satisfactory to borderline goodness-of-fits. The results indicate that the introjected regulation factor, one of the six instrument's factors, is the cause of these borderlines scores. In the translation and adaptation studies, the introjected regulation has showed systematically unsatisfactory internal consistency. There is evidence that the model without introjected regulation factor reached higher goodness-of-fit scores.

Conclusion
We recommend the presence of a linguist to support the translation and adaptation of the instrument.

Keywords: Factor analysis; Psychometrics; Reproducibility of results; Translating.

Resumo

Objetivo
Analisar a validade e confiabilidade da Escala de Motivação do Esporte-II em estudos que usaram a versão original ou outras validadas para diferentes idiomas e contextos.

Método

Revisão sistemática foi realizada utilizando bases do PubMed, Web of Science, Scientific Electronic Library Online*, Literatura Latino-Americana e do Caribe em Ciências da Saúde,* Psychnfo, SportDiscuss *e Periódico CAPES baseadas no protocolo Prisma.*

Resultados

Os 28 estudos incluídos nesta revisão mostraram que o instrumento é bem aceito pala comunidade científica. Os estudos de tradução e adaptação mostraram índices de ajustes do modelo satisfatórios a marginais. Os resultados indicam que o fator regulação introjetada pode ser a causa dos escores limítrofes. Esse fator tem mostrado sistematicamente consistência interna insatisfatória. Há evidências que um modelo sem a regulação introjetada alcance escores de ajuste de modelo mais altos.

Conclusão

Nós recomendamos a presença de um linguista para apoiar os estudos de adaptação e validações.

Palavras-chave: *Análise fatorial; Psicometria; Reprodutividade dos resultados; Tradução.*

The Sport Motivation Scale II (SMS-II) has been used in studies and in sports practice to assess the motivation of sports practitioners. The scale is based on the Theory of Self-Determination allowing to discriminate the different reasons for engagement and interest in sport through a motivation continuum. Based on the Theory of Self-Determination, it is possible to understand the intrinsic and extrinsic factors for participation in sport, considering intrinsic factors the motivation to do something because it is inherently interesting or enjoyable, and extrinsic factors the motivation to do something as a means to an end or a reward (Deci & Ryan, 2000; Ryan & Deci, 2000).

The current SMS-II proposal is an adaptation and update of its original version (SMS) which was created in French and English simultaneously (Briere et al., 1995; Pelletier et al., 1995). The original scale was composed by seven factors that measured the three types of intrinsic motivation (to know, to experience stimulation and to perform), three types of extrinsic regulation (external regulation, introjected regulation and identified regulation) and amotivation. After some debates on its psychometric properties and the need to include an integrated regulation, the authors revised the instrument and, based on the new analysis, proposed a second version called SMS-II (Pelletier et al., 2013). In this new version, the instrument consists of 18 items that comprise six factors named amotivated, external, introjected, identified, integrated and intrinsic regulation. The SMS-II presented a better adjustment of the model than the original version in all indicators and a greater reliability between the subscales.

Given the importance of the instrument from a practical point of view and its theoretical consistency, the SMS-II has been translated and validated for different countries, such as Brazil (Nascimento et al., 2014), France (Pelletier et al., 2019), Iran (Manouchehri et al., 2015), Spain (Viciana et al., 2017), Turkey (Yildiz et al., 2019), Mexico (Pineda-Espejel et al., 2016), and Hungary (Paic et al., 2017). These studies evaluated and presented parameters of validity and reliability of the instrument. Based on these studies, the SMS-II proved itself a viable instrument in various language and cultural contexts and has been widely used (Jelinek et al., 2021).

Considering the Brazilian reality, the SMS-II is the first instrument to be translated and validated to measure the motivation of sports practitioners in our language and culture. Being a pioneering and a short questionnaire, it has been broadly used in the country and by our research group. After conducting investigations with different samples, we found marginal to satisfactory values in the Confirmatory Factorial Analysis corroborating the validation of the model for the

Brazilian context (Barreira et al., 2022). Still, we also found unsatisfactory values (< 0.40) of Cronbach's Alpha and McDonald's Omega for the introjected regulation in all the studies. These results caught our attention as we also found similar findings in other versions validated to different nationalities (Jelinek et al., 2021). According to Jelinek et al. (2021, p. 239), "there have been reports of recurring problems with specific items, issues related to internal consistencies of the subscales, and discrepancies in the pattern of mutual correlations between individual subscales". Based on these initial results and their similarities, we asked: what are the psychometric properties of the SMS-II translated and validated for different contexts? Thus, the aim of this study was to carry out a systematic review analyzing the scientific production using the SMS-II and its validity and reliability.

Method

Search

Literature searches were performed using PubMed, Web of Science, PsychInfo, SportDiscuss, Scientific Electronic Library Online (SciELO), *Literatura Latino-Americana e do Caribe em Ciências da Saúde* (Lilacs) and *Periódico Capes* databases. All searches were conducted in December 2021 using combinations of the following keywords "Sport Motivation Scale II" in English, Portuguese and Spanish. We did not restrict the date of publication as an inclusion or exclusion criteria. The systematic review was performed following the Prisma guideline. Two of the authors (JB and AS) independently analyzed study titles and abstracts. Subsequently, they read the full text of studies deemed potentially eligible for inclusion. Furthermore, reference lists of articles were reviewed to determine the relevance of any additional studies on the topic.

Inclusion and Exclusion Criteria

Studies had to meet the following criteria for inclusion in our review: 1) used the SMS-II as an instrument for data collection; 2) was published in a peer reviewed journal; 3) collected and analyzed the six constructs of the SMS-II questionnaire. As an exclusion criterion we did not analyze studies (i) published in books or conference annals, (ii) that used an adapted version of the SMS-II for the physical education context.

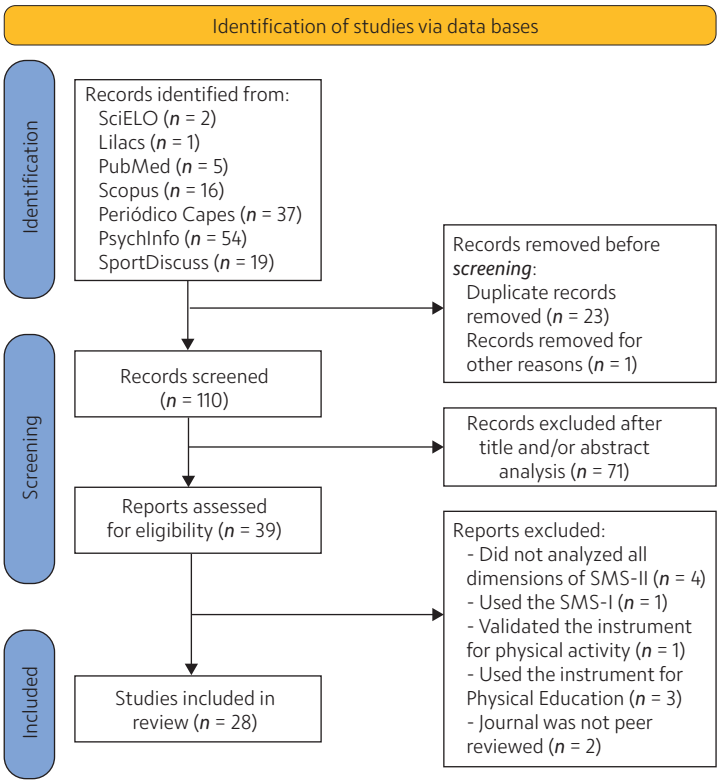
Included Studies

Initially, 134 studies were identified and after deduplication, 24 were excluded from the reviewing processes and 71 were excluded after title and/or abstract analysis. In total, 39 studies were selected for the full text reading. Two authors read these studies and, according to the inclusion and exclusion criteria, 28 studies were selected for our review.

Quality of the Studies

We included in this review studies with different methods, such as validation and translation, intervention, and observation. Therefore, we could not find a specific tool that could evaluate the quality of the studies with such different methodologies. We report the impact factor of their scientific journals as an indication of their quality (Table 1).

Figure 1
PRISMA Search flow diagram



Data Extraction

Two independent researchers extracted data from each study. Variables were collected according two categories: methods and results. For the methods section we collected the following variables: number of participants, age, sex, experimental design, and sport. In the results section, we collected the absolute fit indexes, such as Chi-square (χ^2), Akaike information criterion (AIC), Browne-Cudeck criterion (BCC), Bayes information criterion (BIC), Consistent AIC (CAIC) and Expected cross validation index (EVCI). The Comparative fit indexes were also collected, such as Normed fit index (NFI), Incremental fit index (IFI), Tucker-Lewis index (TLI), Comparative fit index (CFI) and Relative noncentrality fit index (RNI). The collected Parsimonious fit indexes were: Parsimony-adjusted NFI (PNFI), Parsimony-adjusted CFI (PCFI) and Parsimony-adjusted GFI (PGFI). For other indexes we found Goodness-of-fit index (GFI) and Adjusted GFI (AGFI), Root mean square residual (RMR), Standardized RMR (SRMR), Weighted root mean residual (WRMR) and Root mean square error of approximation (RMSEA). The parameters collected for internal reliability were Cronbach's alpha and McDonald's omega.

Statistical Analysis

The descriptive statistics were used to summarize and present the collected data. Absolute and relative frequencies were used for that purpose. The one sample *t*-test was used to compare the collected Cronbach's alpha of each dimension with an expected alpha of 0.7 considered as a good reliability (Agbo, 2010; Hayes & Coutts, 2020). The Cronbach's alpha was the main reliability measure presented in the studies and, for that reason, was used in our analysis. Other parameters

of validity and reliability are also presented in the results section. All the analysis was performed using SPSS software and the statistical significance was set at $p < 0.05$.

Results

Included Studies

Table 1 shows the characteristics of the included studies in the current systematic review. Most of the studies were published in the year of 2018 and presents an exploratory design.

Table 1
Characteristics of the studies that used or validated the questionnaire SMS-II

Category	Frequency	%
Journal		
Apunts. Educacion Fisica y Deportes	1	4
Frontiers in Psychology	3	11
International Journal of Sport and Exercise Psychology	2	7
International Journal of Sports Science & Coaching	1	4
International Journal of Mental Health and Addiction	1	4
Journal of Applied Sport Psychology	1	4
Journal of Education, Health and Sport	1	4
Journal of Physical Education and Sport	2	7
Journal of Park and Recreation Administration	1	4
Journal of Sport & Exercise Psychology	1	4
Journal of Sport Behavior	2	4
Journal of Sport Sciences Researches	1	4
Motivation Science	1	4
Pakistan Journal of Psychological Research	1	4
Perceptual and Motor Skills	2	7
Psychological Reports	1	4
Revista da Educação Física	2	7
Revista de Psicología del Deporte	1	4
Testing, Psychometrics, Methodology in Applied Psychology	1	4
Trends in Sports Science	1	4
Revista Internacional de Ciencias del Deporte (RICYDE)	1	4
Year		
2014	1	4
2015	1	4
2016	5	18
2017	2	7
2018	7	25
2019	3	11
2020	3	11
2021	6	21
Country		
Australia	2	7
Brazil	7	25
China	1	4
Hungary	2	7
Spain	1	4
USA	3	11
Norway	2	7
Others	10	36

Translation and Validation

We found four studies that involved the translation and validation the SMS-II in different countries. The psychometric properties of each questionnaire are shown in Table 2. We presented the indexes that were reported at least for two studies and used the following recommended cutoff: GFI >0.9, RMSEA <0.05, TLI and CFI >0.9, and SRMR <0.09 (Schreiber, 2017). All the studies showed high values of validity.

Table 2
Studies that translated and validated the SMS-II for different languages and countries

Authors	Country	*n*	Sample	GFI	RMSEA	TLI	CFI	χ^2	χ^2/df	SRMR	AIC
Li et al. (2018)	China	259	University athletes	-	0.05	0.91	0.93	201.1	-	0.06	-
Nascimento et al. (2014)	Brazil	364	National athletes	0.93	-	0.91	0.93	429.5	112	-	367.5
Pelletier et al. (2019)	France	247	Athletes	-	0.06	0.91	0.93	230.5	120	0.06	-
Viciana et al. (2017)	Spain	766	Adolescent athletes	0.97	0.04	0.95	0.96	167.4	-	-	244.4
Pineda-Espejel et al. (2016)	Mexico	279	Athletes	-	0.03	-	0.98	202.1	-	-	-
Smohai et al. (2021)	Hungary	1197	Recreational	-	0.06	0.89	0.92	-	-	-	-
			Competitive	-	0.06	0.92	0.94	-	-	-	-
Jelínek et al. (2021)	Czech Republic		Athletes	-	0.08	-	0.9	282.1	-	-	-

Note: AIC: Akaike Information Criterion; CFI: Comparative Fit Index; GFI: Goodness-of-fit; RMSEA: Root Mean Square Error of Approximation; SRMR: Standardized Root Mean Square Residual; TLI: Tucker-Lewis Index; χ^2/df: Chi-square/degrees of freedom; χ^2: Chi-square.

Although all studies showed a good psychometric property, the study of Viciana et al. (2017) validated the instrument with only five dimensions for the Spanish context. The authors compared four models employing the maximum likelihood estimation (with six, five, three, and two factors). The five-factor S-SMS-II, without the introjected regulation, showed the best indexes of fit (Table 2). Similarly, the study of Pineda-Espejel et al. (2016) analyzed the psychometric properties of the Mexican Spanish version of the SMS-II. The authors excluded item 16 of the questionnaire given its low reliability. It is worth noting that this item is part of the introjected regulation.

It is important to note that the psychometric properties were mainly presented by the studies that translated and validated the instrument. Among the studies that used the SMS-II only for data collection, few of them calculated and presented the instrument's properties (Table 3). The Cronbach's alpha was the most used measure among them (Table 3).

Table 3
Number of studies that reported the measures of validity and reliability of the SMS-II in their results

Measure	Yes		No	
	n	%	*n*	%
Confirmatory Factorial Analysis	2	9%	19	91
Exploratory Factorial Analysis	0	0	21	21
Goodness-of-Fit Index	1	5	20	20
Root Mean Square Error of Approximation	3	14	18	18
Adjusted Goodness-of-Fit Index	0	0	21	21
Tucker-Lewis Index	2	9	19	19
Comparative Fit Index	2	9	19	19
Chi-Square	4	18	17	17
Chi-square divided by Degree freedom	1	5	20	20
Standardized Root Mean Square Residual	3	14	18	18
Akaike Information Criterion	0	0	21	21
Cronbach's Alpha	11	52	10	10
McDonalds' Omega	0	0	21	21

Note: data presented as absolute (relative) frequencies.

Reliability

Three studies cited the Cronbach's alpha reported by Pelletier et al. (2013) in the original study, but did not present the reliability measure of their own data (Gonzalez, 2021; Piasecka et al., 2018; Russell & Molina, 2018). Two studies presented a general alpha based on all domains and did not discriminated by each dimension (Bingol & Yildiz, 2021; Fiorese et al., 2017; Lucas et al., 2020; Roberto et al., 2020). Four studies did not report the alpha based on Pelletier et al. (2013) neither based on their data (Castro et al., 2020; Jordalen, 2016; Jordalen et al., 2018; Menegassi et al., 2018; Stenling et al., 2015; Wahl-Alexander & Chomentowski, 2018).

Nine studies calculated and reported the alpha for each dimension. The frequency of dimensions that showed alpha above or below 0.7 are presented in Table 4. We found that most of the dimensions presented alpha above 0.7. However, most of the studies showed a value below 0.7 for the introjected regulation.

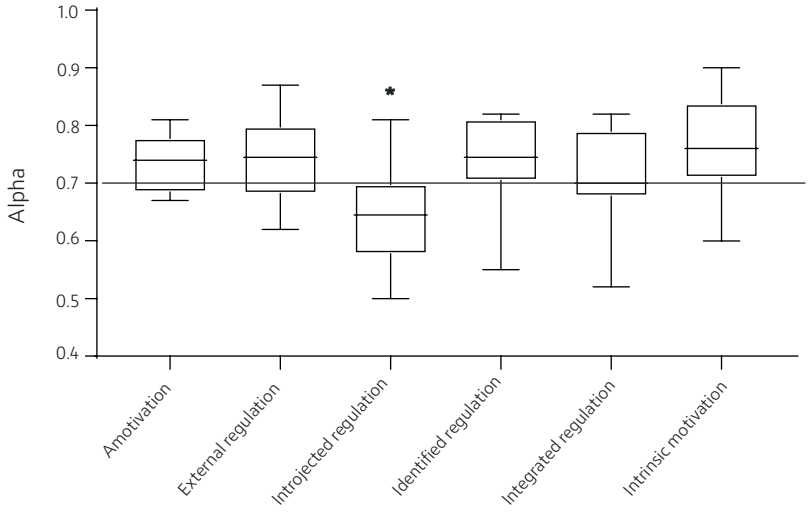
Table 4
Number of studies with Cronbach's Alpha above or below 0.70 in all dimensions of SMS-II

Alpha	< 0.70		> 0.70	
	n	%	*n*	%
Amotivation	4	31	9	69
External regulation	5	38	8	62
Introjected regulation	9	75	3	25
Identified regulation	2	15	11	85
Integrated regulation	3	23	10	77
Intrinsic motivation	1	8	12	92

Note: data presented as absolute (relative) frequencies.

Figure 1 shows the alpha reported by the studies for each dimension. The one sample t-test comparison with an expected alpha of 0.7 reveals a significant difference only in the introjected regulation (t-value = 2.313; p-value = 0.047) showing lower values compared to the expected. The characteristics of these studies are presented in Table 5.

Figure 2
Cronbach's alpha reported by the nine studies for each dimension



Note: *Significant difference in one sample t-test considering an expected alpha of 0.7 (t = 2.313; p < 0.05).

Table 5
Characteristics of studies that reported the alpha for all the dimensions

Authors	Country	*n*	Gender		Age		Sport or context	Alpha IR
			Men (*n*)	Women (*n*)	*M*	*(SD)*		
Li et al. (2018)	China	258	169	89	20.5	(1.4)	University athletes	0.69
Schaefer et al. (2016)	Australia	173	164	9	52.9	(14.2)	Golf	0.70
Sukys et al. (2019)	Lithuania	239	110	129	21.8	(3.1)	Professional athletes	0.69
Nascimento et al. (2014)	Brazil	364	213	151	22.1	(4.8)	National athletes	0.61
Sheehan et al. (2018)	Irish	215	140	75	22.8	(4.1)	Elite and semi-elite athletes	0.61
Pelletier et al. (2019)	France	237	127	110	17.1	(2.8)	Swimmers and other sports	0.71
Ahmad & Safdar (2020)	Pakistan	105	105		20.0	(2.7)	Regional players	0.60
Lucas et al. (2021)	Brazil	461	325	136	15.1	(1.4)	Club and school teams	0.50
Kovácsik et al. (2021)	Hunagry	149	53	96	21.0	(2.9)	Recreational	0.57
Pineda-Espejel et al. (2016)	Mexico	274	143	131	23.1	(5.6)	Elite athletes	0.81
Smohai et al. (2021)	Hungary	1.197	599	598	27.8	(10.3)	Recreational and elite athletes	0.51
Jelínek et al. (2021)	Czech Republic	243	120	123	16.4	(1.3)	Elite and semi-elite athletes	0.68

Note: IR: Introjected Regulation.

Discussion

Our systematic review analyzed studies using the SMS-II inventory which measures sport motivation according to the theory of self-determination. We analyzed the validity and reliability of the SMS-II translated and adapted for different cultural contexts. In this review, we observed that the SMS-II is well accepted by the scientific community, being used and published in scientific journals recognized by their editorial rigor and impact. The SMS-II has been used mainly for exploratory descriptive studies allowing to identify the motivational profile of athletes and teams, and to build a body of evidence about psychometric property of the SMS-II.

Brazil showed the highest number of published studies using the SMS-II (N = 7, 25%). A possible explanation for this result is the fact that the Brazilian version was one of the first to be translated and validated immediately after the launch of SMS-II (Nascimento et al., 2014). Furthermore, in the last decade, we have seen an increase in the number of sport psychology study groups in the country, establishing international cooperative projects and looking for tendencies of sport psychology around the world (Queiroz et al., 2016). As a result, the number of scientific papers has increased and sport psychologists have been more present in many sports contexts (Acharya, 2010).

Hair et al. (2010) suggested that the goodness-of-fit model should present absolute and incremental indexes above 0.90. The SMS-II was translated for 7 languages (Portuguese, Chinese, Spanish, French, Mexican Spanish, Hungarian and Czech) and the reliability and validity reached satisfactory results (GFI, TLI e CLI, between 0.91 and 0.97) (Schreiber, 2017). Therefore, the data collected in this review corroborates the validity and reliability of the SMS-II (Deci & Ryan, 2000; Pelletier et al., 1995, Pelletier et al., 2007, Pelletier et al., 2013; Ryan & Deci, 2000). Also, the data shows its ability to measure the motivation in different contexts, such as high performance, educational and recreational.

Interestingly, the model proposed by Viciana et al. (2017) in Spain contains only 5 factors. The introjected regulation was excluded because it did not reach satisfactory internal reliability ($\alpha \geq 0.70$) and was compromising the goodness-of-fit model. In that way, the model with 5 factors showed better good-of-fit ($\chi^2 = 167.378$, $p < 0.05$; $\chi^2/DF = 2.498$; GFI = 0.971; RMSEA = 0.044;

AGFI = 0.955; TLI = 0.954; CFI = 0.966; AIC = 244.378) than the version with 6 factors. It is worth noting that the model of Viciana et al. (2017) presented a better goodness-of-fit than other translations and validations, indicating that these models could be better adjusted based on an adequacy in the introjected regulation construct. The cultural adaptation of the SMS-II to the Mexican context also drew attention to the introjected regulation by suggesting the exclusion of item 16 due to its low reliability (Pineda-Espejel et al., 2016).

In this review, only in 3 of 12 studies, the introjected regulation reached a satisfactory internal consistency value ($\alpha \geq 0.7$). Furthermore, the Cronbach's alpha average value was significantly different from the expected value ($\alpha = 0.7$) (Figure 1). Although the use of Cronbach's alpha has been questioned, recent studies that evaluated the reliability of SMS-II with other metrics has also shown unsatisfactory values for the introjected regulation using parameters such as McDonalds' Omega (Barreira et al., 2022). These findings suggest that the reliability issue of the introjected regulation goes beyond the use of the Cronbach's alpha. Based on these, we reinforce that the introjected regulation dimension meets the theoretical model of the TAD and, in the original version of the SMS-II, presented satisfactory values of validity and reliability (Pelletier et al., 2013). Therefore, it appears that the reliability of this construct is influenced by the translation and validation processes. In this way, we suggested that the items composing introjected regulation should be reviewed by a linguist with deep knowledge of sport psychology and familiar with TAD to support the translation and adaptation procedure (Borsa et al., 2012).

Although our study has shown interesting results, it is important to recognize its limitations. First, we did not analyze the quality of the included studies and it is possible that part of them present some bias. Second, we analyzed the reliability mainly based on Cronbach's alpha that is the most reported index by the studies. However, it has been reported that this index may not be the best approach to measure the internal consistency of an inventory, because it is sensitive to the number of items in a factor and to the number of observation (Agbo, 2010). Even so, Barreira et al. (2022) has recently calculated the Cronbach's alpha and McDonalds' Omega for all the dimensions of the SMS-II and found unsatisfactory values for both measures concerning the introjected regulation. We recommend that future studies analyze the validity and reliability of constructs and provide these parameters in their work. Experts in the translation and validation processes can also focus on adaptations that overcome the limitations found so far in the introjected regulation construct.

Final Considerations

The SMS-II has proved to be an important instrument to measure motivation in sports, leading researchers around the world to translate and adapt it for their language and culture. The seven studies that translated and validated the instrument have showed satisfactory values on goodness-of-fit on validation and reliability test. Still, two of them proposed modifications in the introjected regulation factor by excluding the construct or one of its items. Most of the studies that used the SMS-II for data collection did not report validity and reliability indexes. The Cronbach's alpha was the most reported index (52% of the studies) showing a satisfactory internal consistency for five dimensions and an unsatisfactory consistency for the introjected regulation. Once the original version of the instrument did not present limitations regarding this construct, we suggest a greater attention when using translated versions or adapting the instrument for other cultural contexts.

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