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Adaptación, validación y fiabilidad de la versión indonesia del Cuestionario de fortaleza mental en el deporte (SMTQ)

Adaptation, Validation, and Reliability of the Indonesian Version of the Sports Mental Toughness Questionnaire (SMTQ)

Adaptação, validação e fiabilidade da versão indonésia do Sports Mental Toughness Questionnaire (SMTQ)

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RESUMEN

El concepto de fortaleza mental (MT) se reconoce cada vez más como un factor clave en el rendimiento deportivo. El Cuestionario de Fortaleza Mental en el Deporte (SMTQ) es un instrumento de medición de MT desarrollado en un contexto deportivo y en inglés. Sin embargo, no hay muchos estudios que prueben las estructuras psicométricas en diferentes contextos lingüísticos y culturales. Por lo tanto, esta investigación tiene como objetivo adaptar y probar el SMTQ en el contexto indonesio y analizar la invariancia en función de los atletas frente a los no atletas. Un total de 856 personas participaron en este estudio, pero los datos finales se analizaron para 724 participantes (M_{age} = 21,56 años, SD = 7,63). El número de atletas fue de 385 personas (M_{age} = 20,79 años, SD = 5,05), mientras que el número de no atletas fue de 339 personas (M_{age} = 22,42 años, SD = 9,70). Se utilizó el análisis factorial confirmatorio (CFA) para analizar la estructura psicométrica del SMTQ. Los resultados de la investigación mostraron que los tres modelos probados (modelo de un solo factor, modelo de tres factores y modelo de orden superior) no cumplieron con el ajuste del modelo. Los resultados del modelo revisado muestran que el modelo de tres factores revisado es un modelo que se ajusta a los datos (CFI = .983, TLI = .977, RMSEA = .054, SRMR = .049). Los resultados de la invariancia encontraron que no hubo una disminución significativa en el ajuste del modelo y la invariancia de SMTQid logró una invariancia estricta. La validez de SMTQid muestra valores de carga factorial muy buenos y se encuentra dentro de los criterios de bueno a excelente (λ = .57 a .86), así como la validez convergente que muestra una correlación significativa con MTI (r = .38, $p < .001$). Los resultados de la prueba de fiabilidad muestran valores de CR = .82, .79 y .81 y valores de α = .73, .60 y .83 para cada una de las escalas de confianza, constancia y control del SMTQ.

Palabras clave: Análisis factorial de confirmación, SMTQ, fortaleza mental, fiabilidad, validación

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ABSTRACT

The concept of mental toughness (MT) is increasingly recognized as a key factor in athletic performance. The Sport Mental Toughness Questionnaire (SMTQ) is an MT measuring instrument developed in a sports context and English. However, there are not many studies that test psychometric structures in different language and cultural contexts. Therefore, this research aims to adapt and test the SMTQ in the Indonesian context and analyze invariance based on athletes vs. non-athletes. A total of 856 people participated in this study but the final data were analyzed for 724 participants (M_{age} = 21.56 years, SD = 7.63). The number of athletes was 385 people (M_{age} = 20.79 years, SD = 5.05), while the number of non-athletes was 339 people (M_{age} = 22.42 years, SD = 9.70). Confirmatory factor analysis (CFA) was used to analyze the psychometric structure of the SMTQ. The research results showed that the three models tested (single-factor model, three-factor model, and higher-order model) did not meet the model fit. The results of the revised model show that the revised three-factor model is a model that fits the data (CFI = .983, TLI = .977, RMSEA = .054, SRMR = .049). The invariance results found that there was no significant decrease in model fit and the SMTQid invariance achieved strict invariance. The validity of SMTQid shows very good factor loading values and falls within the good to excellent criteria (λ = .57 to .86), as well as convergent validity which shows a significant correlation with MTI (r = .38, p < .001). The results of the reliability test show CR values = .82, .79, and .81 and α values = .73, .60, .83 for each of the confidence, constancy, and control scales in the SMTQ.

Keywords: Confirmation factor analysis, SMTQ, mental toughness, reliability, validation

RESUMO

O conceito de resistência mental (TM) é cada vez mais reconhecido como um fator chave no desempenho atlético. O Sport Mental Toughness Questionnaire (SMTQ) é um instrumento de medida de MT desenvolvido em contexto desportivo e inglês. No entanto, não existem muitos estudos que testem as estruturas psicométricas em diferentes contextos linguísticos e culturais. Assim sendo, esta investigação tem como objetivo adaptar e testar o SMTQ no contexto indonésio e analisar a invariância baseada em atletas versus não atletas. Um total de 856 pessoas participaram neste estudo, mas os dados finais foram analisados para 724 participantes (M_{age} = 21,56 anos, DP = 7,63). O número de atletas foi de 385 pessoas (Mage = 20,79 anos, DP = 5,05), enquanto o número de não atletas foi de 339 pessoas (M_{age} = 22,42 anos, DP = 9,70). A análise fatorial confirmatória (AFC) foi utilizada para analisar a estrutura psicométrica do SMTQ. Os resultados da investigação mostraram que os três modelos testados (modelo de um fator, modelo de três fatores e modelo de ordem superior) não cumpriram o ajuste do modelo. Os resultados do modelo revisto mostram que o modelo revisto de três fatores é um modelo que se ajusta aos dados (CFI = 0,983, TLI = 0,977, RMSEA = 0,054, SRMR = 0,049). Os resultados da invariância revelaram que não houve uma diminuição significativa do ajuste do modelo e a invariância SMTQid atingiu a invariância estrita. A validade do SMTQid apresenta valores de carga fatorial muito bons e enquadra-se nos critérios de bom a excelente (λ = 0,57 a 0,86), bem como validade convergente que apresenta uma correlação significativa com o MTI (r = 0, 38, p < 0,001). Os resultados do teste de fiabilidade mostram valores de CR = 0,82, 0,79 e 0,81 e valores de α = 0,73, 0,60, 0,83 para cada uma das escalas de confiança, constância e controlo no SMTQ.

Palavras chave: Análise fatorial de confirmação, SMTQ, resistência mental, fiabilidade, validação

INTRODUCTION

Nowadays, studies regarding mental toughness have attracted many scientists (Gucciardi, 2017; Stamatis et al., 2020; Wandik et al., 2024). This happens because there is a belief that the athlete's success or failure on the field is a factor that plays a big role in the athlete's mentality (Crust, 2007; Liew et al., 2019; Putra et al., 2024c; Guntoro & Putra, 2022). Physical and technical quality at the elite level is seen as not significantly different because athletes have been trained using the latest methods (Maksum, 2022; Guntoro et al., 2023) so athletes' mental variables are seen as the main determinant concerning achievements on the field (Gucciardi et al., 2014; Sheard et al., 2009; Sutoro et al., 2023).

The concept of "mental toughness" is defined in various ways by experts. For example, Gucciardi et al. (2009) define MT as a collection of values, attitudes, emotions, and cognitions that are attached to a person and influence

that person in responding to and assessing pressure, challenges, and difficulties faced to achieve their goals. However, by Gucciardi (2017) the definition was updated and stated as "as a state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits." In general, mental toughness is considered a multidimensional construct and is often associated with unshakable self-confidence, the ability to bounce back after defeat/failure (resilience), never giving up, being able to deal with difficulties and pressure effectively, and being able to maintain concentration despite many experiences and potential disruption (Liew et al., 2019). In the world's largest multi-sport event, the Olympics, Gould et al. (2002) state that the factor that most determines the results of matches and athletes' achievements on the field is mentality. This may happen because the physical and technical factors, at the world elite level, are relatively the same, because the athletes have been trained with a variety of training programs and cutting-edge methods (Maksum, 2022). Therefore, at this level, athletes' mentality factors are believed to make a major contribution to the field (Maksum, 2007).

We reviewed studies on the theme of sports psychology, especially mental toughness in Indonesia, and found that there was a trend of increasing the number of publications. Based on data in the scientific article indexing system created by our country, namely the digital reference network (https://garuda.kemdikbud.go.id/), there has been a significant increase in scientific publications with the keyword "athlete's mentality." We searched on January 17, 2024. In 2010-2020, 46 documents were obtained, while in the 2020-2023 period, there were 53 documents. Although there was only an increase of seven documents in three years, we believe that this trend is increasing because it is very likely that researchers in Indonesia publish in international journals, so that they are not read by the index engine that we use in the search. This is in line with the opinion of Gucciardi (2017) and Stamatis et al. (2020) who stated that "mental toughness" has become a popular topic that is widely discussed by scientists in the world.

On the other hand, the review we conducted of articles on the theme of "athlete mentality" in Indonesia revealed problems, namely those related mainly to the instruments used. Some try to develop their mental toughness instruments but the procedure is not explained (Giandra & Setyawan, 2014). Some use foreign instruments, but the process of language adaptation and testing in the Indonesian context is not explained (Raynadi et al., 2017). With the facts above, we consider that there is a serious issue with studies on the theme of "athlete mentality" in Indonesia and we believe that there is a need for a standardized instrument in Indonesian that can be used by researchers, coaches, and the public in studying the mental dimensions of athletes. Having standardized measuring instruments will make studies related to athletes' mental health much better and will minimize the occurrence of bias caused by the instruments used.

To our knowledge, several instruments have been developed to reveal mental toughness in the context of sports, and one of them is the Sports Mental Toughness Questionnaire (SMTQ) created by Sheard et al., (2009). SMTQ was developed through two rigorous studies relying on positive psychology propositions (Seligman & Csikszentmihalyi, 2000) which is interesting for further study. SMTQ was developed by involving 1,142 athletes at various levels, namely from regional, national, to international levels. SMTQ was developed through a long and very strict process. At the initial pool stage, 53 items were obtained, and after going through various testing processes, 14 items were selected, which were used to measure MT in the context of sports.

To date, there has only been one study that has attempted to test the SMTQ outside its original language, namely in Turkish (Miçooğulları, 2017). The results of testing in different languages and cultures show that the SMTQ is valid and reliable in measuring MT in the context of sports (Miçooğulları, 2017). Language is not only the main tool for interacting with the world, but also a means of forming culture (Tylén et al., 2010). Different cultures have different conceptions of MT. Traits that are valued in one culture may be considered differently in another culture.

Certain idioms or expressions related to resilience and perseverance may not have direct equivalents in other languages, making it difficult to capture the intended nuances in translation. Therefore, cultural norms play a role in matching appropriate diction. Additionally, MT often involves coping with difficulties and the strategies used to overcome difficulties may differ between cultures (Stamatis et al., 2019). Based on this fact, language is an integral part of a person's cultural schema and even sports performance (Igono, 2019). Different cultures and racial groups

testing is valuable in demonstrating the global validity of the scale and comparing it with the adaptations that must be made in different cultures. The application of the scale to multiple languages would benefit its use as an alternative in international studies and multicultural countries (Beaton et al., 2011). The reliability and validity of scales and reduce psychometric performance in target populations can be weakened by issues related to language translation in instrument testing studies (Gucciardi et al., 2016).

From a study conducted by Sheard et al. (2009) and Miçooğulları (2017), it appears that the psychometric properties of the SMTQ are very good. However, the results of testing in other contexts and cultures, for example, Indonesia, have never been carried out. That is why, we believe that broader testing is needed regarding the validity and reliability of the SMTQ. With this basis, this research was conducted to adapt and test the SMTQ in the Indonesian context and analyze measurement invariance based on athletes vs. non-athletes.

Moreover, previous studies have found that mental training components are influenced by athlete characteristics such as gender and competitive level (Mostajeran et al., 2022).. These factors should be considered in the adaptation process, as they can affect the psychometric performance of the instrument in different subpopulations. This also strengthens the need to examine measurement invariance across relevant athlete groups, such as gender or competition level, to ensure fairness and validity in measurement.

MATERIAL & METHODS

Research Design

This study uses an instrumental study design (Montero & León, 2007; Birr et al., 2023; Pereira et al., 2025). According to Ato et al.,(2013), this design includes all research that analyzes the psychometric properties of psychological instruments. On that basis, this design is considered suitable and representative of the purpose of this study, which is to test an instrument.

Participants

The research invoved 856 participants recruited using the convenience sampling technique. Participants were recruited using convenience sampling techniques by contacting them directly and via social media (WhatsApp). The data used in the analysis were from 724 participants. This was obtained after screening participants who were indicated to be giving a careless response (Respondents' ages range from 14 to 63 years, M_{age} = 21.56 years, SD = 7.63; Male = 488, Female = 236). Details of participant categories are as follows: athlete group of 385 people (M_{age} = 20.79 years, SD = 5.05; Male = 265, Female = 120), non-athlete group of 339 people (M_{age} = 22.42 years, SD = 9.70; Male = 223, Female = 116). Athletes who participated in this study were active in sports such as: aerosports (n=5), aquatics (n=14), weightlifting (n=10), Judo (n=13), athletics (n=36), basketball (n=16), handball (n=12), volleyball (n=28), badminton (n=14), rowing (n=10), futsal (n=34), hockey (n=10), muaythai (n=6), archery (n=5), pencak silat (n=46), petanque (n=8), rugby (n=10), gymnastics (n=15), sepak takraw (n=10), football (n=53), taekwondo (n=10), tennis (n=10), table tennis (n=5), and boxing (n=5). The non-athlete participants were active in sports but did not do sports permanently, and sports tended to be used as a medium to maintain fitness or health, and not to seek achievement. Using G*Power version 3.1.9.7 at an alpha level of 0.05 and statistical power of 0.80 (80%), the minimum sample size required was 193 participants. Thus, the number of participants involved in this study is greater than the recommended minimum sample size.

Instruments

The instrument that was adapted and validated was the Sports Mental Toughness Questionnaire (SMTQ) developed by Sheard et al. (2009). SMTQ has three subscales, namely confidence (e.g., I have unshakeable confidence in my abilities), constancy (e.g., I take responsibility for setting myself challenging targets), and control (e.g., I get anxious by events I do not expect or cannot control). The three sub-scales are translated into fourteen items with alternative answers in the form of a four-point Likert scale ranging from not at all true to very true (1 to 4). The CFA test results show that the model fits well, namely the values obtained are GFI = .95, AGFI = .93, RMSEA =

.05, and RMR = .05, TLI = .91, CFI = .92, IFI = .93 (Sheard et al., 2009). The original SMTQ factor loading values range from 0.61 and 0.76 and are quite high in internal consistency (ρ = .72 to .79) (Sheard et al., 2009).

To test convergent validity, the Mental Toughness Index (MTI) developed by Gucciardi et al., (2014) with eight items (e.g., I can regulate my *focus* when performing tasks) was used in this research. Alternative MTI answers are in the form of a continuum ranging from 1 (False, 100% of the time) to 7 (True, 100% of the time). MTI's loading factor value ranges from 0.563 to 0.759, with good reliability (CR = .864; α = .862) and has been used in the Indonesian context (Putra et al., 2024a; Putra, Sutoro, et al., 2024b).

Procedure

This research procedure was approved by the Health Research Ethics Committee of our institution, Cenderawasih University, Number 065/KEPK-FKM UC. All respondents were asked to provide informed consent before participating in this study. Thus, the data we received and analyzed are data that have been approved by the respondent. We began this research by applying for permission from the SMTQ instrument developer. We handed over the original SMTQ to two English language experts to translate into Indonesian after we received permission to carry out language adaptation and testing in the Indonesian context. Later, the results of this synthesis stage were submitted to four sports psychology experts, all of whom had doctoral-level education. For example, in SMTQ item number 1, the first English expert translated it as "I interpret threats as positive opportunities." While the second expert translated it as: "I (see) understand threats as positive opportunities." From these results, synthesis and agreement were carried out so that it became "I interpret threats as positive opportunities." The results of this synthesis stage were then submitted to four sports psychology experts, all of whom had doctoral-level education. The four experts were asked to assess the suitability of the substance of each item in the Indonesian version of the SMTQ with the original version. For example, in item number 1, the first expert suggested translating it as: "I view threats as positive opportunities." The second and fourth experts translated it as: "I interpret threats as positive opportunities." While the third expert said, "I view threats as positive opportunities." From these results, it was then synthesized and became "I view threats as positive opportunities." The results of the synthesis of the four experts were submitted to an Indonesian language expert to check the readability level of the Indonesian version of the SMTQ. After that, we tested the readability level on three athletes at the junior high school level, three athletes at the high school level, and three sports students. We then submitted the final results of the Indonesian version of the SMTQ instrument (SMTQid) to a different English language expert from the initial stage to be translated back into the original language. After we got the SMTQid and SMTQ back translation, we then sent the two instruments to the SMTQ developer to be checked and get input regarding the results of the language adaptation that we had done. After receiving input and being declared "OK" by the original developer, we collected data from the Indonesian community.

Statistical analysis

Initial data screening was carried out to see if there was a careless response. Analysis was carried out by looking at long strings (i.e., the consecutive string of identical responses given by a participant regardless of item wording, either positive or negative), as well as Mahalanobis D to detect multivariate outliers. Mahalanobis D was calculated with a confidence level of 95%. Careless response analysis was carried out with the R package (Yantes & Wilhelm, 2023; R Core Team, 2016). The next analysis was carried out to check the data distribution, namely whether the data obtained were normally distributed or vice versa. The normality test refers to the Skewness and Kurtosis values. For multivariate outliers, we used Mahalanobis D. We also performed item-total correlation (rix) analysis to provide a more comprehensive picture.

The next analysis was Confirmatory Factor Analysis (CFA) to test whether the model fit the data. We used weighted least squares means and adjusted variance (WLSMV) estimation in our analyses as the literature suggested that this estimator is more appropriate for ordinal data (Beauducel & Herzberg, 2006). Three models were proposed and compared. Model 1 was a single-factor model, Model 2 was a three-factor model, and Model 3 was a higher-order model (see Figure 1). The analysis was carried out with the R package (Rosseel, 2012; R Core Team, 2016). To assess the accuracy of the model tested (SMTQid), we used parameters such as chi-square ($\chi 2$), the comparative fit index (CFI), the Tucker-Lewis index (TLI), standardized root mean square residual (SRMR),

and root mean squared error of approximation (RMSEA). The following are the cut-off values used to assess model fit: CFI and TLI scores > .90 (Browne & Cudeck, 1992), SRMR scores ≤ .07 (Bagozzi, 2010), and RMSEA scores ≤ .08 (Browne & Cudeck, 1992). After the model was fit, the analysis continued to see the factor loadings of each item in the SMTQ. The factor loading criteria refer to the recommendations given by Comrey & Lee (1992) (i.e., > .71 = excellent; > .63 = very good; > .55 = good; > .45 = fair; < .32 = poor). Next, a reliability analysis was carried out to assess the internal consistency of SMTQid and used Composite Reliability (CR) and Cronbach Alpha. The accepted reliability value is > .70 (Nunnally & Bernstein, 1994; Taber, 2018).

A multigroup CFA was conducted to explore four distinct types of measurement invariance across status (athlete or non-athlete): configural, metric, scalar, and strict. In the configural invariance (M1), each group was allowed unrestricted estimation of all parameters. For the metric invariance (M2), the item factor loadings were equally constrained across groups. Scalar invariance (M3) involved constraining factor loadings and intercepts for all groups. In the strict invariance phase (M4), equality across groups was enforced for factor loadings, intercepts, and residual variances. Measurement invariance is considered not met if: ΔCFI ≥ -.01, ΔRMSEA ≥ .015, and ΔSRMR ≥ .010 (Chen, 2007).

Finally, convergent validity was examined by analyzing the correlation among three subscales of the SMTQ and the MTI using Pearson's correlation coefficient. It was hypothesized that all scales would show a positive correlation with the MTI, given that they all served as indicators of mental toughness.

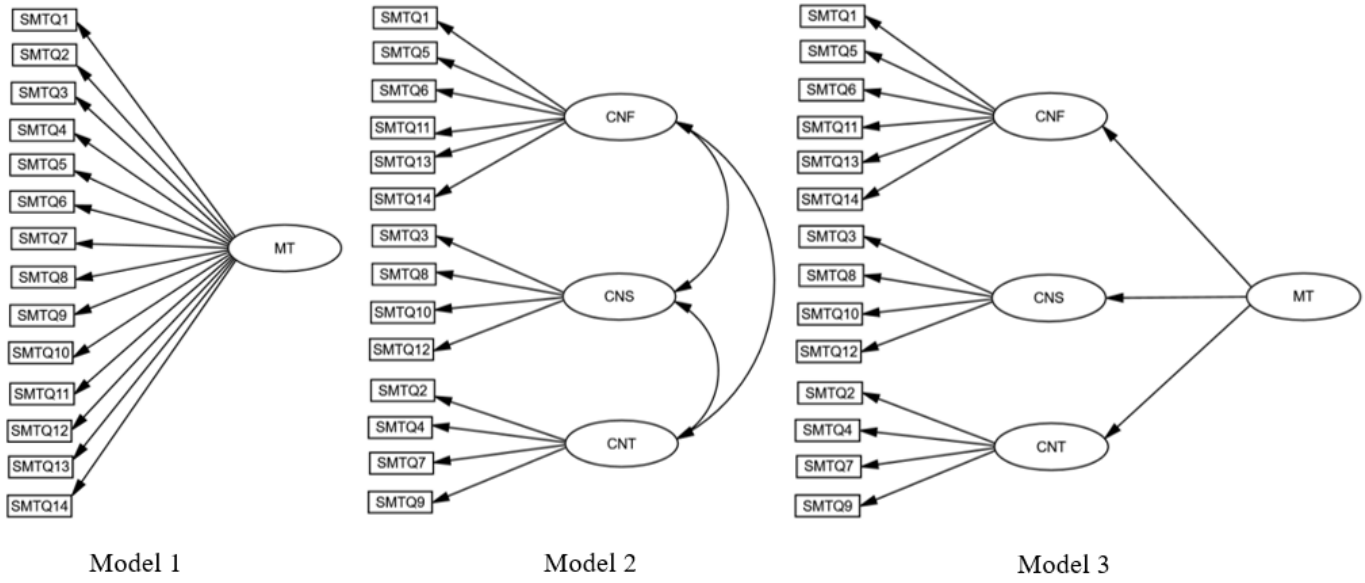

Figure 1. Three CFA Models for the SMTQ. MT = Mental toughness, CNF = Confidence, CNS = Constancy, CNT = Control

RESULTS

Descriptive statistics

Table 1 shows each SMTQ subscale's mean, SD, skewness, kurtosis, item-total correlation, Cronbach's Alpha if items are deleted, and Cronbach's Alpha. Item-total correlations range from .32 to .80, and all items have higher item-total correlations than the traditional cut-off of .30 (Field, 2013). The range of skewness and kurtosis indicates that the scores are normally distributed. Analysis of multivariate outlier data using Mahalanobis D at the 0.001 level (df=14) found a Chi-Square value of 36.123. Based on this value, no data indicates an outlier.

Table 1. Descriptive statistics of the SMTQ

Item	M	SD	Skewness	Kurtosis	*r*ix	α-x	α
Confidence	3.17	0.48	-0.24	-0.14			0.73
SMTQ1	2.78	0.92	-0.35	-0.49	0.32	0.77	
SMTQ5	3.65	0.54	-1.24	0.85	0.49	0.71	
SMTQ6	2.87	0.8	-0.45	-0.12	0.55	0.7	
SMTQ11	3.26	0.7	-0.62	0.07	0.75	0.65	
SMTQ13	3.27	0.67	-0.48	-0.28	0.72	0.66	
SMTQ14	3.2	0.7	-0.46	-0.3	0.6	0.69	
Constancy	3.3	0.53	-0.34	-0.89			0.60
SMTQ3	3.55	0.55	-0.73	-0.55	0.49	0.59	
SMTQ8	3.48	0.61	-0.82	0.04	0.46	0.61	
SMTQ10	3.28	0.94	-1.11	0.12	0.59	0.43	
SMTQ12	2.89	0.93	-0.38	-0.82	0.61	0.41	
Control	2.64	0.78	-0.07	-0.72			0.83
SMTQ2	2.57	1	-0.03	-1.09	0.74	0.78	
SMTQ4	2.89	0.92	-0.33	-0.85	0.78	0.76	
SMTQ7	2.61	0.93	-0.06	-0.88	0.8	0.75	
SMTQ9	2.48	0.97	0.06	-0.97	0.58	0.84	

Note: Mean (M), Standard Deviation (SD), item-total correlation (*r*ix), Cronbach's alpha (α), and Cronbach's alpha if item deleted (α-x).

Confirmatory Factor Analysis

Table 2 depicts the model fit indices of three models: single-factor model (1), three-factor model (2), and higher-order model (3). The three existing models do not meet the model fit based on the CFI, TLI, RMSEA, and SRMR values. Modifications to the model were then carried out by deleting items that had very low factor loadings. Three items identified as having factor loadings of less than .30 (SMTQ1, SMTQ7, and SMTQ8) were then deleted for further analysis. This follows the value recommendations given by Comrey & Lee (1992). In the revised model, the model with three factors (2R model) has the best model fit. This model is also the only model that meets the CFI, TLI, RMSEA, and SRMR criteria.

Table 2. Measurement models of SMTQ

Model	df	χ^2	CFI	TLI	RMSEA [90% CI]	SRMR
Single-factor (1)	77	2020.54	.627	.559	.161 [.154 - .168]	.177
Three-factor (2)	74	1124.95	.798	.752	.137 [.130 - .144]	.131
Higher-order factor (3)	75	1551.03	.717	.661	.134 [.127 - .141]	.154
Single-factor revised (1R)	44	994.16	.756	.695	.183 [.174 - .193]	.160
Three-factor revised (2R)	**41**	**107.30**	**.983**	**.977**	**.054 [.045 - .063]**	**.049**
Higher-order factor revised (3R)	42	2020.54	.814	.763	.128 [.118 - .137]	.136

Note: Note. CFI = comparative fit index; RMSEA = root-mean-square error of approximation; CI = confidence interval; SRMR = standardized root-mean-square residual.

Measurement invariance across status (athlete vs non-athlete)

Based on the 2R model, measurement invariance testing was conducted by status through multigroup CFA. Table 3 summarizes the model fit for each stage of measurement invariance testing. Measurement invariance is considered not met if: ΔCFI ≥ -.01, ΔRMSEA ≥ .015, ΔSRMR ≥ .010 (Chen, 2007). Table 3 shows that the model fit indices (e.g., χ2, CFI, RMSEA, SRMR) for each model are relatively stable compared with other model fit indices. Considering all these results, the three models (M2 to M4) do not show a significant decrease in model fit, so it can be concluded that the three-factor structure achieved strict invariance between athletes and non-athletes. The same thing was found from the invariance analysis based on gender (male vs. female). This implies that the measure

allows for accurate and meaningful comparisons of the construct across different groups, ensuring that any observed differences are due to true variations in the construct rather than measurement biases.

Table 1. Measurement invariance of SMTQ Indonesia across status (athlete vs non-athlete)

Model	Model fit					Model comparison			
	χ2 (df)	RMSEA	CFI	TLI	SRMR	ΔRMSEA	ΔCFI	ΔTLI	ΔSRMR
Status (athlete vs. non-athlete)									
Configural (M1)	171.53 (82)	.055	.969	.959	.048				
Metric (M2)	174.32 (90)	.051	.971	.965	.049	-.004	.002	.006	.001
Scalar (M3)	189.53 (98)	.051	.969	.965	.051	.000	-.002	.000	.002
Strict (M4)	210.68 (109)	.051	.965	.965	.054	.000	-.003	.000	.003
Gender (male vs. female)									
Configural (M1)	133.31 (82)	.042	.987	.982	.053				
Metric (M2)	144.09 (90)	.041	.986	.983	.055	-.001	-.001	.001	.002
Scalar (M3)	147.14 (98)	.037	.987	.986	.052	-.004	.001	.003	-.003
Strict (M4)	158.79 (109)	.036	.987	.987	.055	-.001	.000	.001	.003

Validity of the SMTQ

Three subscales of SMTQ were correlated with MTI, which measures mental toughness. Convergent validity is achieved when all subscales positively correlate with MTI. The result indicated that all subscales positively correlated with MTI (see Table 4). The correlation coefficient between the sum score of SMTQ and MTI was r = .38, p < .001. As SMTQ was moderately correlated with MTI, therefore convergent validity of SMTQ was achieved. Apart from that, the reliability coefficient for each subscale also shows good results with a CR value range of .82, .79, and .81 for the confidence, constancy, and control scales.

Table 4. Analysis of measurement accuracy

Factor	Indicator	λ	CR	Factor		
				Confidence	Constancy	Control
Confidence	SMTQ5	0.57	.82			
	SMTQ6	0.51				
	SMTQ11	0.76				
	SMTQ13	0.76				
	SMTQ14	0.59				
Constancy	SMTQ3	0.57	.79	.07		
	SMTQ10	0.75				
	SMTQ12	0.86				
Control	SMTQ2	0.77	.81	.18	.82	
	SMTQ4	0.85				
	SMTQ9	0.78				
SMTQ total				.37**	.73**	.86**
MTI total				.33**	.13**	.19**

Note: ** p < .01, CR = composite reliability

DISCUSSION

This study aims to adapt and test the SMTQ in the Indonesian context and analyze measurement invariance based on athletes vs. non-athletes. The adaptation of the Sports Mental Training Questionnaire (SMTQ) to the Indonesian context is crucial for accurately assessing mental toughness in Indonesian athletes. Mental toughness plays a

significant role in sports performance (Crust & Clough, 2005) and culturally adapted tools can provide more accurate assessments for athletes in different cultural contexts (Mostajeran et al., 2022). The adaptation process involves translating and validating the scale in the sports context (Mostajeran et al., 2022) and it is essential to consider the cultural and contextual factors that may affect mental toughness (Rintaugu et al., 2022). This is supported by the need to adapt measurement tools to the Indonesian language (Rukmini et al., 2022) and the importance of considering cultural and contextual factors in the manifestation, assessment, and treatment of mental health disorders (Perry et al., 2019).

The process of adaptation should involve input from relevant stakeholders, including athletes, coaches, and sports psychologists, to ensure that the adapted tool aligns with the Indonesian socio-cultural context (Turana et al., 2023). Additionally, the adaptation process may benefit from utilizing techniques such as back-translation to ensure linguistic and conceptual equivalence (Borualogo & Jefferies, 2019). Furthermore, the impact of stimulus and response types should be considered when adapting assessments cross-linguistically and cross-culturally (Hein et al., 2019). The relationship among cultural intelligence, psychological resilience, and cross-cultural adaptation emphasizes the importance of considering cultural factors in the adaptation process (Chu Kequn, 2023). Moreover, the adaptation process should take into account the specific contextual factors that affect training environments and outcomes for athletes (Rintaugu et al., 2022). This aligns with the understanding that lay perceptions of mental toughness emphasize determination and resilience as central aspects (Sorensen et al., 2016). In conclusion, the adaptation of the SMTQ to the Indonesian context is essential for accurately assessing mental toughness in Indonesian athletes. The process should involve rigorous translation and validation procedures, considering linguistic and conceptual equivalence, and accounting for cultural and contextual factors that affect mental toughness in sports.

The results of the CFA analysis showed that the three models tested ─ the single-factor model, three-factor model, and higher-order model ─ did not meet the model fit based on the CFI, TLI, RMSEA, and SRMR values, so the model was revised by removing items that had low loading factors. The results of the revised model showed that the revised three-factor model was the only model that fit the data (CFI = .983, TLI = .977, RMSEA = .054, SRMR = .049). The revised three-factor model was then tested for invariance based on status (athlete vs. non-athlete) and found that there was no significant decrease in model fit and the SMTQid invariance achieved strict invariance. The validity of SMTQid shows very good factor loading values and falls within the good to excellent criteria (λ = .57 to .86). These results are supported by convergent validity which shows that there is a significant positive correlation with MTI (r = .38, $p < .001$). The results of the reliability test showed CR values = .82, .79, and .81 and α values = .73, .60, .83 for each of the confidence, constancy, and control scales in the SMTQ.

The Persian version of the SMTQ demonstrates that mental training components are affected by athlete characteristics, such as competitive level or gender (Mostajeran et al., 2022). This suggests that the psychometric properties of the SMTQ may be affected by athlete-specific factors, highlighting the need to consider such variables in the adaptation process. Similarly, the Belief about Medicines Questionnaire (BMQ) in the Maltese language exhibited a four-factor structure comparable to previous studies in different languages, indicating the importance of cross-cultural validation for ensuring the instrument's reliability and validity (Gatt et al., 2017). This aligns with the need to assess the cross-cultural applicability of the SMTQ to ensure its psychometric properties hold across diverse cultural contexts. Furthermore, the evaluation of the psychometric properties of the German Hospital Survey on Patient Safety Culture highlights limitations concerning cross-national studies, emphasizing the importance of considering cultural differences in the validation of measurement tools (Gambashidze et al., 2017). This underscores the significance of adapting the SMTQ to the Indonesian context to account for cultural nuances that may impact its psychometric properties.

Additionally, the cross-cultural validation of the Implicit Positive and Negative Affect Test (IPANAT) demonstrates good reliability, metric invariance, and construct validity across countries and languages (Quirin et al., 2018). This emphasizes the necessity of establishing the cross-cultural validity of psychological assessment tools, including the SMTQ, to ensure their applicability and generalizability across diverse cultural settings. In summary, comparing the results of the adaptation of the SMTQ with findings from studies validating similar

instruments in different languages or cultural settings underscores the importance of considering athlete-specific factors, cross-cultural validation, and cultural nuances in ensuring the reliability and validity of the SMTQ. These comparisons highlight the need for rigorous validation processes to establish the psychometric properties of the SMTQ in the Indonesian context and their implications for the field of sports psychology.

For sports psychologists, the adapted SMTQ offers a standardized tool to assess athletes' mental toughness, enabling the identification of psychological strengths and areas for development. The questionnaire's psychometric properties and cultural adaptation are crucial for ensuring its validity and reliability in the Indonesian context, providing sports psychologists with a robust assessment tool for mental toughness. Furthermore, the SMTQ can be integrated into ongoing athlete development programs, fostering a culture of mental resilience and well-being within the Indonesian sports community.

Moreover, the questionnaire's adaptation to the Indonesian context opens avenues for cross-cultural research on mental toughness and psychological skills training, contributing to the global body of knowledge in sports psychology. By providing a standardized and culturally adapted tool for assessing mental toughness, the SMTQ has the potential to positively impact athlete development, coaching practices, and research endeavors in Indonesia's sports landscape. The findings from the adaptation of the Sports Mental Training Questionnaire (SMTQ) in the Indonesian context have significant implications for coaches, sports psychologists, and athletes in Indonesia. Coaches can utilize the adapted SMTQ to gain insights into athletes' mental toughness levels, enabling them to tailor mental toughness training programs to address specific psychological skill areas. The Ottawa Mental Skills Assessment Tool (OMSAT-3*) study demonstrates the discriminative ability of mental skills assessment tools between competitive and elite-level athletes (Bush Durand et al., 2001). This suggests that the adapted SMTQ can aid coaches in identifying and addressing mental toughness disparities across different levels of athletic competition, thereby enhancing the effectiveness of mental toughness training programs.

Sports psychologists can leverage the adapted SMTQ to assess athletes' mental toughness and design targeted interventions to enhance psychological skills. The cross-cultural validation of the Implicit Positive and Negative Affect Test (IPANAT) emphasizes the importance of validating psychological assessment tools across different cultural contexts (Quirin et al., 2018). Similarly, the adapted SMTQ's validation in the Indonesian context ensures its applicability in assessing mental toughness in diverse cultural settings, providing sports psychologists with a reliable tool for guiding mental toughness interventions and research.

For athletes in Indonesia, the adapted SMTQ offers a structured approach to evaluating and improving their mental toughness. The Persian version of the SMTQ study highlighted the relationship between mental training components and athletes' competitive levels (Mostajeran et al., 2022) indicating that the adapted SMTQ can assist athletes in understanding their mental training needs based on their competitive levels. This empowers athletes to actively engage in their mental skills development and collaborate with coaches and sports psychologists to enhance their mental toughness, thereby positively impacting their athletic performance and well-being.

The potential for the adapted SMTQ to be used in ongoing athlete development and research is substantial. The evaluation of the psychometric properties of the German Hospital Survey on Patient Safety Culture emphasizes the importance of assessing the reliability and validity of measurement tools for cross-cultural comparisons (Gambashidze et al., 2017). Similarly, the adapted SMTQ's validation in the Indonesian context provides a foundation for longitudinal tracking of athletes' mental toughness, evaluating the effectiveness of mental toughness training programs, and contributing to evidence-based practices in sports psychology research. In conclusion, the findings from the adaptation of the SMTQ in the Indonesian context have far-reaching implications for coaches, sports psychologists, and athletes in Indonesia. The adapted SMTQ can enhance mental toughness training programs, empower athletes, and contribute to the advancement of sports psychology research in Indonesia.

Certainly, here is a reflection on potential limitations within the study titled “Adaptation, validation, and reliability of the Indonesian version of the Sports Mental Toughness Questionnaire (SMTQ)‘‘: One of the potential limitations of the study could be related to the sample size. If the study had a relatively small sample of athletes, it might limit the generalizability of the findings. A larger and more diverse sample could provide a broader

representation of the Indonesian athlete population. While efforts were made to ensure the cultural relevance of the adapted SMTQ, the findings might not be entirely generalizable to all Indonesian athletes.

Different sports, regions, and athlete demographics could exhibit variations in mental toughness that are not fully captured in the study. Cultural nuances, colloquialisms, or subtle linguistic variations might not have been eliminated, potentially affecting the responses and validity of the adapted SMTQ. The study may not have fully addressed the complexity of cultural factors influencing mental toughness. The study may have focused primarily on the adaptation and validation of the questionnaire, leaving other aspects of mental toughness unexplored. Recognizing these potential limitations is important for a comprehensive understanding of the study's findings and their applicability in practice.

This could include suggestions for integrating the questionnaire into routine assessments or using it to track mental toughness development over time. Coaches and sports psychologists should administer the questionnaire at the beginning of training seasons to establish a baseline of mental toughness, which can be used to track progress and identify areas in need of development. If certain aspects of mental toughness are lacking, as identified by the questionnaire, specific psychological skills training can be implemented. For team sports, the SMTQ is used to gauge the collective mental toughness of a team. The SMTQ is used in long-term developmental studies to track the growth of mental toughness from youth to elite levels.

Other suggestions include (1) proposing areas for future research, such as longitudinal studies to track changes in mental toughness over time, or comparative studies with athletes from different cultural backgrounds using the adapted questionnaire; (2) conducting longitudinal research to track the development of mental toughness over time among Indonesian athletes; (3) Although the Indonesian SMTQ provides a standardized tool for assessing mental toughness within Indonesia, its use in cross-cultural comparisons requires caution. The content and cultural nuance embedded in the Indonesian version may differ from versions in other languages. Therefore, any comparison between Indonesian athletes and athletes from other cultural contexts must be preceded by thorough testing of cross-cultural measurement invariance and conceptual equivalence. Without rigorous steps, comparisons may lead to misleading interpretations due to linguistic or cultural biases.

CONCLUSIONS

The study set out to adapt the Sports Mental Toughness Questionnaire (SMTQ) for use in the Indonesian context, ensuring that the tool is culturally relevant and linguistically appropriate. The successful adaptation involved a careful translation process and expert consultations to maintain the original instrument's integrity. Validation of the Indonesian SMTQ demonstrated that the instrument retains its validity, accurately reflecting the construct of mental toughness as it is understood in both Western and Indonesian sports contexts. The reliability assessments indicate that the Indonesian SMTQ provides consistent and stable results, making it a reliable tool for assessing mental toughness among Indonesian athletes and non-athletes. However, the study acknowledges the need for ongoing evaluation and potential refinement of the SMTQ to ensure its applicability across different sports, levels of competition, and diverse athlete populations within Indonesia. Future research should aim to further establish the SMTQ's utility across these varying contexts and extend its use in longitudinal studies to track the development of mental toughness over time.

PRATICAL APPLICATIONS

The Indonesian version of the SMTQ can be confidently used by sports psychologists, coaches, and researchers to measure and develop mental toughness in Indonesian athletes. The questionnaire stands as a robust tool for the assessment of mental toughness, with promising implications for the enhancement of athletic performance and psychological resilience among Indonesian athletes.

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CONFLICT OF INTEREST

The authors has no conflicts of interest to report.

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