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Indonesian Version of the Short Mental Toughness Questionnaire (MTQ): Factor Structure and Measurement Invariance

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ABSTRACT

This study aims to evaluate the factor structure of the short version of the Mental Toughness Questionnaire (S-MTQ) in the Indonesian context and test measurement invariance based on gender (male vs. female) and status (athlete vs. non-athlete). A total of 710 people (M_{age} = 22.07 years; SD = 7.99) consisting of 490 (69.01%) males and 220 (30.99%) females; 476 (67.04%) athletes and 234 (32.96%) non-athletes were involved in the study. Confirmatory factor analysis (CFA) was used to evaluate the factor structure of the short MTQ. The results showed that the unidimensional models tested, MTQ-18 and MTQ-10, were unfit. Therefore, a revision was carried out by removing items that had low loading factor values. The results of the revised Indonesian version (MTQid-6) found CFI = .983, TLI = .969, RMSEA = .052, and SRMR = .024, which indicated that the MTQid-6 unidimensional model was very satisfactory. MTQid-6 has a loading factor category ranging from good to very good (λ = .50 to .74). This validity is strengthened by convergent validity results, which show that MTQid-6 has a significant correlation with MTI, PPI-A, and APSQ ($p < .001$). The reliability analysis results show high internal consistency values, namely α = .762, ω = .763. Invariance testing found invariance at the configural, metric, and scalar levels (ΔCFI ≤ -.01, ΔRMSEA ≤ .015). With these results, MTQid-6 can be used to measure MT, both in athletes and non-athletes, in both males and females in the Indonesian population.

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INTRODUCTION

Instruments used in scientific research are a crucial aspect (Kerlinger, 2006). When they are used to collect data whose validity and reliability are questionable, the data produced by the measuring instrument very likely have a high error content (Azwar, 2013). Concerning the assessment of the mental aspects of athletes, the problem in Indonesia is the instruments used for it (Putra et al., 2023). It was discovered that the development process was not explained in detail when the instrument was developed. Similarly, in applying external instruments, the adaptation of the language and testing process was not performed in an internationally recognized way (ITC, 2017; Hambleton & de Jong, 2003; Ohrbach et al., 2013). In other words, instruments that reveal aspects of mental toughness written in Indonesian are still very limited and separate the issues. To overcome this, it is urgent to adapt the language to the standardized or commonly used one so that the study of mental toughness in Indonesia becomes better and people can use instruments that are already in Indonesian without testing them first.

Mental toughness (MT) is understood in various ways (Stamatis et al., 2021). Up to now, it has been defined as a collection of values, attitudes, emotions, and cognitions attached to a person and affect him or her when responding to and assessing pressure, challenges, and difficulties he or she faces to achieve his or her goals (Gucciardi et al., 2008). Later, Gucciardi (2017) modernized the definition, and he wrote that mental toughness is "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. There are many qualities usually associated with it, including unwavering self-confidence, the ability to bounce back after defeat/failure (resilience), the ability to never give up, the ability to deal with difficulties and pressure effectively, and the ability to maintain concentration despite many experiences and potential disruption (Liew et al., 2019). Other experts also expressed the same thing. Clough and Strycharczyk (2012) write that MT is the quality that largely establishes how people deal effectively with challenges, stressors, and pressure irrespective of prevailing circumstances.

In MT research, the MTQ-48 (Clough et al., 2002) has become a very popular instrument and is widely used by researchers in the field (Gucciardi et al., 2012). Clough and colleagues developed MTQ-48 based on the Hardiness theory created by Kobasa (1979). Hardiness theory explains the personality characteristics of a person who is strong, stable, and

resistant to stress, which is characterized by three dominant dimensions: control, commitment, and challenge. Based on this theoretical basis, MTQ-48 was developed with four dimensions which are widely known as 4Cs, namely those consisting of commitment, challenge, control, and confidence (Clough et al., 2002). During its development, the psychometric properties of the MTQ-48 were widely criticized and debated (see debates in Gucciardi et al., 2012; Clough et al., 2012; Gucciardi et al., 2013). On the other hand, by researchers, the MTQ-48 is still often used to measure mental aspects in sports contexts (Crust & Azadi, 2010; Vaughan et al., 2018). That is why, Dagnall et al. (2019) and Papageorgiou et al. (2018) then retested the instrument more rigorously and produced more concise versions, namely the MTQ-10 and MTQ-18. Both the MTQ-48 and the short version of the MTQ included populations in Europe.

Apart from MTQ, several instruments have been recorded as having been created by experts. For example, instruments created by experts to measure MT in a sports context include the Mental Toughness Index (MTI; Gucciardi et al., 2014), Mental Toughness Questionnaire (MTQ; Cherry, 2005), Sport Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009), and the Psychological Performance Inventory-Alternative (PPI-A; Golby et al., 2007). However, some instruments are specific to sports, such as cricket (Gucciardi & Gordon, 2009), volleyball (Tiwari & Sharma, 2007), and football (Gucciardi et al., 2009). Even though there are several similar instruments, MTQ is an instrument that scholars often use to reveal MT dimensions (Birch et al., 2019; Clough et al., 2002; Gucciardi et al., 2012). On the other hand, several studies show serious issues regarding the psychometric properties of the MTQ, and further testing is needed (Gucciardi et al., 2012; Vaughan et al., 2018).

To date, only limited testing of the short version of the MTQ outside its original language and culture has been carried out in Russian (Denovan et al., 2021) and found that it is psychometrically acceptable, but issues related to the factor structure still need to be addressed in future research. Facts in the field also show that MTQ is often directed at measuring the MT of athletes and non-athletes or male and female subjects. Psychometrically, if the two groups are compared (athletes vs non-athletes; male vs female), it is very important to measure invariance first on the instrument used (Chen, 2007). That is why Dagnall et al. (2019) tested the factor structure of the short version of the MTQ and conducted an invariance analysis based on gender. Vaughan et al. (2018) tested the MTQ and, in their research, carried out the analysis of variance based on athlete and non-athlete status. Kawabata et al. (2021), in their rigorous study of the MTQ, also used invariance based on gender and found that both

the short version of the MTQ and the very short version of the MTQ (MTQ-6) were valid measuring tools in measuring MT.

With the various issues surrounding the MTQ and the results of the latest studies, as stated above, we see that further testing is needed regarding the psychometric structure in language and cultural contexts other than the original. Different cultures and languages have different conceptions of MT. MT expression may vary between languages (Pennebaker et al., 2003). With this in mind, assessing the psychometric properties of an instrument translated beyond its original language is important to ensure that it is valid and reliable in measuring a broader population. For this reason, this study aims to evaluate the factor structure of the short version of the MTQ (MTQ-18 and MTQ-10) in the Indonesian context. In addition, the study also aims to test measurement invariance based on gender (male vs. female) and status (athlete vs. non-athlete).

METHODS

Participants

Participants were recruited online and offline using the convenience sampling method. The researchers distributed the filling link to colleagues in several sports study programs and sports coaches to pass on to athletes or students. Through this method, 653 participants participated in this study. For the offline method, the researchers distributed the instrument to athletes from the Student Education and Training Center (PPLP) Papua, Indonesia. Through this method, 104 people participated. A total of 757 people participated in this study, but 47 data had to be excluded after data screening due to careless responses and outliers. Therefore, the number of data analyzed further in this study is 710. There were 490 male participants (69.01%) and 220 (30.99%) female participants. Of these respondents, 476 (67.04%) athletes and 234 (32.96%) non-athletes. The age range of participants was between 13 and 60 years, with a mean age value of 22.07 years and a standard deviation of 7.99.

Data Collection Procedure

This research procedure was approved by the Health Research Ethics Committee Cenderawasih University, Number 065/KEPK-FKM UC. All respondents were asked to provide informed consent before participating in this study. Thus, the data received and analyzed are data that the respondent has approved. The researchers began this research by applying for permission from the MTQ instrument developer. After receiving permission to

carry out language adaptation and testing in the Indonesian context, they handed over the original MTQ to two English language experts to translate into Indonesian. The results of this synthesis stage were then submitted to three sports psychology experts, all of whom have doctoral-level education. The three experts were asked to assess the suitability of the substance of each item in the Indonesian version of the MTQ with the original version. The results from the three experts were then synthesized and submitted to an Indonesian language expert to check the readability level of the Indonesian version of the MTQ. After that, the researchers tested the readability level on three athletes at the junior high school level, three athletes at the high school level, and three sports students. At this stage, respondents were asked to give a rating from number 1 (which means the sentence is very difficult to understand) to number 5 (which means the sentence is very easy to understand) on each item in the Indonesian version of the MTQ. Items that receive an average score of 1 and 2 are considered to have a low readability level so improvements need to be made conversely, if the average item value is high then the item is considered to have a good readability level. They then submitted the final results of the Indonesian version of the MTQ instrument (MTQid) to a different English language expert from the initial stage to be translated back into the original language. After receiving the MTQid and MTQ back translation, the researchers then sent the two instruments to the MTQ developer to review and get input regarding the results of the language adaptation that had been done. After receiving input and being declared "OK" by the original developer, the researchers collected data from the Indonesian community. Data collection was carried out directly by researchers, and colleagues were asked for their help in distributing links to instrument testing to athletes or students.

Data Collection Tools

Mental Toughness Questionnaire (MTQ)

The instruments tested and validated in this study were the MTQ-18 (e.g., Even when under considerable pressure I usually remain calm)(Dagnall et al., 2019) and the MTQ-10 (e.g., I generally feel in control)(Papageorgiou et al., 2018). MTQ was developed to reveal a person's mental toughness. MTQ-18 has a value of CFI = 0.900, SRMR = 0.055, and RMSEA = 0.059 while MTQ-10 has a value of CFI = 0.950, SRMR = 0.037, and RMSEA = 0.055 (Dagnall et al., 2019). Alternative answers in the MTQ are in the form of a five-point Likert scale, ranging from strongly disagree, disagree, neither agree nor disagree, agree to strongly agree (1-5)(Dagnall et al., 2019; Papageorgiou et al., 2018). In MTQ-18, there are 9 items whose scoring method is

reversed, namely item numbers 2, 3, 6, 8, 9, 11, 12, 16, and 17, while in MTQ-10, there are 4 items, namely numbers 2, 3, 6, and 7. Initially, MTQ was viewed as multidimensional with dimensions known as 4/6C (Clough et al., 2002). However, in subsequent tests, the MTQ was considered more appropriate as unidimensional (Dagnall et al., 2019; Papageorgiou et al., 2018). A high MTQ score indicates that a person's MT is also high and vice versa.

Mental Toughness Index (MTI)

The MTI was developed by Gucciardi et al., (2014) to measure athletes' mental toughness. It contains eight items (e.g., I can find a positive in most situations.) and has alternative answers in the form of a continuum ranging from 1 (False, 100% of the time) to 7 (True, 100% of the time). The MTI has been adapted into Indonesian and has very good loading factor values (λ = .563 to .759) and excellent internal consistency reliability (CR = .864; α = .862; Putra, Kurdi, et al., 2024). Apart from that, the Indonesian version of MTI (MTIid) also has very satisfactory fit values, namely CFI = .967, TLI = .954, GFI = .966, SRMR = .034, and RMSEA = .069 (Putra, Kurdi, et al., 2024).

Psychological Performance Inventory-Alternative (PPI-A)

The PPI-A, which was developed by Golby et al. (2007) and has been adapted into the Indonesian version, will be used (Putra, Sutoro, et al., 2024). PPI-A was developed to measure athletes' mental toughness. It consists of four sub-scales, namely determination (e.g., The goals I've set for myself as a player keep me working hard.), self-belief (e.g., I lost my confidence very quickly), positive cognition (e.g., I can clear interfering emotions quickly and regain my focus), and visualization (e.g., I visualize working through challenging situations before competition). The Indonesian version of the PPI-A consists of nine items with alternative answers in the form of a Likert scale, ranging from almost never, seldom, sometimes, often to almost always (1-5). In the Indonesian version, PPI-Aid has very good loading factor values (λ = .563 to .759) and internal consistency α = .74 to 77. Apart from that, PPIid also has a very satisfactory fit value, namely CFI = .961; GFI = .969; TLI = .938; SRMR = .038; RMSEA = .057 (Putra, Sutoro, et al., 2024).

Athlete Psychological Strain Questionnaire (APSQ)

The APSQ developed by (Rice et al., 2019) aims to look at a person's mental health, especially in the context of sports. The APSQ has three subscales, namely self-regulation difficulties (e.g., I was irritable, angry, or aggressive), performance concerns (e.g., I worried

about life after sport), and externalized coping (e.g., I needed alcohol or other substances to relax). The three sub-scales are translated into 10 statements with alternative answers in a Likert scale ranging from none of the time, a little of the time, some of the time, most of the time to all of the time (1 to 5). The APSQ has been adapted into Indonesian, and the Indonesian version of the APSQ (APSQid) has very good loading factor values (λ = .53 – .72) and internal consistency reliability including excellent (ω = .819; α = .822; Putra, Rahayuni, et al., 2025). Apart from that, APSQid also has very satisfactory fit values, namely CFI = 0.950, TLI = 0.929, GFI = 0.959, SRMR = 0.044, RMSEA = 0.062 (Putra, Rahayuni, et al., 2025).

Data Analysis

Initial analysis was carried out to see the presence of careless responses and test normality. The normality test refers to the Skewness, Kurtosis, and Shapiro-Wilk values. After that, confirmatory factor analysis (CFA) was calculated using the maximum likelihood (ML) estimator. To assess the accuracy of the model tested (Indonesian version of MTQ), 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) was used. 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 looking at the factor loadings of each item in the MTQid in various samples. 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). Reliability analysis was carried out to assess the internal consistency of the MTQid and the researchers used Cronbach's Alpha (α), McDonald's omega (ω), and item-total correlation (*r*ix). A multigroup CFA was conducted to explore four distinct types of measurement invariance across status (male vs. female; athlete vs. non-athlete; and age range of <18 vs. ≥18): 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 was considered not fulfilled if: ΔCFI ≥ -.01, ΔRMSEA ≥ .015 (Chen, 2007). Next, convergent validity was analyzed by correlating MTQid scores with MTI, PPI-A, and APSQ scores using Pearson's correlation

coefficient. It was hypothesized that the MTQid score would show a positive correlation with the MTI and PPI-A while the APSQ would have a negative correlation. The analysis in this research was carried out with the help of the JASP program version 0.18.1.0.

RESULTS

Initial and descriptive analysis

Initial analysis was conducted for data screening purposes, such as careless responding and data normality. Univariate normality analysis shows that the data are normally distributed (Table 1) but multivariate analysis shows a value of S-W = .945 ($p < .001$) which indicates that the assumption of multivariate normality is not met. Therefore, CFA analysis on the maximum likelihood (ML) estimator was carried out with bootstrapping (600 resamplings).

Table 1
Descriptive Result and Data Normality (n = 710)

	i1	i2	i3	i4	i5	i6	i7	i8	i9	i10	i11	i12	i13	i14	i15	i16	i17	i18	MTQ
M	2.96	3.88	3.90	3.28	2.78	4.02	4.09	3.62	2.46	2.46	2.60	4.40	3.25	2.74	2.95	3.09	4.25	3.40	63.48
SD	1.16	.936	.85	1.17	1.14	1.08	.93	.955	1.08	1.16	1.15	.81	1.06	1.14	1.11	1.11	.79	1.35	7.26
Sk	.19	-.60	-.43	-.19	.26	-.93	-.99	-.26	.52	.47	.44	-1.23	-.27	.291	.12	.01	-.81	-.39	-.08
Kr	-.79	.05	-.11	-.83	-.62	.17	.89	-.32	-.191	-.60	-.44	.90	-.30	-.63	-.62	-.58	.24	-.97	-.38
S-W	.91	.86	.86	.91	.91	.81	.82	.89	.89	.89	.90	.73	.904	.91	.91	.91	.80	.88	.99
Min	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	42.00
Max	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	5.00	83.00

Note: i = item number; M = Mean; SD = Standard deviation; Sk = Skewness; Kr = Kurtosis; S-W = Shapiro-Wilk; Min = Minimum; Max = Maximum

Confirmatory Factor Analysis

Confirmatory Factor Analysis (CFA) on two MTQ models (MTQ-18 and MTQ-10) showed that the model accuracy was not satisfactory (Table 2). The CFI, TLI, RMSEA, and SRMR values were far from being recommended. Apart from that, the results of the analysis also showed that nine items in the MTQ-18 and MTQ-10 had factor loadings below 0.32 (Table 3). On the other hand, items in MTQ-10 whose factor loading threshold is acceptable ($\lambda \geq 0.32$) are also part of MTQ-18. Therefore, the researchers collected items with a factor loading ≥ 0.32, with nine total items. The results of the CFA analysis on these nine items showed that the model did not fit (CFI = 0.779, TLI = 0.706, RMSEA = 0.120, and SRMR = 0.073). Therefore, the researchers carried out revisions by removing items with low factor loadings. After removing three items from the properties, the research results showed that the model was better and entered marginal fit. Considering that the model was still marginally fit, a covariance correlation was carried out based on the modification index (MI) value. The final results show

that the Indonesian version of the MTQ with six items has a value of CFI = .983, TLI = .969, RMSEA = .052, and SRMR = .024, which indicates a very satisfactory model fit (Table 2). The factor loading value is relatively high (Figure 1).

Table 2
Measurement Models of MTQ-18 and MTQ-10, and Revision of the Indonesian Version of Short MTQ

Model	df	χ^2	CFI	TLI	RMSEA [90%CI]	SRMR
MTQ-18						
Unidimensional (1)	135	1288.770	.510	.445	.110 [.104 - .115]	.105
MTQ-10						
Unidimensional (2)	35	331.452	.721	.642	.109 [.099 - .120]	.081
MTQ Indonesia (MTQid-6)						
Unidimensional (3)	8	23.363	.983	.969	.052 [.028 - .077]	.024

Note. df = degrees of freedom; $\chi 2$ = chi-square; CFI = comparative fit index; TLI = Tucker-Lewis index; RMSEA = root mean square error of approximation; CI = confidence interval; SRMR = standardized root mean residual

Table 3
Factor Loading MTQ-18 and MTQ-10

No. Item	MTQ-18			MTQ-10		
	Std. Error	p	λ	Std. Error	p	λ
i1	0.044	< .001	0.595	0.045	< .001	0.629
i2	0.040	< .001	0.344	0.040	< .001	0.357
i3	0.037	< .001	0.352	0.037	< .001	0.378
i4	0.045	< .001	0.560	0.047	< .001	0.540
i5	0.043	< .001	0.649	0.044	< .001	0.697
i6	0.047	< .001	0.202	0.047	< .001	0.166
i7	0.041	0.696	0.017			
i8	0.041	< .001	0.230	0.042	< .001	0.288
i9	0.045	< .001	0.307			
I10	0.046	< .001	0.479	0.047	< .001	0.493
i11	0.049	< .001	0.188			
i12	0.035	< .001	0.288			
i13	0.045	0.394	-0.036	0.046	0.655	0.019
i14	0.045	< .001	0.568			
i15	0.043	< .001	0.616	0.045	< .001	0.522
i16	0.046	< .001	0.310			
i17	0.034	< .001	0.365			
i18	0.057	0.001	-0.136			

Note. Std. = Standard; p = p-value; λ = loading factors

Invariance analysis

Multi-group CFA was performed to investigate measurement invariance based on gender differences (males vs. females) and status (athletes vs. non-athletes). Invariance testing uses four levels of measurement invariance: configural, metric, scalar, and strict. The results of measurement invariance based on gender show that there is measurement invariance at configural, metric, and scalar (ΔCFI ≤ -.01, ΔRMSEA ≤ .015). At the same time, at the strict level, the value obtained is greater than the threshold used so that it can be stated that at the strict level, there is no measurement invariance (Table 4). For invariance based on athlete vs. athlete status, non-athletes were found to have measurement invariance at the configural and metric levels, while for the scalar level, it was found to be ΔCFI = -.012 (ΔCFI ≥ -.01) and ΔRMSEA = 0.004 (ΔRMSEA ≤ .015). In other words, the invariance results are based on athlete vs. athlete groups; non-athlete occurs only at the configural and metric levels, while at the scalar and strict levels, the invariance is not fulfilled (Table 4). The same thing was found from the invariance analysis based on age (<18 vs. ≥18), namely that there was measurement invariance at the configural and metric levels, while for the scalar, it was found that ΔCFI = -0.018 (ΔCFI ≥ -.01) and ΔRMSEA = 0.010 (ΔRMSEA ≤ .015). In other words, invariance results based on age (<18 vs. ≥18) occur only at the configural and metric levels, while at the scalar and strict levels, the invariance is not fulfilled (Table 4).

Figure 1
MTQid-6 Unidimensional Model and Magnitude of Loading Factors

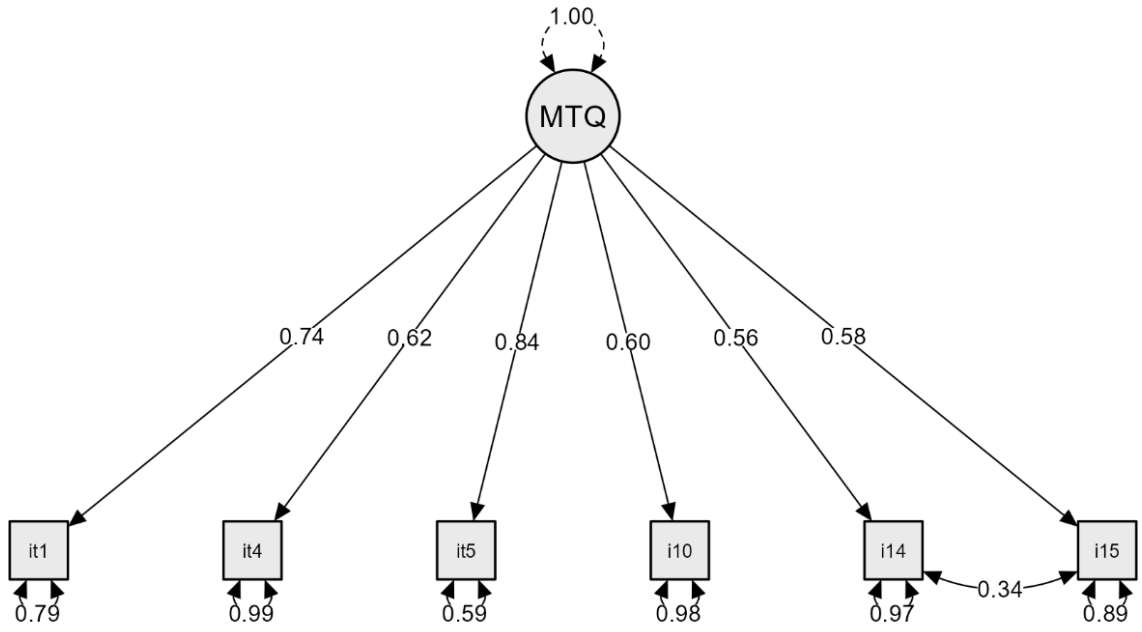

Table 4
Summary of Invariance Analysis by Gender, Athlete, and Age

Group and Invariance Level	Model fit		Model comparison	
	CFI	RMSEA	ΔCFI	ΔRMSEA
Gender (male vs. female)				
Configural (M1)	0.980	0.058	-	-
Metric (M2)	0.978	0.053	-0.002	-0.005
Scalar (M3)	0.968	0.057	-0.010	0.004
Strict (M4)	0.955	0.060	-0.013	0.003
Athlete (athlete vs. Non-athlete)				
Configural (M1)	0.963	0.078	-	-
Metric (M2)	0.963	0.068	0.000	-0.010
Scalar (M3)	0.951	0.070	-0.012	0.002
Strict (M4)	0.949	0.064	-0.002	-0.006
Age (<18 vs. ≥18)				
Configural (M1)	0.976	0.063	-	-
Metric (M2)	0.975	0.056	0.001	-0.007
Scalar (M3)	0.957	0.066	-0.018	0.010
Strict (M4)	0.957	0.059	0.000	-0.007

Validity and Reliability MTQid-6

Convergent validity analysis was carried out by correlating MTQid-6 scores with MTI, APSQ, and PPI-A, namely instruments that measure the construct of mental toughness. Convergent validity is achieved when a significant correlation exists between MTQid-6 with MTI, APSQ, and PPI-A. The results of the analysis indicate that there is a significant positive correlation between MTQid-6 and MTI (r = .234, p < .001; Table 4). The same thing was found with the APSQ: the value obtained was r = -.539, p < .001. MTQid-6 is statistically significant with all factors in the APSQ. The correlation between MTQid-6 and PPI-A shows a significant positive correlation (r = .224, p < .001). Only the visualization factor is not significant, while the other three factors in the PPI-A have significant correlation values (p < .001). These results indicate a correlation among the Indonesian version of the MTQ (MTQid-6) with the MTI, APSQ, and PPI-A. In other words, the convergent validity of MTQid-6 has been achieved. These results strengthen the findings in the CFA, which show that the loading factor value for each item in the Indonesian version of the MTQ ranges from .50 to .74, or in the fair to excellent category (Table 5).

The reliability test results using internal consistency with Cronbach's Alpha and McDonald's Omega, respectively, found scores of α = .762, and ω = .763 (Table 5). The item-total correlation coefficient value is also quite high. This indicates that MTQid-6 is reliable.

Table 5
Factor Loading, Internal Consistency, and Convergent Validity

Item	λ	*r*ix	α	ω	1	2	3	4	5	6	7	8	9	10	11
i1	.64	.684													
i4	.53	.639													
i5	.74	.738	.762	.763											
i10	.52	.620													
i14	.50	.678													
i15	.53	.694													
MTQid (1)					-										
MTI (2)					.234**	-									
SR (3)					-.466**	-.396**	-								
Per (4)					-.524**	-.266**	.632**	-							
EC (5)					-.287**	-.254**	.434**	.479**	-						
APSQ (6)					-.539**	-.375**	.880**	.890**	.668**	-					
Det (7)					.153**	.463**	-.231**	-.145	-.163**	-.218**	-				
SB (8)					.246**	.430**	-.331**	-.241	-.175**	-.314**	.485**	-			
PC (9)					.242**	.479**	-.290**	-.194	-.066	-.246**	.478**	.562**	-		
Vis (10)					.048	.435**	-.168**	-.055	-.076*	-.124**	.499**	.460**	.490**	-	
PPI-A (11)					.224**	.574**	-.325**	.203**	-.145**	-.286**	.760**	.786**	.836**	.767**	-

Note. i = item number; λ = loading factors; rix = item-total correlation; α = Cronbach's Alpha; ω = McDonald's omega; SR = self-regulation; Per = performance; EC = external coping; Det = determinant; SB = self-belief; PC = positive cognition; Vis = visualization; *p < .05; **p < .001

DISCUSSION

This study seeks to evaluate the factor structure of the short versions of the MTQ (MTQ-18 and MTQ-10) in the Indonesian context and test measurement invariance based on gender (male vs. female) and status (athlete vs. non-athlete). The results showed that the unidimensional model tested in MTQ-18 and MTQ-10 did not fit. Therefore, a revision was carried out by removing items that had low loading factor values. The results of the revised Indonesian version showed that the model was better than the previous one, although it was still in the marginal fit category. Therefore, modifications were carried out by carrying out covariance correlation, and the modification results for MTQid-6 found model robustness indices at CFI = .983, TLI = .969, RMSEA = .052, and SRMR = .024. These results indicate that the MTQid-6 unidimensional model is very satisfactory. The results found in this study are different from those found in previous studies (Dagnall et al., 2019; Papageorgiou et al., 2018), which showed that the MTQ-18 and MTQ-10 were suitable models. However, regarding whether MTQ is more appropriate as multidimensional or unidimensional, the results of this study are in line with previous studies which found MTQ to be a unidimensional model (Dagnall et al., 2019; Papageorgiou et al., 2018).

In terms of psychometric structure, the results of this study confirm previous studies which indicate that the 4/6Cs theoretical model that underlies the preparation of the MTQ is one of the issues in the psychometric properties of the MTQ and this is in line with what was found by Gucciardi et al., (2012) when testing the MTQ. In addition, research conducted by Birch et al. (2017) also strengthens previous findings, showing that the 4/6Cs model is less suitable for measuring MT in student-athletes. The research involved samples of athletes and students. Another similar study also revealed that the 4/6Cs theoretical model in elite athletes obtained poor fit data (Vaughan et al., 2018). With these facts, the findings in this study relatively find the same thing regarding the psychometric structure of the MTQ, namely that there are weaknesses in it so the model tends not to fit.

The reduction of the items in the MTQid to six items shows that only these six items have factor loading values in the Indonesian version. For items with a value of less than .32, the researchers removed them from the MTQid property. This follows the rule of thumb that it can still be acceptable (Comrey & Lee, 1992). A loading factor value above .32 indicates that the item is statistically significant in measuring the latent variable. This study identified nine items with a loading factor of less than .32 in the MTQid, namely item numbers 6, 7, 8, 9, 11, 12, 13, 16 and 18. Even though the nine items have been removed from the MTQid property,

the model is not yet fit, so three other items that have low loading factors, namely items number 2, 3, and 17, have been removed. even though it still fits marginally. It can be seen that the items are unfavorable and need to be reversed in scoring (Dagnall et al., 2019; Papageorgiou et al., 2018). None succeeded in having a high value, so all unfavorable items in the MTQid were excluded.

Referring to the classification of loading factor values from Comrey & Lee (1992), it can be stated that the Indonesian version of MTQ very short (MTQid-6) has a category range between good to very good. What was found in this study is in line with the findings of Kawabata et al. (2021), which shows that the very short MTQ (VS-MTQ) or 6-item version has a high loading factor value. However, if Kawabata and colleagues (2021) excluded reverse score items in the VS-MTQ because there were potential wording effects (Wang et al., 2015), this study did not do this, and the item exclusion relied on the loading factor value. Based on the loading factor values, the results of this study seem to find the same thing as Kawabata et al. (2021). Namely, unfavorable items do not pass the expected loading factor threshold ($\lambda \geq .50$). In other words, unfavorable items should be excluded from the model in this study. The above validity is strengthened by convergent validity results, which show that MTQid-6 has a significant correlation with MTI, PPI-A, and APSQ ($p < .001$).

The results of the MTQid-6 invariance test using the criteria from Chen (2007) ($\Delta CFI \geq -.01$, $\Delta RMSEA \geq .015$) can be stated that there is measurement invariance at the configural, metric, and scalar levels, while at the strict level, there is no measurement invariance. By referring to the criteria above, the results of this study are in line with previous studies that tested MTQ invariance and found that there was no significant reduction in model fit at the configural, metric, and scalar levels (Dagnall et al., 2019; Vaughan et al., 2018). In other words, this study confirms previous findings examining the MTQ. However, whereas previous studies only used gender groups (male vs. female), this study not only analyzed gender differences but also conducted analyses based on status (athlete vs. non-athlete groups) and age (<18 vs. ≥18).

The reliability analysis results show the values $\alpha = .762$, $\omega = .763$, and rix = .620 to .738. This indicates that the reliability of MTQid-6 is good. These results confirm the findings in the short version of the MTQ, which shows that the reliability of the MTQ found a value of $\alpha = .77$ (Papageorgiou et al., 2018). The MTQ reliability value, which is not very different, is also reported at .70 (Gucciardi et al., 2013). However, some researchers find the MTQ reliability

value above .80 (see, for example, Dagnall et al., 2019; Vaughan et al., 2018). Thus, the reliability of the MTQid-6 confirms the MTQ test results in studies.

In general, this research shows the importance of assessing the psychometric properties of an instrument translated into Indonesian to ensure that the measuring tool is valid and reliable for the target population. This study has carried out language and cultural adaptations by involving linguists and sports psychologists to address issues related to cultural and linguistic differences (Geisinger, 1994), connotations and expressions (Andayani et al., 2020), as well as linguistic gaps (Gjersing et al., 2010) that could weaken the validity of the scale (Denovan et al., 2021) have been strictly bypassed. Thus, the results of the evaluation of the MTQ factor structure found that MTQid-6 in the Indonesian context was considered valid and reliable for measuring MT in Indonesia, in athletes and non-athletes, and in males and females.

Limitations

Even though this study has attempted to carry out language adaptation and rigorous testing of psychometric properties and carry out invariance in two different groups (males vs. females; athletes vs. non-athletes), whereas previous studies only carried out invariance based on gender (Dagnall et al., 2019; Vaughan et al., 2018), but we consider there are three limitations to this study. First, although the athlete subjects involved were relatively large, this study did not classify athlete levels (e.g.: regional, national, and international). Second, the subject's age was not analyzed in more depthby classifying it between teenagers and adults. Third, this study only focuses on measuring mental-related dimensions and does not relate them to other constructs, for example, happiness in life (Dagnall et al., 2019; Wandik et al., 2024), grit and hardiness (Denovan et al., 2021), stress, depression and burnout (Kawabata et al., 2021; Gerber et al., 2018), religiosity and anxiety (Guntoro & Putra, 2022), physical capacity (Guntoro et al., 2023) and other psychological dimensions so that more in-depth analysis can be carried out such as structural equation modeling (SEM). By linking it with other variables and using SEM, it will be possible to explore more deeply the reliability of the MTQid-6 instrument and its contribution to the other constructs being investigated.

CONCLUSION

This study provides new insight concerning evaluating the short version MTQ factor structure (MTQ-18 and MTQ-10). Testing MTQ in the Indonesian context found a more concise MTQ, namely MTQ version 6 (MTQid-6). The MTQid-6 model fits the data and has good validity and reliability, so the MTQid-6 can be used to measure MT in athletes and non-

athletes, both men and women in Indonesia. Using valid and reliable measuring instruments to reveal MT, studies on MT, especially in Indonesia, will have more reliable data and results.

Based on these findings, we recommend that future studies consider the classification of athlete levels (e.g., regional, national, and international) and age levels (adolescents and adults) so that they can be analyzed in more depth regarding these categories. In addition, linking it with other relevant variables can be done to find more comprehensive results regarding the validity of MTQid-6 as an MT measurement tool for athletes and non-athletes in Indonesia.

PRACTICAL IMPLICATIONS

By successfully carrying out a psychometric structure evaluation of the short version of the MTQ, the researchers recommend trainers, students, and the public who want to study MT use the MTQid-6 as a data collection instrument. In addition, MTQid-6 can be used by practitioners in Indonesia to detect early MT conditions (athletes and non-athletes, males and females), which can then be used as initial information to provide support and improve the quality of MT. In other words, studies related to MT in Indonesia, either experimental, for example, providing MT training programs (Sutoro et al., 2023) or descriptive, can use MTQid-6 as a tool to measure the MT of research subjects.

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Authors' Contributions

The first, second, third, and tenth authors contributed to conceptualizing the research, research outline, and research method. The fourth, fifth, sixth, seventh, eighth, and ninth authors contributed to data collection and data analysis. The tenth, first, second, and third authors carried out critical interpretation of the final draft and finalization of the article.

Declaration of Conflict Interest

The authors have no conflicts of interest to report.

Ethics Statement

The protocol of the study was approved by the Health Research Ethics Committee, Faculty of Public Health, Universitas Cenderawasih with the number 065/KEPK-FKM UC issued on August 1, 2023. All respondents were requested to provide written informed consent before participating in this study.

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