

## An Indonesian Version of Mental Toughness Index: Testing Psychometric Properties in Athletes and Non-athletes

### Una versión indonesia del índice de dureza mental: prueba de propiedades psicométricas en atletas y no atletas

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**Abstract.** To date, the mental toughness index (MTI) has been adopted in five different languages but there has been no attempt to adapt and test it in the Indonesian context. On the other hand, the study of mental toughness is experiencing an upward trend but there are problems with the measurement tools used. This research aims to adapt and test the MTI to the Indonesian context by involving athletes and non-athletes as well as gender differences. There were 400 participants, with details of the athlete group = 211 people ( $M_{age} = 19.18$  years,  $SD = 1.06$ , Male = 146, Female = 65), non-athlete group = 189 people ( $M_{age} = 23.38$  years,  $SD = 7.11$ , Male = 144, Female = 45), and based on gender, male = 290 people ( $M_{age} = 21.38$  years,  $SD = 5.41$ ), while female = 110 people ( $M_{age} = 20.61$  years,  $SD = 5.24$ ). MTI was tested using confirmatory factor analysis (CFA) with maximum likelihood (ML) assisted by the IBM SPSS v.26 and IBM Amos v. programs. 22. Overall, the Indonesian version of MTI (MTIid) shows model fit, namely the values obtained are CFI = .967, TLI = .954, GFI = .966, SRMR = .034, and RMSEA = .069. Eight items in the MTIid have a convergent validity value that is statistically significant ( $p < 0.001$ ) and the loading factor is very good ( $\lambda = .563$  to  $.759$ ), three items are in the excellent category, two items are very good, and three items are good. The internal consistency reliability of the MTIid was excellent ( $CR = .864$ ;  $\alpha = .862$ ). MTIid is a valid and reliable measuring tool for measuring aspects of mental toughness, both in groups of athletes and non-athletes and based on gender differences (male and female).

**Keywords:** Mental toughness, psychometric, validation, sport psychology, athlete, non-athlete.

**Resumen.** Hasta la fecha, el índice de fortaleza mental (MTI) se ha adoptado en cinco idiomas diferentes, pero no ha habido ningún intento de adaptarlo y probarlo en el contexto indonesio. Por otro lado, el estudio de la fortaleza mental está experimentando una tendencia al alza pero existen problemas con las herramientas de medición utilizadas. Esta investigación tiene como objetivo adaptar y probar el MTI al contexto de Indonesia involucrando a atletas y no atletas, así como a las diferencias de género. Hubo 400 participantes, con detalle del grupo de deportistas = 211 personas (Edad = 19,18 años, DE = 1,06, Masculino = 146, Femenino = 65), grupo de no deportistas = 189 personas (Edad = 23,38 años, DE = 7,11, Masculino = 144, Femenino = 45), y según género, masculino = 290 personas (Edad = 21,38 años, DE = 5,41), mientras que femenino = 110 personas (Edad = 20,61 años, DE = 5,24). MTI se probó mediante análisis factorial confirmatorio (CFA) con máxima verosimilitud (ML) asistido por los programas IBM SPSS v. 26 e IBM Amos v. 22. En general, la versión indonesia de MTI (MTIid) muestra un ajuste del modelo, es decir, los valores obtenidos son CFI = 0,967, TLI = 0,954, GFI = 0,966, SRMR = 0,034 y RMSEA = 0,069. Ocho ítems del MTIid tienen un valor de validez convergente estadísticamente significativo ( $p < 0,001$ ) y el factor de carga es muy bueno ( $\lambda = 0,563$  a  $0,759$ ), tres ítems están en la categoría excelente, dos ítems son muy buenos, y tres artículos son buenos. La fiabilidad de la consistencia interna del MTIid fue excelente ( $CR = 0,864$ ;  $\alpha = 0,862$ ). MTIid es una herramienta de medición válida y fiable para medir aspectos de la fortaleza mental, tanto en grupos de deportistas como de no deportistas y en función de diferencias de género (masculino y femenino).

**Palabras clave:** fortaleza mental, psicométrico, validación, psicología del deporte, deportista, no deportista.

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## Introduction

In the past two decades, mental toughness has become a very popular study topic discussed by scientists (Gucciardi, 2017; Stamatis et al., 2020). The reason is that experts agree that athletes' mental toughness is a key factor and determines athletes' success on the field (Gould et al., 2002; Crust, 2007; Lauer et al., 2010; Gucciardi & Gordon, 2011; Short & Atkinson, 2015; Liew et al., 2019; Guntoro et al., 2023; Akbar et al., 2024). Apart from that, sports psychology experts also see that at the elite level, physical and technical quality is relatively no different because the athletes have experienced a long forging (training) process with technological intervention and various advanced

scientific knowledge (Golby & Wood, 2016; Gucciardi, 2017; Stamatis et al., 2020). In this context, athletes' mental variables are the key to achieving achievements (Maksum, 2007; Gucciardi et al., 2014; Sheard et al., 2009; Maksum, 2022; Kusuma, Kusnanik, Lumintuarso, & Phanpheng, 2024).

An American professional tennis player, Alexandra Stevenson, stated that mental toughness was 90 percent of the game (Lauer et al., 2010). Not much different, the legendary Indonesian men's singles badminton player, Rudy Hartono, said that the key to a player's success in winning every tournament was mental and physical strength (Kompas, 2018). The question now is, what mental quality do athletes in Indonesia have? This question is difficult to answer

because the measuring instruments used by one researcher and another have different parameters.

Based on the review the writers conducted, the mental quality of athletes (mental toughness) can be measured using the Mental Toughness Index (MTI; Gucciardi et al., 2014), Mental Toughness Questionnaire (MTQ; Cherry, 2005), Sports Mental Toughness Questionnaire Sport Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009), and the Psychological Performance Inventory-Alternative (PPI-A; Golby, Sheard, & van Wersch, 2007). However, some instruments are specific to certain sports, such as cricket (Gucciardi & Gordon, 2009), volleyball (Tiwari & Sharma, 2007), and football (Gucciardi, Gordon, & Dimmock, 2009a), while the more common is the Mental Toughness Questionnaire-48 (MTQ-48; Clough et al., 2002).

In Indonesia, many studies have been conducted on mental toughness. A search for scientific articles on the digital reference database and indexing machine created by our government, namely the digital reference group (Garuda) with the keyword "athlete's mentality" in the 2010-2023 period found eighty-six documents. The results of our analysis of these articles found that: (1) several articles did not clearly state the instruments used to reveal athletes' mentality, (2) some researchers developed their own, but how the development process was not explained specifically (Giandra & Setyawan, 2014; Periyadi, 2016; Setiawan et al., 2020; Masrun, 2016; Budiman, 2015; Raynadi et al., 2017) so we think there are still weaknesses in the development procedures carried out. With the facts above, we consider that an international standard instrument in Indonesian is needed so that researchers, trainers, and the public can use a reliable instrument. Having reliable measuring instruments will make studies related to athletes' mental health much better and minimize the occurrence of bias caused by the instruments used. The question then is, what instruments will be adapted and tested in this study?

We chose the Mental Toughness Index (MTI; Gucciardi et al., 2014) as an instrument that was adapted and tested in the Indonesian context. The choice of instrument is based on the following considerations. (1) MTI provides a new theoretical basis that the concept of mental toughness is unidimensional (Gucciardi et al., 2014) and this is different from the previous view which saw it as multidimensional (Clough et al., 2002). (2) MTI was developed following strict procedures, namely going through five stages of study involving various research samples, including junior athletes, seniors, non-athletes, and military members. (3) The original MTI was developed in English (Gucciardi et al., 2014) and to date, it has been tested and adapted to various languages, such as Chinese and Malaysian (Gucciardi, Zhang, Ponnusamy, Si, & Stenling, 2016), Greek (Stamatis et al., 2019), Portuguese (Moreira, Codonhato, & Fiorese, 2021), and Spanish (Stamatis et al., 2021). This indicates that the MTI is an instrument that is often used by scientists to investigate mental toughness variables. (4) Until now, as we know, there have been no studies that have adapted it to

Indonesian. Even though MTI has been adopted in Asia, namely in China and Malaysia (Gucciardi, Zhang, Ponnusamy, Si, & Stenling, 2016), as stated by Markus & Kitayama (1991) there are cultural differences in seeing and assessing oneself, which has implications for cognition, emotion, and motivation. We assess that these three dimensions are closely related to the concept of mental toughness. Apart from that, Indonesia's population of 278.8 million people places the country as the country with the largest population in Southeast Asia, third in Asia, and fourth in the world.

Many Indonesians have become interested in studying the theme of sports psychology, including mental toughness. This cannot be separated from the emergence of the jargon "mental revolution" by President Joko Widodo in 2014. However, this term was used by the first President of Indonesia, Ir. Soekarno, in 1957. Soekarno proclaimed a "mental revolution" because it was expected that Indonesians would become new humans with a white heart, a will of steel, the spirit of an eagle, and a spirit of burning fire (Kominfo, 2015). In the era of President Jokowi, the "mental revolution" was interpreted as a change in the way of thinking to respond, act, and work (KemenkoPMK, 2021). In other words, the "mental" dimension is believed to be an important aspect of building human resources. Because the mental aspect was considered very important, Soekarno changed the composition of the lyrics of the Indonesian national song entitled "Indonesia Raya" from one of the verses: "Wake up the body, wake up the soul" to "Wake up the soul, wake up the body." Indonesia's First President considered that the people could not build a capable physique before building our soul first. The word "soul" referred to in the song's lyrics can refer to the concept of "mental." To build a strong physique, the people need a strong mentality. A strong or tough mentality is the basis for developing optimal physical capacity (Putra, Sinaga, Hidayat, Kardi, & Larung, 2023).

Unfortunately, as we mentioned earlier, no one has adapted the language and tested MTI in the Indonesian version. Thus, research on adapting and testing the psychometric properties of the MTI we assess is necessary to provide empirical evidence of a reliable measuring tool in revealing mental toughness. Based on this, this research aims to adapt and test the MTI to the Indonesian context by involving athletes and non-athletes as well as gender differences.

## Material and methods

### Participants

This research involved 417 people, but after screening the incoming data, it was found that 17 data had to be excluded because they were outliers (a detailed explanation of the outlier data can be seen in the results section). Details of participant categories are as follows: athlete group of 211 people ( $M_{age} = 19.18$  years,  $SD = 1.06$ , Male = 146, Female = 65), non-athlete group of 189 people ( $M_{age} = 23.38$  years,  $SD = 7.11$ , Male = 144, Female = 45), based on

gender, for the male participant group, there were 290 people ( $M_{\text{age}} = 21.38$  years,  $SD = 5.41$ ), while for the female participant group there were 110 people ( $M_{\text{age}} = 20.61$  years,  $SD = 5.24$ ). Overall or combined there were 400 people ( $M_{\text{age}} = 21.17$  years,  $SD = 5.37$ , Male = 290, Female = 110).

### **Instruments**

The instrument that was adapted and validated was The Mental Toughness Index (MTI) developed by Gucciardi et al., (2014). MTI has seven dimensions, namely self-belief (I believe in my ability to achieve my goals), attention regulation (I can regulate my focus when performing tasks), emotion regulation (I can use my emotions to perform the way I want to), success mindset (I strive for continued success), context knowledge (I execute my knowledge of what is required to achieve my goals), buoyancy (e.g., I consistently overcome adversity), and optimism (I can find a positive in most situations). These seven dimensions are translated into eight items with alternative answers in the form of a continuum ranging from 1 (False, 100% of the time) to 7 (True, 100% of the time). The original MTI has very good loading factor ( $\lambda = 0.56 - 0.80$ ) and very high composite reliability ( $\rho = .86$  to  $.89$ ) (Gucciardi et al., 2014).

### **Procedure**

This research procedure was approved by the Health Research Ethics Committee number 266/KEPK/EC. All respondents were asked to provide informed consent before participating in this study. Thus, the data we gathered and analyzed are data that have been approved by the respondent.

We began this research by applying for permission from the MTI instrument developer. After receiving permission to carry out language adaptation and testing in the Indonesian context, we handed over the original MTI to two English language experts to translate into Indonesian. The results of the synthesis stage were then submitted to two sports psychology experts and one sports coaching expert, all of whom have doctoral-level education. The three experts assessed the suitability of the substance of each item in the Indonesian version of the MTI 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 MTI. After that, we tested the readability level of three junior high school athletes, three high school athletes, and three sports students. We then submitted the final results of the Indonesian version of the MTI instrument (MTIid) to a different English language expert from the initial stage to be translated back into the original language. The Indonesian version of the final MTI instrument can be seen in the appendix.

### **Statistical analysis**

Initial analysis was carried out to check data such as outliers and normality. Outlier analysis refers to the

Mahalanobis D2 value with a probability value of 0.001. 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. After that, confirmatory factor analysis (CFA) was calculated using maximum likelihood (ML). To assess the accuracy of the tested model (MTIid), parameters such as chi-square ( $\chi^2$ ), the comparative fit index (CFI), the Tucker-Lewis index (TLI), goodness fit index (GFI), 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 values  $> .90$  (Browne & Cudeck, 1992), GFI values  $\geq .93$  (Cho, Hwang, Sarstedt, & Ringle, 2020), SRMR values  $\leq .07$  (Bagozzi, 2010), and RMSEA scores  $\leq .08$  (Browne & Cudeck, 1992). After the model was fit, the analysis continued to look at the loading factors of each item in the MTIid in various types of samples. Loading factor criteria referred 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 conducted to assess the internal consistency of MTIid. We used construct reliability (CR) and Cronbach Alpha (CA) to test reliability in this study. The accepted reliability value was  $> .70$  (Nunnally & Bernstein, 1994; Taber, 2018). All analyses in this research were carried out with the help of the IBM SPSS v.26 and IBM Amos v. programs. 22.

### **Results**

With the number of items in the MTI being eight and using a probability value of 0.001, the result was the chi-square value = 26,124. Based on these criteria, 17 data had a Mahalanobis D2 value greater than 26,124, namely data from respondents number 293, 308, 310, 326, 355, 394, 319, 171, 102, 388, 336, 41, 236, 330, 207, 327, and 246. Respondents whose data were outliers were then excluded from the analysis so that the amount of data analyzed in the next stage was 400 data. The next test was carried out to determine the normality of the data distribution. The results of the normality test with Skewness and Kurtosis showed that the values exceeded 2 and 7 respectively, indicating that the data distribution was not normal. Therefore, CFA testing uses Maximum Likelihood (ML).

The results of the descriptive analysis of each item of the Indonesian version of MTI (MTIid) in each research sample category are presented in Table 1. In general, in all sample categories, item number 4 (I strive to be continuously successful) has the highest average value, while item number 5 (I use the knowledge I have to find something needed to achieve my target) has the lowest average value.

Testing the Indonesian version of MTI with CFA found that the model fits all types of sample categories (athlete, non-athlete, male, female, and combined) (Table 1). Even though the chi-square value is statistically significant ( $p < 0.05$ ), this can be tolerated considering that the other

parameters (e.g., CFI, TLI, GFI, SRMR, and RMSEA) follow the applicable cut-off values in determining model fit, namely CFI and TLI > .90, GFI ≥ .93, SRMR ≤ .07, and RMSEA ≤ .08 (Table 2).

Table 1. Descriptive statistical results for each item and sample demographics

Item	Athletes (n = 211)		Non-Athletes (n = 189)		Males (n = 290)		Females (n = 110)		Combination (n = 400)	
	M	SD	M	SD	M	SD	M	SD	M	SD
Item 1	6.00	0.96	5.86	1.00	5.91	0.98	6.01	0.99	5.94	0.98
Item 2	5.40	1.01	5.46	1.05	5.44	1.01	5.38	1.06	5.43	1.03
Item 3	5.48	1.02	5.57	1.09	5.55	1.03	5.45	1.12	5.52	1.05
Item 4	6.54	0.69	6.37	0.83	6.42	0.78	6.57	0.71	6.46	0.76
Item 5	6.08	0.83	6.04	0.92	6.04	0.88	6.10	0.88	6.06	0.88
Item 6	5.31	1.00	5.39	1.02	5.37	1.04	5.29	0.93	5.35	1.01
Item 7	5.54	0.91	5.63	0.98	5.57	0.94	5.61	0.94	5.58	0.94
Item 8	5.80	0.92	5.92	0.92	5.83	0.88	5.92	1.01	5.85	0.92
Age	19.18	1.06	23.38	7.11	21.38	5.41	20.61	5.24	21.17	5.37
Male	146		144		-		-		290	
Female	65		45		-		-		110	

Note: M = Mean; SD = standar deviation.

Table 2. Summary of fit indices for the Indonesian version of the MTI model (MTIid)

Sample	$\chi^2$	df	p	CFI	TLI	GFI	SRMR	RMSEA (90% CI)
Athletes (n = 211)	45.063	20	.001	.959	.943	.950	.041	.077 [.047, .107]
Non-athletes (n = 189)	37.151	20	.011	.968	.956	.956	.038	.068 [.032, .101]
Males (n = 290)	55.047	20	.000	.957	.940	.955	.040	.078 [.047, .096]
Females (n = 110)	34.175	20	.025	.961	.945	.932	.049	.081 [.029, .126]
Total (n = 400)	57.939	20	.000	.967	.954	.966	.034	.069 [.049, .090]

Note.  $\chi^2$  = chi-square; df= degrees of freedom; CFI = comparative fit index; TLI = Tucker-Lewis index; GFI = Goodness Fit Index; SRMR = standardized root mean residual; RMSEA = root mean square error of approximation.

Table 3. Standardized Loading factors ( $\lambda$ ) and Residual Variances ( $\theta$ ) of MTIid

Item	Athletes (n = 211)		Non-Athletes (n = 189)		Males (n = 290)		Females (n = 110)		Combination (n = 400)	
	$\lambda$	$\theta$	$\lambda$	$\theta$	$\lambda$	$\theta$	$\lambda$	$\theta$	$\lambda$	$\theta$
Item 1	.631	.376	.588	.472	.651	.457	.695	.594	.61	.481
Item 2	.733	.468	.569	.315	.585	.443	.769	.352	.652	.356
Item 3	.564	.384	.621	.467	.505	.664	.644	.33	.588	.428
Item 4	.505	.39	.622	.434	.644	.492	.361	.324	.563	.378
Item 5	.719	.332	.699	.422	.679	.421	.759	.434	.711	.399
Item 6	.779	.354	.74	.729	.721	.904	.785	.731	.759	.725
Item 7	.728	.707	.818	.74	.771	.766	.773	.453	.772	.603
Item 8	.667	.466	.661	.654	.738	.762	.647	.503	.657	.604

After the model was fit, we tested the unidimensionality of MTIid. The eight indicators in MTIid are statistically significant with a p-value < 0.001. This is reinforced by the large convergent validity or loading factor values for the eight MTIid indicators in athletes, non-athletes, males, females, and combined samples (Table 3). If we look closely, there is only one item that has a low value, namely item number 4 ( $\lambda = .361$ ) in the female sample category. However, these items, in other sample categories, have high loading factors. Apart from that, if we look closely at the results in the combined sample group, it appears that indicators or items number 5, 6, and 7 are in the excellent category, items number 8 and 2 are in the very good category, items number 1, 3 and 4 are in the good category (Table 3). This evidence of convergent validity shows that

the eight items in the MTIid are valid indicators in measuring the latent construct of mental toughness and are unidimensional.

The result of the reliability testing shows that the Indonesian version of MTI (MTIid) as a whole has excellent reliability values, namely CR = .864 and  $\alpha = .862$  (Table 4). For variance extracted (AVE), a value of .446 was obtained, which indicates that reliability is not high. However, with reference to the CR,  $\alpha$ , and  $\rho$  values of each item, this indicates that there is high internal consistency in the MTIid, which means that all items in the MTIid consistently represent the same latent construct, namely mental toughness.

Table 4. Results of reliability analysis on MTIid (n = 400)

Item MTI	$\lambda$	$\lambda^2$	$\delta$	CR	$\alpha$
Item 1	.61	.372	.628		
Item 2	.652	.425	.575		
Item 3	.588	.346	.654		
Item 4	.563	.317	.683		
Item 5	.711	.506	.494	.864	.862
Item 6	.759	.576	.424		
Item 7	.772	.596	.404		
Item 8	.657	.432	.568		
Total	5.312	3.569	4.431		

Note:  $\lambda$  = Lamda;  $\delta$  = Measurement error; CR = Custruct Reliability;  $\alpha$  = Cronbach Alpha.

## Discussion

This research aims to adapt the MTI to the Indonesian context and test the psychometric properties of the MTI in the Indonesian version. The results of model testing show that the model fits the various sample categories used. In the athlete group, the values obtained were CFI = .959, TLI = .943, GFI = .950, SRMR = .041, and RMSEA = .077. The same thing was found in the non-athlete group, namely CFI = .968, TLI = .956, GFI = .956, SRMR = .038, and RMSEA = .068. Based on the gender of the research sample, the CFI (M = .957, F = .961), TLI (M = .940, F = .945), GFI (M = .955, F = .932), SRMR (M = .945) values were obtained. 040, F = .049) and RMSEA (M = .078, F = .081). Overall, the results are consistent with the findings in the athlete and non-athlete groups and based on gender differences, namely CFI = .967, TLI = .954, GFI = .966, SRMR = .034, and RMSEA = .069. The parameter values above correspond to the cut-off points stated by experts (e.g., Browne & Cudeck, 1992; Cho, Hwang, Sarstedt, & Ringle, 2020; Marsh et al., 2004; Bagozzi, 2010). Although it is also acknowledged that several experts suggest different cut-off points in several parameters (e.g., Hu & Bentler, 1999; Bagozzi & Yi, 2012), the results of our study still show a good model fit. This confirms the findings of previous research that adapted and tested MTI in Chinese and Malaysian (Gucciardi, Zhang, Ponnusamy, Si, & Stenling, 2016), Greek (Stamatis et al., 2019), Portuguese (Moreira et al., 2021), and Spanish (Stamatis et al., 2021) who found that model-fit. This is not surprising because the original MTI demonstrated excellent model fit (Gucciardi et al., 2014). The results of the

Indonesian version of the MTI unidimensionality test (MTIid) strengthen previous findings which stated that the MTI was unidimensional. Eight indicators in the MTI are statistically significant with high loading factors in various categories of the research sample. These results confirm previous findings which showed that eight items in the MTI had good loading factors in measuring the mental toughness variable (Gucciardi et al., 2014). In line with this, testing the MTI in five different languages and countries strengthens these findings that the MTI is a unidimensional and reliable measuring tool in measuring mental toughness. In general, a comparative description of the MTI loading factor ( $\lambda$ ) values is presented in Table 5.

Table 5.  
Comparison of the loading factor ( $\lambda$ ) results of this study with other studies

Item MTI	Indonesian	Malaysian	Chinese	Greek	Portuguese	Spanish
	Version MTI	Version MTI <sup>a</sup>	Version MTI <sup>b</sup>	Version MTI <sup>c</sup>	Version MTI <sup>d</sup>	Version MTI <sup>e</sup>
Item 1	.61	.56	.63	.81	.57	.80
Item 2	.65	.64	.73	.61	.55	.68
Item 3	.59	.62	.80	.68	.51	.71
Item 4	.56	.66	.72	.46	.52	.75
Item 5	.71	.64	.74	.73	.62	.82
Item 6	.76	.68	.71	.69	.63	.64
Item 7	.77	.61	.77	.72	.54	.83
Item 8	.66	.60	.79	.59	.56	.51

Note: <sup>a</sup>Research conducted by Gucciardi, Zhang, Ponnusamy, Si, & Stenling (2016); <sup>b</sup>Research conducted by Stamatis et al. (2019); <sup>c</sup>research conducted by Moreira, Codonato, & Fiorese (2021); <sup>d</sup>Research conducted by Stamatis, Morgan, Flores, et al. (2021).

Even though the sample group of male athletes and non-athletes, and total convergent validity was found to be good, in the sample group of females, there was one item that had a low loading factor value (item 4 = .361). In this context, we are of the view that the high average score on item number 4 and the low standard deviation ( $6.57 \pm 0.71$ ) indicate that the female sample group tends to respond highly (numbers 6 and 7) so the answers to this item are less varied. Apart from that, we also think that it is related to the small number of the sample in this group. Bagozzi (2010) states that although a sample size of 100 is acceptable, if possible it could be above 200. The same thing was expressed by Comrey & Lee (1992) that a sample of 100 was poor while 200 was fair. On this basis, we assess that the low loading factor on item number 4 ( $\lambda = .361$ ) is also due to the small number of the sample in the female category. However, on other sample criteria, it appears that these items have high loading factor values (athlete,  $\lambda = .505$ ; non-athlete,  $\lambda = .622$ ; male,  $\lambda = .644$ ; combined,  $\lambda = .563$ ).

With this fact, we consider that this item can be used because the other sample criteria, male athletes and non-athletes and the total sample show a high loading factor ( $\lambda = .505$  to  $.644$ ). This is in line with tests carried out by other researchers which show that item number 4 has a loading factor ( $\lambda$ ) value between .46 and .7575 (Gucciardi et al., 2016; Stamatis et al., 2019; Moreira et al., 2021; Moreira et al., 2021). Likewise, in the original version, item number 4 has a loading factor value between .66 and

.70 (Gucciardi et al., 2014). Apart from that, this study also shows that overall, items number 5, 6, and 7 are in the excellent category; items number 8 and 2 are in the very good category; items number 1, 3, and 4 are in the good category (category determination see Comrey & Lee, 1992).

Internal consistency reliability testing shows that MTIid has excellent reliability values ( $CR = .864$ ;  $\alpha = .862$ ). This confirms previous findings which show that MTI has excellent internal consistency scores (Gucciardi et al., 2014). Indeed, high-reliability values were found for several parameters, but the average variance extracted (AVE) value was found to be .446, which indicated that the convergent was not good. The finding of a not-high AVE value is in line with the results of a study conducted by Moreira et al. (2021). We assess that the AVE value is not high because there is a loading factor value in MTIid that is below .70. When there is a value of  $\lambda < .70$ , the AVE value will be below .50 (Ghozali, 2017). However, the reliability value with other parameters appears high and this is also in line with other findings which conclude that the MTI reliability value is excellent (Gucciardi et al., 2014; Gucciardi et al., 2016; Stamatis et al., 2019; Moreira et al., 2021).

### Limitations and future research directions

Although we have attempted to involve a diverse sample group in this research, we consider there are several limitations. First, this study did not use a similar instrument to test construct validity as other studies have done (see Cowden, 2020 and Moreira et al., 2021). Several similar instruments have been developed by experts, for example, the Sports Mental Toughness Questionnaire (SMTQ; Sheard et al., 2009), the Mental Toughness Questionnaire (MTQ; Dagnall, Denovan, Papageorgiou, & Clough, 2019), the Psychological Performance Inventory-Alternative (PPI-A; Golby et al., 2007) and other similar measuring tools. Second, the participants involved in this study were divided into two categories, namely the athlete and non-athlete groups, and the male and female groups. The facts show that there are various levels of athletes, from regional, national, to international level athletes; novice, teenagers, youth, and adult/senior athletes; amateur, sub-elite, and elite athletes.

With these limitations, we provide recommendations for future research to add other variables by using similar instruments or instruments that measure other psychological constructs such as anxiety (Putra et al., 2021; Putra & Guntoro, 2022), resilience (Wagnild & Young, 1993), religiosity and happiness (Guntoro & Putra, 2022) as well as performance in sports and non-sport contexts. In addition, we also recommend involving a more diverse research sample group like what was done by Gucciardi et al. (2014), and dividing the athlete groups in more detail. Testing in athletes with disabilities (Santana et al., 2022) could be an alternative to broader testing in future studies. As with the results obtained in this study, studies in

Indonesia have attempted to provide mental intervention or training, such as psychological skills training (Golby & Wood, 2016; Brewer & Shillinglaw, 2016), mental skills training (Gucciardi, Gordon, & Dimmock, 2009b; Dohme, Bloom, Piggott, & Backhouse, 2020), mental toughness training circles (Sutoro, Guntoro, & Putra, 2023) can use MTIid as a measuring tool to determine the impact of the mental training provided.

## Conclusions

Overall, the Indonesian version of MTI (MTIid) shows a good model fit, namely the values obtained are CFI = .967, TLI = .954, GFI = .966, SRMR = .034, and RMSEA = .069. Eight items in the MTIid have a convergent validity value that is statistically significant ( $p < 0.001$ ) and the loading factor is very good ( $\lambda = .563$  to  $.759$ ), namely three items are in the excellent category, two items are in the very good category, and three items are in the good category. The internal consistency reliability of the MTIid is excellent (CR = .864;  $\alpha = .862$ ). It can be stated that MTIid is a valid and reliable measuring tool in measuring aspects of mental toughness, both in groups of athletes and non-athletes and based on gender (men and women). Thus, the results of this research will contribute to similar studies in Indonesia, especially those interested in understanding aspects of mental toughness. Sports coaches and professionals outside of sports can utilize and use MTIid to reveal mental toughness so that the intervention given is appropriate to the psychological condition concerned.

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## Conflicts of interest

All authors declare that they have no conflicts of interest with any person, company, or institution.

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**Anexos:**

**Mental Toughness Index Versi Indonesia (MTIid)**  
*The Indonesian version of mental toughness (MTIid)*

**Petunjuk Pengisian:** Dengan menggunakan skala di bawah ini, berikan tanggapan terhadap setiap pernyataan yang ada berdasarkan kesesuaian Anda dalam berpikir, merasa, dan berperilaku sebagai seorang atlet – *ingat bahwa tidak ada jawaban yang betul atau salah; oleh sebab itu jawablah sejujurnya!* Berikut adalah contohnya:

<b>Pernyataan</b>	<b>Alternatif Jawaban</b>								
Saya berjuang untuk bisa terus menerus sukses	<b>Keliru</b>	1	2	3	4	<b>5</b>	6	7	<b>Betul</b>

Anda hanya perlu memilih salah satu alternatif jawaban yang sesuai dengan kondisi Anda.

<b>No Pernyataan</b>	<b>Alternatif Jawaban</b>								
1 Saya percaya dengan kemampuan Saya untuk mencapai target yang diharapkan.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
2 Saya mampu mengatur fokus dalam melaksanakan tugas.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
3 Saya mampu mengontrol emosi sesuai yang Saya inginkan.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
4 Saya berjuang untuk bisa terus menerus sukses.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
5 Saya memanfaatkan pengetahuan yang dimiliki untuk menemukan sesuatu yang dibutuhkan dalam mencapai target Saya.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
6 Saya mampu konsisten dalam mengatasi kesulitan.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
7 Saya mampu memanfaatkan keterampilan dan pengetahuan yang dimiliki secara tepat ketika menemukan tantangan.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>
8 Saya dapat menemukan sisi positif dalam berbagai situasi.	<b>Keliru</b>	1	2	3	4	5	6	7	<b>Betul</b>

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