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MENTAL TOUGHNESS IN SPORT QUESTIONNAIRE (MTSQ-19)*

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Mental toughness is a very complex construct which has attracted the attention of scientists, competitors, coaches, and psychologists. The aim of this study was to develop an abbreviated version of the Mental Toughness in Sport Questionnaire (MTSQ), reducing the original 42-factor structure to 19 factors, and to evaluate the psychometric properties of this abbreviated instrument. The study group consisted of 559 athletes. The presented model is appropriately tailored to the data obtained from the target population. Compared to the previous version, the simplified 19-item measure demonstrated a significantly better overall fit. Moreover, all additional absolute indices of misfit yielded lower values in the 19-item model, further supporting its superior structural adequacy. Those results support the assumption of higher validity of the 19-item simplified measure compared to the previous 42-item measure of mental toughness. The MTSQ-19 demonstrates good psychometric properties and addresses a methodological gap identified in previous research on mental toughness in sport.

Keywords: mental toughness; stress; sport psychology; mental training

Mental toughness (MT) as a dimension is particularly difficult to conceptualize (e.g., Gucciardi & Gordon, 2011). Defeat and victory encompass nu-

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merous aspects, involving a range of strategies and the interplay of complex causes. These factors include psychological and physical-motor elements, as well as technical and tactical components. The psychological aspect, particularly the ability to handle difficult and complex situations, is a key differentiator between winning and losing (Brewer, 2009). Research conducted at the highest level, such as the Olympics, has shown that MT is one of the most valued skills for achieving success in sports as well as maintaining optimal performance (Dyer & McGuiness, 1996; Gould et al., 2002, Gucciardi et al., 2017, 2021). MT can be seen as the predisposition to return to a state of homeostasis after experiencing a stimulus such as a crisis, development, transformation, injury, or failure. It involves the ability to motivate oneself to act appropriately and vigorously (Przybylski, 2018). MT involves a lower tendency to be overwhelmed by difficult situations, such as competing, effectiveness, dynamics in coping with stress, a positive attitude in handling situations, self-denial in overcoming challenges, and faith in one's ability to overcome barriers (Kobasa et al., 1982; 1985; Wiebe, 1991; Wiebe & Williams, 1992).

An important element of MT is emotional resilience, which is the ability to effectively cope with and control strong negative emotions (Gracz & Sankowski, 2007; Gucciardi et al., 2017, 2021; Przybylski, 2018). MT includes a lower tendency to react with stress, the ability to handle stressful situations, self-awareness, and flexibility in action. In summary, it is the ability to effectively deal with internal and external barriers in the sports environment while enhancing stress resistance (Bull et al., 2005; Connaughton et al., 2008; Fourie & Potgieter, 2001; Jones et al., 2007; Thelwell et al., 2005). Working on these aspects of MT training is beneficial for everyone and is equally helpful in other areas of life. Skills such as relaxation, imagery, and concentration are also important (Przybylski, 2018; Skakoon, 2015).

There are few tools worldwide that measure specific aspects of mental toughness in sport. A range of instruments have been developed to assess mental toughness (MT); however, they differ substantially in their underlying theoretical assumptions and in the dimensions they capture. Existing measures often conceptualize MT within broad, multidimensional frameworks that integrate emotional control, confidence, perseverance, or cognitive-behavioral strategies. Although such approaches allow for detailed profiling, many instruments are lengthy, require advanced psychometric interpretation, or lack consistent empirical support regarding their factorial validity. In several cases, the proposed structures have not been thoroughly examined using both explor-

atory and confirmatory techniques, resulting in ambiguities concerning the conceptual boundaries of MT.

Conversely, shorter and more parsimonious tools operationalize MT as a unidimensional construct, emphasizing the capacity to function effectively under pressure. While these instruments offer practical advantages, their brevity limits their ability to represent the complexity of MT, especially in competitive sport contexts where multiple stress-related competencies interact dynamically. Moreover, many existing measures were created for specific athletic populations or particular sports, reducing their applicability across broader performance environments and limiting opportunities for cultural adaptation. Collectively, these limitations highlight a need for MT assessments that are theoretically coherent, psychometrically robust, and suitable for diverse athletic settings. A particularly important gap concerns the lack of instruments explicitly grounded in stress-related processes—understood both as exposure to stressors and as the capacity to cope with them effectively. Addressing MT through the lens of stress burdens provides a more contextually anchored and behavior-oriented understanding of the construct.

In this context, the adaptation of the Mental Toughness in Sport Questionnaire is warranted. The MTSQ-19 is based on a distinct conceptualization of mental toughness as a pattern of responses to sport-specific stressors, offering a theoretically aligned and empirically testable framework. Its structure and purpose respond directly to the shortcomings of previous measures by providing a concise, culturally relevant, and psychometrically sound tool, tailored for use in Polish sport settings. The adaptation fills a clear methodological and theoretical gap, enabling more accurate assessment of MT as it manifests under real-world demands.

In Poland, such tools are almost entirely lacking. This motivated us to develop a questionnaire assessing MT from a different perspective, focusing on stress-inducing factors. The 19-item version was validated against the original instrument (Przybylski, 2018). There is a notable lack of validated instruments of this type available in Poland, so this methodological gap provided the rationale for developing a new questionnaire designed to assess MT from a distinct perspective, emphasizing the identification of stress-inducing factors. The 19-item version of the instrument underwent a validation procedure in which its psychometric properties were compared with those of the original measure (42 items) described by Przybylski (2018).

The Mental Toughness in Sport Questionnaire (short version) is an abbreviated version of the original MTSQ-42 (Przybylski, 2018). The earlier ver-

sion focused on three scales: negative states prior to performance, the burden of the training regime, and relations with the coach. The abbreviated version was developed based on these specific factors, which, as demonstrated, constitute well-defined scales for assessing the intensity of stressors. The short version was developed on the basis of stress-related factors and employs a distinct conceptual framework for mental toughness—specifically, the construct of stress resilience—setting it apart from prevailing MT theories. As a concise, psychometrically validated instrument, the short version offers a rigorous foundation for examining the multidimensional and interdisciplinary nature of mental toughness within the context of sport. Globally, researchers emphasize the importance of using shorter instruments that are more convenient for athletes while adequately defining the construct in scientific research (e.g., Chen Liew et al., 2019; Clough et al., 2002; Cowden et al., 2021; Demir et al., 2025; Gucciardi, 2009; Jones et al., 2007). Since the original MTSQ-42 is a robust but relatively lengthy tool, our goal was to create a shorter scale that remains equally representative; therefore, items with the highest factor loadings were selected. Given the tendency to validate tools in relation to their original versions, we aimed to determine whether the abbreviated version would retain the three subscales of the MTSQ-42 or emerge as a measure of a single overarching construct—mental toughness (potentially reflecting a bifactorial structure). Furthermore, as a 10-point scale may be overly complex, we opted for a widely used 7-point scale.

METHOD

Participants

A convenient sample of $N = 559$ athletes participated in the study, consisting of 338 females (60.4%) and 221 males (39.6%). The mean age of participants was $M = 23.06$ ($SD = 6.49$).

Athletes represented different sport types: 198 of them pursued team sports (39.1%) and 247 did individual sports (48.7%). Regarding sport level, 116 participants (28.9%) reported recreational involvement, 213 (42.0%) competed at the national level, and 178 (35.1%) at the international level.

Measures and Procedure

The study received ethical approval as part of a broader research project from the Ethics Committee (application no. 43/2023, Faculty of Social Sciences, University of Gdansk).

The Mental Toughness Questionnaire-19 is a unidimensional instrument designed to measure an individual's response to stressors occurring in the sports environment. Respondents rate each statement on a seven-point Likert scale, where 1 indicates no impact or absence of the stressor and 7 indicates a very strong stress-inducing effect.

The reliability analysis of the MTSQ-19 demonstrated that the instrument shows high internal consistency. Its Cronbach's alpha was $\alpha = .92$, CI = [0.89, 095], indicating good to very good reliability. These results indicate that the MTSQ-19 provides a stable and precise assessment of mental toughness and resilience in athletic populations.

Participants completed a questionnaire assessing the extent to which specific situations in their sport environment evoked stress or discomfort. They were asked to evaluate a series of factors commonly encountered in athletic settings and to indicate the severity of the stress associated with each factor using a 7-point Likert-type scale, ranging from very low to very high levels of experienced stress. Respondents rated each item by considering whether the factor occurred in their athletic context and how strongly it affected them emotionally or motivationally.

To provide respondents with sufficient clarity, each scale point was defined in terms of the intensity of stress experienced. After reviewing these scale definitions, participants proceeded to evaluate all items. The questionnaire covers a range of stress-inducing conditions related to interpersonal interactions, expectations, performance outcomes, and situational pressures. For illustration, a sample item reads "Ambiguous evaluation style of the coach." A full list of items is available in the supplementary material.

RESULTS

Item Selection

To select items representing the best relation to global mental toughness on a dataset ($N = 559$), IRT (Item Response Theory) analysis using maximum

likelihood estimation in the GRM Graded Response Model (Samejima, 2019) was conducted. The IRT model assumed one common factor to measure ability θ_G and three subscales (θ_1 θ_2, and θ_3) corresponding to three factors described in the original paper (Przybylski, 2018). This method is adequate for polytomous items such as Likert scale items and the bifactor structure used in the MTSQ-42. To select the most informative and adequate items of all 42 included in the MTSQ-42 inventory, the coefficients of factor loadings obtained in the general-factor analysis (Loadings, η^2), as well as IRT coefficients of easiness (a), discrimination (d), and indices of item information (RMSEA, *p*-value), were analyzed (see Table 1 for details).

The analyses were conducted using R 4.5.1 for Windows (R Core Team, 2025), with the support of several packages: 'dplyr' (Wickham et al., 2021) to simplify data manipulation, 'mirt' (Chalmers, 2012) to estimate IRT models, 'psych' to conduct reliability analyses, and 'lavaan' (Rosseel, 2012) to perform CFA analyses within the structural equation modeling framework.

This analysis reveals that some items stand out significantly, as their traces are not parallel to others, suggesting that those items should be excluded from the analysis/measurement. These 12 items are: 1, 2, 3, 4, 5, 6, 8, 10, 11, 16, 19, 20, 22, 23, 26, 34, 39, 40, 41. A detailed analysis of the distribution of indicators d1 through d7 revealed that four items, i.e. 9, 15, 18, and 31, exhibited a markedly divergent response pattern compared to the rest, which may be attributed to their specific content characteristics. Consequently, these items were excluded from the final version of the instrument.

Refinement of the Tool Using a Bifactor Model

In the current version of the manuscript, a revised analytical approach was applied using a bifactor model, which tested a dual-factor structure of measurement: (a) a general factor and (b) three specific subfactors—*Coach–Athlete Relationship*, *Training Load*, and *Pre-Competition Negative State* (Arbuckle, 2011). Selection criteria were factor loadings for general-factor θ_G of item $\lambda > 0.50$, item discrimination $a > 1.2$, and item information RMSEA < 0.025. Due to these criteria, 23 out of 42 items were selected (7, 9, 12, 13, 14, 15, 17, 18, 21, 24, 25, 27, 28, 29, 30, 31, 32, 33, 35, 36, 37, 38, 42) as the most representative of general toughness.

The model fit was satisfactory (RMSEA < 0.08, CFI > 0.90). Based on the results of this model, and guided by factor loadings for the general factor

($\lambda > 0.50$) as well as item discrimination coefficients ($\lambda > 1.20$), 19 items were selected from the original pool of 42. These items were simultaneously the most strongly associated with the general factor and the most effective in differentiating between high and low trait levels. Regarding once again the first author's definition of mental toughness, mental toughness is associated with sport-related awareness, challenge orientation, and the drive to achieve success. It is the ability to cope with adversity through skills such as emotional control, concentration, motivation, and self-confidence. Mental toughness can be trained, and individuals who possess it tend to perform better in stressful situations—both in sport and in everyday life.

The measure obtained using the IRT Graded Response Model with 42 items, assuming their bifactor structure, revealed highly satisfactory reliability for the general-factor θ_G (Theoretical $\omega = 0.948$; Empirical Mokken $\omega = 0.946$), with information centered at θ between two standard deviations below and above the mean, and is very symmetric.

This suggests that the measurement is the most reliable and informative for subjects characterized by average ability, so extreme (low and high) ability (below two standard deviations under and above two standard deviations above the mean) cannot be measured with high precision.

The final, shorter version of the MTSQ contains 19 items: 7, 12, 13, 14, 17, 21, 24, 25, 27, 28, 29, 30, 32, 33, 35, 36, 37, 38, 42, best representing general factor loadings, being the most discriminative and mostly parallel in terms of information to other items in the measurement (see Table 2 for details).

The correlation between the total score of the 19 selected test items and the total score of the original 42-item version was $r = 0.82$, based on a sample of 559 participants. This result indicates that the 19 selected items strongly reflect both the content and the variability of the full 42-item scale.

Detailed inspection of the summary of IRT coefficients estimated in the simplified 19-item measurement model supports the adequacy of item selection. Factor loadings λ for general factor for all items are above 0.50 discrimination coefficients *a* for all items are above 1.2, and the RMSEA indicator of misfit is below 0.02 for each item in the measurement of general mental toughness. This indicates sufficient reliability of the measure of mental toughness.

Measurement Validity

The bifactor model extracted 58.8% of total measurement variance in 19 items ($SS\lambda$ = 11.183), and the global model indices of fit show sufficient (but not perfect) fit of the measurement to data: $\chi^2(152) = 1116.341$, $p < 0.001$; RMSEA = 0.082, 95% CI [0.077, 0.087], SRMR = 0.079, TLI = 0.919, CFI = 0.908. Compared to the previous model, the simplified 19-item measurement revealed a significantly better fit to data ($\chi^2[161] = 41186$; $p < .001$), and all other unscaled indices of misfit (AIC, BIC, SABIC, etc.) present lower values in the 19-item simplified measurement model. These results support the assumption of higher validity of the 19-item simplified measurement compared to the previous 42-item measurement in the context of general mental toughness.

The short 19-item version of the MTSQ demonstrated superior model fit compared to the original 42-item version, as indicated by global fit indices. In the examined sample (N = 559), the 42-item model showed moderately acceptable fit to the data (AIC = 75,539; BIC = 75,782), whereas the bifactor model based on the 19-item version exhibited substantially better fit (AIC = 34,034; BIC = 34,594). The difference between the two models was statistically significant, with $\chi^2(161) = 41.186$ and $p < .001$.The 19-item version of the Mental Toughness in Sport Questionnaire (MTSQ-19) is suitable for assessing the general level of mental toughness, whereas the full 42-item version remains valuable for in-depth analysis of specific subscales. The primary advantage of the shortened form lies in its brevity and ease of administration, which facilitates efficient data collection. However, this comes at the cost of reduced descriptive granularity. Currently, the MTSQ-19 is employed in repeated-measures designs to monitor intra-individual changes over time, minimizing the risk of cognitive fatigue among participants.

Table 1

Summary of Two Measurement Models: A Comparison

Model	AIC	AICc	SABIC	HQ	BIC	logLik	χ^2	*df*	*p*
42 items	75,539	6,357	75,849	76,026	76,782	–37,475			
19 items	34,031	34,127	34,171	34,252	34,594	–16,883	41,186	161	<.001

Note. AIC = Akaike information criterion, AICc = sample size corrected AIC, BIC = Bayesian information criterion, SABIC = sample-adjusted Bayesian information criterion, loglik = Natural logarithm of the maximum likelihood estimator.

Factor Structure of 19-Item Measurement

To test the structure of the 19-item MTSQ measurement, factor loadings, discrimination coefficients *a* and item information RMSEA indices for corresponding factors described in the previous 42-item tool for each item were analyzed. The results support the assumption that the three-factor structure of the measurement is appropriate (due to factor loadings [$\lambda > 0.50$], but not highly informative [RMSEA > 0.025]) and not sufficiently reliable ($1.1 > a > 1.3$) (Table 2).

DISCUSSION

The present study examined the factor structure, construct validity, and reliability of the shorter version of the MTSQ-42 (Przybylski, 2018). Analyses based on item response theory (IRT) confirmed the internal consistency and psychometric soundness of the MTSQ-19. This provides initial support for its use among Polish athletes, representing the first validated mental toughness scale tailored to Polish sport conditions (Przybylski, 2011). Our findings align with prior efforts to abbreviate and validate mental toughness questionnaires, such as the SMTQ (Sheard et al., 2009) and the MTQ-18/MTQ-10 (Dagnall et al., 2019). Similar to these instruments, the MTSQ-19 balances efficiency with psychometric robustness. Moreover, the results are consistent with theoretical frameworks emphasizing the multidimensional nature of mental toughness (Clough et al., 2002; Jones et al., 2007). In line with systematic reviews (Chen Liew et al., 2019), our study contributes to the growing evidence base supporting the adaptation of MT measures across cultures and contexts. Additionally, the bifactor model and IRT analyses corroborate the argument for a general factor underlying mental toughness, while preserving subscale specificity, which is critical for nuanced interpretation (Gucciardi et al., 2009).

The shortened version enhances practicality without compromising validity, supporting the conceptualization of MT as a measurable construct across diverse performance settings (Gucciardi et al., 2009). The efficiency of the MTSQ-19 makes it suitable for repeated-measures designs, reducing cognitive fatigue while enabling longitudinal monitoring of athletes' MT (Connaughton et al., 2008). Furthermore, the findings contribute to ongoing debates about the relationship between MT and mental health (Gucciardi et al., 2017).

Table 2

Summary of Item Loadings, Coefficients of Discrimination and Information for Measuring MSTQ-19 Subscales

	Factor loadings and explained variance		Item information	
Item	λ	η^2	RMSEA	*p*
7	.620	.616	.025	.309
9	.600	.640	.025	.311
12	.630	.603	.031	.353
13	.620	.616	.028	.331
14	.590	.652	.026	.313
15	.590	.652	.027	.321
17	.620	.616	.026	.312
18	.630	.603	.030	.343
21	.580	.664	.031	.352
24	.630	.603	.030	.347
25	.690	.524	.030	.347
27	.660	.564	.023	.296
28	.630	.603	.032	.359
29	.600	.640	.026	.317
30	.670	.551	.026	.313
31	.710	.496	.032	.357
32	.640	.590	.024	.299
33	.680	.538	.026	.316
35	.550	.698	.028	.330
36	.630	.603	.026	.315
37	.650	.578	.030	.347
38	.580	.664	.027	.320
42	.560	.686	.029	.339

Note. λ = factor loading (standardized loading indicating the strength of the relationship between the item and the latent factor); η^2 = coefficient of discrimination (proportion of item response variance explained by the latent factor); RMSEA = root mean square error of approximation (item-level index of model misfit); *p* = item information (precision with which the item measures the latent construct within the IRT framework).

Importantly, the bifactor structure suggests that MT can be modeled as a hierarchical construct, which aligns with contemporary psychometric theory and facilitates integration with predictive models of performance and well-being (Jones et al., 2007).

From an applied perspective, the MTSQ-19 can be incorporated into mental training programs designed to enhance coping strategies and MT (Cowden et al., 2021; Mack & Ragan, 2008). Its brevity facilitates use in high-performance environments where time efficiency is crucial. The tool may also serve as a diagnostic measure for tailoring interventions to individual athletes, complementing stress management and mindfulness-based approaches (Brewer et al., 2009). Additionally, its psychometric rigor ensures that practitioners can rely on accurate assessments when designing personalized mental skills programs, which is essential for optimizing competitive outcomes (Gucciardi et al., 2017).

Limitations

Despite promising results, several limitations must be acknowledged. The sample distribution across age groups was uneven, limiting conclusions about developmental differences. The representation of sport disciplines was not systematic, which may have biased the findings. As noted by Ruiz and Watt (2014), balanced sampling across disciplines and levels of advancement is essential. Moreover, the current study did not include sport-specific or demographic variables, which should be addressed in future research. Another limitation concerns the absence of external validity checks, such as correlations with performance metrics or psychological well-being indicators, which would strengthen the interpretability of the scale (Chen Liew et al., 2019).

Further validation of the MTSQ-19 is recommended, including adaptation to specific sports (e.g., AfMTI in football; Gucciardi, 2009) and cross-cultural contexts. Longitudinal studies should examine sensitivity to interventions, such as stress-coping training, to confirm whether the scale captures changes over time. Comparative analyses with other MT questionnaires will also strengthen its theoretical and practical utility. Future research should also explore the integration of psychometric data with physiological markers (e.g., heart rate variability) to provide a multidimensional understanding of resilience (Mack, 2019).

CONCLUSION

In summary, the MTSQ-19 demonstrates sound psychometric properties and offers a practical tool for assessing mental toughness among Polish athletes. Its brevity enhances its utility in both research and applied settings, while future work should focus on cross-cultural adaptation, sport-specific validation, and intervention sensitivity. The evidence from bifactor modeling and IRT confirms that the scale captures both general and specific dimensions of MT, making it a robust instrument for diverse applications (Gucciardi et al., 2009; Przybylski, 2018).

CRediT Author Statement

JACEK PRZYBYLSKI (70%): conceptualization, methodology, software, validation, resources, writing (original draft), supervision, writing (review and editing).

KAROL KARASIEWICZ (30%): formal analysis, resources, writing (original draft).

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