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REVIEW ARTICLE

Mental Toughness and Success in Sport: A Review and Prospect

Richard Gregory Cowden*

North-West University Institute of Psychology and Well-being, South Africa

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Abstract:

Background:

Mental toughness (MT) is often referred to as one of the most important psychological attributes underpinning the success of athletes. Although selected studies have examined this common supposition, research in this area has yet to be synthesized.

Objective:

The purpose of this study was to review the quantitative literature on MT, competitive standard, achievement level, and performance (competitive and non-competitive) in sport.

Method:

Searches using a specified key term were performed in 10 databases during August 2016. Following an initial screening of the unique records that were identified (N = 1025), 19 peer-reviewed articles met the eligibility criteria for inclusion in the review.

Results:

The majority of MT-competitive standard studies (N = 10) found total (66.7%) or subcomponent (71.4%) MT differences, with mentally tougher athletes participating at higher levels of competition. Of the remaining studies (N = 9), most indicated (77.8%) mentally tougher athletes tend to achieve more or perform better.

Conclusion:

Collectively, the results point to mentally tougher athletes' superior levels of success. The findings are discussed alongside the limitations associated with this part of the current MT in sport literature, with several important areas outlined for scholars to consider and pursue when conducting future research.

Keywords: Mental toughness, Competitive standard, Achievement, Performance, Success, Sport, Athlete.

INTRODUCTION

Pivotal to athletic performance is the ability to more maintain desired athletic performance levels during particularly critical periods of competition [1], such as during pressurised situations that typically evoke elevated levels of anxiety (e.g., penalty kicks) or when exposed to unexpected adversities (e.g., unfavourable umpire calls on crucial points) [2, 3]. These kinds of situations become markedly important when athletes, who are separated by marginal physical and technical differences, are engaged in closely contested matches, games, or races [4]. It is within these competitive conditions, in particular, that athletes' responses define their degree of success (or lack thereof); responses that are largely dependent on athletes' psychological attributes [5]. One of these attributes appears to be mental toughness (MT), which has often been classified as a critical success factor due to the role it plays in fostering adaptive responses to positively and negatively construed pressures, situations, and events [6 - 8]. However, as scholars have intensified

* Address correspondence to this author at the North-West University, 22 Willow Manor, Ditedu Street, Potchefstroom, 2531, South Africa; Tel: +27 (0) 73 338 2709; E-mail: richardgregorycowden@gmail.com

efforts towards understanding the psychological *differentiator* that MT represents, early definitions varied in scope and have often been criticized [9, 10]. With the escalation in research attention that MT has been given recently, the accumulating evidence suggests MT refers to a multifaceted construct that facilitates the consistent pursuit of performance excellence, irrespective of the type (i.e., internal versus external), direction (i.e., positive versus negative), and degree (i.e., mild versus severe) of demands experienced [11 - 13].

The growing research emphasis towards the concept has arguably been stimulated by two factors, one of which is the developmental capacity of MT [14, 15]. Without support for the latter, research and interventions that emphasize a stable and unchanging construct have limited practical relevance [16], particularly to athletes categorized as "mentally weak". Several qualitative inquiries have found MT changes throughout the course of human development and is influenced by various individuals (e.g., coach, peers), experiences (e.g., critical events, both positive and negative), and personal factors (e.g., curiosity) [17 - 19]. Mirroring this, Anthony, Gucciardi, and Gordon's [20] synthesis of the qualitative literature delineated four sources of MT development: personal attributes, interactions with the environment, opportunities for progressive development, and continued and diverse critical incident experiences.

Qualitative investigations have been supplemented by initial research involving targeted interventions, a number of which have provided support for the modification of MT [21, 22]. Similar gains have also been found over longer intervals. In Bell, Hardy, and Beattie's [23] longitudinal intervention involving adolescent cricketers, the experimental group was found to have significantly greater post-test coach-rated MT scores (i.e., 12-month post-intervention), as compared to (a) the group's pre-test scores and (b) the control group's post-test scores. Taken together, these studies offer emerging support for the amenability of MT, both over time and through intervention efforts.

The second (and perhaps strongest) factor underpinning the prominent attention that MT has been given is based on the implicit associations it has with success and superior performance outcomes. The MT-performance link has roots in early studies that retrospectively sampled elite and super-elite performers, such as past Olympic champions and athletes labelled as "mentally toughest" during their tenure as international performers [2, 24]. A common critique of such studies is that athletes should not be presumed to be knowledgeable or archetypical of what embodies MT on the basis of the experiences they recollect or their past sporting achievements [25].

More recently, researchers have not only broadened conceptualizations and applications of MT to non-elite athletes [26, 27], but begun to quantifiably examine whether MT is able to predict or differentiate athletes according to competitive (e.g., race times) [27] and non-competitive performance indicators (e.g., 20 meter shuttle run test) [28]. However, in many studies, the reporting of performance-related MT computations form part of subsidiary results, which are not typically discussed in much detail [29, 30]. Considering MT holds such a strong conceptual association with athletic performance [31], an empirical vagueness presently exists in this area [4, 25]. Specifically, it is still uncertain whether MT contains or is manifested in better performance, achievement, or success outcomes, or whether MT is more likely reflected in non-performance factors (e.g., increasing the likelihood of positive psychobehavioral responses to certain conditions). Therefore, it appears a prudent moment in the progression of MT to reflect on the MT-performance relationship by synthesizing the literature in this area. To date, no study has attempted to integrate this body of research, and doing so might inform the selection of variables that determine how the effectiveness of interventions are evaluated (i.e., performance versus behavioral criteria). Thus, the aim of the current study was to systematically review the available quantitative literature that has examined MT in relation to competitive and non-competitive measures indicative of success in sport (e.g., athletic achievement, competitive standard, performance correlates).

METHOD

Search Strategy

Using the assistance of a qualified librarian with over 20 years' experience, a database search was conducted in August 2016 using the following combination of key terms – [(mental toughness OR mentally tough) AND (athlete* OR player* OR participant* OR sportsm* OR sportswom*) AND (sport* OR athletic* OR match* OR game* OR race*) AND (compet* OR achieve* OR rank* OR outcome* OR perform*)].

A search of 10 databases – ScienceDirect (N = 716), SPORTDiscus (N = 94), PsychARTICLES (N = 7), PsychINFO (N = 109), PubMed (N = 38), Academic Search Premier (N = 53), SocINDEX (N = 9), Web of Science (N = 102), and Scopus (N = 174) – limited by source type (i.e., books, chapters in books, and peer-reviewed articles) revealed 1302 records. All duplicates (N = 277) were eliminated through automatic removal and manual screening.

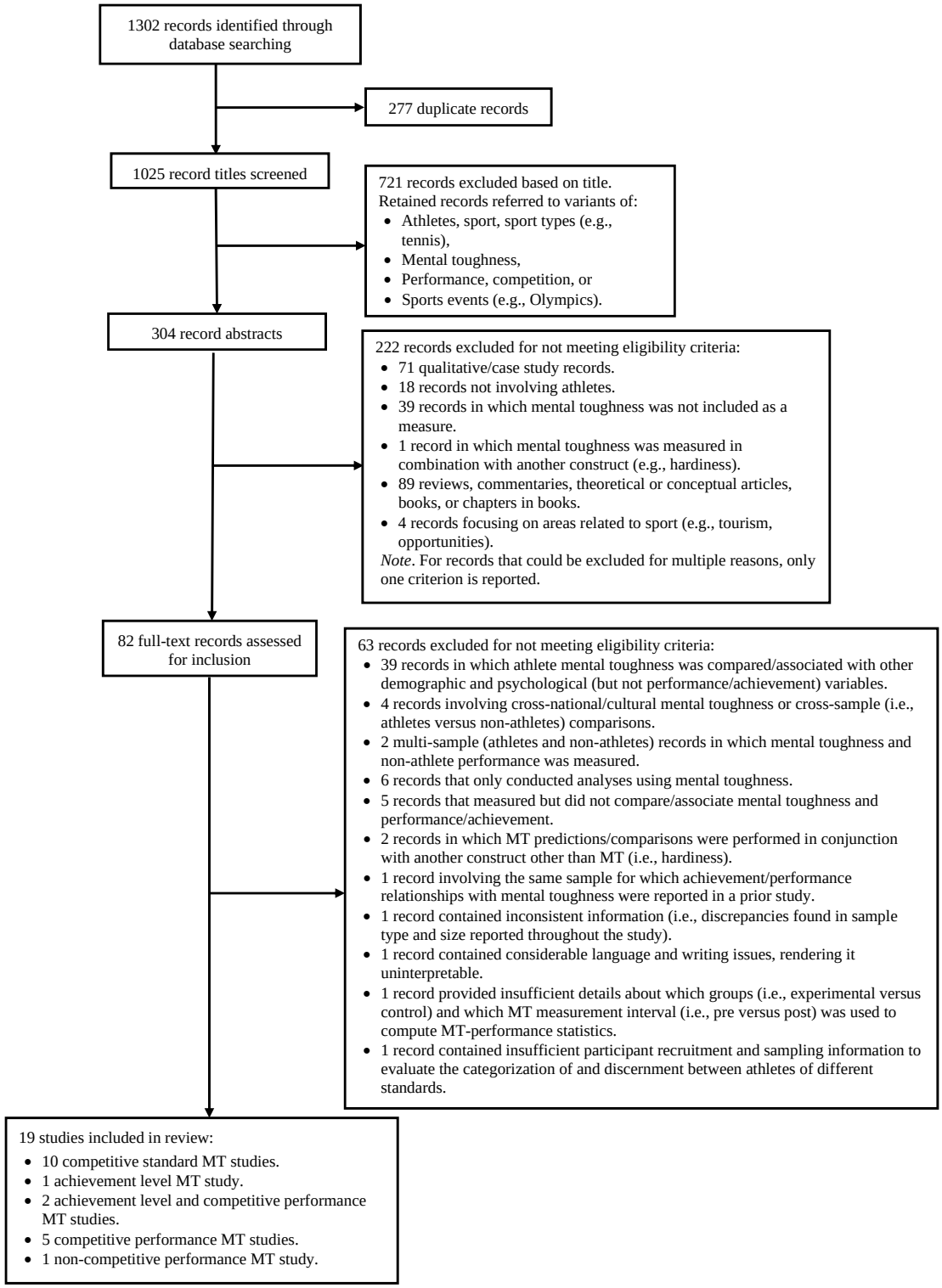

Fig. (1). Process flow diagram from identification to inclusion of studies.

Inclusion and Exclusion Criteria

The inclusion of articles followed a three-phased approach (Fig. (**1**)) using the PRISMA guidelines [32]. In phase one, the titles of the 1025 records were initially examined, with records ineligible if they did not refer to the following terms (or close variants of such): sport, athlete(s), sport types (e.g., boxing), mental toughness, performance, competition, or sports events (e.g., Olympics). This process resulted in the removal of 721 records. The abstracts of the

remaining 304 records were scrutinized in phase two, with records (N = 222) excluded if they (a) only contained qualitative/case study methods and results, (b) were based on non-athletes or non-sport performers, (c) were reviews, commentaries, theoretical, or conceptual articles, books, or chapters in books, (d) did not measure (quantitatively) mental toughness, or (e) examined areas unrelated to direct athlete involvement in sport (e.g., spectators).

In the third phase, the full-texts of the final 82 records were examined. Records that met the inclusion criteria were either studies that: (a) compared athletes' mental toughness according to competitive (e.g., match outcome) or non-competitive (e.g., physical strength) performance indicators or athletic achievement (e.g., competitive playing standard), (b) compared the competitive or non-competitive performance indicators of achievement or performance of athletes with varying degrees of mental toughness (e.g., categorized as high versus low), (c) examined relationships between mental toughness and competitive or non-competitive performance or athletic achievement indicators, (d) predicted competitive and non-competitive performance statistics using mental toughness, or (e) did not conduct comparative or predictive analyses using mental toughness in conjunction with other psychological constructs (e.g., hardiness). Following application of the above, a total of 19 articles were eligible and included in the review (marked with an asterisk in the Reference list).

Data Extraction

Data on the sample characteristics, methodological approaches, and relevant results were extracted and captured for each of the eligible studies. Recorded study and sample characteristics included the geographic location, sport types, competitive standard of sport participation, years of experience, sex, age, and race of the participants. The type of research design, MT instruments (along with source of measurement and the manner in which the instrument was used), measures of performance, achievement level, competitive standard, statistical analyses, and analytical outcomes were also documented.

RESULTS

The articles that met the inclusion criteria cover a recent and relatively short duration of 10 years (2007 to 2016). Most studies (78.9%) were conducted among samples from Australia (N = 4), the United Kingdom, (N = 6), and The United States (N = 5), each of which are high income and developed, Westernized nations [33]. Except for one longitudinal study (albeit MT-performance statistics were only computed using MT recorded on one occasion), researchers employed cross-sectional designs to examine MT. A combination of general (21.1%), sport-general (68.4%), and sport-specific (10.5%) MT instruments were used, which were most often used as a single, self-report source of athletes' MT (N = 17). The majority of studies (52.6%) compared athlete MT according to competitive standards of participation, while the remainder associated MT with athletic achievement level (N = 3), competitive (N = 7), or non-competitive (N = 1) performance indices (two studies examined achievement level and competitive performance).

Sample Characterization

A description of key study and sample characteristics is detailed in Table **1**. There were 4169 participants sampled across the 19 studies, 70.9% of which were males. This is attributable to the (a) five studies that only included male participants and (b) 10 studies with samples that contained fewer females than males. In studies that provided average ages split by sex (N = 5), male groups were older than female groups. Most samples included senior (18 or older) athletes (N = 12), whereas others only juniors (N = 4) or a combination of the two (N = 3). Of the studies that focused on a single sport, there were slightly fewer team (N = 6) than individual (N = 8) sports; 26.3% included a variety of individual and team sport types.

Except for six studies, which included athletes from a single competitive standard, a range of competitive standards were represented. However, the terminology and groupings used by researchers tended to differ across many of the studies. For instance, selected researchers used country, provincial, and county to distinguish athletes [34], whereas athletes were categorized according to professional status level, such as professional, semi-professional, and amateur [35]. Some combined competitive standards (e.g., club and national level players) [26] that others separated [36]. Less than half of the studies (47.4%) did not provide an account of athletes' sporting experience, and, for those that contained athletes from more than one competitive standard (N = 12), 25% outlined playing experience according to competitive standard of participation.

Table 1. Characteristics of studies and samples included in review (N = 19).

Author (year)	Country	Sex		Age (years)		Sport type(s)	Competitive standard(s)	Years of sport experience [*M* (*SD*) or range]
		♂	♀	Group	*M* (*SD*)			
Wieser & Thiel (2014)*	GB	20	-	18-33	24.8 (4.63)	S	INT; NAT seniors	7.7 (4.84)
Drees & Mack (2012)***	US	54	-	14-18	15.98 (1.24)	WR	REG; REC juniors	1 (*n* = 3); 2-5 (*n* = 25); 6-10 (*n* =16); ≥10 (*n* =10)
Cowden (2016)†	ZA	25	18	-	13.6 (2.4)	T	NAT; REG; REC juniors	-
Cowden *et al.* (2014)**	US	8	8	-	♂ = 20.9 (1.4); ♀ = 19.4 (1.2)	T	UN seniors	-
Gucciardi *et al.* (2009b)†	AU	418	-	15-30	18.97 (3.71)	AF	AM; S-EL; EL juniors and seniors	10.33 (3.57)
Weissensteiner *et al.* (2012)†	AU	21	-	-	NAT/REG = 22.5 (2); CL = 27 (5.8)	C	NAT; REG; CL seniors	NAT/REG = 13.3 (2.8) CL = 17.2 (6.1)
Kuan & Roy (2007)†	MY	21	19	19-27	21.43 (1.66)	WU	UN seniors	2.66 (1.6)
Crust & Azadi (2010)†	GB	67	40	-	♂ = 22.6 (5); ♀ = 21.6 (2.8)	VS	NAT (*n* = 5); C (*n* = 66); CL/UN (*n* = 36) seniors	-
Cowden & Meyer-Weitz (2015)†	ZA	191	174	-	♂ = 31.32 (15.28); ♀ = 26.03 (11.08)	T	INT (*n* = 35); NAT (*n* = 83); UN (*n* = 160); LCT (*n* = 24); C (*n* = 63) seniors	INT = 19.06 (16.54); NAT = 20.04 (13.68); UN = 11.32 (4.05); LCT = 18.21 (12.58); CC = 24.37 (14.07)
Nicholls *et al.* (2009)†	GB	454	223	15-58	22.66 (7.2)	VS	INT (*n* = 60); NAT (*n* = 99); C (*n* = 198); CL/UN (*n* = 289); BEG (*n* = 31) juniors and seniors	11.65 (7.43)
Mahoney *et al.* (2014)†	AU	136	85	-	♂ = 14.39 (1.44); ♀ = 14.29 (1.53)	CC	AM juniors	4.47 (2.57)
Chen & Cheesman (2013)†	US	136	-	18-42	27.2 (4.8)	MMA	PRO (*n* = 49); S-PRO (*n* = 39); AM (*n* = 48) seniors	-
Madrigal *et al.* (2013)†	US	74	69	18-24	19.98 (NS)	B	UN seniors	-
Newland *et al.* (2013)†	US	92	105	-	-	B	UN seniors	-
Sheard *et al.* (2009)†	GB	778	364	16-63 (n_1 = 633); 18-48 (n_2 = 509)	N_1 = 21.5 (5.48); N_2 = 20.2 (3.35)	VS	INT (*n* = 79); NAT (*n* = 150); C/PROV (*n* = 479); CL/REG (*n* = 434) juniors and seniors	-
Meggs *et al.* (2014)†	GB	65	40	18-25 (*n* = 78); 26-35 (*n* = 10); ≥36 (*n* = 17)	-	VS	INT (*n* = 9); NAT (*n* = 18); REG (*n* = 29); REC (*n* = 49) seniors	7.5 (1.33)
Crust (2009)†	GB	55	57	-	♂ = 30.1 (11.6); ♀ = 28.6 (8.9)	VS	CL to NAT (*n* = 63); REC (*n* = 49) seniors	-
Hagag & Ali (2014)†	EG	12	10	-	-	F	INT seniors	-
Gucciardi *et al.* (2016)†	AU	330	-	15-18	16.86 (.71)	AF	AM juniors	9.32 (2.51)

Note. GB = United Kingdom, US = United States of America, ZA = South Africa, AU = Australia, MY = Malaysia, EG = Egypt, ♂ = Male, ♀ = Female, n = number of participants, M = Mean, SD = Standard deviation, S = Soccer, WR = Wrestling, T = Tennis, AF = Australian football, C = Cricket, VS = Variety of sports, WU = Wushu, CC = Cross-country running, MMA = Mixed martial arts, B = Basketball, F = Fencing, NAT = National, REG = Regional, CL = Club, C = County, LCT = Local county tournament, UN = University (team/league), INT = International, REC = Recreational (school/leisure), AM = Amateur, S-EL = Sub-elite, EL = Elite, B = Beginner, PRO = Professional, S-PRO = Semi-professional, PROV = Provincial. † = cross-sectional, self-report study design. * = cross-sectional, coach-rated study design (one coach rating per instrument). ** = cross-sectional, coach and athlete-rated study design. *** = Longitudinal, self-report study design.

Mental Toughness and Competitive Standard

An overview of each of the studies that examined competitive standard differences in MT is presented in (Table **2**) ($N = 10$). Among those that conducted competitive standard comparisons using total MT ($N = 9$) and subcomponent MT ($N = 7$), significant differences in total MT or at least one subcomponent were reported in 66.7% [8, 29, 30, 35, 37, 38] and 71.4% [8, 30, 35, 38, 39] of the studies, respectively. In each case, the MT of athletes participating at higher levels of competition was higher.

Although the MT instruments varied in the quantity (three to 12) and classification (commitment versus constancy) of MT subcomponents, those on which the greatest number of differences were found included confidence or self-belief ($N = 4$), variants of determination (e.g., perseverance; $N = 4$), and control or positive cognition ($N = 2$). However, MT subcomponent distinctions were limited to selected areas in each study ($N = 5$), with researchers finding similarities between groups on at least one MT subcomponent.

Two out of the three studies reported group differences when MT subcomponents were compared between two competitive standard groupings [30, 38]. Of the four studies that found subcomponent MT differences among three or more groups, the two single sport studies identified differences between the highest standard and all lower standards [35, 39]. Differences in the remaining two studies (multiple sports) were solely between the highest and lowest [30], the two highest and two lowest, and the two lowest competitive standard groups [8]. However, in all four studies, at least two groups were similar on one or more of the MT subcomponents.

Table 2. Summary of method and results for mental toughness and competitive standard studies (N = 11).

Author (year)	MT instrument(s)	MT instrument and use	Competitive standards	Data analyses	Result(s)
Crust (2009)	MTQ48	Total MT and subscales (i.e., Challenge, Commitment, Interpersonal confidence, Confidence abilities, Emotional control, Life control)	• Club to national ($n = 63$) • Recreational ($n = 49$)	Independent samples t-test for total MT and subscales (Bonferroni adjusted applied to *p*-values for multiple comparisons)	• No differences found between the group on total MT and the subscales ($p < .05$)
Gucciardi *et al.* (2009)	AfMTI	MT subscales (i.e., Thrive through challenge, Sport awareness, Desire success, Tough attitude)	• Elite ($n = 118$) • Sub-elite ($n = 167$) • Amateur ($n = 138$)	ANOVAs for each subscales, followed by post-hoc comparisons	• Except for tough attitude ($p > .05$), ↑ scores for elite ($p < .017$) compared to sub-elite group • ↑ scores on all subscales for elite ($p < .001$ to $.017$) compared to amateur group • No differences between amateur and sub-elite groups
Nicholls *et al.* (2009)	MTQ48	Total MT and subscales (i.e., Challenge, Commitment, Interpersonal confidence, Confidence abilities, Emotional control, Life control)	• International ($n = 60$) • National ($n = 99$) • County ($n = 198$) • Club/university ($n = 289$) • Beginner ($n = 31$)	ANOVA for total MT, and, due to sex differences in subscale MT, a competitive standard by sex MANOVA for the MT subscales	• No differences in total MT ($p > .05$) • No main effect for competitive standard ($p = .25$) or competitive standard by sex interaction effect ($p = .06$)
Sheard *et al.* (2009)	SMTQ	Total MT and subscales (i.e., Confidence, Constancy, Control)	• International ($n = 79$) • National ($n = 150$) • County/provincial ($n = 479$) • Club/regional ($n = 434$)	ANOVA for total MT, with post hoc comparisons. MANOVA for MT subscales, with post-hoc comparisons (Dunn-Sidak method used)	• ↑ total MT among international and national compared to county/provincial and club/regional athletes ($p < .05$) • ↑ confidence and constancy among international and national compared to county/provincial and club/regional athletes ($p < .001$) • ↑ confidence and constancy among county/provincial compared to club/regional athletes ($p < .001$)
Crust & Azadi (2010)	MTQ48	Total MT	• National/county ($n = 71$) • Club/university ($n = 36$)	Independent samples *t*-test	• ↑ total MT among national/county group ($p = .03$)

(Table 2) contd.....

Author (year)	MT instrument(s)	MT instrument and use	Competitive standards	Data analyses	Result(s)
Weissensteiner *et al.* (2012)	Mental toughness Inventory	Total MT and subscales (i.e., Task Focus, Task Familiarity, Perseverance, Positivity, Positive Comparison, Stress Minimization, Self-efficacy, Potential, Mental Self-concept, Personal bests, Task value, Goal commitment)	• National/regional (n = 11) • Club (n = 10)	ANOVA for total MT and follow-up ANOVAs for each subscale	• ↑ total MT among national/regional group (p < .05) • ↑ self-belief, personal bests, task value, perseverance, and goal commitment among national/regional group (p < .05)
Chen & Cheesman (2013)	PPI-A and SMTQ	Total SMTQ and subscales (i.e., Confidence, Constancy, Control) Total PPI-A and subscales (i.e., Determination, Self-belief, Positive cognition, Visualization)	• Professional (n = 49) • Semi-professional (n =39) • Amateur (n = 48)	MANOVA for total SMTQ and PPI-A scores, followed by ANOVAs for each. MANOVA with all 7 subscales, followed by ANOVAs (Bonferroni adjustments applied to follow-up analyses)	• ↑ total MT scores on the SMTQ (p < .01) and PPI-A (p < .005) among professional group compared to semi-professional and amateur group • ↑ determination (p = .007), positive cognition (p < .001), and confidence (p < .001) among professional group compared to semi-professional and amateur groups
Meggs *et al.* (2014)	SMTQ	Total MT and subscales (i.e., Confidence, Constancy, Control)	(a) Grouping 1: • International and national (n = 27) • Regional and school/recreational (n = 78) (b) Grouping 2: • International and national (n = 27) • Regional (n = 29) • School/recreational (n = 49)	(a) Independent samples t-tests (b) Independent samples t-tests	(a) • ↑ total MT among international and national athletes (p < .02). • ↑ confidence among international and national athletes (p < .001) (b) • ↑ control among international and national compared to school/recreational athletes (p < .05)
Wieser & Thiel (2014)	Modified SMTQ (inclusion of duplicate item to assess consistency) and PPI-A	Average total MT % (i.e., Modified total SMTQ% + total PPI-A%) / 2	• International (n = 8) • Non-international (n = 12)	Independent samples t-test	• ↑ average total MT % among international soccer players (p < .04)
Cowden & Meyer-Weitz (2015)	SMTQ	Total MT and subscales (i.e., Confidence, Constancy, Control)	• International (n = 35) • National (n = 83) • University team/league (n = 160) • Local county (n = 24) • County club (n = 63)	ANOVA for total MT and MANOVA for MT subscales (Bonferroni adjustments applied to follow-up analyses)	• No differences in total MT (p = .094) and each of the subscales (p = .274)

Note. N = number of studies, n = number of participants, MT = mental toughness, MTQ48 = Mental Toughness Questionnaire 48, AfMTI = Australian football Mental Toughness Inventory, SMTQ = Sports Mental Toughness Questionnaire, PPI-A = Psychological Performance Inventory – Abbreviated, ANOVA = Analysis of Variance, MANOVA = Multivariate Analysis of Variance, ↑ = higher/greater.

Mental Toughness, Achievement, and Performance

Table **3** summarizes the studies (N = 9) that explored MT according to athletic achievement and performance. For achievement level, one study revealed mentally tougher tennis athletes were ranked higher using athlete-rated MT [4], whereas another did not [40]. Although the sample size in the former was small (n = 18), the same study found greater coach-rated MT was associated with better rankings [40]. Starting status was also unrelated to self-reported MT in a study involving basketball players [41]. Distinctions in the specificity and sensitivity of the achievement measures that were used might explain the inconsistent results. Also, none of the studies conducted MT subcomponent analyses, and whether MT-achievement level relationships are dependent on selected MT areas is indeterminable.

The seven studies that compared or associated MT with competitive performance indices involved a single sport, and only one (14.3%) did not find that MT predicted performance [42]. One of the remaining six studies found MT was associated with some performance statistics and not others [4], and another found that MT predicted performance for males, but not females [41]. Even though six of these studies indicated some degree of competitive performance may be distinguished or predicted by MT, only two (33.3%) conducted subcomponent analyses [43, 44]. In both studies, athletes' performance was distinguished by self-confidence and one or more types of control (e.g., negative energy

control). The single study that reported on MT and non-competitive performance found a positive association between the two [28]. Notably, it was the only study included in the review that controlled for athletes' physiological characteristics (e.g., body mass) beyond that of basic demographics.

Table 3. Summary of method and results for mental toughness and achievement/performance studies (N = 9).

Achievement or Performance Area	Author (year)	MT instrument(s)	MT instrument and use	Achievement or Performance Measure	Data analyses	Result(s)
Achievement level	Newland *et al.* (2013)	PPI-A	Total MT	Starting status (starter = starting ≥ 50% of games, non-starter = starting < 50% of games)	2 (sex) by 2 (starting status) ANOVA for MT	• No main effect for starting status (p = .89)
	Cowden *et al.* (2014)	Modified SMTQ (item 1 removed)	Total MT	Team rank – average playing position over past 5 matches (lower ranking superior)	Pearson correlations for coach and athlete MT ratings	• ↑ MT associated with better ranking for coach-rated MT (r = -.65, p < .01), but not athlete-rated MT (r = .06, p < .05)
	Cowden (2016)	Mental Toughness Inventory	Total MT	Ranking (lower rankings superior)	Spearman correlation	• ↑ MT associated with better ranking (r = -.29, p < .05)
Competitive performance	Drees & Mack (2012)	MeBTough	Total MT	(a) Season win/loss % (b) Season performance record – winning record (N = 38), losing record (n = 16)	(a) Pearson correlation (b) Independent samples t-test	(a) ↑ post-season MT associated with higher winning % (r = .27, p < .05) (b) ↑ post-season MT among winning record wrestlers (p < .05)
	Cowden (2016)	Mental Toughness Inventory	Total MT	(a) Match outcome (Loss = 0, Win = 1) (b) Competitive performance indices (see Cowden 2016 for calculation details)	(a) Point-biserial correlation (b) Pearson correlations	(a) ↑ MT associated with greater likelihood of winning (r = .52, p < .01) (b) ↑ MT associated with winning a greater % of 3 or more consecutive points per game (r = .39, p < .01), a better ratio of break points won per game (r = .39, p <.01), a better ratio of break point chances as receiver versus server (r = .36, p < .01), a higher % of points won on even (equal) serve (r = .36, p <.01) and return score (r = .28, p <.05), a higher % of serve points won when ahead (r = .27, p <.05), a higher % of return points won when behind (r = .31, p <.05), and a higher % of critical serve points won (r = .29, p <.05). Remaining 10 competitive performance-MT correlations were not significant (p > .05)
	Kuan & Roy (2007)	PPI	Total MT and subscales (i.e., Self-confidence, Negative energy control, Attention control, Visualization and imagery control, Motivation, Positive energy, Attitude control)	Medal status (medallist versus non-medallist)	Independent samples t-tests	• ↑ MT among medallists on self-confidence (p = .001) and negative energy control (p = .042)
	Mahoney *et al.* (2014)	Mental Toughness Index	Total MT	Standardized race times (lower times superior)	Pearson correlation	• ↑ MT associated with better race times (r = -.21, p < .01)

(Table 3) contd.....

Achievement or Performance Area	Author (year)	MT instrument(s)	MT instrument and use	Achievement or Performance Measure	Data analyses	Result(s)
	Madrigal *et al.* (2013)	MTS and MeBTough	Total MT	Season free throw % (n = 44)	Pearson correlations	• MTS and MeBTough scores unrelated to season free throw % (r = -.08, p > .05)
	Newland *et al.* (2013)	PPI-A	Total MT	Basketball performance = Field goal % (Total points in game + Rebounds + Assists + Steals) – Personal fouls – Turnovers + 10	(a) Pearson correlation (b) Due to sex MT differences (ANOVA), separate hierarchical moderated regression analyses (IVs = MT, starting status, interaction) to predict performance	(a) MT unrelated to basketball performance (r = .12, p = .09) (b) • Males: ↑ basketball performance among starters (r = .51, p < .05) and those with higher MT (r = -.03, p < .05). Starters with higher levels of MT (interaction) tended to perform better (r = .36, p < .05) • Females: ↑ basketball performance among starters (r = .58, p < .05) only
	Hagag & Ali (2014)	PPI	Total MT and subscales (i.e., Self-confidence, Negative energy control, Attention control, Visualization and imagery control, Motivation, Positive energy, Attitude control)	Medal status (medallist versus non-medallist)	Independent samples t-tests	• ↑ total MT, self-confidence, visualization and imagery control, and positive energy control among medallists (p < .05)
Non-competitive performance	Gucciardi *et al.* (2016)	Semantic differential MT scale	Total MT	20 meter multistage shuttle run test [MST] (lower time superior)	Bayesian structural equation modelling to predict MST (longer distances superior)	↑ MT associated with better MST performance (r = .24, 95% *CI* = .14 to .34), when controlling for age, football playing experience, height, and body mass

Note. N = number of studies, n = number of participants, MT = mental toughness, MeBTough = Mental, Emotional, and Bodily Toughness Inventory, MTS = Mental Toughness Scale, SMTQ = Sports Mental Toughness Questionnaire, PPI = Psychological Performance Inventory, PPI-A = Psychological Performance Inventory – Abbreviated, ANOVA = Analysis of Variance, IV = independent variable, ↑ = higher/greater.

DISCUSSION

This study represents the first known review of the quantitative literature on MT and athletic achievement, competitive standards of participation, and performance. In total, 19 studies were eligible for inclusion, with 78.9% of all studies finding MT distinguished between or predicted competitive standards, achievement levels, or performance outcomes. Accordingly, the results from the review suggest athletes who report or are rated higher in MT generally participate at higher levels of competition, achieve more, and produce better performances. Collectively, these findings support the commonly held belief that mentally tougher athletes tend to be more successful [2, 39, 45].

Mental Toughness and Competitive Performance

The majority of the studies (70%) included in the review indicated MT was able to discriminate between two or more groups of athletes participating at various competitive standards. However, competitive standard may not possess adequate sensitivity to determine subtle differences between athletes, as a large proportion of the six studies with three or more competitive standard groupings did not find differences between the two highest (50%) and the two lowest competitive standards (83.3%). Two possible reasons for this exist. The first is the inclusion of multiple sporting codes into many (50%) of the study samples. Given researchers have asserted sport type differences in MT development [46] and the type of MT that each sport emphasizes [47], combining team, individual, contact, and non-contact sports may limit the extent to which competitive standard MT discrepancies are identified within each sport.

The second reason is the unsystematic manner in which competitive standards were categorized in the studies. This includes the specificity that researchers used to classify groups, with some including a broad array of athletes (e.g., club to national level) [26] and others using a narrow scope for grouping them (e.g., international level) [34]. Heterogeneous competitive standard groupings may dilute the MT of a group, whereas an impartial determination of MT is more likely

when distinct categorizations are used. Therefore, group classifications have an obvious effect on whether group differences may be detected. The studies also differed in competitive standard coverage (e.g., international to beginner versus international to county club) and terminology used to designate groups (e.g., elite versus professional), the latter of which is particularly important for making cross-study comparisons.

The issue of categorizing athletes pervades the sport and exercise psychology literature, and a recent review identified eight categories (e.g., professionalism, training, international/national) that are used to define elite athletes in particular [48]. In order to improve consistency among researchers, Swann *et al.* [48] propose an equation for classifying athletes' along a continuum of 'eliteness'. Although designed for elite athletes, employing a similar type of approach to MT studies would facilitate standardized competitive standard groupings that allow comparisons between studies that differ based on, among other factors, sample type (e.g., males versus females) and sport code.

Mental Toughness, Achievement, and Performance

Approximately 88% of relevant studies found athletes with higher levels of MT tend to achieve more or perform better. The strength of many of these studies is the use of sport-specific measures to objectively evaluate performance, which, compared to competitive standard, provide more direct evidence supporting the influence of MT on athletic performance. However, given MT applies primarily to the most critical, pressurized, or adversarial competitive situations [11, 49], it is surprising that only two studies have measured competitive performance indices of this kind [4, 42]. In both studies, there was limited support for the superior performance of mentally tougher athletes during such conditions. For example, Cowden [4] found that MT predicted one out of six performance indices during critical moments in tennis competition. Identifying the most important competitive situations that warrant MT is likely more challenging in selected sports (e.g., long distance running), but if MT represents the psychological attribute that differentiates the 'good' from the 'great' [45] then scholarly attention should be directed towards identifying sport-specific *mental toughness moments* and evaluating the performance of athletes during these moments. This includes determining the type/s of MT that specific situations require, but the findings in this review indicate that only two studies have evaluated overall competitive performance in relation to MT subcomponents [43, 44]. Therefore, investigations that evaluate performance based on a MT – situation x type – competition framework would make a major contribution towards determining which conditions and responses explain why mentally tougher athletes generally produce better performances than their mentally weaker counterparts.

Despite the promising athletic performance enhancing benefits associated with being mentally tougher, the findings in this review indicated that little consideration has been given to the role of MT while controlling for the physical (e.g., anthropometry), technical, and tactical abilities of athletes or the opponents they compete against. Several researchers have proposed athletes' skills or physical abilities may be stronger determinants of their achievements or performance outcomes [34, 36], and it is likely that MT is less relevant during competitive engagements in which competitors' physical abilities and skill levels are unbalanced. Thus, more accurately ascertaining the influence of MT on performance outcomes should involve measuring and statistically controlling for such factors.

Study Design and Mental Toughness Measurement

The findings from this review indicate that the MT literature on dimensions of athletic success lacks longitudinal studies to establish causal sequences of relationships between variables. Considering the gradual development of MT [50], research is required to track MT and competitive standard, achievement, or performance changes over prolonged periods of time. Following the careers of a cohort of high performing middle-to-late adolescent athletes would be an appropriate place to begin, as they could be monitored for long-term periods as they progress from amateurs to super-elite professionals. By obtaining a variety of competitive standard, achievement, and performance (competitive and non-competitive) indices, more definitive deductions might be drawn about the manner in which changes in MT affect athletes' success.

Preferential research designs should also be accompanied by appropriate measurement techniques. Even though a large number of studies in this review focused specifically on team sports, each study measured athletes' MT individually and overlooked the concept and measurement of team MT. Research on resilience in sport has supported several psychosocial processes that distinguish team from individual resilience [51], indicating team resilience comprises more than merely totalling each team member's individual resilience [52]. The same could be expected for MT given that researchers have identified MT attributes (e.g., team unity) [53] that are germane to team, but not individual sports. Irrespective of the personal, individual nature of MT [49], it is likely that a team's performance is

influenced by a unique combination of the MT qualities that each team member brings to competition. The use of individual athlete MT measurements in the studies included in this review might explain why most team sport studies (66.7%) found MT was unrelated to athletic achievement or competitive performance [41, 42].

In addition, almost 90% of the articles that formed part of this review measured MT using single sourced, athlete self-report ratings. Coupled with likely reporting bias, the use of a wide range of instruments that were used across the studies indicates the inconsistency with which MT has been measured. As a more objective and context specific approach, researchers have recently proposed [54] and developed [55] behavioral measures of MT (e.g., checklists). Although behavioral approaches have yet to be applied to the MT of athletes based on competitive participation, achievement, and performance levels, they offer standardized multi-source MT ratings based on observable sport-specific behavioral criteria.

Selected Limitations

The present review is not without limitations. Most notably is the likelihood of publication bias, which readers should consider when interpreting the findings. This stems from the general preferences of journals to publish statistically significant results [56] and the decision to exclude scholarly unpublished records from this review. Also, much of the literature on MT in sport emanates from developed, Westernized, and predominantly individualistic sociocultural contexts [36], a pattern that was mirrored in the studies included in this review. Acknowledging cultural distinctions in the self-identities, perceptual lenses, and personal meanings of athletes [57, 58], the manner in which MT is conceived and applied may differ in more collectivistic, culturally diverse, and less affluent settings. Therefore, the findings from this review may not be fully generalizable to various sporting contexts and cultural orientations. Attention is drawn to the cross-sectional designs that almost all of the studies in this review utilised, and the causal direction of the relationships between the variables in this study cannot be established (i.e., whether MT is a principal cause underlying athletes' success). Because the debate about which attributes constitute MT continues [49], more than 10 different MT instruments were used in the reviewed studies, each of which vary considerably in the characteristics that they measure. Regardless of the general direction of the findings from this review, it is unclear whether these instruments are broad or narrow enough to exclusively capture MT as opposed to other similar constructs (e.g., hardiness, resilience).

CONCLUSION

MT has often been asserted or implied to correspond with higher competitive standards, achievement levels, and performance outcomes. The findings from this review of the quantitative MT in sport literature provided substantial support for this perspective, although the current literature in this area is limited by cross-sectional methodologies, inconsistent definitions of athlete groups and measurement of MT, neglecting other important factors that influence sport performance (e.g., physical abilities), and the use of success markers that lack sufficient sensitivity and specificity. Among other factors, these should be considered in future studies that seek to generate more concrete conclusions about the extent to which MT represents one of the most important psychological attributes that influences athletic success.

CONFLICT OF INTEREST

The authors confirm that this article content has no conflict of interest.

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