Mental toughness and mental health among health and social care workers in the context of COVID-19

Oana Ciocanel, BSc, MSc

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School of Health and Wellbeing
College of Medical, Veterinary and Life Sciences
University of Glasgow

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Chapter One: Systematic Review

The relationship between mental toughness and mental health: A systematic review

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Abstract

Purpose: Mental toughness (MT) refers to one's capacity to effectively cope with adversity. Since the COVID-19 pandemic, interest in public mental health has grown, highlighting protective factors such as MT. However, review evidence on its link to mental health remains limited. This systematic review examined the relationship between MT and depression, anxiety, and mental well-being.

Methods: A systematic search was conducted across multiple databases, including CINAHL, EMBASE, Medline, PsycINFO, and SCOPUS. Study quality was assessed using the Mixed Methods Appraisal Tool, and a narrative synthesis approach was employed.

Results: A total of 22 studies were included, mostly cross-sectional. All studies reported significant correlations between MT and mental health, indicating that higher MT is associated with better outcomes. Specifically, a moderate-to-strong negative relationship was found between MT and depression with correlation coefficients (r) ranging from -0.35 to -0.69 (all $p<0.01$), while the association with anxiety varied from weak-to-strong, with r values between -0.21 and -0.82 (all $p<0.001$). Additionally, a moderate-to-strong positive relationship was observed between MT and mental well-being ($r=0.31$ to 0.77, all $p<0.01$). Regression analyses further supported these findings, though associations may be influenced by factors such as athlete and student status, as well as cultural context.

Conclusions: Higher MT is associated with better mental health, though individual, cultural, and methodological factors may affect its strength. Future research should focus on using standardised assessment methods and longitudinal studies with larger samples to better identify the factors impacting the strength of the MT-mental health link.

Keywords: Mental toughness, depression, anxiety, mental well-being, review.

Introduction

In light of ongoing challenges following the COVID-19 pandemic, an important question is why some individuals experience negative mental and psychological consequences, while others adapt and avoid adverse outcomes. The pandemic has heightened interest in public mental health and overall well-being, leading to increased research into effective interventions and potential protective factors. One such factor is mental toughness (MT), an umbrella concept that comprises positive psychological resources that enable individuals to initiate and maintain goal-directed behaviour in the face of adversity (Gucciardi et al., 2015; Lin et al., 2017). Although MT has been defined in various ways (see Jones & Parker, 2013 for a review), the most widely used model is the 4C model (Clough et al., 2002). This model describes MT as a multidimensional concept that includes control (the ability to regulate life and emotions), commitment (the ability to continue with goals despite obstacles), challenge (the tendency to view obstacles as opportunities rather than threats), and confidence (in one's abilities and relationships).

MT is often discussed alongside resilience, grit, and hardiness and is frequently used interchangeably with them. While these concepts share similarities, they each have distinct theoretical foundations and influence mental health differently (Gucciardi, Gordon & Dimmock, 2009). Resilience refers to an individual's ability to adapt to challenges, emphasising the capacity to "bounce back" after a stressful event and "bounce forward" by learning from experiences (Garcia-Dia et al., 2013). While both resilience and MT help individuals cope with adversity, MT also includes proactive components, such as seeking self-development opportunities (Gucciardi, 2017). Grit is characterised by perseverance in achieving long-term goals despite obstacles (Duckworth et al., 2007). Although both involve persistence, MT is a broader concept that includes traits like confidence and emotional control. Hardiness is characterised by control, commitment, and the tendency to view obstacles as opportunities for growth (Kobasa, Maddi, & Kahn, 1982). While it overlaps with MT in control and commitment, MT also includes confidence and challenge.

Several validated instruments have been developed to measure MT and to support the delineation of, and overlap between, related constructs. One of the most widely used is the

MTQ48 (Clough et al., 2002), which conceptualises MT using the 4C model (i.e. Control, Commitment, Challenge, and Confidence). Another tool, the Mental Toughness Index (MTI; Gucciardi et al., 2015), offers a more flexible, unidimensional alternative. In contrast, resilience scales such as the Connor-Davidson Resilience Scale (Connor & Davidson, 2003) and grit tools such as the Grit-S (Duckworth & Quinn, 2009) measure narrower constructs and do not incorporate key MT attributes such as emotional control and perception of challenge.

In summary, MT can be distinguished from related constructs by its unique combination of proactive, multidimensional attributes and its validated tools. Understanding these differences is crucial for developing targeted interventions and accurately interpreting research on mental health outcomes.

Originally rooted in sports psychology (Fourie & Potgieter, 2001), MT has gained more relevance as research suggests that it can be enhanced through targeted interventions (Gucciardi et al., 2015). Consequently, interest in the impact of MT on mental health has expanded beyond sports to other contexts, such as education and the workplace (Mojtahedi et al., 2021, De Kock et al., 2022; Ward, et al., 2018). There is evidence from cross-sectional studies suggesting that mental toughness is a potential buffer against adverse mental health outcomes, such as depression and anxiety, across various populations (Gerber, et al., 2013; Stamp et al., 2015; Jin & Wang, 2016; Lin et al., 2017).

The current review aims to address gaps in the literature and differs from previous published reviews in two ways. First, although interest in the role of MT in promoting mental health has grown, previous reviews have mainly focused on sport and performance settings (e.g. among athletes or students) (Crust, 2007; Gerber, 2011; Chang et al., 2012). Second, the literature has mainly focused on resilience and related constructs such as grit and hardiness rather than on MT specifically, and little new review evidence has been published since Lin et al. (2017). However, since the COVID-19 pandemic, additional research on MT has been conducted. To our knowledge, no review on the MT-mental health link has been published, highlighting the need for this study.

Aims and Review Questions

The aims of this systematic review are therefore twofold: 1) investigate the relationship between MT and mental health outside sport and performance settings, and 2) explore potential moderating variables in the relationship between MT and mental health outcomes.

This review aimed to answer the following questions:

1. What is the strength of the relationship between mental toughness and mental health?
2. Does the relationship between MT and mental health hold after taking into account covariates (e.g. gender, age, occupation)?
3. What factors, if any, influence the direction and the strength of this relationship?

Method

This systematic review has been developed in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Protocols (PRISMA-P) guidelines (Moher et al. 2009) and recent PRISMA 2021 updates (Page et al., 2021). The review was registered in the International Prospective Register of Systematic Reviews, PROSPERO database (CRD42022382942).

Search Strategy

The search strategy was first developed for Medline (OVID) with a librarian using a modified Population, Exposure, Comparator, Outcomes and Study (PECOS) framework (Morgan, et al., 2018) and adapted for other databases. A systematic search was initially conducted in January 2023 across CINAHL (EBSCOhost), EMBASE (OVID), Medline (OVID), PsycINFO (OVID), and SCOPUS, covering all available records. A subsequent search was conducted in December 2024 in the same databases, covering the period from 15/01/2023 to the date of the second search. Forward and backward citation tracking and reference lists searches were also performed. Search terms, based on previous reviews (Gheshlagh, et al. 2017; Lin et al., 2017), reflected inclusion criteria for mental toughness, anxiety, depression, and mental well-being. A copy of each search strategy is included in Appendix 1.1.

Eligibility criteria

Criteria for inclusion were formulated in accordance with the PECOS (Morgan, et al., 2018) and included the following: 1) Studies involving adults (≥18 years old); studies with a mean age of 17.5 years or older, or those conducted in developmental contexts (e.g., vocational training) that reflect a transition to adulthood, were also included; 2) Studies written in English, published in peer-reviewed journals, and with full-text available; 3) Observational, mixed-methods, or experimental studies incorporating quantitative data, including cross-sectional and longitudinal designs; 4) Studies examining the relationship between MT and mental health outcomes (e.g., anxiety, depression, or mental well-being), which applied a validated MT instrument and used validated tools to measure both MT and mental health outcomes; 5) Interventional studies if they reported pre-intervention correlations between MT and mental health measures.

Studies were excluded if they: 1) Focused only on MT within sport or performance settings without broader mental health outcomes (e.g., mental well-being); 2) Examined only context-specific constructs such as competitive trait anxiety rather than general mental health outcomes; 3) they did not use a validated instrument specifically designed to measure MT; 4) Were non-English language; 5) Used qualitative methods only; 6) Analysed MT only in relation to performance outcomes (e.g., sports or academics); or 7) Were editorials, non-peer-reviewed articles, literature reviews, systematic reviews, meta-analyses, conference abstracts, posters, theses, or dissertations.

Screening Stage

All references were stored and managed using EndNote software, which was used to track the review process and remove duplicates automatically. The primary reviewer manually checked and removed remaining duplicates. Screening and selection were performed in two stages using a tool based on inclusion/exclusion criteria (Appendix 1.2.). First, the primary reviewer read the titles and abstracts, excluding studies as appropriate. Potentially relevant studies were then obtained in full text and examined against the inclusion criteria by the primary reviewer. To ensure reliability, a subset of studies (500 at title/abstract stage and 24

at the full-text stage) were independently screened by a second reviewer. Discrepancies were resolved through discussion.

Data extraction

Data extraction was completed by the primary reviewer using a form developed for this review. This included information such as study design, population, MT and mental health measurement tools, outcomes, and correlation and regression findings. To ensure the reliability and accuracy of the data extraction, a second reviewer checked the extracted data from 10 of the included studies. Authors were not contacted for additional data, as all but one study (Mojtahedi et al., 2021) provided sufficient information for extraction. While overall MT correlations were missing, subcomponent data were available, making the study eligible. Given the minimal impact and time constraints, author contact was not sought.

Quality Appraisal

Due to the varied study designs included in the review, it was decided to use the Mixed Methods Appraisal Tool (MMAT) by Hong et al. (2018) to appraise the quality of the included studies. The primary reviewer evaluated each study's methodological quality, and the second reviewer independently assessed a subset of 10 papers using the same tool, with any discrepancies resolved through discussion. The initial agreement between raters was Cohen's kappa =0.83 (91% agreement), which improved to kappa=0.98 (99% agreement) after discussion. The quality appraisal stage was not used to exclude eligible studies. Instead, it helped identify those that offered the strongest evidence and shape the review's conclusions.

Data Synthesis

Given the study diversity, a narrative synthesis approach was employed, following the guidelines outlined by Popay et al. (2006). Data was organised into tables, categorised, described, and examined for relationships within and across studies. Findings were synthesised to address the review questions, with a particular focus on the relationship between MT and mental health, as well as potential moderating variables.

Results

Literature search

Across two searches conducted in January 2023 and December 2024, a total of 9208 records were identified. After removing duplicates (n=3293), 5915 records were screened by title and abstract for relevance. Substantial inter-rater reliability was achieved at the title and abstract screening stage (Cohen's kappa= 0.767, 77% agreement), in line with McHugh's (2012) interpretation guidelines. A total of 235 reports were reviewed in full and assessed against the inclusion criteria, resulting in 20 eligible studies included from the database searches. An additional six records were identified through citation searching, with two meeting the eligibility criteria. Inter-rater reliability at the full-text screening stage was near-perfect (Cohen's kappa = 0.91, with an agreement rate of 95%). In total, 22 studies were eligible and included for quality appraisal and data extraction. See Figure 1.1. for an overview of the screening and selection process.

Studies on other MH outcomes (e.g. stress, burnout, emotional reactivity, and emotional exhaustion) were listed in the appendices (see Appendix 1.3) but excluded from the review. Although these outcomes are related to mental health, they do not fully align with our selected outcomes. Moreover, they were identified incidentally and would not provide a comprehensive representation if subjected to another targeted search that had been intended to encompass those search terms. Similarly, studies on related constructs such resilience, hardiness, and grit, even when described as 'mental toughness' were also excluded. Only studies explicitly measuring MT with validated, MT-specific instruments were included to ensure consistency and conceptual clarity (see Appendix 1.2.).

Study Characteristics

Table 1.1 describes the characteristics of the 22 included studies, published between 2013 and 2024. The studies were conducted across 13 countries, with the largest representation from the United Kingdom (N = 7), Switzerland (N = 3), Iran (N = 3), and China (N = 3). The total sample size across all studies was 12596 participants, ranging from 45 (Ajilchi et al., 2021) to 3649 (Papageorgiou et al., 2023). However, some studies may have overlapping data. Brand et al. (2014), Gerber, Brand et al. (2013), and Gerber, Kalak et al. (2013) likely

share samples due to overlapping participant characteristics, data collection periods, and authors. Similarly, Papageorgiou et al. (2019) and Papageorgiou et al. (2023) likely overlap in data. While these studies do not explicitly state data reuse, the similarities suggest potential overlap. Assuming full data reuse within each author group, the estimated total number of participants across all studies is 11,026.

Participants included university students, vocational students, athletes, and general adult populations. Several studies focused on specific groups, such as elite collegiate athletes (Li et al., 2021), medical students (Haghighi et al., 2018), and mothers of physically disabled children (Salehian, 2022). The majority of studies (N = 17) used a cross-sectional design, three adopted longitudinal designs (Denovan et al., 2021; Gerber, Brand et al., 2013, Truhan et al., 2021), and one was an interventional study (Ajilchi et al., 2021). The most commonly used MT assessment tools included the MTQ-48 (n=9), MTQ-10 (n=5), Sports Mental Toughness Questionnaire (SMTQ) (n=2), and the Mental Toughness Index (MTI) (n=3). Additional measures included the Very Short Mental Toughness Questionnaire (VS-MTQ) (n=2) and the Ahwaz Toughness Inventory (AHI) (n=1). Depression, anxiety, and mental well-being were measured using validated scales such as the Beck Depression Inventory (BDI), Patient Health Questionnaire (PHQ-9), Depression, Anxiety, and Stress Scale (DASS-21), State-Trait Anxiety Inventory (STAI), and the Warwick- Edinburgh Mental Well-being Scale (WEMWBS).

Quality appraisal

Table 1.2 summarises the quality appraisal ratings. Overall, ratings were moderate. All studies clearly defined their research questions and used appropriate methodologies, with all employing validated psychometric instruments. However, for most cross-sectional studies, it was unclear whether they had low risk of non-response bias (N=18) or representative samples (N=17). Longitudinal studies (Truhan et al.; 2021, Denovan et al. 2021) and interventional research (Ajilchi et al., 2021) provided stronger evidence but faced challenges with retention and adherence. For instance, Ajilchi et al. (2021) used randomisation to reduce bias, yet the lack of blinding and unclear adherence tracking raised methodological concerns.

Figure 1.1 *PRISMA Flow Diagram (Page et al. 2020)*

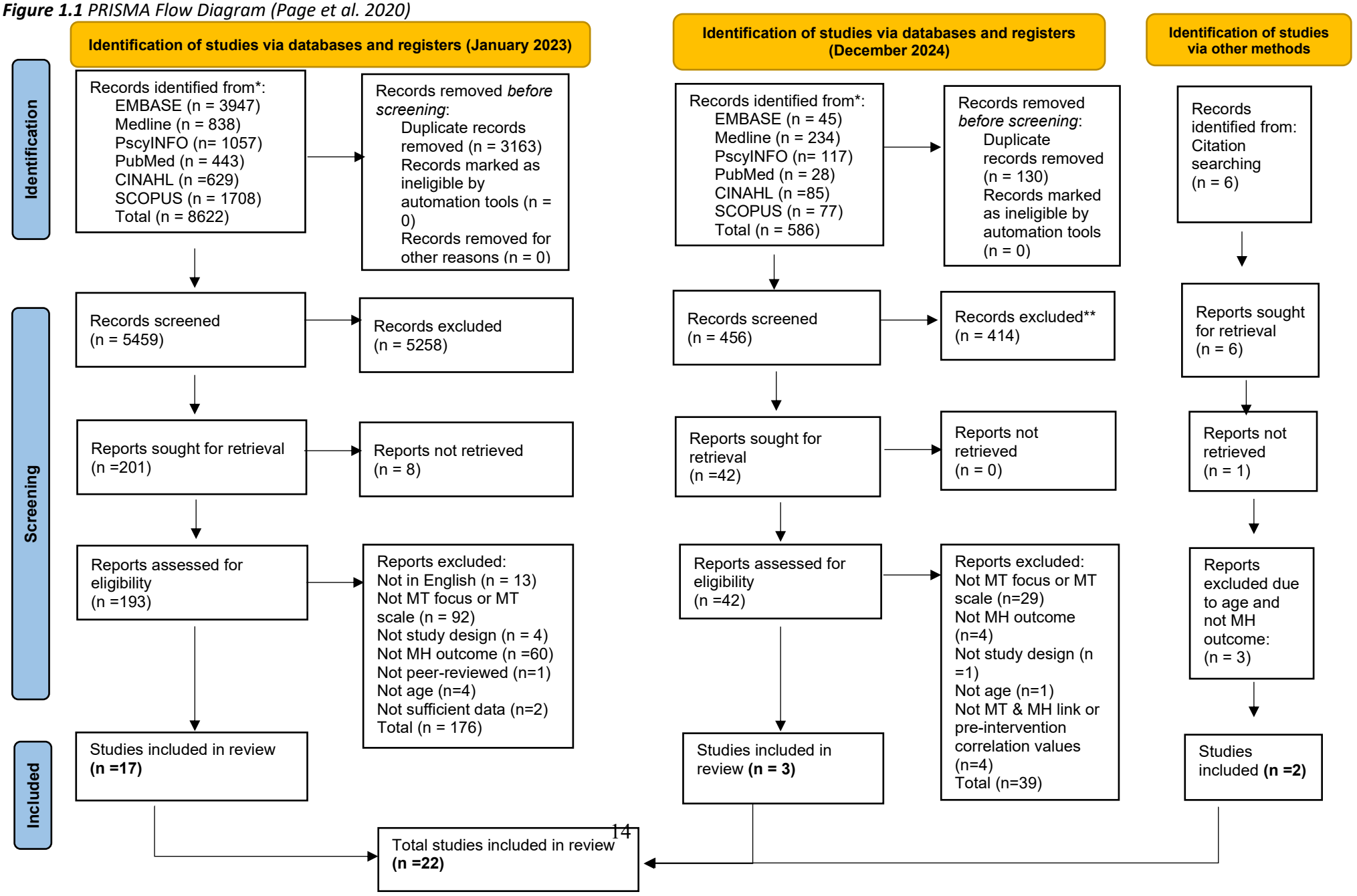

Table 1.1

Characteristics of the studies included in the systematic review

Reference	Location	Design	*N*	Population	MT Scale	Outcome	Instruments	Analysis Type	Overall Correlation Findings	Overall Regression Findings
Ajilchi, et al., 2021	Iran	Interventional	45	Female athletes (mean age = 21.55)	SMTQ	Well-being	PWB Scale	Correlation	Pre-intervention MT positively correlated with pre-intervention PWB (r=.63, p<.01).	-
Brand et al. (2014)	Switzerland	Cross-sectional	284	Adolescents (mean age=18.26, SD=4.17)	MTQ48	Depression	BDI	Correlation	MT negatively correlated with depression (r=-.65, p<.001).	-
Denovan et al. (2021)	UK	Longitudinal, assessing participants at two time points over a three-month interval	333	Undergraduate (mean age=19.02, SD=2.62)	MTQ10	Depression	BDI	Correlation	MT negatively correlated with depression at baseline (r = -.39, p < .001) and 3-month follow-up (r = -.44, p < .001).	-
Gerber, Brand, et al. (2013)	Switzerland	Longitudinal	865	Vocational students (mean age=17.86)	MTQ18	Depression, Well-being	CES-D, SWLS	Correlation & Regression	MT negatively correlated with depression (r=-.36, p<.001) and positively with life satisfaction (r=.32, p<.001).	MT predicted depression (β = -.18, p<.001) and life satisfaction (β = .12, p<.001) at 10-month follow-up
Gerber, Kalak, et al., (2013)	Switzerland	Cross-sectional	424	*Sample 1*: high school students (mean age 18.3, SD=4.17) *Sample 2*: 140 undergraduates (mean age 20.0, SD=5.0)	MTQ48	Depression	BDI	Correlation & Regression	MT negatively correlated with depression (r=-.65, p<.001) in both samples.	MT predicted depressive symptoms, (β = -.29, p < .001 for high school students, β = -.37, p < .001 for undergrad students)
Haghighi et al. (2018)	Iran	Cross-sectional	207	Medical students (mean	MTQ48	Depression, Anxiety	BDI, STAI	Correlation	MT negatively correlated with depression (r=−.39,	-

				age 22.04, SD=2.74)					p<.001) and anxiety (*r*=−.71, p<.001).	
Kalinin et al. (2021)	Romania	Cross-sectional	47	Athletes (mean age 21.89, SD=2.72)	MTI	Depression, Anxiety	DASS-21	Correlation	MT negatively correlated with anxiety (*r*=−.52, p<.01) and depression (*r*=−.49, p<.01).	-
Kara et al. (2021)	Turkey	Cross-sectional	634	Professional athletes, recreational athletes and sedentary individuals	SMTQ	Anxiety	STAI	Correlation	MT negatively correlated with anxiety (r=−.36, p<.01).	-
Li et al. (2021)	China	Cross-sectional	285	Elite collegiate athletes (mean age 20.3, SD=1.51)	MTI	Anxiety	GAD-7	Correlation & Regression	MT negatively correlated with anxiety (*r*=−.22, p<.01)	MT had a small, non-significant effect on anxiety (β=−.09, p=.08, 95% CI [-.21, .03].
Loh et al. (2021)	Singapore	Cross-sectional	320	Students (160 athletes and 160 non-athletes) (mean age 23.2, SD=2.1)	MTQ10	Anxiety	STAI-T	Correlation & Regression	MT negatively correlated with anxiety. Overall sample: *r*=-78, p<.01 Athletes*:* MT and Anxiety, *r*=-.83, p<.01 Non-athletes: MT and Anxiety, *r*=-.63, p<.01. Male*:* MT and anxiety, *r*=.73, p<.01 Female*:* MT and anxiety, *r*=-.82, p<.01.	MT stronger predictor for athletes (β = -.77, p < .001) than non-athletes (β = -.38, p < .001)
Malhotra & Kaur (2017)	India	Cross-sectional	80	Athletes (17-21 years)	MTQ48	Depression, Anxiety	DASS-21	Correlation	MT negatively correlated with depression and (r=-.43, p<.01) and	-

									anxiety (r=-.45, p<.01).	
Mojtahedi et al. (2021)	UK, Ireland, North America, India, Brazil	Cross-sectional	723	Adults (Sample A: mean age=34.10, SD=14.34; Sample B: mean age= 36.09, SD=12.79)	MTQ48	Depression, Anxiety	DASS-21 STAI	Correlation	Negative correlations between all MT components and anxiety and depression (*r*'s ranged from .25 to .67, *p*<.001).	-
Morrison et al. (2024)	Australia	Cross-sectional	128	Athletes (mean age 18.34, SD=2.20)	VS-MTQ	Depression, Anxiety	DASS-21	Correlation & Regression	MT negatively correlated with depression (r=-.35, p<.01) and anxiety (r=-.21, p<.05).	MT predicted depression (*ß* =-.40, *p* < .001) and anxiety (*ß* = -.40, *p* < .001).
Mutz et al. (2017)	UK	Cross-sectional	364	Adults (mean age=24.31, SD=9.16)	MTQ48	Depression	CUDOS, PHQ-9	Correlation	MT negatively correlated with depressive symptoms: CUDOS *r* = -.53, *p* < .001, 95% CI [-.60, -.44]; PHQ-9 *r* = -.49, *p* < .001, 95% [-.56, -.40])	-
Naden, et al. (2023)	UK	Cross-sectional	281	Adults (mean age, 48.44, SD=15.39)	MTQ10	Depression, Anxiety, Well-being	HADS, PHQ-9, WEMWBS	Correlation & Regression	MT negatively correlated with anxiety (*r*=−.68, p<.001, 95% CI [-.74, -.62] and both measures of depression (HADS-D, *r*=−.628, p<.001, 95% CI [-.69, -.55]; and PHQ-9, *r*=−.68, p<.001, 95% CI [-.74, -.61]). MT was positively correlated with well-being (*r*=.699, p<.001, 95% CI [.63, .75]).	MT predicted anxiety (β=−0.70, p<.001), depression (β=−.52, p<.001) and well-being (β=.54, p<.001).

Papageorgiou, Denovan & Dagnall (2019)	UK	Cross-sectional	Study 1: 364 (mean age 24.31, SD=9.16), Study 2: 354 (mean age 25.30, SD=7.22), Study 3: 144 (mean age 22.08, SD=5.50)	Adults of various backgrounds (Studies 1 & 2), Undergraduate students (Study 3)	MTQ48	Depression	PHQ-9, BDI	Correlation & Regression	MT negatively correlated depressive symptoms: Study 1: *r*=-.53, p<.001 Study 2: r=-.51, p<.001 Study 3**:** *r*=-.64, p<.001	MT negatively predicted depressive symptoms: Study 1: b weight=-6.78, p<.001, 95% CI [-7.93, -.5.62]. Study 2: b weight=-8.59, p<.001, 95% CI [-10.34, -6.84]. Study 3: b weight=-10.96, p<.001, 95% CI [-14.73, -.7.18].
Papageorgiou et al. (2023)	UK, Greece, Italy, Russia, Canada	Cross-sectional	3,649	Adults (mean age 29.91, SD=5.56)	MTQ10	Depression, Anxiety	DASS-21	Correlation & Regression	MT negatively correlated with depression (*r*=−.54, p<.001) and anxiety (*r*=−.45, p<.001) across all countries. ***UK:*** MT and Depression: *r*=−.65, p<.001*;* MT and Anxiety: *r*=−.61, p<.001 ***Greece****:* MT and Depression: *r*=−.53, p<.001*;* MT and Anxiety: *r*=−.46, p<.001 ***Italy****:* MT and Depression: *r*=−.63, p<.001*;* MT and Anxiety: *r*=−.49, p<.001 ***Russia****:* MT and Depression: *r*=−.45, p<.001*;* MT and	MT predicted depression (β=-.53, p<.001) and anxiety (β=-.45, p<.001).

									Anxiety: *r*=−.36, p<.001 ***Canada****:* MT and Depression: *r*=−.57, p<.001*;* MT and Anxiety: *r*=−.38, p<.001	
Qi, Shi & Cui (2022)	China	Cross-sectional	612 pairs of young adults and their parents	Young adults (mean age 21.91) and parents (mean age 50.34)	MTQ10	Well-being	WEMWBS	Correlation and regression	Youth MT correlated positively with youth well-being (*r*=.67, p<.001)	Youth MT predicted well-being (β=-.47, p<.001)
Salehian (2022)	Iran	Descriptive correlational	150	Mothers of physically disabled children, aged 30-45 years	AHI	Well-being, Life Satisfaction	Active Well-being Scale, Diener Life Satisfaction Scale	Correlation & regression	MT positively correlated with well-being (*r*=.31, p<.05) and life satisfaction (r=.80, p<.05).	MT predicted well-being (β=.43, p<.001)
Stamp et al., (2015)	UK	Cross-sectional	168	Undergraduate students (mean age 20.83, SD=3.4)	MTQ48	Psychological Well-being	SPWB	Correlation	Positive correlations between all components of MT and all subscales of psychological wellbeing (*r*'s ranged from .17 to .77, *p*<.05)	-
Truhan, et al. (2021)	UK and Greece	Cross-sectional (large-scale pre-COVID data collection) Semi-longitudinal (follow-up during COVID-19 to assess changes)	Two samples: Cross-sectional: 1,846 (UK: 611, Greece: 1,235) Semi-longitudinal: 184 (UK: 93, Greece: 91)	Adults (mean age 32.90, SD=12.97)	MTQ10	Depression, Anxiety	DASS-21	Correlation & regression	<u>Cross-sectional sample:</u> MT and Depression: UK: *r*=−0.65, p<.001, GR: *r*=−.54, p<.001. MT and Anxiety: UK: *r*=−.61, p<.001; GR: *r*=−.47, p<.001. <u>Semi-longitudinal sample</u> (follow-up during COVID):	<u>Cross-sectional sample:</u> *Depression*: UK: b weight=−.98, p<.001, 95% CI [-1.07, -.88). GR: b weight=−.85, p<.001, 95% CI [-.92, -.77]. *Anxiety*: UK: b weight=−.84, p<.001, 95% CI [-.93,

									MT and Depression: UK: *r*=−.71, p<.001; GR: *r*=−.47, p <.001. MT and Anxiety: UK: *r*=−.66, p<.001; GR: *r*=−.46, p<.001	-.75]; GR: b weight=−.67, p<.001, 95% CI [-.73, -.60]. <u>Semi-longitudinal sample:</u> *Depression*: UK: b weight=-.88, p<.001, 95% CI [-1.17, -.58]; GR: b weight=-.71, 95% CI [-1.06, -.36]; GR: b weight=-.71, p<.001, 95% CI [-1.06, -.36]; *Anxiety:* UK: b weight=-.36, p<.05, p<.05, 95% CI [-.64, -.07]; GR: b weight=-.41, p<.001, 95% CI [-.63, -.19];
Zhao et al. (2023)	China	Cross-sectional	289	College athletes (post-COVID) (mean age 20.31, SD=1.60)	MTI	Depression	PHQ-9	Correlation & Regression	MT negatively correlated with depression (*r*=−.35, p<.01)	MT negatively predicted depression (*β*=−.23, p<.01).

r, Pearson correlation coefficient, CI, confidence interval; *β* (beta), standardised regression coefficient, b weight (or b),unstandardised regression coefficient; MTQ48, MTQ18, MTQ10: Mental Toughness Questionnaire (48-item, 18-item, 10-item versions); SMTQ: Sports Mental Toughness Questionnaire, MTI: Mental Toughness Index; VS-MTQ: Very Short Mental Toughness Questionnaire; AHI: Ahvaz Hardiness Inventory; BDI: Beck Depression Inventory; CUDOS: Clinically Useful Depression Outcome; CES-D: Center for Epidemiologic Studies Depression Scale-German Version; DASS-21: 21-item Depression Anxiety Stress Scale; GAD-7: Generalized Anxiety Disorder Scale; HADS: Hospital and Depression Scale; PHQ-9: 9-item Patient Health Questionnaire; PWB: Psychological Well-Being Scale; SPWB: Scales of Psychological Well-Being; STAI, STAI-T: State-Trait Anxiety Inventory (Total and Trait versions); PSWLS: Satisfaction with Life Scale; WEMWBS: Warwick-Edinburgh Well-being Scale.

Table 1.2

MMAT quality appraisal ratings

MMAT Appraisal of Cross-Sectional Studies							
Reference	**Are there clear research questions?**	**Do the Collected Data Allow Us to Address the Research Questions?**	**Is the Sampling Strategy Relevant to Address the Research Question?**	**Is the Sample Representative of the Target Population?**	**Are the Measurements Appropriate?**	**Is the Risk of Nonresponse Bias Low?**	**Is the Statistical Analysis Appropriate to Answer the Research Question?**
Brand et al. (2014)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Gerber, Kalak, et al., (2013	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Haghighi et al. (2018)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Kalinin et al. (2021)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Kara et al. (2021)	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Li et al. (2021)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Loh et al. (2021)	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Malhotra & Kaur (2017)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Mojtahedi et al. (2021)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Morrison et al. (2024)	Yes	Yes	Can't tell	No	Yes	Can't tell	Yes
Mutz et al. (2017)	Yes .	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Naden, et al. (2023)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Qi, Shi & Cui (2022)	Yes	Yes	Yes	Yes	Yes	Can't tell	Yes
Papageorgiou, Denovan & Dagnall (2019)	Yes	Yes	Yes	No	Yes	Can't tell	Yes

Papageorgiou et al. (2023)	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Salehian (2022)	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes
Stamp et al., (2015)	Yes	Yes	Yes	No	Yes	Can't tell	Yes
Zhao et al. (2023)	Yes	Yes	Yes	Can't tell	Yes	Can't tell	Yes

MMAT Appraisal of Randomised Controlled Trials or Experimental Studies

Reference	**Are there clear research questions?**	**Do the Collected Data Allow Us to Address the Research Questions?**	**Is the randomisation appropriately performed>**	**Are the groups comparable at baseline?**	**Are there complete outcome data?**	**Are outcome assessors blinded to the intervention provided?**	**Did the participants adhere to the assigned intervention?**
Ajilchi et al. (2021)	Yes	Yes	Yes	Yes	Yes	No	Can't tell

MMAT Appraisal of Prospective Cohort and Experimental Studies

Reference	**Are there clear research questions?**	**Do the Collected Data Allow Us to Address the Research Questions?**	**Are the participants representative of the target population?**	**Are measurements appropriate regarding both the outcome and intervention (or exposure)?**	**Are there complete outcome data?**	**Are the confounders accounted for in the design and analysis?**	**During the study period, is the intervention administered (or exposure occurred) as intended?**
Denovan et al. (2021)	Yes	Yes	Can't tell	Yes	Can't tell	Yes	Yes
Gerber, Brand, et al. (2013)	Yes	Yes	Can't tell	Yes	Can't tell	Yes	Yes
Truhan, et al. (2021)	Yes	Yes	Can't tell	Yes	No	Yes	Yes

MT and Mental Health: Correlation Findings

MT and Depression

Fifteen studies examined the relationship between MT and depression, all reporting significant negative correlations. Effect sizes ranged from moderate to strong (r=–.35 to –.69, all p<.01), with MT consistently associated with lower levels of depressive symptoms (Table 1.1). Sample sizes varied considerably, from small athlete samples (e.g., n= 47 in Kalinin et al., [2021] and n=80 in Malhotra & Kaur [2017]) to larger studies with over 600 participants (e.g. n=723 in Mojtahedi et al. [2021]) and even very large samples (n=3649 in Papageorgiou et al. [2023].

This negative relationship between MT and depression was observed across a variety of populations and designs. For example, in adolescents and undergraduate students (e.g. Brand et al., 2014; Gerber et al. 2013; Gerber, Kalak et al., 2013; Denovan et al., 2021; Haghighi, et al. 2018; Papageorgiou, Denovan & Dagnall, 2019), moderate to strong correlations were evident. The strongest correlation (r=–.65) was reported by Gerber, Kalak et al. (2013) and Brand et al. (2014). In adult samples, some of the strongest associations were reported by Naden et al. (2023), who found an r value of –.69 in a diverse adult sample of 281 participants, and by Papageorgiou et al. (2023), who observed correlations ranging from –.54 to –.65 across multiple countries. Studies that combined adult and undergraduate samples (Papageorgiou, Denovan & Dagnall, 2019) reported correlations ranging from –.51 to –.64, with student samples often exhibiting the strongest association (r = –.64).

In athlete populations, Kalinin et al. (2021) reported the strongest correlation at –.52, while Malhotra & Kaur (2017) found an r value of –.43. However, both athlete studies were based on very small sample sizes. For instance, Kalinin et al. (2021) included only 47 athletes and Malhotra & Kaur (2017) included only 80 participants.

Longitudinal designs further support these findings. One study involving students (Denovan et al., 2021) found that MT was significantly associated with depression both at baseline (r = –.39) and at a 3-month follow-up (r = –.44, both p < .001). Additionally, Truhan et al. (2021) used both cross-sectional and longitudinal designs. In their cross-sectional analysis, they found strong negative correlations between MT and depression in the UK (r = –.65, p < .001)

and Greece (r = –.54, p < .001). In the longitudinal analysis during the COVID-19 follow-up, the UK sample maintained a strong association (r = –.71, p < .001), whereas the Greek sample showed a moderate correlation (r = –.47, p < .001).

MT Subcomponents and depression

Several studies explored the link between MT subcomponents and depression, consistently showing that higher levels of most MT traits were associated with lower depressive symptoms (see Table 1.3). For example, Malhotra et al. (2017) reported significant negative associations for commitment, control, and confidence in abilities (r=–.25 to –.37), while the challenge component was not significant (r=–.16). In contrast, Papageorgiou, Denovan and Dagnall (2019) found stronger negative correlations for all subcomponents (r values from –.43 to –.62). A similar pattern was observed by Brand et al. (2014) and Gerber, Kalak et al. (2013), with r values ranging from –.44 to –.62. Mutz et al. (2017) further confirmed these trends, reporting correlations that ranged from –.18 to –.48.

MT and Anxiety

Eleven studies examined the relationship between MT and anxiety, consistently reporting significant negative correlations (r=–21 to .83, all p<.001), indicating that higher MT is linked to reduced anxiety. Among athlete populations, the findings were mixed. Some studies reported moderate negative associations (e.g. Kalinin et al. 2021, Kara et al. 2021; Malhotra & Kaur, 2017), while others found either much stronger or weaker correlations. For instance, Loh et al. (2021) reported very strong effects in a Singaporean athlete sample (r = –.83) and in their combined sample of athletes and non-athletes (r=–.78), whereas Morrison et al. (2024) and Li et al., (2021) reported the weakest associations (r = –.21 and r =–.22, respectively) in Australian and Chinese athlete samples.

In contrast, among student and diverse adult samples, the results were more consistent. Haghighi et al. (2018) found a strong negative relationship in a sample of 207 Iranian medical students, and Loh et al. (2021) observed a correlation of –.63 among 160 Singaporean non-athlete college students. Similarly, Naden et al. (2023) reported a moderate-to-strong negative correlation (r = –0.68, p < .001) in a diverse adult sample, and Truhan et al. (2021) reported moderate-to-large effect sizes in both their cross-sectional and

longitudinal analyses in their UK and Greek samples, with r values ranging from -.46 to -.66 (all p< .001).

MT Subcomponents and anxiety

Several studies examined the relationship between individual MT subcomponents and anxiety, indicating some variability in their protective effects (Table 1.3). For example, Malhotra et al. (2017) found that life control and confidence in abilities had the strongest negative associations with anxiety (r values around –.35), while commitment and emotional control showed significant, though slightly weaker correlations (r values of –.31 and –.32). Similarly, Mojtahedi et al. (2021) also found that all MT subcomponents were negatively correlated with anxiety. Among these, control showed the strongest protective effects (r ranging from –0.51 to –0.57), while challenge exhibited the weakest association (r ranging from –0.25 to –0.44).

MT and Mental Well-Being

Six studies examined the association between MT and mental well-being, all reporting positive correlations (r=.31 to .77, all p<.001). These studies included diverse populations, such as athletes (Ajilchi et al. 2021) students (Gerber, Brand et al., 2013; Stamp et al., 2015), the general population (Qi, Shi & Cui, 2022; Naden et al. 2023), and a sample of Iranian mothers of physically disabled children (Salehian, 2022). For instance, Ajilchi et al. (2021) reported one of the highest effects among athletes (r=-.63), while Naden et al. (2023) found similarly strong associations among 281 UK young adults (r=.69). In student samples, Gerber, Brand et al. (2013) and Stamp et al. (2015) observed positive correlations with r values ranging from .17 to .77.

MT Subcomponents and mental well-being

Stamp et al. (2015) provided a more nuanced perspective by examining MT subcomponents in relation to various aspects of psychological well-being, as measured by Ryff's scales. They found that all MT components were positively correlated with all six dimensions of well-being. Particularly, some of the strongest relationships were observed between confidence in abilities and self-acceptance (r = .77, p < .01), commitment and environmental mastery (r

= .70, p < .01), life control and environmental mastery (r = .67, p < .01), and confidence in abilities and environmental mastery (r = .66, p < .01) (See Table 1.3).

Table 1.3

MT Subcomponent Correlations and Regression Coefficients

Reference	Location	MTQ48 Subcomponent	Outcome	*r* value (p-value)	β value (p-value)
Brand et al. (2014	Switzerland	Challenge	Depression	-.51 (p<.001)	-
		Commitment	Depression	-.53 (p<.001)	-
		Control	Depression	-.57, (p<.001)	-
		Confidence	Depression	-.61,(p<.001).	-
Gerber, Kalak et al. (2013)	Switzerland	Challenge	Depression	-.44 (p < .001)	-
		Commitment	Depression	-.46 (p < .001)	
		Emotional control	Depression	-.49 (p <.001)	
		Life control	Depression	-.48 (p < .001)	
		Confidence	Depression	-.62 (p <.001)	
Malhotra et al. (2017)	India	Challenge:	Depression	*.16 (p>.05)*	-
		Commitment	Depression	*-.33 (p<.01)*	-
		Commitment	Anxiety	-.32 (p<.01	-
		Emotional control	Depression	-.37 (p<.01)	-
		Emotional control	Anxiety	-.31 (p<.01)	-
		Life control	Depression	-.36 (p<.01)	-
		Life control	Anxiety	-.35 (p<.01)	-
		Confidence	Depression	-.25 (p<.05)	-
		Confidence	Anxiety	-.35 (p<.01)	-
Mojtahedi et al. (2021) Sample A	UK and Ireland	Challenge	Depression	.46 (p<.001)	−.05 (p>.05)
		Commitment	Depression	-.51 (p<.001)	−15 (p<.05)
		Control	Depression	-.57 (p<.001)	−.20 (p<.01)
		Confidence	Depression	-.61 (p<.001)	-.39 (p<.001)
Mojtahedi et al. (2021) Sample B	North America, India, Brazil	Challenge	Depression	-.33 (p<.001)	-.24 (p<.001)
		Commitment	Depression	-.69 (p<.001)	-.49 (p<.001)
		Control	Depression	-.67 (p<.001)	-.41 (p<.001)
		Confidence	Depression	-.54 (p<.001)	-.04 (p>.05)
Mojtahedi et al. (2021) Sample A	UK and Ireland	Challenge	Anxiety	-.44 (p<.001)	-.06 (p>.05)
		Commitment	Anxiety	-.42 (p<.001)	-.03 (p>.05)
		Control	Anxiety	-.56 (p<.001)	-.37(p<.001)
		Confidence	Anxiety	-.51 (p<.001)	-.17 (p<.05)
Mojtahedi et al. (2021) Sample B	North America, India, Brazil	Challenge	Anxiety	-.25 (p<.001)	.21 (p<.001)
		Commitment	Anxiety	-.59 (p<.001)	-.51 (p<.001)
		Control	Anxiety	-.57 (p<.001)	-.41 (p<.001)
		Confidence	Anxiety	-.40 (p<.001)	.14 (p>.05)
Mutz et al. (2017)	UK	Challenge	Depression (CUDOS)	-.20 (p<.001)	-
		Challenge	Depression (PHQ-9)	-.18 (p<.001)	-
		Commitment	Depression (CUDOS)	-.46 (p<.001)	-
		Commitment	Depression (PHQ-9)	-.40 (p<.001)	-
		Control	Depression (CUDOS)	-.45 (p<.001)	-
		Control	Depression (PHQ-9)	-.42 (p<.001)	-
		Confidence	Depression (CUDOS)	-48 (p<.001)	-
		Confidence	Depression (PHQ-9)	-46 (p<.001)	-
Papageorgiou, Denovan and Dagnall (2019)	UK	Challenge	Depression	-.43 (p<.001)	-
		Commitment	Depression	-.51 (p<.001)	-
		Control	Depression	-.62 (p<.001)	-

Stamp et al. (2015)	UK	*C*onfidence	Depression	-.57 (p<.001)	-
		Challenge	PWB- Self-acceptance	.47 (p<.01)	
			PWB- Personal growth	.50. (p<.01)	
			PWB-Positive relations	.32 (p<.01)	
			PWB-Purpose in life	.36 (p<.01)	
			PWB-Env. mastery	.48 (p<.01)	
			PWB-Autonomy	.37 (p<.01)	
		Commitment	PWB- Self-acceptance	.56 (p<.01)	
			PWB- Personal growth	.52 (p<.01)	
			PWB-Positive relations	.38 (p<.01)	
			PWB-Purpose in life	.64 (p<.01)	
			PWB-Env. mastery	.70 (p<.01)	
			PWB-Autonomy	.44 (p<.01)	
		Emotional control	PWB- Self-acceptance	.46 (p<.01)	
			PWB- Personal growth	.28 (p<.01)	
			PWB-Positive relations	.29 (p<.01)	
			PWB-Purpose in life	.18 (p<.01)	
			PWB-Env. mastery	.47 (p<.01)	
			PWB-Autonomy	.38 (p<.01)	
		Life control	PWB- Self-acceptance	.62 (p<.01)	
			PWB- Personal growth	.40 (p<.01)	
			PWB-Positive relations	.43 (p<.01)	
			PWB-Purpose in life	.57 (p<.01)	
			PWB-Env. mastery	.67 (p<.01)	
			PWB-Autonomy	.42 (p<.01)	
		Confidence	PWB- Self-acceptance	.77 (p<.01)	
			PWB- Personal growth	.43 (p<.01)	
			PWB-Positive relations	.53 (p<.01)	
			PWB-Purpose in life	.44 (p<.01)	
			PWB-Env. mastery	.66 (p<.01)	
			PWB-Autonomy	.45 (p<.01)	

Note: *r,* Pearson correlation coefficient, CI, confidence interval; *β* (beta), standardised regression coefficient, b weight (or b), unstandardised regression coefficient; CUDOS: Clinically Useful Depression Outcome; PHQ-9, PHQ-9: 9-item Patient Health Questionnaire; PWB, Psychological Well-being; Env., Environmental.

Mental toughness as a predictor: Regression Findings

MT as a predictor of Depression

Regression analyses from five studies indicated that higher MT significantly predicted lower depression levels. For example, Morrison et al. (2024) and Naden et al. (2023) reported strong negative predictive effects, with standardised regression coefficients (β) ranging from-.40 to -.70 (all p<.001) (Table 1.1). Zhao et al. (2023) found a similar pattern in 289 Chinese students (β=-.23, p<.01). Denovan et al. (2021) and Gerber, Brand et al. (2023) further supported MT's protective role, showing that higher baseline MT predicted fewer depressive symptoms at follow-up.

Mojtahedi et al. (2021) examined the MT subcomponents across two samples (n=723) (Table 1.3). In Sample A (n = 372), a model with four MT traits explained 41% of the variance in depression (F (4,351) = 60.53, p < .001), with commitment, control, and confidence as

significant predictors. In Sample B (n = 347), a similar model explained 55.2% of the variance, with challenge, commitment, and control as significant predictors, while confidence did not reach significance.

In a large-scale study by Truhan et al. (2021) involving 1,846 adults from the UK and Greece, MT was found to negatively predict depression in both cross-sectional and longitudinal analyses, with unstandardized regression coefficients (B values) ranging from –0.85 to –0.98 ($p < .001$).

MT as a predictor of Anxiety

Regression analyses consistently showed that higher MT predicted lower anxiety. For instance, Naden et al. (2023) and Morrison et al. (2024) reported strong negative effects (β=-.40 to -.70, all $p<.001$). Loh et al (2021) further supported this relationship, showing that MT significantly predicted lower anxiety across all groups, regardless of gender or athlete status. In particular, MT explained more variance in athletes (82%) than non-athletes (33%), with a stronger negative effect in athletes (β =-.77, $p<.001$) after controlling for gender and training years, while the effect remained significant but weaker in non-athletes (β =-.38, $p<.001$). In contrast, Li et al. (2021) found only a small, non-significant effect of MT on anxiety (β=-.09, $p=.08$) in 284 Chinese students.

MT as a predictor of Mental Well-Being

Regression analyses confirm that higher mental toughness (MT) is a significant predictor of enhanced mental well-being, with beta coefficients ranging from 0.12 to 0.54 (all $p < .001$). For example, among undergraduate students, Gerber, Brand et al. (2013) found that higher MT was associated with increased life satisfaction (β=0.12, $p < .001$). In a sample of 281 adults, Naden et al. (2023) reported similarly effects ($\beta = 0.54$, $p < .001$). Additional evidence comes from studies of young adults, where Qi, Shi & Cui (2022) observed a predictive effect ($\beta = 0.47$, $p < .001$), and from research on mothers of physically disabled children, with Salehian (2022) reporting that MT predicted well-being ($\beta = 0.43$, $p < .001$).

Influences on the MT–Mental Health Relationship

Country-level variability

Papageorgiou et al. (2023) examined MT across multiple countries and found that while MT was negatively correlated with both depression and anxiety in all populations, the strength of these associations varied. For depression, the strongest protective effects were observed in the UK and Italy (r=-.65 and -.63, respectively), moderate effects in Canada and Greece (r=-.57 and -.53), and the weakest in Russia (r=-.45). A similar pattern was found for anxiety, with the UK showing the strongest relationship (r=-.61), moderate effects in Italy and Greece (r=-.49 and -.46) and the weakest in Russia (r=-.36). Truhan et al. (2021) further demonstrated that the negative relationship between MT and both depression and anxiety was more pronounced in UK samples (r= -.61 to -.71) compared to Greek samples (r=-.46 to -.54) across both cross-sectional and longitudinal analyses.

Demographic and contextual factors

Moderation models and interaction terms in regression models from several studies suggest that while higher MT is generally associated with better mental health outcomes, its protective effects depend on individual characteristics and contextual factors. In particular, factors such as athletic status, student status, gender and stress levels appear to influence the strength of the relationship between MT and mental health. For example, studies comparing athletes and non-athletes have found that MT is more strongly protective in competitive and structured settings. Loh et al. (2021) reported that athletes showed a much stronger negative association between MT and anxiety (r=-.83) compared to non-athletes (r=-.63), and regression analyses revealed that MT accounted for 82% of the variance in anxiety among athletes versus only 33% among non-athletes. Similarly, studies including both adult and undergraduate samples (e.g. Papageorgiou, Denovan & Dagnall, 2019) suggest that students often show stronger relationships between MT and depression, with correlations as high as -.64. Gender also appears to play a moderating role. In a Singaporean sample, Loh et al. (2021) found that the protective effect of MT on anxiety was more pronounced for females (r=-.82) than for males (r=-.73).

Moreover, several studies have examined whether MT can moderate the impact of stress on mental health outcomes. For instance, Gerber, Brand et al. (2013) found that higher

baseline MT predicted fewer depressive symptoms at follow-up, even after controlling for stress. This indicates that MT can buffer against the negative effects of stress on mental health. This moderating role was further supported by findings from Haghighi et al. (2018), who observed that students with lower MT experienced greater increases in depressive symptoms under high stress.

Discussion

This review provides compelling evidence to suggest that higher MT is associated with lower depressive and anxiety symptoms and improved mental well-being. Particularly, a moderate-to-strong negative relationship was found between MT and depression, while the association with anxiety ranged from weak-to-strong. Similarly, a moderate-to-strong positive relationship was observed with mental well-being. Regression analyses further confirmed MT as a significant predictor of mental health, consistently linking higher MT to lower depression and anxiety and greater well-being even after adjustment for covariates. Our findings align with other reviews focused on specific populations including athletes, students, and military personnel. For example, Aditya et al. (2024) synthesised evidence from 12 studies, finding that higher MT in athletes is associated with better mental health and overall well-being. Similarly, Lin et al. (2017) found a significant relationship between MT and a range of outcomes across diverse contexts, including the workplace, military, students, and athletic populations.

Although the MT-mental health relationship remains significant across different populations, study designs and countries, its protective effects appeared to vary depending on individual and cultural factors. Our review suggests that factors such as athletic status, gender, cultural differences, and stress levels can influence the strength of this relationship. For example, stronger correlations were observed in high-performance and structured contexts, such as academia and sports, where athletes and students exhibited stronger MT-mental health relationships compared to the general population. One possible explanation is that the rigorous demands of academic and competitive contexts require sustained focus and resilience, which can be enhanced through specialised coping and adaptation processes (Gucciardi et al. 2009, 2015), leading to a stronger MT protective effect on mental health.

Our review further indicates that the protective effects of MT on anxiety differ by gender, with females potentially benefitting more from higher MT levels. One possible explanation is that women tend to use different stress response strategies, such as “tend and befriend” approach described by Taylor et al. (2000), which may enhance MT’s components like emotional control and interpersonal confidence. Additionally, research suggests that women appear more vulnerable to anxiety (McLean et al., 2011), making the protective effects of MT particularly relevant for them.

Additionally, cross-culturally differences were evident, with MT possibly being more protective in some Western countries (e.g. UK, Italy) than others (e.g. Russia). Among MT subcomponents, commitment and control emerged as the most universally protective factors, but their strength may depend on cultural differences. Possible explanations for these differences include variations in how MT and mental health are perceived and developed across countries along with differences in life stressors among cultures (Papageorgiou et al., 2023). Additionally, sampling differences may have contributed, as the UK and Ireland sample may have been more homogenous, while the global sample included participants from diverse backgrounds, potentially influencing the strength of the relationships.

Lastly, our review suggested that the relationship between MT and mental health holds even after controlling for stress, with MT continuing to significantly predict both depression and life satisfaction.

Limitations of the included studies (based on MMAT)

Several limitations should be considered when interpreting the current findings. Despite strong links found between MT and mental health, most studies relied on cross-sectional designs, limiting causal inferences. Moreover, variation in sample sizes, particularly in athlete-focused studies, affects generalizability. Some studies had fewer than 80 participants, while others involved over 1500 participants, leading to potential inconsistencies in effect sizes and limiting direct comparisons.

The inconsistency in findings, particularly related to the MT-anxiety link, which ranged from weak to strong, could be explained by differences in sample sizes, the measurement instruments used, and the overall quality of the studies. In addition, cultural validity may also be a contributing factor, given that many MT and anxiety measures were originally developed in Western countries and may not reflect these concepts in non-Western contexts. While some studies reported they have adapted the MT and MH outcome instruments for different cultural populations, the reliability of these adaptations remains unclear. In summary, these methodological limitations, along with the overall moderate quality of the studies, reduce confidence in the conclusions drawn.

Heterogeneity in measurement tools further complicates comparisons between studies. Different versions of the Mental Toughness Questionnaire (MTQ48, MTQ18, and MTQ10), the Mental Toughness Index, and the VS-MTQ were used, raising concerns about conceptual consistency. Shorter MT measures (e.g. MTQ10) may not fully capture the concept, leading to differences in effect sizes. Similarly, depression and anxiety were measured using different scales (BDI, PHQ-9, DASS-21, HADS, GAD-7), each assessing different aspects of mental health. Mental well-being was assessed with tools like the PWB scale, Life Satisfaction Scale, and WEMWBS, which assess different aspects of well-being. These variations could impact the generalizability of findings.

Limitations of this review

This review is limited to English-language studies, potentially excluding relevant research and leading to an incomplete picture of the MT-mental health relationship. Additionally, variability in study design, measurement tools, and participant characteristics, prevented a meta-analysis, limiting the ability to quantify effect sizes and draw definite conclusions about the strength of the MT-mental health link.

Another limitation is the possible inclusion of overlapping datasets, which may have introduced duplication bias or overrepresented findings. While narrative approach reduces this risk compared to meta-analysis, limited reporting made overlap hard to confirm. To avoid omitting important data, we have decided to adopt a balanced and inclusive approach.

Implications for Practice and Theory

This comprehensive synthesis provides insights into the protective role of MT in enhancing mental health outcomes. The consistent significant results across different populations and study designs suggest that MT interventions could help reduce depression and anxiety while enhancing well-being in clinical, educational, and competitive settings. Clinically, the results support the use of MT-focused assessments to identify those at greater risk of adverse mental health outcomes, particularly in high-stress settings. Practitioners might also enhance existing resilience or wellbeing interventions by incorporating MT components (i.e. control, commitment, challenge, and confidence). Furthermore, these findings offer a foundation for developing tailored MT interventions by emphasizing the need to identify and understand the factors influencing the MT-mental health link. Accounting for these differences will ensure that such interventions are better suited to diverse populations.

From a theoretical perspective, the review supports the relevance of the 4C model (Clough et al., 2002) and reinforces the idea that MT is a multidimensional construct applicable in various contexts, not just performance-related ones. It also highlights the need for further refinement and validation of MT instruments across different settings and populations.

Future research

Future research would benefit from standardised assessment tools for both MT and mental health outcomes to allow for more reliable comparisons and stronger conclusions about the protective role of MT. Future research should further explore how cultural, individual, and environmental factors influence the relationship between MT and mental health. Longitudinal and experimental research are needed to better understand the mechanisms through which MT influences mental health outcomes. Additionally, research should identify the most impactful MT components for different groups (e.g. athletes, students) and develop targeted interventions to support mental health across diverse populations.

Conclusion

This systematic review highlights a significant relationship between MT and mental health outcomes, with higher MT linked to lower depression and anxiety and improved mental well-being. However, several limitations need to be considered that affect the generalizability of findings, including the reliance on cross-sectional designs, a wide range of sample sizes (with some studies having very small samples), and the diversity in measurement tools. Future research should focus on using standardised assessments and longitudinal studies with larger samples to enhance reliability. Despite these limitations, the findings suggest that integrating MT into interventions could be a beneficial way to improve mental health.

Declaration

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Chapter 2: Major Research Project

A longitudinal exploration of mental toughness and mental health among health and social care workers during the COVID-19 pandemic

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Plain Language Summary

A longitudinal exploration of mental toughness and mental health among health and social workers during the COVID-19 pandemic

Background: Previous studies suggest that the COVID-19 pandemic has negatively affected the mental health of health and social care workers. However, not all staff have been impacted in the same way. One factor that appears to protect individuals against poor mental health outcomes (such as anxiety and depression) is mental toughness. Mental toughness refers to the ability to adapt well to challenges and adversity. The relationship between mental toughness and mental health (specifically depressive and anxiety symptoms) among health and social care workers is not well studied.

Aims: The aim of this study was to explore the association between mental toughness and psychological outcomes (anxiety, depression, and well-being) among a sample of health and social care workers during the COVID-19 pandemic.

Methods: We analysed data from a study conducted by De Kock et al. (2022), which involved 169 participants who were 18 years or older, residing in the UK, and working as NHS health or social care workers during the COVID-19 pandemic. The study, which adhered to all ethical requirements, used online surveys to gather data at two points approximately six weeks apart. Using statistical software, we examined whether mental toughness at the start of the study was related to improved anxiety, depression, and mental well-being scores at follow-up.

Main Findings: The results tentatively suggest a bidirectional relationship between mental toughness and mental wellbeing over time. Mental toughness may improve mental wellbeing, with mental toughness statistically predicting better wellbeing scores, although the effect size was modest. Mental wellbeing also statistically predicted mental toughness at follow-up. However, these results were no longer statistically significant after additional relationships between all the variables were taken into account in the analyses.

Conclusions: The results suggest the mental toughness may play an important protective role in improving mental wellbeing among NHS staff. If the possible bidirectional relationship between mental toughness and mental wellbeing were confirmed in future research, this may suggest that interventions aimed at improving mental toughness could foster better mental wellbeing, and vice versa.

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Abstract

Objectives: To investigate the association between mental toughness (MT) and psychological outcomes (depression, anxiety, and mental well-being) among health and social care workers (HSCWs) during the COVID-19 pandemic.

Design: Secondary analysis of cohort data collected by De Kock et al. (2022).

Methods: Data from 169 participants, collected at two times around 6 weeks apart to investigate the relationship between MT and mental health outcomes, were analysed using correlations and regression analyses. Cross-lagged analyses were also employed to examine the associations between MT and mental health outcomes simultaneously after controlling for three covariates (gender, psychiatric disorder, and having worked directly with COVID-19 patients).

Results: MT positively correlated with mental wellbeing (MWB) and negatively correlated with anxiety and depression at both Time 1 and Time 2. Results from the cross-lagged analysis suggested a bidirectional relationship between MT and MWB over time: higher MT at Time 1 significantly predicted higher MWB at Time 2 (β = 0.16; 95% CI 0.022, 0.309), and greater MWB at T1 significantly predicted higher levels of MT at T2 (β = 0.19; 95% CI 0.028, 0.352). However, these were no longer statistically significant in a more complex model taking into account interrelationship among other variables. MT at Time 1 did not significantly predict anxiety and depression at Time 2, nor vice versa, in cross-lagged models.

Conclusions: If the possible bidirectional relationship between MT and MWB were confirmed in future research, this suggests that interventions aimed at improving MT could foster better mental wellbeing, and vice versa, among HSCWs.

Words: 250

Keywords: Mental Toughness, Health and Social Care Workers, anxiety, depression, mental well-being, COVID-19.

Introduction

Research has consistently shown that the Coronavirus Disease 2019 (COVID-19) pandemic negatively impacted the mental health of health and social care workers (HSCW), affecting both clinical staff (e.g., doctors, nurses) and non-clinical staff (e.g., managerial, administrative, and support roles). Studies worldwide, including UK-based surveys (NHS Staff Survey, 2021), consistently reported increased anxiety, emotional exhaustion, low mental well-being, and job-related strain across all roles (World Health Organisation, 2022; Luo et al., 2020; Cai et al., 2020; De Kock et al., 2021). Contributing factors included high workloads, physical exhaustion, lack of personal protective equipment, inadequate staff levels, and fear of transmitting the virus to friends and family (Cai et al., 2020).

The impact of the pandemic on mental health can be further understood using theoretical frameworks such as the Job Demands-Resources (JD-R) model (Bakker & Demerouti, 2017), which explains how high job demands and limited resources can lead to burnout and psychological distress. This model applies across all HSCW staff groups, recognising that non-clinical workers can also experience increased workloads, role uncertainty, and emotional pressure. Guidelines from the WHO (2020) and the British Psychological Society (2020) highlighted the importance of addressing the mental well-being of all NHS and social care staff, including those not in direct patient-facing roles.

However, not all HSCWs exposed to stress and anxiety during the COVID-19 pandemic developed adverse mental and psychological consequences, with research suggesting that there are some protective factors. Research carried out during previous outbreaks (e.g., MERS-CoV, Ebola, and SARS) and the COVID-19 pandemic indicates that psychological resilience can serve as a buffer against poor mental health (MH) among HSCWs (Chew et al., 2020; De Kock, et al. 2021).

Resilience refers to one's capacity to adapt to challenging or stressful circumstances (Garcia-Dia et al., 2013). Whilst resilience is a multifaceted construct, one concept closely related to it, and shown to be amenable to modification, is mental toughness (MT). MT is an umbrella concept comprising a collection of psychological variables that enable individuals to initiate

and maintain goal-directed behaviour when faced with challenging situations (Gucciardi et al., 2015).

Both MT and resilience support positive adaptation to challenges and adversity. Nevertheless, MT is dissimilar to resilience in two ways. First, the construct of MT does not imply the presence of adversity in someone's environment, whereas resilience does. MT describes an individual's response to adversity but also involves a predisposition to look for opportunities/challenges for self-development (Gucciardi, 2017). Second, MT can be directly measured as a particular collection of attributes (Lin et al., 2017), while resilience is a broader concept that comprises several protective factors (e.g., social and biological) and is measured indirectly (Luthar et al., 2006).

MT is also often discussed alongside constructs such as hardiness and grit. While these are positively correlated (Cowden, et al., 2016; Lin et al., 2017), these are underpinned by distinct theoretical foundations and have different implications for mental health (Gucciardi, Gordon & Dimmock, 2009). Grit emphasises long-term persistence, whereas MT encompasses a broader range of attributes like confidence, emotional control, and a proactive approach (Clough et al., 2002). Unlike hardiness, which is typically viewed as a fixed personality trait, MT is considered modifiable (Strycharczyk & Clough, 2015), with evidence suggesting it can change through life experiences and environmental factors (Lin et al., 2017). As such, MT may be developed (Fitzwater, Arthur & Hardy, 2018), making it a promising target for interventions aimed at improving mental health outcomes.

Research shows that MT is associated with better mental health outcomes across different populations and contexts, including students, athletes, and the general population (Luthar & Cicchetti, 2000) (Gerber et al., 2013; Lin et al., 2017). More recently, Gasteiger et al. (2023) found that MT significantly predicted mental health, reducing anxiety and depression, with individuals exhibiting higher levels of MT consistently reporting better mental well-being throughout the pandemic.

Although a relatively large body of cross-sectional evidence highlighting the MT's protective role emerged early in the COVID-19 pandemic (Mojtahedi et al., 2021), longitudinal research

remains limited. Additionally, although research has consistently indicated positive associations between MT and MH, the bidirectional relationship is less well understood. Most studies have used mental health indicators as outcome measures, with only a small number considering them as predictive factors. To our knowledge, the only research that has focused on the influence of mental health on resilience reported that participants with high anxiety displayed lower resilience (Pollack et al., 2004; Wu, et al., 2020).

MT offers a useful framework for understanding resilience and adaptation during adversity among HSCWs (Mojtahedi et al., 2021), a group already vulnerable to adverse MH outcomes. The pandemic significantly heightened these risks (Lamb et al. 2021), and supporting their well-being is critical to support both individual functioning and the quality of patient care (World Health Organisation, 2022; British Psychological Society, 2020).

The current study

This study aimed to address several gaps in the existing literature and differs from previously published studies in several ways. First, while most studies on MT have focused on athletes and students, this study examined MT among HSCWs, a population exposed to prolonged stressors during the COVID-19 pandemic (Lin et al., 2017; Gerber et al., 2013). Second, most existing studies on MT and related psychological concepts have been cross-sectional, limiting insight into how MT and mental health outcomes vary over time. By adopting a longitudinal design, this study examines the temporal dynamics between MT and MH outcomes. Third, although MT is typically examined as a predictor of mental health, the reverse (i.e. how mental health might impact MT) remains underexplored. This study considers whether MH may influence MT, drawing from resilience literature that suggests that individuals with high anxiety tend to report lower resilience (Pollack et al., 2004; Wu, et al., 2020). Lastly, the study contributes to ongoing debates about whether MT is stable or a modifiable attribute responsive to experience and environment (Lin et al., 2017). Given the unique stressors faced by HSCWs, the findings offer timely insight into MT as a potential target for interventions to support staff mental health.

Aims and Research Questions

This study aimed to explore the relationship between MT and MH outcomes among HSCWs based in a remote area in Scotland during the COVID-19 pandemic. Specifically, this study aimed to: 1) examine longitudinal changes in Mental Toughness (MT), adverse mental health outcomes (Anxiety and Depression), and Mental Well-Being (MWB) over time, 2) investigate the bidirectional longitudinal associations between MT and mental health outcomes (anxiety, depression, and MWB), and 3) explore potential covariates in the relationship between MT, MH and MWB outcomes.

This study aimed to address the following research questions:

Primary research questions

1. To what extent did the Time 2 scores of anxiety, depression and MWB (September 2020) differ from the Time 1 (July 2020) scores?
2. Was a measure of MT associated with these changes?

Secondary research questions

1. What was the relationship (unidirectional or bidirectional) between MT and anxiety, depression and MWB over time?
2. What sociodemographic factors were associated with MT?
3. What were potential covariates that could affect the relationship between MT, anxiety, depression and MWB?

Based on prior research, we hypothesised that:

1) MT would act as a protective factor for MH among HSCWs, with T1 MT, anxiety, depression and MWB being highly intercorrelated (i.e. r >=0.3, Mojtahedi, 2021). That is, higher MT levels are associated with lower distress and higher MWB levels;
2) MT would predict more favourable MH and MWB levels at follow-up, after adjusting for the T1 values of those measures;
3) Higher MT at T1 would be associated with stable MH and MWB scores over time.

Materials and Methods

Design

This study was a secondary data analysis using data collected during the longitudinal cohort study by De Kock et al. (2022). Reporting is in accordance with the Strengthening the

Reporting of Observational Studies in Epidemiology (STROBE) cohort study checklist (Vandenbroucke et al., 2007) (see Appendix 2.1).

Ethical approval

The original cohort study obtained management approval from NHS Highland (NHSH) and ethics approval from the Health Research Authority (20/SW/0098). All participants provided consent for their data to be used in future research. After discussing data access permissions, this project was sponsored and received management approval from the NHS Highland Research, Development & Innovation (RD&I) Department (see Appendix 2.2).

Research Procedure

Recruitment for the cohort study was facilitated by GP practice managers and NHSH Human Resources, who circulated emails and newsletters containing links to the study. Social media platforms were also used to recruit participants. Potential participants were directed via weblink to a secure data collection website, where they read the study details, completed an informed consent form and completed the measures. The first assessment (T1) occurred between mid-July 2020 and mid-August 2020, whilst the second assessment (T2) occurred from end August 2020 to mid-September 2020.

Participants

For the purpose of this study, health and social care workers (HSCWs) refers to individuals employed in both clinical roles (e.g., nurses, doctors, healthcare assistants) and non-clinical roles (e.g., managerial, administrative, and support staff) within health and social care settings. The sample included 225 HSCWs employed across NHS services in the Highland region of Scotland, comprising a mix of clinical and non-clinical staff. 56 participants did not fill out the questionnaires at T2. The final sample, which completed the measures at both T1 and T2, included 169 participants. Due to access being limited to a subsample of participants with complete data, a comparison with those lost to follow-up was not possible. Inclusion criteria were: aged 18 years and older, residing in the UK, and working as a health or social care worker in NHSH during the COVID-19 pandemic.

Measures

Participants were invited to fill out demographic information questions (at T1 only) and psychological measures (at both T1 and 2).

Demographic and work-related information items included age, job role, qualifications, setting, workload burden, and prior diagnosis of a psychiatric disorder. For the latter, participants were asked to indicate whether they had a history of psychiatric disorders using a binary response format (yes/no). No further diagnostic detail was available in the dataset.

Depression was assessed using the Patient Health Questionnaire (PHQ-9; Kroenke et al., 2001). This 9-item self-administered tool measures symptom severity within the last 14 days, with scores ranging from 0-27 (with higher scores indicating higher levels of depression). The PHQ-9 has revealed good validity and reliability (Kroenke et al., 2001), and has been used extensively in the UK (Lamb et al., 2021) and internationally (Luo, et al., 2020) to assess depressive symptoms in numerous populations during the pandemic. The threshold for identifying clinical depression was set at a score of 10 (Kroenke et al., 2001).

Anxiety was measured using the Generalized Anxiety Disorder Scale-7 (GAD-7; Spitzer et al., 2006). Participants were asked to rate the severity of their anxiety symptoms in the last 14 days. These scores were summed, with maximum score of 21, with higher scores indicating higher anxiety. The GAD-7 has revealed good internal validity and reliability (Spitzer et al., 2006). Furthermore, the GAD-7 has been used to assess levels of anxiety among frontline workers during this pandemic, both internationally (Lai et al., 2020) and in the UK (Lamb et al., 2021; De Kock et al., 2022). A score of 10 was used as the threshold for identifying symptoms of clinical anxiety (Spitzer, Kroenke & Williams, 2006).

Mental well-being was measured using the Warwick-Edinburgh Mental Well-being Scale (WEMWBS) (Tennant et al., 2007). This 14-item tool assesses psychological functioning and subjective well-being, with scores ranging from 14-70. Higher scores suggest greater mental well-being. This tool has shown good validity (Tennant et al., 2007) and has been used to measure mental well-being of NHS workers during this pandemic (Greenberg et al., 2021).

The clinical threshold for identifying clinical depression was set for 40 and scores >60 are indicating high mental well-being.

Mental toughness was measured using the Mental Toughness Index (MTI) (Gucciardi et al., 2015). This scale includes eight items (e.g. "I consistently overcome adversity") rated on a seven-point Likert scale. Scores range from 8-56, with higher values indicating greater MT. This scale has demonstrated sound psychometric properties (Cowden et al., 2020; Gucciardi et al., 2015).

Statistical analysis

SPSS 29 Statistics software was used to calculate descriptive statistics and correlations between MT and mental health outcomes (anxiety, depression, and mental well-being) at the two timepoints. Then, paired t-tests examined mean changes in MT and MH outcomes across the two timepoints. Spearman correlations examined the correlations between all psychological variables. Multiple linear regressions were also used to examine the associations between MT at T1 and Change scores for anxiety, depression and MWB.

The SPSS AMOS 29 package was used for cross-lagged analysis to assess the reciprocal influences between MT and mental health over time. The cross-lagged panel model included cross-lagged path coefficients and stability coefficients between T1 and T2 for MT and mental health, indicating how prior scores of one variable related to subsequent scores of the other (see diagram below and appendices for list of supplementary analyses completed). Additionally, participants' gender, psychiatric diagnosis and working with COVID-19 patients were entered as control variables in the cross-lagged model.

The data were reviewed to verify the assumptions of the statistical analyses and to identify any missing data. Initial checks were performed to assess the normality of the dependent variables using kurtosis and skewness metrics (skewness <1.0). The results, supported by histograms, indicated that the GAD-7 and PHQ-9 variables were not normally distributed. As a result, medians with interquartile ranges (IQRs) were reported and the non-parametric (Spearman) correlation was applied. For the linear regression analyses, the residuals were examined and confirmed to be normally distributed, justifying the use of linear regression

models. Cronbach's alphas were also calculated to determine the internal consistency of the measures (see Appendix 2.3. for details). To assess the cross-lagged model fit, we applied the following criteria and optimal ranges (Hooper et al., 2008): 1) X^2/degree of freedom (df) values under 2, 2) RMSEA values below .08, and 3) CFI, NFI and TLI values above .95.

Within the sample of 169 participants who took part at both time points, missing data were minimal, with most participants providing complete information across the majority of variables. Therefore, we proceeded with a complete case analysis. Additionally, Full Information Maximum Likelihood (FIML) was used in the AMOS analysis, to maximise the inclusion of all available data from all participants.

G-Power was used to conduct a sensitivity power analysis (Faul et al., 2009). The analysis showed that for our sample (n=169, alpha=.05, 5 predictors), the study had a power of 0.96 for small to moderate effect sizes and above (f^2=0.10). Even with a smaller effect size (f^2=0.05), the power remained at 0.82, exceeding the recommended threshold of 0.80 (Cohen, 1992).

Results

Participant demographics

The majority of participants were female (88.2%), aged 40 or over (73.4%), had not previously been diagnosed with a psychiatric disorder (77%), had more than 10 years of experience in their respective job roles (70.4%), and held a postgraduate qualification (60.9%). Most participants worked in primary care (23.1%) or hospitals (44.4%), with the majority not working directly with COVID-19 patients (77%). See Table 2.1 for participant demographics and missing data across the two waves of data collection.

Table 2.1
Distribution of Participant Characteristics at Time 1

Characteristic		***Baseline (N=169), n (%)***
Gender	Female	149 (88.2)
	Male	20 (11.8)
	Missing n	0
Dependent Children	Yes	56 (33.3)
	No	112 (66.7)
	Missing n	1

Age Category	18-25	4 (2.4)
	26-30	10 (5.9)
	31-40	31 (18.3)
	>40	124 (73.4)
	Missing n	0
Job Type	Admin	16 (9.5)
	Doctor	39 (23.0)
	Nurse	48 (28.4)
	Carer	6 (3.6)
	Healthcare assistant	10 (5.9)
	Allied Health Professional	21 (12.4)
	Other	32 (18.9)
	Missing n	0
Work setting	GP practice	39 (23.1)
	Hospital	75 (44.4)
	Care Home	4 (2.4)
	Other	53 (31.4)
	Missing n	0
Working with Covid-19	Yes	38 (22.8)
	No	129 (77.2)
	Missing n	2
Work disruption	No disruption	3 (1.8)
	Minor	15 (8.9)
	Moderate	65 (38.5)
	Major	66 (39.1)
	Severe	20 (11.8)
	Missing n	0
Hours worked per week	<20	8 (4.5)
	20-30	31 (18.3)
	31-40	100 (59.2)
	>40	30 (17.8)
	Missing n	0
Shielding status†	Personally Shielding	7 (4.1)
	Not Shielding	162 (95.9)
	Family member Shielding	17 (10.1)
	Missing n	0
Education level	≤ Undergraduate	50 (32.7)
	≥ Postgraduate	103 (67.3)
	Missing n	0
Years of experience	>2 years	14 (8.3)
	2-5 years	13 (7.7)
	6-10 years	21 (12.4)
	>10 years	119 (70.4)
	Missing n	2
Psychiatric Diagnosis	Yes	38 (22.5)
	No	131 (77.5)
	Missing n	0

†Participants were allowed to tick more than one answer

Psychological measurements

Table 2.2 displays the descriptive statistics for the psychological measures over the two time points, presented as medians and interquartile ranges (IQR), along with the number and percentages of participants who scored above and below the clinical cut-offs on the well-being, depression and anxiety outcomes. See appendix 2.3 for supplementary information on descriptive statistics for MT, anxiety, depression, and mental well-being at Wave 1 and Wave 2.

The data indicate that mental well-being remained low across both time points, with the percentage of individuals experiencing probable depression staying relatively stable (32.5% at T1, 31.4% at T2), while possible depression saw a slight increase. Depression levels showed a mild reduction in the clinical category from 31% at T1 to 29.8% at T2. However, anxiety levels increased noticeably, with clinical anxiety increasing from 20.6% at T1 to 27.7% at T2.

Table 2.2

Descriptive Statistics for Outcomes at Wave 1 and Wave 2.

Outcome (n missing)	***Median (IQR†)***	***Ordinal classification n (%)***					***Binary classification n (%)***	
Mental well-being		**Probable depression (≤40)**	**Possible Depression (41-44)**	**Average (45-59)**	**High (≥60)**		**Clinical (≤40)**	**Non-clinical (>40)**
T1 (3)	45 (13)	54 (32.5)	28 (16.9)	75 (45.2)	9 (5.4)		54 (32.5)	112 (67.5)
T2 (0)	44 (14)	53 (31.4)	34 (20.1)	73 (43.2%)	9 (5.3)		53 (31.4)	116 (68.6)
Depression		**Normal (0-4)**	**Mild (5-9)**	**Moderate (10-14)**	**Moderately severe (15-19)**	**Severe (20-27)**	**Non-clinical (<10)**	**Clinical (≥10)**
T1 (1)	7 (7.7)	57 (33.9)	59 (35.1)	39 (23.2)	10 (6)	3 (1.8)	116 (69)	52 (31)
T2 (1)	7 (8)	54 (32.1)	64 (38.1)	35 (20.8)	12 (7.1)	3 (1.8)	118 (70.2)	50 (29.8)
Anxiety		**Normal (0-4)**	**Mild (5-9)**	**Moderate (10-14)**	**Severe (15-21)**		**Non-clinical (<10)**	**Clinical (≥10)**
T1 (4)	5 (6)	73 (44.2)	58 (35.2)	28 (17)	6 (3.6)		131 (79.4)	34 (20.6)
T2 (3)	6 (7)	65 (39.2)	55 (33.1)	34 (20.5)	12 (7.2)		120 (72.3)	46 (27.7)

† IQR, Interquartile Range

Relationship between Mental Toughness and Mental Health (Hypothesis 1)

All outcome variables showed significant correlations between their T1 and T2 scores, indicating stability in these measures over time (all p<.001). MT showed a strong positive correlation with MWB at T1 (r=.64) and a moderate correlation at T2 (r = .43; both p< .001). Additionally, MT was negatively correlated with depression and anxiety scores across both waves, with correlations ranging from .23 to .48 (all p<.01). Table 2.3 presents the correlations and their corresponding confidence intervals between MT and mental health outcomes for both Wave 1 and Wave 2.

Table 2.3

Correlation Matrix of Outcome Variables at Wave 1 and Wave 2

	Variables	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*
1.	*T1 Mental toughness*	-							
2.	*T2 Mental toughness*	0.59 (0.48, 0.69) **	-						
3.	*T1 Depression*	-0.48 (-0.59, -0.35) **	-0.32 (-0.46, -0.18) **	-					
4.	*T2 Depression*	-0.28 (-0.42, -0.13)**	-0.54 (-0.64, -0.42)**	0.44 (0.31, 0.56) **	-				
5.	*T1 Anxiety*	-0.41 (-0.53, -0.27)**	-0.30 (-0.44, -0.15) **	0.75 (0.67, 0.81) **	0.36 (0.22, 0.49) **	-			
6.	*T2 Anxiety*	-0.23 (-0.37, -0.07) *	-0.51 (-0.62, -0.39)**	0.37 (0.22, 0.49) **	0.74 (0.66, 0.80) **	0.45 (0.32, 0.57) **	-		
7.	*T1 Mental well-being*	0.64 (0.53, 0.72)**	0.45 (0.31, 0.57)**	-0.74 (-0.80, -0.66)**	-0.39 (-0.51, -0.25)**	-0.66 (-0.74, -0.57)**	-0.37 (-0.50, -0.23) **	-	
8.	*T2 Mental well-being*	0.43 (0.29, 0.54)**	0.71 (0.62, 0.78) **	-0.40 (-0.52, -0.26) **	-0.74 (-0.80, -0.66) **	-0.39 (-0.51, -0.25) **	-0.65 (-0.73, -0.55) **	0.53 (0.41, 0.64)**	-

95% Confidence intervals are given in parentheses; *T1, the first wave; T2, the second wave. P values are two-tailed. *p < 0.01, **p<0.001.* A coefficient of 0.50 or greater is considered to indicate a high correlation level, a value between 0.30 and 0.49 a moderate correlation, and a value of 0.29 or below is considered a small correlation.

Changes in MT and Mental Health across time

As shown in Table 2.4, the paired t-test results indicated minimal overall change in the four psychological measures between the two periods and these were not statistically significant ($p \geq .05$).

Table 2.4

Changes in Mental Toughness and Mental Health across time

Variable (n)	*T1 Mean (SD)*	*T2 Mean (SD)*	*Mean difference*	*Lower 95% CI of the Difference*	*Upper 95% CI of the Difference*	*t-test*	*p-value*
Mental toughness (165)	39.66 (8.51)	38.97 (8.72)	-0.68	-1.96	.59	-1.05	0.29
Depression (167)	7.22 (4.78)	7.37 (4.94)	0.14	-.62	.91	0.37	0.71
Anxiety (162)	6.10 (4.38)	6.70 (4.74)	0.60	-.13	1.34	1.61	0.10
Mental well-being (166)	45.37 (8.95)	45.45 (9.18)	0.08	-1.26	1.43	0.12	0.90

SD, Standard Deviation. CI, confidence Interval. P values are two-tailed.

Longitudinal association of Mental Toughness and Mental Health outcomes

Linear regression analysis of Baseline MT and T2 mental health outcomes (Hypothesis 2)

We used regression analyses predicting anxiety, depression and mental wellbeing (separately) at Time 2 by MT scores at T1, while controlling for the T1 values of those measures.

The regression models were statistically significant for all three outcomes, though the strength of the relationship with MT at T1 varied across each outcome. For depression and anxiety, the models accounted for 21.4% and 20.0% of the variance, respectively, with the T1 values of these outcomes being significant predictors (see Table 2.5). However, MT at T1 was not a significant predictor in these models (depression model: B=-0.029, p=.512; anxiety model: B=-0.13, p=.746). The model for MWB explained a greater proportion of variance

(28.8%). Although MT at T1 did not significantly predict MWB at T2, it approached significance (B=0.188, p=.059) (see Table 2.5).

Table 2.5

Regression Analysis predicting Mental Health Outcomes at T2 from mental health outcomes at T1 and MT at T1

	B	Lower 95% CI for B	Upper 95% CI for B	β	t	p value
Depression at Time 2 (Adjusted R^2 = .214, F (2, 164) = 23.661, p < .001)						
(Constant)	5.175	1.019	9.331		2.459	.015
Depression at T1	.464	.309	.620	.449	5.884	<.001
Mental Toughness at T1	-.029	-.117	.059	-.050	-.657	.512
Anxiety at Time 2 (Adjusted R^2 = .200, F (2, 158) = 21.029, p < .001)						
(Constant)	4.259	.524	7.994		2.252	.026
Anxiety at T1	.486	.327	.645	.450	6.029	<.001
Mental Toughness at T1	-.013	-.095	.069	-.024	-.325	.746
Mental Well-being at Time 2 (Adjusted R^2 = .288, F (2, 162) = 34.129, p < .001)						
(Constant)	18.395	11.718	25.071		5.441	<.001
Mental Well-being at T1	.432	.255	.608	.421	4.828	<.001
Mental Toughness at T1	.188	-.008	.348	.164	2.068	.059

B = unstandardised effect size coefficient representing number of score points on the outcome measure. β = standardised effect size coefficient in standard deviation units. CI = confidence interval.

Linear Regression Analysis of Baseline MT and Mental Health Change Scores (Hypothesis 3)

To test Hypothesis 3, multiple linear regression models were conducted to examine the impact of T1 MT on changes in anxiety, depression, and mental well-being (separately). Difference scores were created for anxiety, depression, and mental wellbeing (time 2 minus time 1), and used as outcomes in the regression.

As shown in Table 2.6, the model for depression was significant, explaining 2.4% of the variance in change scores. Higher MT at T1 was associated with a greater drop in depression change scores (B= -0.102, p=.026). The regression model for mental wellbeing was also significant, accounting for 3.7% of the variance in change scores. Higher levels of MT at T1

were linked to greater positive change in mental wellbeing (B=.225, p=.008). In contrast, the model for anxiety was not significant, explaining only 1% of the variance. Although the coefficient for MT at T1 suggested it was linked with a potentially greater drop in anxiety change scores (B=-.072), it did not reach statistical significance (p=.105).

Table 2.6

Multiple Linear Regression between MT (T1) and change scores on Anxiety, Depression and Mental Wellbeing between T1 and T2

	B	Lower 95% CI for B	Upper 95% CI for B	β	t	p value
Change in Depression (Adjusted R^2 = .024, F (1, 165) =5.064 , p < .05)						
(Constant)	3.894	0.272	7.517		2.123	.035
Mental Toughness at T1	-.102	-.191	-.012	-.173	-2.225	.026
Change in Anxiety (Adjusted R^2 = .010, F (1, 159) = 2.653, p ≥.05)						
(Constant)	2.245	-1.271	5.760		1.261	.209
Mental Toughness at T1	-.072	-.158	.015	-.128	-1.629	.105
Change in Mental Well-being (Adjusted R^2 = .037, F (1, 163) = 7.264, p < .01)						
(Constant)	-9.077	-15.781	-2.37		-2.674	.008
Mental Toughness at T1	.225	.060	.390	.207	2.695	.008

Dependent variables: Change in Anxiety (T2-T1), Change in Depression (T2-T1), Change in Mental Well-being (T2-T1).
B = unstandardised effect size coefficient representing number of score points on the outcome measure. β = standardised effect size coefficient in standard deviation units. CI = confidence interval.

Cross-lagged analysis for MT and level of mental health

To build on the regression analyses above, which examined each mental health outcome separately, a cross-lagged model was constructed to explore the reciprocal longitudinal relationship between MT and all the mental health outcomes simultaneously across the two time points. Figure 1 presents the estimates and these relationships. Fit indices showed an overall adequate goodness of fit for the model: Chi-square= 30.669 (df=21, p=0.79), NFI=.96,

TLI=.96, CFI=.98, RMSEA=.05. Detailed results are presented in Appendix 2.4. Coefficient estimates reported here are standardised (β).

Figure 2.1 shows that MT, mental wellbeing, anxiety, and depression showed significant stability over time. These values at T1 significantly predicted their values at T2, as indicated by the strong and significant autoregressive paths from T1 to T2 measures (estimates ranging from 0.38 to 0.44).

The results demonstrated a bidirectional relationship between MT and MWB over time. Specifically, MT at T1 positively and significantly predicted mental wellbeing at T2 (β =0.16, 95% CI 0.022 to 0.309, p=0.03), suggesting a modest, positive relationship between higher MT at T1 and better mental wellbeing at T2. Additionally, MWB at T1 significantly predicted MT at T2 (β=0.19, 95% CI 0.028 to 0.352, p=0.024), indicating that better MWB at T1 is associated with higher levels of MT at T2.

Regarding anxiety and depression, the path from MT at T1 to these outcomes at T2 remained non-significant; for anxiety: (β =-0.017, 95% CI -0.154 to 0.120, p=0.81); and for depression: (β =-0.020, 95% CI -0.158 to 0.118, p=0.78). Therefore, T1 MT did not significantly predict anxiety or depression at T2. Additionally, anxiety and depression at T1 did not significantly influence MT levels at T2, as shown by the non-significant path coefficients (0.06 and 0.02, respectively).

Gender significantly predicted MWB at T2 negatively, indicating that being female was associated with lower mental wellbeing at T2 (β = -0.13, 95% CI -0.255, -0.005, p=0.04). Having a psychiatric disorder at baseline predicted higher levels of depression at T2 (β = 0.17, 95% CI 0.041, 0.299 p=0.014) and lower MWB at T2, although the latter was not significant (β = -0.11, 95% CI -0.235, 0.015, p=0.08). Working directly with COVID-19 patients did not significantly predict MT, anxiety, or MWB at T2; the coefficient for depressive symptoms was slightly larger but still non-significant (β=0.13, 95% CI -0.001, 0.259, p=0.066).

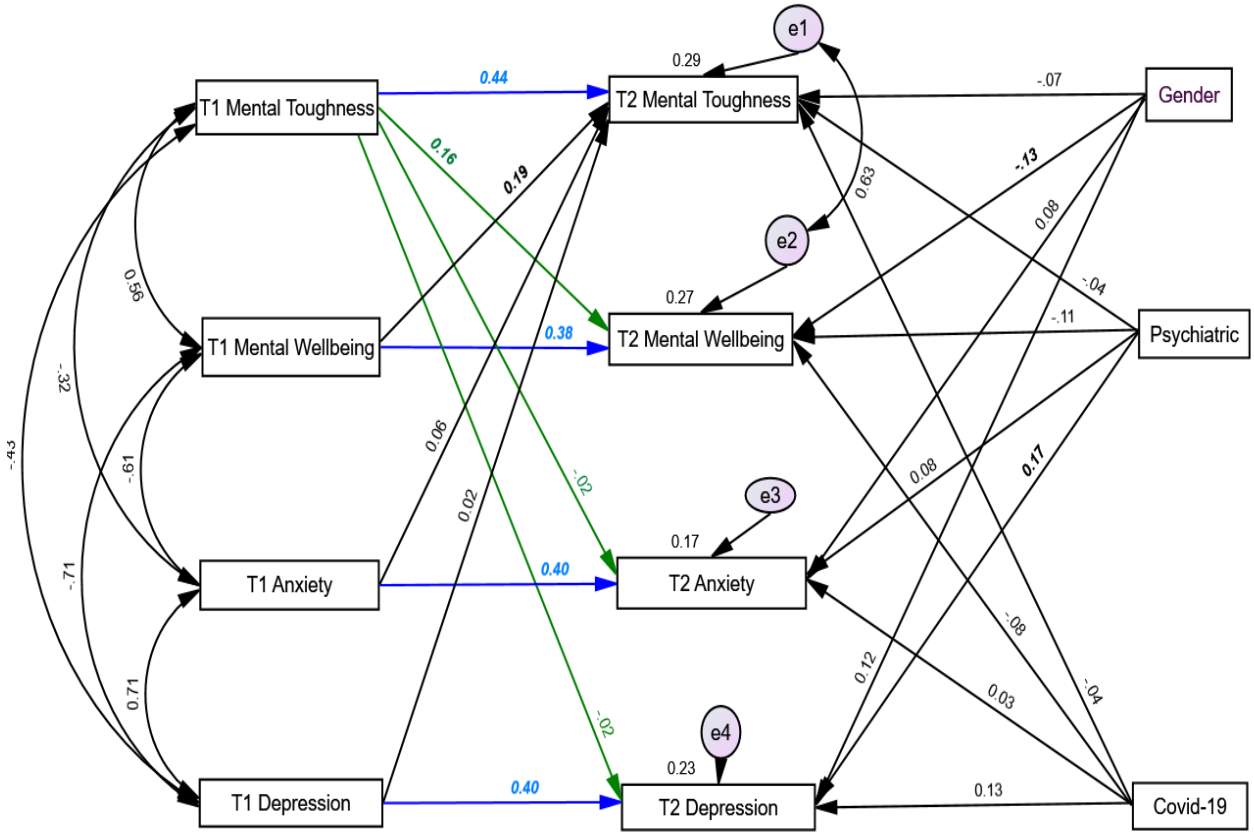

Figure 2.1

Cross-lagged model between MT, anxiety, depression and mental wellbeing. Coefficient for gender path represents the effect size for females**.** Abbreviations: e1, e2, e3, and e4: latent errors. Parameter estimates are standardised, and those shown with bold italics are statistically significant (p<0.05). Covariances between error terms for T2 variables were also included in the model, but these do not appear in the model diagram for ease of presentation. One of them (e1 to e2) is shown as an example. Bidirectional arrows reflect correlations, and unidirectional arrows depict hypothesized directional links. Baseline control variables were gender, psychiatric status and working directly with COVID-19 patients.

The model presented in Figure 1 did not include crossed paths among the mental health measures (e.g. there was no path between T1 MWB and T2 anxiety, etc.). Recognising that these additional interrelationships may exist and could impact on the overall results, Figure 2.2 presents a more comprehensive model that was constructed to include these additional paths. Detailed results are presented in Appendix 2.5. The Chi-square statistic was significant, indicating a poor fit of the model to the data: $\chi^2 = 26.953$, df = 15, p = .029. However, the other fit indices indicated an acceptable model fit (e.g. RMSEA=.69, CFI = .986, TLI = .936, IFI = .986).

The relationships between MT at T1 and MWB, anxiety, and depression at T2 were not statistically significant in this model. This suggests that MT at T1 does not have a strong predictive power for these mental health outcomes at T2, when controlling for other variables in the model. The reciprocal relationship between MT and MWB that was seen in the previous model was no longer statistically significant. The coefficient from T1 MT to T2 MWB was 0.12, 95% CI -0.032, 0.272, p=0.121 (versus 0.16, 95% CI 0.022 to 0.309, in the previous model). The coefficient from T1 MWB to T2 MT was 0.19, which was unchanged from the previous model, but the CI was now wider (-0.008 to 0.388) and was therefore no longer significant.

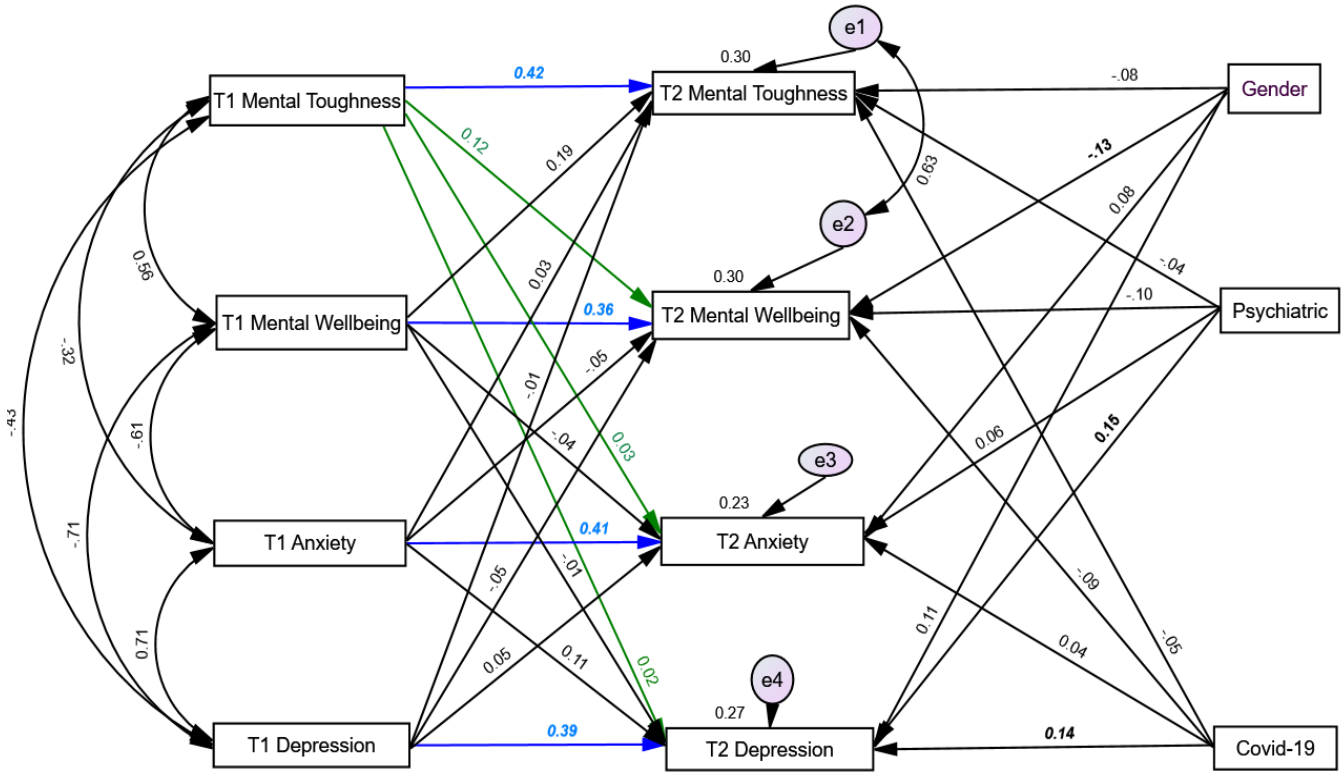

Figure 2.2

Cross-lagged model between MT, anxiety, depression and mental wellbeing with added paths among the mental health measures. Coefficient for gender path represents the effect size for females. Abbreviations: e1, e2, e3, and e4: latent errors. Parameter estimates are standardised, and those shown with bold italics are statistically significant (p<0.05). Covariances between error terms for T2 variables were also included in the model, but these do not appear in the model diagram for ease of presentation. One of them (e1 to e2) is shown as an example. Bidirectional arrows reflect correlations, and unidirectional arrows depict hypothesized directional links. Baseline control variables were gender, psychiatric status and working directly with COVID-19 patients.

The second model produced results similar to the first model concerning gender, psychiatric disorder, and working directly with COVID-19 patients. Specifically, the estimate for gender in model 2 was consistent with model 1, showing that being female significantly predicted slightly lower mental well-being at T2 (β = -0.13, 95% CI -0.256, -0.010, p = .04). The estimate for having a psychiatric disorder was slightly lower in model 2 but still indicated that having a psychiatric disorder predicted higher levels of depression at T2 (β = 0.15, 95% CI 0.027, 0.277, p = .020). Although having a psychiatric disorder also predicted slightly lower mental well-being at T2, this result was not significant (β = -0.10, CI -0.223, 0.021, p = .11), similar to the first model but with a slightly lower estimate. As in the first model, working directly with COVID-19 patients did not significantly predict MT, mental well-being or anxiety at T2. The coefficient for depressive symptoms was slightly larger and significant in the second model (β = 0.13, 95% CI 0.010, 0.268 p = .03), whereas this estimate was not significant in the first model.

Discussion

The current study aimed to examine the bidirectional relationship between mental toughness and mental health outcomes using data from the longitudinal study by De Kock et al. (2022).

The correlation analysis indicated that MT at both time points was significantly positively correlated with mental wellbeing and significantly negatively correlated with anxiety and depression, supporting Hypothesis 1. This finding aligns with previous research on the relationship between MT and mental health outcomes (Gerber, et al., 2013; Lin et al., 2017).

Further regression analyses provide only partial support for Hypothesis 2, which predicted that higher MT at T1 would be associated with more favourable mental health outcomes at follow-up. Higher MT at T1 was not strongly linked to psychological well-being across all measures, with evidence only providing partial support for its influence on MWB. Thus, MT's role in predicting more favourable psychological outcomes is limited, especially for anxiety and depression, where no significant associations were found.

The results for Hypothesis 3 were more complex and unexpected. Rather than supporting the prediction that higher MT would lead to stability in MH and MWB scores over time, the findings indicate that higher MT was linked to greater changes in both depression and MWB scores. Specifically, higher MT at T1 was linked to a greater reduction in depression and an increase in MWB over time, rather than stability. For anxiety, MT at T1 did not significantly predict changes in anxiety, suggesting that MT was not strongly linked to changes in anxiety levels over time. These findings suggest that people with higher MT experienced larger improvements in psychological wellness (particularly in depression and MWB). This result, though unexpected, is logically understandable and aligns with existing evidence that higher MT can foster positive change and growth (Clough et al., 2002; Gerber et al., 2013). Individuals with higher MT may be more resilient and adaptive, leading to greater improvements in their psychological health over time, rather than remaining stable (Gerber et al., 2013, Gucciardi et al., 2015).

Further cross-lagged analyses provided additional partial support for H2, as MT at T1 significantly predicted MWB at T2, though the effect size was modest. This corroborates existing evidence on the positive relationship between MT and MWB (Clough et al., 2002; Gerber et al., 2013; Stamp et al., 2015). However, MT at T1 did not significantly predict lower levels of anxiety and depression at T2, indicating limited influence in these areas. While there was a suggestion in the data of a predictive link between higher MT at T1 and lower anxiety and depressive symptoms at T2, it was not significant. This inconsistency with previous research (Gerber, et al., 2013; Lin et al., 2017) may be due to factors such as timing of measurements, lockdown effects, or social isolation during the pandemic. While MT appears important for MWB, its impact on anxiety and depression might be limited or influenced by other factors not captured in the model.

The results also found that T1 MWB significantly predicted higher MT levels at T2, highlighting the reciprocal relationship between MT and mental wellbeing. The significant positive relationship between MT and MWB over time suggests that these two variables mutually influence each other. This bidirectional influence may indicate that interventions aimed at improving either MT or MWB could potentially benefit both (Gerber et al., 2013; Mahoney et al., 2014; Gucciardi et al., 2015). However, it is important to note that these

relationships were no longer statistically significant in a more complex model that accounted for the interrelationships among other variables.

MT, depression, anxiety, and MWB at T1 significantly predicted their respective outcomes at T2. Additionally, females experienced slightly lower MWB at T2 compared to males, and having a psychiatric disorder was linked with slightly higher T2 depression. Working directly with COVID-19 patients was associated with a slightly lower MWB and slightly higher depressive symptoms at T2, although these associations were not significant.

Strengths and Limitations

This study addressed gaps in the literature by utilising longitudinal data to demonstrate the associations between MT and MH outcomes over time. It extended existing research by applying MT to real-world health and social care settings, where it remains under-researched. The use of validated self-report measures and naturalistic, high-stress context (i.e. the COVID-19 pandemic) also strengthens the applicability of the findings to broader occupational settings.

However, several limitations should be noted. The relatively small sample size and short follow-up period of 1.5 months may limit the generalisability of the findings. This timeframe might have been insufficient to detect meaningful changes in outcomes. It is also important to acknowledge that a significant proportion of the original baseline sample did not participate at Time 2. These non-participants may differ in unknown ways from those who did complete at follow-up (e.g. experiencing higher stress levels or having less time available for research), which could affect the generalizability of the findings. Additionally, the use of self-report measures may introduce bias in the results (Hou, Wen & Cheng, 2002). Furthermore, the study focused solely on MT as a protective factor, without considering other potential protective factors such as family support, daily routine changes, or lockdown duration, which could have mitigated the pandemic's impact on mental health and well-being (Pirkis et al., 2021).

Another limitation of this study is that prior psychiatric history was recorded only as a binary variable (yes/no), with no information on the type or severity of disorders. This limited the

ability to explore whether different diagnoses impacted the association between MT and MH outcomes.

Furthermore, factors related to participants' work status during the pandemic (e.g., furlough, redeployment, remote work) may have influenced reported levels of MT and MH, as well as their relationship. This may be especially relevant for non-clinical staff, who may not have faced the same stressors as frontline clinical roles. However, as work status was not recorded, its impact could not be evaluated.

The timing of data collection may also have influenced the findings due to the contextual pressures during the pandemic, such as school closures and limited childcare, which may have affected female staff to a greater extent. Increased strain on NHS services and seasonal factors could also have contributed to heightened distress. These factors align with the JD-R model (Bakker & Demerouti, 2017), which highlights how high demands and limited resources can impact mental health.

Clinical implications

The findings suggest that MT may play a protective role in supporting MH among HSCWs during high-stress contexts, such as the COVID-19 pandemic. While the pandemic represents a unique context, the findings may have a broader applicability to other high-pressure occupational contexts. Given emerging evidence that MT is modifiable, interventions such as well-being programmes and psychological skills training may help enhance staff well-being. Furthermore, the tentative bidirectional relationship between MT and MH suggests that improving well-being may, in turn, improve MT. Supporting both clinical and non-clinical staff with targeted interventions could also enhance workforce retention and quality of care, particularly during future crises.

Future research

Future studies should use larger sample sizes with longer follow-up periods, mixed-methods designs that include both quantitative and qualitative methods (Fancourt, et. al., 2021), and investigate the role of mediators and moderators on long-term mental health outcomes.

Conclusion

This study found that MT is significantly longitudinally associated with improved mental wellbeing among NHS staff during the COVID-19 pandemic. The study also highlighted the reciprocal relationship where initial mental wellbeing predicted future mental toughness. The bidirectional relationship between MT and MWB suggests that interventions aimed at improving either MT or MWB could potentially benefit both.

Declaration

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Appendices

Appendix 1.1 – Search Strategies

Embase (Results from January 2023)

#	Query	Results from 13 Jan 2023
1	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	9,438
2	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	2,759,386
3	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	1,970,731
4	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	2,144,894
5	2 or 3 or 4	4,598,499
6	1 and 5	7,413
7	limit 6 to (human and english)	6,926
8	limit 7 to (adult <18 to 64 years> or aged <65+ years>)	3,947

Embase (Results from December 2024)

#	Query	Results from 4 Dec 2024

1	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	3,209,097
2	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	2,225,773
3	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	2,472,241
4	1 or 2 or 3	5,258,349
5	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity").mp. [mp=title, abstract, heading word, drug trade name, original title, device manufacturer, drug manufacturer, device trade name, keyword heading word, floating subheading word, candidate term word]	396
6	4 and 5	234
7	limit 6 to (human and english language and yr="2023 - 2024")	45

Medline (OVID)- Results from January 2023

#	Query	Results from 13 Jan 2023
1	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1,650
2	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life	1,898,156

	satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	
3	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1,458,071
4	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms]	1,498,157
5	2 or 3 or 4	3,289,582
6	1 and 5	1,284
7	limit 6 to english language	1,245
8	limit 7 to humans	838

Medline (OVID)- Results from December 2024

#	Query	Results from 4 Dec 2024
1	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]	2,655
2	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp.	2,191,929

	[mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]	
3	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]	1,626,813
4	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, book title, abstract, original title, name of substance word, subject heading word, floating sub-heading word, keyword heading word, organism supplementary concept word, protocol supplementary concept word, rare disease supplementary concept word, unique identifier, synonyms, population supplementary concept word, anatomy supplementary concept word]	1,703,782
5	2 or 3 or 4	3,722,184
6	1 and 5	2,062
7	limit 6 to (english language and humans)	1,307
8	limit 7 to yr="2023 - 2024"	465
9	limit 8 to "all adult (19 plus years)"	234

PsychINFO (Results from January 2023)

#	Query	Results from 14 Jan 2023
1	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	1,729
2	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp.	751,486

	[mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	
3	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	677,507
4	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	588,693
5	2 or 3 or 4	1,352,450
6	1 and 5	1,213
7	limit 6 to (human and english language)	1,057

PsychINFO (Results from December 2024)

#	Query	Results from 4 Dec 2024
1	("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	781,086
2	("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	687,805
3	("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	590,946
4	1 or 2 or 3	1,351,806
5	("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience").mp. [mp=title, abstract, heading word, table of contents, key concepts, original title, tests & measures, mesh word]	2,334
6	4 and 5	1,687
7	limit 6 to (human and english language and "300 adulthood " and "0110 peer-reviewed journal" and english and human and yr="2023 - 2024")	188
8	limit 7 to "remove medline records"	117

PubMed (EBSCOhost) (Results from January 2023)

#	Query	Results from January 2023
1	"mental toughness"[All Fields] OR "mentally tough" [All Fields] OR “mental strength"[All Fields] OR"[All Fields] OR "psychological toughness"[All Fields] OR "mental elasticity" [All Fields] OR "psychological elasticity" [All Fields] OR "mental resilience"[All Fields] OR "psychological resilience""[Title/Abstract]	9,139
2	"mental health"[All Fields] OR "mental problem"[Title/Abstract] OR "mental health disorders"[Title/Abstract] OR "psychological health"[Title/Abstract] OR "stress*"[Title/Abstract] OR "emotional health"[Title/Abstract] OR "emotional disorder"[Title/Abstract] OR "psychological well-being"[Title/Abstract] OR "mental well-being"[Title/Abstract] OR "well-being"[Title/Abstract] OR "quality of life"[Title/Abstract] OR "wellbeing"[Title/Abstract] OR "subjective well-being"[Title/Abstract] OR "life satisfaction"[Title/Abstract] OR "happiness"[Title/Abstract] OR "post-traumatic stress disorder"[Title/Abstract] OR "post-traumatic stress symptoms"[Title/Abstract] OR "PTSD"[Title/Abstract] OR "posttraumatic stress"[Title/Abstract]	2,013,624
3	"depress*"[Title/Abstract] OR "depressive disorders"[Title/Abstract] OR "mood"[Title/Abstract] OR "depressive symptoms"[Title/Abstract] OR "mood disorders"[Title/Abstract] OR "sadness"[Title/Abstract] OR "affect"[Title/Abstract]	1,469,529
4	"anxi*"[Title/Abstract] OR "anxiety disorders"[Title/Abstract] OR "affective symptoms"[Title/Abstract] OR "worry"[Title/Abstract] OR "stress"[Title/Abstract] OR "distress"[Title/Abstract] OR "psychological distress"[Title/Abstract]	1,518,480
5	#2 OR #3 OR #4	3,384,689
6	#1 AND #5	6,703
7	#1 AND #5 Filters: Humans	6,055
8	#1 AND #5 Filters: Humans, Adult: 19+ years, Exclude preprints, Comparative Study, Evaluation Study, Observational Study	443

PubMed (EBSCOhost) (Results from December 2024)

#	Query	Results from January 2023
1	"mental toughness"[Title/Abstract] OR "mentally tough"[Title/Abstract] OR "mental strength"[Title/Abstract] OR "psychological toughness"[Title/Abstract] OR "mental elasticity"[Title/Abstract] OR	2,657

	"psychological elasticity"[Title/Abstract] OR "mental resilience"[Title/Abstract] OR "psychological resilience"[Title/Abstract]	
2	"mental health"[Title/Abstract] OR "mental problem"[Title/Abstract] OR "mental health disorders"[Title/Abstract] OR "psychological health"[Title/Abstract] OR "stress*"[Title/Abstract] OR "emotional health"[Title/Abstract] OR "emotional disorder"[Title/Abstract] OR "psychological well-being"[Title/Abstract] OR "mental well-being"[Title/Abstract] OR "well-being"[Title/Abstract] OR "quality of life"[Title/Abstract] OR "wellbeing"[Title/Abstract] OR "subjective well-being"[Title/Abstract] OR "life satisfaction"[Title/Abstract] OR "happiness"[Title/Abstract] OR "post-traumatic stress disorder"[Title/Abstract] OR "post-traumatic stress symptoms"[Title/Abstract] OR "PTSD"[Title/Abstract] OR "posttraumatic stress"[Title/Abstract]	1,924,141
3	"depress*"[Title/Abstract] OR "depressive disorders"[Title/Abstract] OR "mood"[Title/Abstract] OR "depressive symptoms"[Title/Abstract] OR "mood disorders"[Title/Abstract] OR "sadness"[Title/Abstract] OR "affect"[Title/Abstract]	1,529,891
4	"anxi*"[Title/Abstract] OR "anxiety disorders"[Title/Abstract] OR "affective symptoms"[Title/Abstract] OR "worry"[Title/Abstract] OR "stress"[Title/Abstract] OR "distress"[Title/Abstract] OR "psychological distress"[Title/Abstract]	1,478,559
	#2 OR #3 OR #4	3,357,692
	#1 AND #5	2,025
	#1 AND #5 Filters: #1 AND #5 Filters: Adaptive Clinical Trial, Classical Article, Clinical Study, Clinical Trial, Clinical Trial, Phase I, Clinical Trial, Phase II, Clinical Trial, Phase III, Clinical Trial, Phase IV, Comparative Study, Controlled Clinical Trial, Corrected and Republished Article, Dataset, Evaluation Study, Multicenter Study, Observational Study, Pragmatic Clinical Trial, Randomized Controlled Trial, Validation Study, English, Humans, Adult: 19+ years, Young Adult: 19-24 years, Adult: 19-44 years, Middle Aged + Aged: 45+ years, Middle Aged: 45-64 years, Aged: 65+ years, Exclude preprints, from 2023 - 2025	28

CINAHL (Results from December 2024)

#	Query	Results from December 2024
1	AB ("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience")	930
2	AB ("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-	455,949

	being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress")	
3	AB ("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect")	305,684
4	AB ("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress")	279,527
5	#2 OR #3 OR #4	725,873
6	#1 AND #5	(632)
7	Limiters - Publication Date: 20230101-20241231; Peer Reviewed; Exclude MEDLINE records; Human; Age Groups: Adult: 19-44 years, Middle Aged: 45-64 years, Aged: 65+ years, Aged, 80 and over	85

Scopus (Results from January 2023)

#	Query	Results from January 2023
1	TITLE-ABS-KEY ("mental health" OR "mental problem" OR "mental health disorders" OR "psychological health" OR "stress*" OR "emotional health" OR "emotional disorder" OR "psychological well-being" OR "mental well-being" OR "well-being" OR "quality of life" OR "wellbeing" OR "subjective well-being" OR "life satisfaction" OR "happiness" OR "post-traumatic stress disorder" OR "post-traumatic stress symptoms" OR "PTSD" OR "posttraumatic stress") OR TITLE-ABS-KEY ("depress*" OR "depressive disorders" OR "mood" OR "depressive symptoms" OR "mood disorders" OR "sadness" OR "affect") OR TITLE-ABS-KEY ("anxi*" OR "anxiety disorders" OR "affective symptoms" OR "worry" OR "stress" OR "distress" OR "psychological distress")	781,086
2	TITLE-ABS-KEY ("mental toughness" OR "mentally tough" OR "mental strength" OR "psychological toughness" OR "mental elasticity" OR "psychological elasticity" OR "mental resilience" OR "psychological resilience"))	687,805
	#1 AND #5	2456
	(LIMIT-TO (SUBJAREA , "PSYC")) AND (LIMIT-TO (LANGUAGE , "English")) AND (LIMIT-TO (PUBSTAGE , "final")) AND (LIMIT-TO (DOCTYPE , "ar")) AND (LIMIT-TO (SRCTYPE , "j"))	1708

Scopus, Results from December 2024

#	Query	Results from December 2024
1	((TITLE-ABS-KEY("mental toughness" or "mentally tough" or "mental strength" or "psychological toughness" or "mental elasticity" or "psychological elasticity" or "mental resilience" or "psychological resilience"))	754,123
2	(("anxi*" or "anxiety disorders" or "affective symptoms" or "worry" or "stress" or "distress" or "psychological distress") OR ("depress*" or "depressive disorders" or "mood" or "depressive symptoms" or "mood disorders" or "sadness" or "affect") OR ("mental health" or "mental problem" or "mental health disorders" or "psychological health" or "stress*" or "emotional health" or "emotional disorder" or "psychological well-being" or "mental well-being" or "well-being" or "quality of life" or "wellbeing" or "subjective well-being" or "life satisfaction" or "happiness" or "post-traumatic stress disorder" or "post-traumatic stress symptoms" or "PTSD" or "posttraumatic stress"))	697,302
	#1 AND #2	2567
	PUBYEAR > 2022 AND PUBYEAR < 2026) AND (not reviews) AND (not qualitative) AND (LIMIT-TO (SUBJAREA,"PSYC") OR LIMIT-TO (SUBJAREA,"SOCI")) AND (LIMIT-TO (DOCTYPE,"ar")) AND (LIMIT-TO (LANGUAGE,"English")) AND (LIMIT-TO (EXACTKEYWORD,"Humans") OR LIMIT-TO (EXACTKEYWORD,"Adult")) AND (LIMIT-TO (PUBSTAGE,"final")) AND (LIMIT-TO (SRCTYPE,"j")) AND (LIMIT-TO (OA,"all"))	77

Appendix 1.2 – Study selection form

Study selection form

	Yes/Unsure	No (Exclude)	Comments
Language			
- Is the full paper in English?	Go to the next question	Exclude	
Peer Review			
- Has the paper been peer-reviewed?	Go to the next question	Exclude	
Type of study			
- Is the study described as one of the following?	Go to the next question	Exclude	
- Observational			
- Cross-sectional			
- Prospective			
- Cohort			
- Case control			
- Interventional			
- Qualitative			
- Mixed design			
Participants			
- Are the participants:	Go to the next question	Exclude	
- Majority of participants were closer to adulthood (mean age ≥17.5 years, reflecting late adolescence) or if the developmental context (e.g., vocational training) indicated a transition to adult roles.			
- In a sport/performance context? - Exclude if the study focuses solely on performance outcomes (e.g., tennis performance).			
Outcomes			
- Does the study report on the relationship between mental toughness (MT) and at least one of the following: - Anxiety	Go to the next question	Exclude	
- Depression			
- Mental well-being			
- Does the study report correlation or regression coefficients on the relationship between MT and	Go to the next question	Exclude	

mental health outcomes, controlling for gender and age, and using baseline data (not post-intervention)? - Validated instruments to measure MT and MH outcomes? • See below a list of the validated questionnaires for each of the outcomes			
INCLUDE and Follow-Up	Include and proceed with follow-up		

Notes on Exclusions

- Studies focusing on other related concepts (e.g., **emotional exhaustion, stress, life satisfaction**, sport or academic anxiety) will be excluded and mentioned in appendices.
- Studies focusing on **resilience**, using instruments such as the Connor-Davidson Resilience Scale, Brief Resilience Scale, Resilience Scale for Adults, Psychological Resilience Scale, or Academic Resilience Scale will also be excluded.

Validated Instruments

For Mental Toughness

1. Mental Toughness Questionnaire 48 (MTQ48)
2. Mental Toughness Index (MTI)
3. Sports Mental Toughness Questionnaire (SMTQ)
4. Mental Toughness Questionnaire Plus (MTQPlus)
5. Mental Toughness Scale (MTS)
6. The Psychological Performance Inventory (PPI)
7. Psychological Performance Inventory-Revised (PPI-R)
8. Australian Football Mental Toughness Questionnaire (AFMTQ)
9. Swimming Mental Toughness Inventory (SMTI)
10. Mental Toughness Inventory (MTInv)
11. Mental Toughness Psychological Skills Profile (MTPSP)

12. The Mental, Emotional, and Bodily Toughness Inventory (MeBTough)
13. Mental Toughness Behavior Scale (MTBS)
14. Very Short Mental Toughness Questionnaire (VS-MTQ)

For Anxiety

1. Generalized Anxiety Disorder Scale (GAD-7)
2. State-Trait Anxiety Inventory (STAI)
3. Beck Anxiety Inventory (BAI)
4. Hospital Anxiety and Depression Scale (HADS-Anxiety Subscale)
5. Penn State Worry Questionnaire (PSWQ)
6. Zung Self-Rating Anxiety Scale (SAS)
7. Hamilton Anxiety Rating Scale (HAM-A)
8. Liebowitz Social Anxiety Scale (LSAS)

For Depression

1. Patient Health Questionnaire-9 (PHQ-9)
2. Beck Depression Inventory (BDI)
3. Center for Epidemiologic Studies Depression Scale (CES-D)
4. Hamilton Depression Rating Scale (HAM-D)
5. Zung Self-Rating Depression Scale (SDS)
6. Edinburgh Postnatal Depression Scale (EPDS)
7. Montgomery-Åsberg Depression Rating Scale (MADRS)
8. Hospital Anxiety and Depression Scale (HADS-Depression Subscale)
9. Clinically Useful Depression Outcome Scale (CUDOS)
10. Depression Anxiety Stress Scale-21 (DASS21)

For Mental Well-Being

1. Warwick-Edinburgh Mental Well-Being Scale (WEMWBS)
2. Mental Health Continuum – Short Form (MHC-SF)
3. Satisfaction with Life Scale (SWLS)
4. Ryff's Psychological Well-Being Scales (PWB)
5. Subjective Happiness Scale (SHS)
6. Positive and Negative Affect Schedule (PANAS)
7. Short Form-36 Health Survey (SF-36) – Mental Health Subscale
8. General Health Questionnaire (GHQ-12 or GHQ-28).

Appendix 1.3 – Studies excluded due to focus on other mental health outcomes

Study title	First Author and Year	Outcome(s) measured	Reason for exclusion	Reference
The relationship between Mental toughness and affect intensity	Crust (2009)	Affect intensity	Focused on affect intensity, not anxiety, depression, or general mental well-being as primary outcomes.	Crust, L. (2009). The relationship between mental toughness and affect intensity. *Personality and Individual Differences, 47*(8), 959-963. https://doi.org/10.1016/j.paid.2009.07.023
Psychological predictors of mental toughness in elite tennis	Cowden et al. (2014)	Competitive trait anxiety, Resourcefulness	Focused on competitive trait anxiety, not anxiety, depression or mental well-being	Cowden, R. G., Fuller, D. K., & Anshel, M. H. (2014). *Psychological predictors of mental toughness in elite tennis: An exploratory study in learned resourcefulness and competitive trait anxiety. Perceptual and Motor Skills, 119*(3), 661–678. https://doi.org/...
The relationship between mental toughness, stress, and burnout among adolescents	Gerber et al. (2015)	Stress, Burnout	Focused on stress and burnout, not anxiety, depression or general mental well-being	Gerber, M., et al. (2015). *The relationship between mental toughness, stress, and burnout among adolescents: A longitudinal study with Swiss vocational students. Psychological Reports, 117*(3), 703–723. https://doi.org/...
Burnout and mental health in Swiss Vocational Students	Gerber et al. (2015)	Burnout	Focused on burnout and mental health rather than MT and mental health outcomes	Gerber, M., et al. (2015). *Burnout and mental health in Swiss vocational students: The moderating role of physical activity. Journal of Research on Adolescence, 25*(1), 63–74. https://doi.org/...
Emotional Exhaustion and Sleep Problems in University Students: Does Mental Toughness Matter?	Li et al. (2020)	Emotional exhaustion, Sleep problems	Focused on emotional exhaustion and sleep problems, not anxiety, depression, or mental well-being	Li, C., et al. (2020). *Emotional exhaustion and sleep problems in university students: Does mental toughness matter? Personality and Individual Differences, 163,* ArtID 110046. https://doi.org/10.1016/j.paid.2020.110046
Bridging the Gap: A Network Approach to Dark Triad, Mental Toughness, the Big Five, and Perceived Stress	Papageorgiou et al. (2019)	Stress Outcomes	Focused on stress outcomes and personality traits rather than anxiety, depression, or mental well-being.	Papageorgiou, K. A., et al. (2019). *Bridging the gap: A network approach to Dark Triad, Mental Toughness, the Big Five, and perceived stress. Journal of Personality, 87*(6), 1250–1263. https://doi.org/10.1111/jopy.12555

The Bright Side of Dark: Exploring the Positive Effect of Narcissism on Perceived Stress through Mental Toughness	Papageorgiou et al. (2019)	Stress Outcomes, Narcissism	Focused on the relationship between narcissism, mental toughness, and stress outcomes rather than anxiety, depression, or general mental well-being.	Papageorgiou, K. A., et al. (2019). *The bright side of dark: Exploring the positive effect of narcissism on perceived stress through mental toughness. Personality and Individual Differences, 139,* 116–124. https://doi.org/10.1016/j.paid.2018.11.020
Mental Toughness in Surgeons: How Do We Measure Up?	Percy et al. (2017)	Stress in Surgeons	Examined stress management and mental toughness in surgeons, not anxiety, depression, or mental well-being.	Percy, D., et al. (2017). *Mental toughness in surgeons: How do we measure up? CMAJ. Canadian Medical Association Journal, 60*(4 Supplement 1), S126–S127. https://doi.org/10.1503/cmaj.180296
Burnout Profiles Among Esports Players: Associations with Mental Toughness and Resilience	Poulus et al. (2024)	Burnout, Resilience	Focused on burnout and resilience in esports players, not anxiety, depression, or mental well-being.	Poulus, D. R., et al. (2024). *Burnout profiles among esports players: Associations with mental toughness and resilience. Journal of Sports Sciences, 42*(18), 1685–1694. https://doi.org/10.1080/02640414.2023.2231987
Relationships Between Mental Toughness, Eustress-Distress, and Mindfulness in Adolescents	Yazici-Kabadayi (2024)	Eustress, Distress, Mindfulness	Focused on eustress and distress rather than anxiety, depression, or general mental well-being.	Yazici-Kabadayi, S. (2024). *Relationships between mental toughness, eustress-distress, and mindfulness in adolescents: A network analysis and mediator model testing. Stress and Health, 40*(5). https://doi.org/10.1002/smi.3174
A Mixed-Method Exploration of Mental Toughness, Perceived Stress, and Quality of Life in Mental Health Workers	Turkington et al. (2023)	Stress, Quality of Life	Focused on perceived stress and quality of life rather than anxiety, depression, or general mental well-being.	Turkington, G. D., Tinlin-Dixon, R., & St Clair-Thompson, H. (2023). *A mixed-method exploration of mental toughness, perceived stress and quality of life in mental health workers. Journal of Psychiatric & Mental Health Nursing, 30*(6), 1152–1169. https://doi.org/10.1111/jpm.12929
The Mediating Role of Mental Toughness in the Relationship Between Meta-Emotion	Ghaffari et al. (2024)	Meta-Emotion, Co-Rumination	Focused on meta-emotion and co-rumination rather than anxiety, depression, or general mental well-being.	Ghaffari, M., Esmali, A., Mohammadi, R., Aligolipour, M., & Ramazani Alalani, Z. (2024). Hospital Practice and Research, 8 (2), 245-252. *The mediating role of mental toughness in the*

and Co-Rumination with Health Anxiety in Hospital Nurses				*relationship between meta-emotion and co-rumination with health anxiety in hospital nurses.*
How Social desirability impact life satisfaction among Chinese youth	Lv et al. (2024)	Hardiness	Focused on hardiness, despite being described as MT; used the Hardiness Scale, which measures a concept distinct from MT.	Lv, F., Ye, Z., Liu, Z., Gan, J., Tan, J., Feng, R., Abudurexiti, B., Yu, M., & Gao, D. (2024). How social desirability impacts life satisfaction among Chinese youth: Mediators of mental toughness and emotional intelligence. *Frontiers in Psychiatry, 15*, 1467804. https://doi.org/10.3389/fpsyt.2024.1467804
Does mental toughness predict happiness over and above resilience?	St Clair-Thompson & London (2024)	Happiness	The study focused on happiness, a measure of subjective well-being, which is only one component of mental well-being and does not fully capture its broader scope.	St Clair-Thompson, H., & London, J. (2024). Does mental toughness predict happiness over and above resilience, self-efficacy and grit? *New Ideas in Psychology, 74,* 101093. https://doi.org/10.1016/j.newideapsych.2024.101093
Sustainable Employability of Emergency Nurses: The Effects of Precarious Work and Mental Toughness	Barnard et al. (2023)	Workplace mental-wellbeing	Focused specifically on workplace mental well-being rather than mental well-being as a broader concept.	Barnard, A., Smith, J., & Taylor, R. (2023). Sustainable employability of emergency nurses: The effects of precarious work and mental toughness. *Journal of Nursing Management, 31*(2), 345–356. https://doi.org/10.1155/2023/8840756
Always look on the bright side of life!" – Higher hypomania scores are associated with higher mental toughness, increased physical activity, and lower symptoms of depression and lower sleep complaints	Jahangard, et al. (2017)	Hypomania	Focused on the relationship between hypomania and mental toughness, rather than examining general mental health outcomes.	Jahangard, L., Rahmani, A., Haghighi, M., Ahmadpanah, M., Sadeghi Bahmani, D., Soltanian, A. R., Shirzadi, S., Bajoghli, H., Gerber, M., Holsboer-Trachsler, E., & Brand, S. (2017). *"Always look on the bright side of life!" – Higher hypomania scores are associated with higher mental toughness, increased physical activity, and lower symptoms of depression and lower sleep complaints.* Frontiers in Psychology, 8, 2130. https://doi.org/10.3389/fpsyg.2017.02130
Mental toughness is a mediator of the relationship between positive childhood experiences and wellbeing	Shaw et al. (2022)	Eudaimonic well-being	Measured eudaimonic well-being with the SPWB-18, which was not included as a mental well-being measure in our criteria.	Shaw, L., Hansen, H., & St Clair-Thompson, H. (2022). Mental toughness is a mediator of the relationship between positive childhood experiences and wellbeing. *European Journal of Developmental Psychology, 20*(1), 130–146. https://doi.org/10.1080/17405629.2022.2058485

Appendix 1.4 – PRISMA 2020 Reporting Checklist

Section and Topic	Item #	Checklist item	Location where item is reported
TITLE			
Title	1	Identify the report as a systematic review.	P. 7
ABSTRACT			
Abstract	2	See the PRISMA 2020 for Abstracts checklist.	P. 8
INTRODUCTION			
Rationale	3	Describe the rationale for the review in the context of existing knowledge.	P. 9- 10
Objectives	4	Provide an explicit statement of the objective(s) or question(s) the review addresses.	P. 10-11
METHODS			
Eligibility criteria	5	Specify the inclusion and exclusion criteria for the review and how studies were grouped for the syntheses.	P. 11- 12
Information sources	6	Specify all databases, registers, websites, organisations, reference lists and other sources searched or consulted to identify studies. Specify the date when each source was last searched or consulted.	P. 11
Search strategy	7	Present the full search strategies for all databases, registers and websites, including any filters and limits used.	Appendix 1.1
Selection process	8	Specify the methods used to decide whether a study met the inclusion criteria of the review, including how many reviewers screened each record and each report retrieved, whether they worked independently, and if applicable, details of automation tools used in the process.	P. 12
Data collection process	9	Specify the methods used to collect data from reports, including how many reviewers collected data from each report, whether they worked independently, any processes for obtaining or confirming data from study investigators, and if applicable, details of automation tools used in the process.	P. 12
Data items	10a	List and define all outcomes for which data were sought. Specify whether all results that were compatible with each outcome domain in each study were sought (e.g. for all measures, time points, analyses), and if not, the methods used to decide which results to collect.	Tables 1.1 & 1.3
	10b	List and define all other variables for which data were sought (e.g. participant and intervention characteristics, funding sources). Describe any assumptions made about any missing or unclear information.	P. 12
Study risk of bias assessment	11	Specify the methods used to assess risk of bias in the included studies, including details of the tool(s) used, how many reviewers assessed each study and whether they worked independently, and if applicable, details of automation tools used in the process.	P. 13
Effect measures	12	Specify for each outcome the effect measure(s) (e.g. risk ratio, mean difference) used in the synthesis or presentation of results.	Tables 1.1 & 1.3
Synthesis methods	13a	Describe the processes used to decide which studies were eligible for each synthesis (e.g. tabulating the study intervention characteristics and comparing against the planned groups for each synthesis (item #5)).	P. 13
	13b	Describe any methods required to prepare the data for presentation or synthesis, such as handling of missing summary statistics, or data conversions.	P. 12- 13

Section and Topic	Item #	Checklist item	Location where item is reported
	13c	Describe any methods used to tabulate or visually display results of individual studies and syntheses.	Tables 1.1 & 1.3
	13d	Describe any methods used to synthesize results and provide a rationale for the choice(s). If meta-analysis was performed, describe the model(s), method(s) to identify the presence and extent of statistical heterogeneity, and software package(s) used.	P. 13
	13e	Describe any methods used to explore possible causes of heterogeneity among study results (e.g. subgroup analysis, meta-regression).	N/A
	13f	Describe any sensitivity analyses conducted to assess robustness of the synthesized results.	N/A
Reporting bias assessment	14	Describe any methods used to assess risk of bias due to missing results in a synthesis (arising from reporting biases).	N/A
Certainty assessment	15	Describe any methods used to assess certainty (or confidence) in the body of evidence for an outcome.	N/A
RESULTS			
Study selection	16a	Describe the results of the search and selection process, from the number of records identified in the search to the number of studies included in the review, ideally using a flow diagram.	Figure 1.1
	16b	Cite studies that might appear to meet the inclusion criteria, but which were excluded, and explain why they were excluded.	P. 12 & Appendix 1.2
Study characteristics	17	Cite each included study and present its characteristics.	Table 1.1
Risk of bias in studies	18	Present assessments of risk of bias for each included study.	Table 1.2
Results of individual studies	19	For all outcomes, present, for each study: (a) summary statistics for each group (where appropriate) and (b) an effect estimate and its precision (e.g. confidence/credible interval), ideally using structured tables or plots.	Tables 1.1 & 1.3
Results of syntheses	20a	For each synthesis, briefly summarise the characteristics and risk of bias among contributing studies.	P. 13-33
	20b	Present results of all statistical syntheses conducted. If meta-analysis was done, present for each the summary estimate and its precision (e.g. confidence/credible interval) and measures of statistical heterogeneity. If comparing groups, describe the direction of the effect.	N/A
	20c	Present results of all investigations of possible causes of heterogeneity among study results.	N/A
	20d	Present results of all sensitivity analyses conducted to assess the robustness of the synthesized results.	N/A
Reporting biases	21	Present assessments of risk of bias due to missing results (arising from reporting biases) for each synthesis assessed.	N/A
Certainty of evidence	22	Present assessments of certainty (or confidence) in the body of evidence for each outcome assessed.	N/A
DISCUSSION			

Section and Topic	Item #	Checklist item	Location where item is reported
Discussion	23a	Provide a general interpretation of the results in the context of other evidence.	P. 32-33
	23b	Discuss any limitations of the evidence included in the review.	P. 34
	23c	Discuss any limitations of the review processes used.	P. 34-35
	23d	Discuss implications of the results for practice, policy, and future research.	P. 35
OTHER INFORMATION			
Registration and protocol	24a	Provide registration information for the review, including register name and registration number, or state that the review was not registered.	P. 11
	24b	Indicate where the review protocol can be accessed, or state that a protocol was not prepared.	P. 11
	24c	Describe and explain any amendments to information provided at registration or in the protocol.	N/A
Support	25	Describe sources of financial or non-financial support for the review, and the role of the funders or sponsors in the review.	P. 36
Competing interests	26	Declare any competing interests of review authors.	P. 36
Availability of data, code and other materials	27	Report which of the following are publicly available and where they can be found: template data collection forms; data extracted from included studies; data used for all analyses; analytic code; any other materials used in the review.	N/A

Appendix 2:1 STROBE Checklist

STROBE Statement—Checklist of items that should be included in reports of ***cohort studies***

	Item No	Recommendation
Title and abstract	1	(*a*) Indicate the study's design with a commonly used term in the title or the abstract
		(*b*) Provide in the abstract an informative and balanced summary of what was done and what was found
Introduction		
Background/rationale	2	Explain the scientific background and rationale for the investigation being reported
Objectives	3	State specific objectives, including any prespecified hypotheses
Methods		
Study design	4	Present key elements of study design early in the paper
Setting	5	Describe the setting, locations, and relevant dates, including periods of recruitment, exposure, follow-up, and data collection
Participants	6	(*a*) Give the eligibility criteria, and the sources and methods of selection of participants. Describe methods of follow-up
		(*b*) For matched studies, give matching criteria and number of exposed and unexposed
Variables	7	Clearly define all outcomes, exposures, predictors, potential confounders, and effect modifiers. Give diagnostic criteria, if applicable
Data sources/ measurement	8*	For each variable of interest, give sources of data and details of methods of assessment (measurement). Describe comparability of assessment methods if there is more than one group
Bias	9	Describe any efforts to address potential sources of bias
Study size	10	Explain how the study size was arrived at
Quantitative variables	11	Explain how quantitative variables were handled in the analyses. If applicable, describe which groupings were chosen and why
Statistical methods	12	(*a*) Describe all statistical methods, including those used to control for confounding
		(*b*) Describe any methods used to examine subgroups and interactions
		(*c*) Explain how missing data were addressed
		(*d*) If applicable, explain how loss to follow-up was addressed
		(*e*) Describe any sensitivity analyses
Results		
Participants	13*	(a) Report numbers of individuals at each stage of study—eg numbers potentially eligible, examined for eligibility, confirmed eligible, included in the study, completing follow-up, and analysed
		(b) Give reasons for non-participation at each stage
		(c) Consider use of a flow diagram
Descriptive data	14*	(a) Give characteristics of study participants (eg demographic, clinical, social) and information on exposures and potential confounders
		(b) Indicate number of participants with missing data for each variable of interest
		(c) Summarise follow-up time (eg, average and total amount)
Outcome data	15*	Report numbers of outcome events or summary measures over time

Main results	16	(*a*) Give unadjusted estimates and, if applicable, confounder-adjusted estimates and their precision (eg, 95% confidence interval). Make clear which confounders were adjusted for and why they were included
		(*b*) Report category boundaries when continuous variables were categorized
		(*c*) If relevant, consider translating estimates of relative risk into absolute risk for a meaningful time period
Other analyses	17	Report other analyses done—eg analyses of subgroups and interactions, and sensitivity analyses
Discussion		
Key results	18	Summarise key results with reference to study objectives
Limitations	19	Discuss limitations of the study, taking into account sources of potential bias or imprecision. Discuss both direction and magnitude of any potential bias
Interpretation	20	Give a cautious overall interpretation of results considering objectives, limitations, multiplicity of analyses, results from similar studies, and other relevant evidence
Generalisability	21	Discuss the generalisability (external validity) of the study results
Other information		
Funding	22	Give the source of funding and the role of the funders for the present study and, if applicable, for the original study on which the present article is based

*Give information separately for exposed and unexposed groups.

Note: An Explanation and Elaboration article discusses each checklist item and gives methodological background and published examples of transparent reporting. The STROBE checklist is best used in conjunction with this article (freely available on the Web sites of PLoS Medicine at http://www.plosmedicine.org/, Annals of Internal Medicine at http://www.annals.org/, and Epidemiology at http://www.epidem.com/). Information on the STROBE Initiative is available at http://www.strobe-statement.org.

Appendix 2:2 Management Approval Letter

TEMP009 Version 6 July 2021

Dr Beth Sage
Research, Development & Innovation Director
NHS Highland RD&I Office
Centre for Health Science
Old Perth Road
Inverness
IV2 3JH

E-mail: beth.sage@nhs.scot

NHS Highland

28 October 2022

NHS Highland RD&I Ref: **HIGHLAND 1839**
NRSPCC Ref: **NA**

Oana Ciocanel
Trainee Clinical Psychologist
Department of Psychological Services,
Drumossie Unit,
New Craigs Hospital,
Inverness,
IV3 8NP
oana.ciocanel2@nhs.scot

Dear Ms Ciocanel,

Management Approval for Non-Commercial Research

I am pleased to tell you that you now have Management Approval for the research project entitled: **'The relationship between mental toughness and mental health' [Protocol Version1 8th September 2022].**

I acknowledge that:

- The project is sponsored by NHS Highland.
- The project has no external funding.
- Ethics approval for the project is not required.
- The project does not require an Organisational Information Document.

The following conditions apply:

- The responsibility for monitoring and auditing this project lies with the University of Glasgow.
- This study will be subject to ongoing monitoring for Research Governance purposes and may be audited to ensure compliance with the UK Policy Framework for Health and Social Care Research (2018, V3.3 07/11/17, however prior written notice of audit will be given.

POSITIVE ABOUT DISABLED PEOPLE

- Any researchers coming into NHS Highland for the purposes of carrying out research with patients will require a Letter of Access before starting the study at this site. Please contact a member of the RD&I Governance team at nhsh.nhshighlandresearchpassports@nhs.scot for further assistance, if this is required.
- The paperwork concerning all incidents, adverse events and serious adverse events thought to be attributable to a NHS Highlands participant's involvement in this project should be notified to the NHS Highland RD&I Governance team. Please email documents to nhsh.RandD@nhs.scot.
- You are reminded that all amendments (substantial or non-substantial) to the protocol and associated study documents or to the REC application should be notified to the NHS Highland RD&I Office to obtain amendment approval (nhsh.RandD@nhs.scot). Guidance can be found at https://www.nhsresearchscotland.org.uk/services/permissions-co-ordinating-centre/permissions
- If applicable, monthly recruitment rates should be notified to the NHS Highland RD&I Governance team, detailing date of recruitment and the participant trial ID number (please do not include names or other identifiable information). This should be done by e-mail on the first week of the following month, to Chris Cunningham, RD&I Facilitator at nhsh.RandD@nhs.scot. Please quote your RD&I Highland reference number (Highland 1839).
- Please report any other changes in resources used, or staff involved in the project, to nhsh.RandD@nhs.scot.

Please quote your RD&I Highland reference number (Highland 1839) on all correspondence.

Yours sincerely,

Anna McIver
RD&I Governance Manager

cc

Jo Fraser, RD&I Administration Assistant, NHS Highland RD&I Division nhsh.RandD@nhs.scot
Chris Cunningham, RD&I Facilitator, NHS Highland RD&I Division nhsh.randd@nhs.scot
Mhairi Robertson, QA Assistant, NHS Highland RD&I Division , mhairi.robertson@nhs.scot
Dr Hannes DeKock, Department of Clinical Pychology, New Craigs Hospital, hannes.de@nhs.scot
Dr Breda Cullen, Mental Health and Wellbeing, Academic Centre, Gartnavel Royal Hospital, breda.cullen@glasgow.ac.uk

Appendix 2.3 Descriptive Statistics for outcomes at Wave 1 and Wave 2.

Variable			*Range*	*Min*	*Max*	*Median*	*Skewness (SE)*	*Kurtosis*	*Shapiro-Wilk (statistic, p value)*	*Cronbach's α*
Mental Wellbeing	T1	166	46	24	70	45	.283 (.188)	-1.373 (.375)	.98 (.199)	.92
	T2	169	50	20	70	44	.068 (.187)	-.142 (.371)	.98 (.139)	.94
Depression	T1	168	21	0	21	7	.65 (.187)	-.041 (.373)	0.95 (<.001)	.84
	T2	168	23	0	23	7	.708 (.187)	.230 (.373)	.95 (<.001)	.85
Anxiety	T1	165	19	0	19	5	0.721 (.189)	-.033 (.376)	.943 (<.001)	.86
	T2	166	18	0	18	6	.482 (.188)	-.678 9.375)	.94 (<.001)	.87
Mental Toughness	T1	168	40	8	56	40	-.552 (.187)	.629 (.373)	.97 (.008)	.91
	T2	166	48	16	56	39	-.196 (.188)	-.547 (.375)	.98 (.076)	.92

SE, Standard error. Note: N = 169. Standard deviations are given in parentheses. Numbers 1 and 2 after variable names refer to the assessment waves.

Appendix 2.4 Results of cross-lagged model-Figure 1

Predictor Variable	*Outcome*	*Unstandardized Estimate (B)*	*S.E.*	*Standardised Estimate (β)*	*95%Confidence Interval for β*	*P value*
T1 Mental toughness	*T2 MWB*	*.165*	*.077*	*.161*	*0.022, 0.300*	***.033***
	T2 Anxiety	*-.009*	*.039*	*-.017*	*-0.154, 0120*	*.810*
	T2 Depression	*-.011*	*.041*	*-.020*	*-0.158, 0.118*	*.784*
	T2 MT	*.448*	*.076*	*.443*	*0.290, 0.595*	*****
T1 Mental Wellbeing	*T2 Mental Wellbeing*	*.369*	*.058*	*.376*	*0.260, 0.491*	*****
T1 Mental Wellbeing	*T2 Mental Toughness*	*.180*	*.079*	*.190*	*0.028, 0.352*	***.024***
T1 Anxiety	*T2 Anxiety*	*.416*	*.059*	*.397*	*0.283, 0.497*	*****
T1 Anxiety	*T2 Mental Toughness*	*.120*	*.144*	*.061*	*-0.093, 0.215*	*.403*
T1 Depression	*T2 Depression*	*.404*	*.053*	*.403*	*0.303, 0.503*	***<.001***
T1 Depression	*T2 Mental Toughness*	*.040*	*.146*	*.022*	*-0.135, 0.179*	*.783*
Gender (1=female, 2=male)	*T2 MWB*	*-3.610*	*1.807*	*-.132*	*-0.255, -0.005*	***.046***
	T2 MT	*--1.968*	*1.707*	*-.075*	*-3.504, 3.354*	*.249*
	T2 Anxiety	*1.072*	*.987*	*.076*	*-0.056, 0.208*	*.277*
	T2 Depression	*1.695*	*.999*	*.115*	*-0.012, 0.242*	*.090*
Psychiatric status	*T2 MWB*	*-2.384*	*1.398*	*-.113*	*-0.235, 0.015*	*.088*
	T2 MT	*-.907*	*1.320*	*-.045*	*-0.168, 0.078*	*.492*
	T2 Anxiety	*.825*	*.763*	*.076*	*-0.054, 0.206*	*.280*
	T2 Depression	*1.90*	*.773*	*.167*	*0.041, 0.299*	***.014***
Having worked with COVID-19 patients	*T2 MWB*	*-1.734*	*1.400*	*-.082*	*--0.208, 0.044*	*.216*
	T2 MT	*-.739*	*1.323*	*-.036*	*-0.171, 0.081*	*.576*
	T2 Anxiety	*.343*	*.765*	*.032*	*0.186, 0.454*	*.653*
	T2 Depression	*1.422*	*.774*	*.125*	*-0.001, 0.259*	*.066*

*MWB, mental wellbeing, MT, mental toughness, S.E. Standard Error, Highlighted values are significant, p<.05. ***p < 0.001*

Appendix 2.5 Results of cross-lagged model-Figure 2

Predictor Variable	*Outcome*	*Unstandardized Estimate (B)*	*S.E.*	*Standardised Estimate (β)*	*95%Confidence Interval for β*	*P value*
T1 Mental toughness	*T2 MWB*	*.130*	*.084*	*.121*	*-0.032, 0.272*	*.121*
	T2 Anxiety	*.019*	*.046*	*.035*	*-0.625, 0.132*	*.671*
	T2 Depression	*.009*	*.046*	*.015*	*-0.078, 0.108*	*.846*
	T2 MT	*.422*	*.079*	*.416*	*0.257, 0.574*	*******
T1 Mental Wellbeing	*T2 Mental Wellbeing*	*.364*	*.102*	*.365*	*0.162, 0.567*	*******
T1 Mental Wellbeing	*T2 Mental Toughness*	*.183*	*.097*	*.194*	*-0.008, 0.388*	*.058*
T1 Anxiety	*T2 Anxiety*	*.445*	*.107*	*.412*	*0.185, 0.638*	*******
T1 Anxiety	*T2 Mental Toughness*	*.059*	*.186*	*.030*	*-0.343, 0.403*	*.753*
T1 Depression	*T2 Depression*	*.397*	*.111*	*.386*	*0.160, 0.611*	*******
T1 Depression	*T2 Mental Toughness*	*-.018*	*.191*	*-.010*	*-0.393, 0.373*	*.926*
Gender (1=female, 2=male)	*T2 MWB*	*-3.703*	*1.799*	*-.133*	*-0.256, -0.010*	***.040***
	T2 MT	*-2.031*	*1.703*	*-.077*	*-3.569, 3.415*	*.233*
	T2 Anxiety	*1.138*	*.982*	*.079*	*-0.052, 0.210*	*.247*
	T2 Depression	*1.686*	*.992*	*.112*	*-0.016, 0.236*	*.089*
Psychiatric status	*T2 MWB*	*-2.175*	*1.392*	*-.101*	*-0.223, 0.021*	*.118*
	T2 MT	*-.773*	*1.318*	*-.038*	*-0.161, 0.085*	*.558*
	T2 Anxiety	*.723*	*.760*	*.065*	*-0.065,0.195*	*.341*
	T2 Depression	*1.780*	*.768*	*.152*	*0.027, 0.277*	***.020***
Having worked with COVID-19 patients	*T2 MWB*	*-2.033*	*1.394*	*-.095*	*-0.220, 0.030*	*.145*
	T2 MT	*-.922*	*1.320*	*-.045*	*-0.171, 0.081*	*.485*
	T2 Anxiety	*.454*	*.761*	*.041*	*-0.092, 0.174*	*.551*
	T2 Depression	*1.614*	*.769*	*.139*	*0.010, 0.268*	***.036***

*MWB, mental wellbeing, MT, mental toughness, S.E. Standard Error, Highlighted values are significant, p<.05. ***p < 0.001*

Appendix 2.6 MRP Proposal

The MRP Proposal can be accessed at:
https://osf.io/g6q2e/files/osfstorage/66967dffe9fa13059056a67a

(Note: In retrospect, I realized that the original wording did not convey the intended meaning, specifically the prediction of more favourable outcomes at follow-up, which could lead to potential confusion. The revised Hypothesis 2 now states, "MT would predict more favourable MH and MWB levels at follow-up," instead of the original, "MT would predict changes in MH and MWB outcomes over time.").