

Mental strength assessment in combat sports practitioners and non-practitioners

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ABSTRACT

Mental strength is defined as a person's ability to persist through challenging situations and recover from hardships and failures. Due to combat sports (CS) vigorous nature, several authors have identified various psychological factors modified through CS engagement and experience. This research aimed to determine the psychometrics of the Mental Strength Scale, explore the correlations between mental strength and age, CS experience, and competitive engagement, and investigate the existing group differences in mental strength based on sex, age, CS engagement, competition engagement, and CS experience. The total sample included 431 participants from 18 to 67 years of age, including 373 CS practitioners and 58 non-practitioners. Results revealed that The Mental Strength Scale demonstrated good internal validity (Cronbach's alpha = 0.809) and convergent validity (Grit Scale correlation: $p < .001$, $r = .539$; Brief Resilience Scale correlation: $p < .001$, $r = .551$). A positive correlation was found between CS experience and mental strength. Group comparison demonstrated higher mental strength in CS practitioners than non-practitioners and in men compared to women. Moreover, CS participants in the >5, 2-5, and <2 years of experience reported higher mental strength than participants with no CS experience. In conclusion, the findings confirm that the Mental Strength Scale is a good psychometric instrument to assess the degree of mental strength, particularly in CS practitioners, and that CS engagement and experience positively influence the development of mental strength.

Keywords: Mental toughness, Perseverance, Resilience, Jiu-Jitsu, BJJ, Judo, Wrestling, Muay Thai, Martial arts.

Cite this article as:

Lorenço-Lima, L. (2024). Mental strength assessment in combat sports practitioners and non-practitioners. *Journal of Human Sport and Exercise*, 19(2), 473-482. <https://doi.org/10.14198/jhse.2024.192.04>



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Submitted for publication October 16, 2023.

Accepted for publication November 28, 2023.

Published April 01, 2024 (*in press* December 26, 2023).

JOURNAL OF HUMAN SPORT & EXERCISE ISSN 1988-5202.

© Faculty of Education. University of Alicante.

doi: 10.14198/jhse.2024.192.04

INTRODUCTION

From ancient war to contemporary society, strong individuals have been admired for their incredible ability to persist when faced with challenging situations and to spring back from extensive hardships, misfortunes, and failures. While great physical strength is a common attribute of many admired individuals, the interest in the psychological factors impacting performance has increased over the past 200 years (Lochbaum et al., 2022). In the military, Yerkes (1918) proposed over 100 years ago the development of psychological centres to address mental strength in training camps.

Several authors have presented comprehensive definitions of mental toughness (Dagnall et al., 2019; Madrigal et al., 2013). However, with numerous theoretical components, its field application becomes complex, and many constructs are overlooked when taking the theory into practice. Fundamentally, mental strength encompasses two main components: perseverance and resilience. Perseverance is rooted in the Latin word *perseverant* (abiding by strictly) and is defined as persistence in pursuing a task despite difficulty (Dagnall et al., 2019). Resilience is rooted in the Latin word *resile* (re = back, and salire = to jump) and is defined as a person's ability to bounce back and recover from hardships (Smith et al., 2008). Therefore, mental strength is defined as a person's ability to persist through challenging situations and to recover from hardships and failures. The Mental Strength Equation is expressed as: Mental strength = perseverance + resilience.

CS engagement has been shown to influence mental strength factors such as grit and resilience positively (Sawyer et al., 2018; Pujso et al., 2019; Shamshirian et al., 2021; Lorenzo-Lima, 2023; Sivan & Zeba, 2023). These relationships can be explained by the vigorous nature of CS (Franchini et al., 2017; Lorenzo-Lima et al., 2020) and the direct impact of time spent in vigorous physical activity on grit (Daniels et al., 2021) and resilience (Dunston et al., 2022). However, no studies have addressed mental strength in combat sports as currently defined.

The relevance of improving mental strength factors can be credited to the positive correlations between grit and well-being (Datu et al., 2022) and life satisfaction (Li et al., 2018; Datu et al., 2022; Liu et al., 2022). Resilience greatly predicted higher life satisfaction and lower depression (Ye et al., 2022). Moreover, those engaged in sports are generally more satisfied with their mental health than non-athletes (Lorenzo-Lima et al., 2023).

The purpose of this study was to 1) determine the psychometrics of the Mental Strength Scale, 2) explore the existing correlations between mental strength and age, CS experience, and competitive engagement, and 3) investigate the existing group differences in mental strength based on sex, age, CS engagement, competition engagement, and CS experience. It was hypothesized that mental strength would show H1) to positively correlate with age, H2) to positively correlate with CS experience, H3) to positively correlate with competitive engagement, H4) to be higher in males than females, H5) to be higher in CS practitioners, H6) to be higher in older participants, H7) to be higher in more experienced participants, and H8) to be higher in participants with higher competition engagement.

METHODS

Participants

The total sample included 431 participants from 18 to 67 years of age (40.83 ± 12.30), including 346 males and 85 females. Of the total sample, 373 were CS practitioners and 58 non-practitioners. CS group reported

engagement in grappling (i.e., Judo, Brazilian Jiu-Jitsu, and Wrestling) or striking (i.e., Muay Thai, Boxing, Taekwondo, and Karate) with an average experience of 13.91 ± 14.95 years in their CS.

A priori power analysis was performed with a medium effect size (.25), $\alpha = .05$, and power criterion of .80. The analysis revealed a need for 200 participants as the minimum sample for age group comparison (5 groups), 180 participants for CS experience group comparison (4 groups) and 159 participants for competition engagement comparison (3 groups).

Procedures

In the present cross-sectional quantitative research, data was collected anonymously from May to October 2023 via Google Forms and disseminated through social media and email campaigns. No compensation was offered to the participants.

The Google Form contained the Mental Strength Scale, Grit Scale, Brief Resilience Scale, and questions about the participant's age, sex, CS experience, and competitive engagement (competitions over the previous 12 months).

Participants were divided into five age groups (18-27, 28-37, 38-47, 48-57, and >57 years old), four CS experience groups (0, < 2, 2-5, and >5 years of experience), and three competition engagement groups (non-competitors, 1-4 competitions, and >4 competitions). Correlations were performed using the participants' raw data (age, CS experience, and competition engagement).

Materials

The Mental Strength Scale (MSS) was used to assess the participants' explicit attitudes and behavioural responses when facing obstacles (perseverance) and failure (resilience). MSS was developed as a simplified tool for field applications containing negatively and positively worded items to mitigate the effects of response bias and social desirability. An initial analysis of the internal reliability coefficients, redundancy, and clarity of 20 statements resulted in eliminating eight items. An exploratory factor analysis with the remaining 12 statements led to the elimination of two additional statements to retain items with factor loadings above .40. The final Mental Strength Scale is composed of 10 items as a 5-point Likert scale (Appendix 1). Items 3, 6, 7, and 10 are positively worded, varying from 1 for "*strongly disagree*" to 5 for "*strongly agree*." Items 1, 2, 4, 5, 8, and 9 are negatively worded and reversely coded. Participants were instructed to mark the option that best described their thoughts over the past month while considering their sport or exercise engagement. Total scores were determined by the average of the ten items, with 5 representing high mental strength and 1 representing low mental strength.

The Grit Scale (GS) and the Brief Resilience Scale (BRS) provided convergent validity to the MSS in the present study. The GS is a 12-item, 5-point Likert scale, where participants were asked to mark the statement that best described them compared to most people (Duckworth et al., 2007). Answers for items 1, 4, 6, 9, 10, and 12 vary from 1 for "*not like me at all*" to 5 for "*very much like me*" (Duckworth et al., 2007). Items 2, 3, 5, 7, 8, and 11 were reversely coded. The total score was determined by the average of the 12 items (Duckworth et al., 2007). The maximum possible score is 5, representing extremely gritty individuals, and the lowest is 1 for not at all gritty (Duckworth et al., 2007).

The BRS is a 6-item, 5-point Likert scale, where participants were asked to mark one box per row that best described them, with answers varying from 1 for "*strongly disagree*" to 5 for "*strongly agree*" (Smith et al., 2008). Statements 1, 3, and 5 were positively worded, and statements 2, 4, and 6 were negatively worded

and reversely coded, with total scores determined by the average of the six items (Smith et al., 2008). Scores between 1.00 and 2.99 represent low resilience, 3.00 and 4.30 represent normal resilience, and 4.31 and 5.00 represent high resilience (Smith et al., 2013).

Statistical analyses

The primary analyses assessed the MSS's factor structure, reliability, and validity. An exploratory factor analysis was conducted with principal components analyses (PCA) with a fixed number of factors of 2 and Varimax rotation. Internal consistency was examined via Cronbach's alpha. Convergent validity was determined via Pearson's correlation with the GS and the BRS.

Correlations were performed via Pearson's *r*. Sex and CS engagement comparisons were performed through independent samples *t*-tests. Analyses of covariance (ANCOVA) with Fisher's Least Significant Difference (LSD) post-hoc and sex as covariate were performed to compare the age, CS experience, and competition engagement groups. IBM SPSS Statistics (Version 29) was used for data analyses with an alpha level of .05.

RESULTS

Mental strength scale psychometrics

Exploratory factor analysis revealed two dimensions. The first conceptual dimension contained six items addressing the "risk of failure," and the second dimension contained four items about "facing obstacles." Table 1 displays the factor loadings and commonalities of the MSS items. Cronbach's alpha was calculated, producing an overall reliability coefficient of .809 for the total sample and indicating good reliability. Cronbach's alpha of .806 was found for the CS practitioner group and .783 for the non-practitioners.

Table 1. Factor analysis of the mental strength scale with varimax rotation.

MSS Items	Varimax loading	Commonalities
Risk of Failure		
Challenges make me doubt myself ^a	.753	.578
I hate challenges ^a	.562	.485
I'm scared of failing ^a	.774	.600
It's hard to recover from failure ^a	.696	.491
I don't like to get out of my comfort zone ^a	.723	.531
If it's hard, I may not finish it ^a	.596	.465
Facing Obstacles		
I enjoy opportunities to challenge myself	.609	.524
Challenges make me stronger	.789	.626
I have overcome challenges in the past	.783	.617
I work hard to overcome challenges	.653	.434

Note. ^a Item reverse coded.

A validity coefficient of .539 ($p < .001$) was obtained, indicating a moderate correlation, and suggesting that the MSS is tapping into the same construct as the GS. MSS total scores were also correlated with the BRS, presenting a validity coefficient of .551 ($p < .001$), indicating a moderate correlation and suggesting that the MSS is tapping into the same construct as the BRS and, therefore, providing convergent validity evidence for the MSS.

Correlations

A significant correlation was found between experience and mental strength, $r(429) = .177$, $p < .001$ (one-tailed). The null hypothesis is rejected; 3.13% of the variation in mental strength is accounted for by CS experience (small effect).

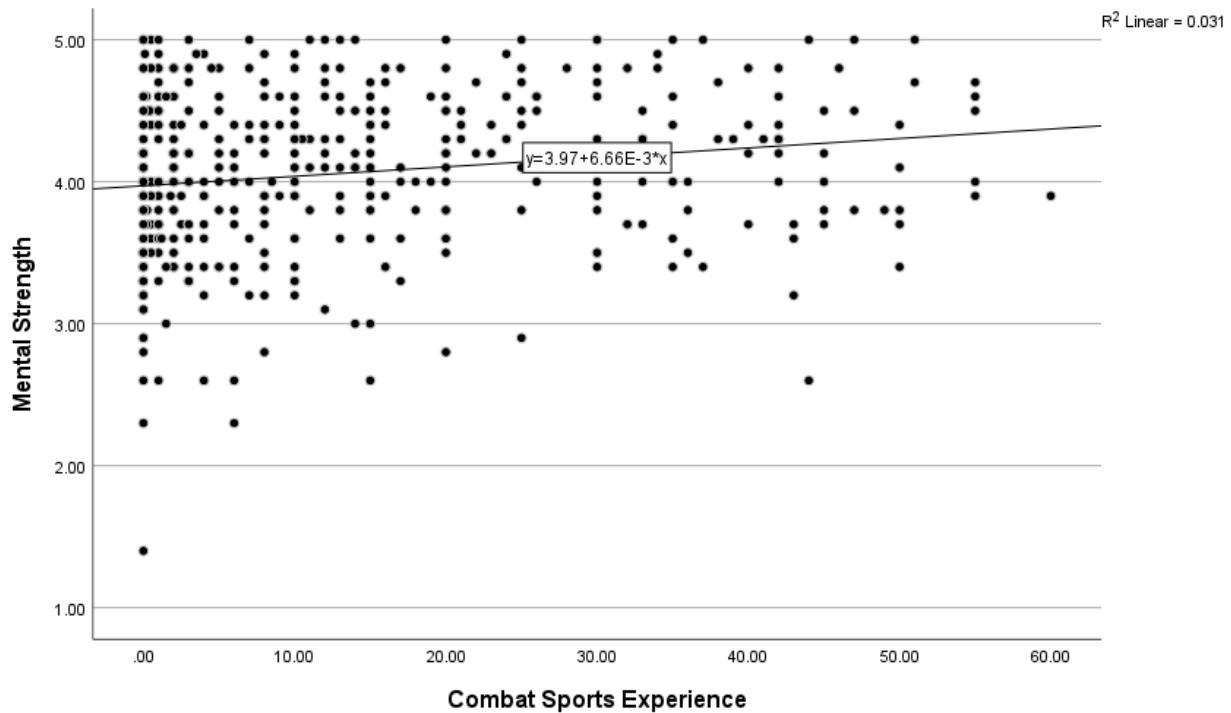


Figure 1. Scatterplot Depicting the Correlation Between CS Experience and Mental Strength.

No correlation was found between age and mental strength $r(429) = .042$, $p = .380$ (one-tailed). No correlation was found between competitive engagement and mental strength, $r(429) = .039$, $p = .422$ (one-tailed).

Group comparison

An independent samples *t*-test demonstrated a statistically significant difference in mental strength between males and females $t(429) = 2.962$, $p = .002$, $r^2 = 0.0200$, 95% CI [.06736, .33310] (one-tailed). The null hypothesis is rejected; men demonstrated higher mental strength than women (Table 2). An independent samples *t*-test demonstrated a statistically significant difference in CS experience between males and females $t(137.515) = 3.564$, $p < .001$, $r^2 = 0.0287$, 95% CI [2.69156, 9.39860] (one-tailed). The null hypothesis is rejected; men demonstrated higher CS experience than women (Table 2).

Table 2. Independent samples T-Test for sex comparison.

	Total	Males	Females
Sample size	431	346	85
Age	40.83 ± 12.30	40.74 ± 12.36	41.20 ± 12.13
Experience in years	13.91 ± 14.95	15.10 ± 15.01*	9.06 ± 13.75*
Competitions per year	0.90 ± 2.37	0.98 ± 2.43	0.56 ± 2.11
MSS score	4.06 ± 0.56	4.10 ± 0.54*	3.90 ± 0.62*

Note. * $p < .05$.

An independent samples *t*-test demonstrated a statistically significant difference in mental strength between CS practitioners and non-practitioners $t(429) = 4.247, p < .001, r^2 = 0.0403, 95\% \text{ CI } [.17796, .48457]$ (one-tailed). The null hypothesis is rejected; CS practitioners presented higher mental strength than non-practitioners (Table 3).

Table 3. Independent samples T-Test for CS practitioners versus non-practitioners comparison.

	Total	CS Practitioners	Non-Practitioners
Sample size	431	373	58
Age (years)	40.83 ± 12.30	40.77 ± 12.45	41.24 ± 11.40
Gender (% male)	80.3	85.5	46.6
MSS score	4.06 ± 0.56	4.11 ± 0.54*	3.78 ± 0.64*

Note. * $p < .05$.

An analysis of covariance with CS experience as the independent variable demonstrated a significant difference in mental strength between groups, $F(3, 426) = 5.991, p < .001$, when adjusted for the covariate sex (Table 4). Fisher's Least Significant Difference post hoc analyses revealed that participants in the >5 ($p < .001$), 2-5 ($p = .011$), and < 2 years of experience ($p = .016$) reported higher mental strength than participants with no CS experience. No other post hoc comparison was significant ($p > .05$).

Table 4. Analysis of covariance (LSD post hoc) between experience groups.

	0	<2	2-5	>5
Sample size	58	53	59	261
Mental strength score	3.75 ± 0.62 ^{a,b}	4.05 ± 0.60*	4.05 ± 0.51 ^a	4.14 ± 0.53 ^b

Note. ^{a,b} $p < .05$.

No statistically significant differences were found in mental strength between age groups $F(4, 425) = 1.779, p = .132$, or competition engagement groups $F(2, 427) = .357, p = .700$.

DISCUSSION AND CONCLUSIONS

The present study aimed to present the psychometrics of the MSS; explore the correlations between mental strength and age, CS experience, and competitive engagement; and compare group differences in mental strength based on sex, age, CS engagement, competition engagement, and CS experience. The MSS presented good overall internal consistency (Cronbach's $\alpha = .809$) and satisfactory evidence of convergent validity and, therefore, being a reliable instrument to assess mental strength in CS athletes.

Results rejected hypotheses 1 and 6, as no correlation between resilience and age or group differences were found.

Hypotheses 2 and 7 were retained, as results revealed a positive correlation between mental strength and CS experience (small effect). Group comparisons showed higher mental strength in the <2, 2-5, and >5 years of experience groups than the participants with no CS experience. These findings are congruent with the results found by Küçük (2020), who showed a significantly positive correlation between resilience and experience in karatekas. Pujszo et al. (2019) found a significant positive relationship between CS experience and resilience in adult practitioners. Moreover, Lorenco-Lima (2023) showed a significant positive correlation between CS experience and grit, with practitioners in the >5 years of experience group presenting significantly higher grit than participants in the <2 and 2-5 groups.

Hypotheses 3 and 8 were rejected as no correlation or group differences were found between mental strength and competition engagement. These results are partially incongruent with the findings of Lorenco-Lima (2023), who showed a positive correlation between competition engagement and grit, with athletes engaged in >4 competitions per year presenting higher grit than those engaged in 1-4 competitions per year but not than non-competitors.

Hypothesis 4 was retained as the comparison between sexes revealed higher mental strength in males than females. This finding is congruent with the results of Küçük (2020), Pujszo et al. (2019), and Lorenco-Lima (2023), who also found psychological (resilience and grit) differences between male and female CS practitioners.

Hypothesis 5 was retained as group comparison revealed higher mental strength in CS practitioners than non-practitioners. This result is compatible with Shamshirian et al. (2021), who found higher resilience in wrestlers than non-wrestlers and no significant difference based on the level of competition (national vs. international).

This study is not exempt from limitations. The cross-section nature of this research precludes any causality assumptions. The self-reported answers could potentially lead to social desirability bias. The author encourages future studies to explore mental strength in combat sports through a longitudinal design to establish causality and directionality. Moreover, the subcategorization of CS, including sparring versus no-sparring, could facilitate understanding the potential mechanism related to mental strength improvements.

In conclusion, the MSS is a simple and reliable instrument to assess mental strength in CS practitioners, given its good internal consistency and convergent validity. CS engagement and experience were shown to influence mental strength. These findings add to the combat sports literature, suggesting a positive role of combat sports in mental strength development. These findings provide strong evidence of the impact of combat sports in promoting mental strength and, therefore, all mental strength-related outcomes.

SUPPORTING AGENCIES

No funding agencies were reported by the author.

DISCLOSURE STATEMENT

No potential conflict of interest were reported by the author.

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APPENDIX A

Mental strength scale

Thinking about your athletic and exercise engagement, mark the box that best represents your thoughts over the past month. There is no right or wrong answer, just answer it to the best of your ability!

Mark one box per row that best describes your thoughts		Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
MSS 1	Challenges make me doubt myself	5	4	3	2	1
MSS 2	I hate challenges	5	4	3	2	1
MSS 3	I enjoy opportunities to challenge myself	1	2	3	4	5
MSS 4	I am scared of failing	5	4	3	2	1
MSS 5	It's hard to recover from failure	5	4	3	2	1
MSS 6	Challenges make me stronger	1	2	3	4	5
MSS 7	I have overcome challenges in the past	1	2	3	4	5
MSS 8	I don't like to get out of my comfort zone	5	4	3	2	1
MSS 9	If it's hard, I may not finish it	5	4	3	2	1
MSS 10	I work hard to overcome challenges	1	2	3	4	5



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