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Original Research

The Effect of a Strength and Conditioning Protocol on NCAA Division 1 Women's Basketball Players' Mental Toughness

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ABSTRACT

International Journal of Exercise Science 16(5): 315-326, 2023. Mental toughness (MT) is a popularized term in sports since it has been found to be positively related to performance. Self-assessment is the most common method of MT data collection. In the strength and conditioning (S&C) context, MT research has focused on males with a notable lack of female participants. Division 1 NCAA strength and conditioning coaches (SCC) spend more hours with their athletes during offseason training than any other coach. The purpose of this study was to measure the perceived effectiveness of an off-season S&C training regimen on MT levels of female athletes while also examining the differences in these perceptions between athletes, teammates, and their SCC. Following a quasi-experimental, longitudinal design, 12 student-athletes assessed their own (n = 58) and one teammate's (n = 58) levels of MT using the Mental Toughness Index five times over their off-season training S&C regimen. The SCC rated his players, as well (n = 60). MT levels increased significantly post-intervention [F (1, 23) = 7.27, p = .001]. The student-athletes perceived the effect of the intervention as more substantial compared to the SCC [F (1, 117) = 49.03, p < .001]. A more compatible perception of MT was found between athlete and teammate; no statistical significance was observed [F (1, 115) = 1.51, p = .221]. Evidence to support that this off-season S&C program worked regarding increasing MT levels was found. Our findings indicate compatibility between athletes, but not between athletes and coach, in recognizing this construct.

KEY WORDS: Multi-rating, mentally tough, collegiate athletics, female student-athlete

INTRODUCTION

Mental toughness (MT) is defined as "a state-like psychological resource that is purposeful, flexible, and efficient in nature for the enactment and maintenance of goal-directed pursuits" (18). Although many definitions exist, the above definition of MT points to the complexity (22) of this psychological construct, which is primarily examined in the current study.

Research on how MT affects athletic and nonathletic performance is accumulating. In educational settings, students with high levels of MT tend to achieve higher grades and report

more positive emotional states. In addition, researchers have studied the relationship between MT and various cognitive processes, including memory and attention. Individuals with high levels of MT were better able to recall items from a list that they had been told to remember, even when they were also presented with items from a list that they had been told to forget. Other research has found that individuals with high levels of MT and conscientiousness are more likely to invest effort in switching encoding strategies and forgetting irrelevant information, which may contribute to better memory performance (e.g., 12, 13, 24, 39).

Concerning the workplace, mentally tough individuals may be more likely to perform well. For instance, in a study by Marchant et al. (2009), higher levels of MT were associated with more senior managerial positions in a sample of individuals working in UK-based organizations. Another study by Gucciardi et al. (18) found that employee MT scores were directly related to higher levels of work performance as rated by supervisors.

MT has also been found to be related to performance in military settings. Godlewski and Kline (2012) found that in a sample of Canadian Forces recruits, higher levels of MT were associated with stronger commitment and better transitions, which in turn led to lower turnover intentions and behavior. A study by Gucciardi et al. (18) found that MT scores predicted success on a military selection test in a sample of male candidates, over and above hardiness and self-efficacy. A more recent study by Gucciardi et al. (19) examined the relationship between MT and behavioral perseverance in military personnel over an extended period. The study used a cross-sectional design and included assessments of MT and stress (as measured by hair cortisol concentration) before a Special Forces selection course lasting three weeks. A total of 122 military personnel participated in the study, and 26 of them (about 21%) passed the selection course. The results of the study showed that for a one-unit increase in MT, there was a roughly 68% increase in the odds of selection. Another study by Arthur et al. (2015) found that MT scores predicted military course performance among paratroop recruits, over and above individual fitness. Most MT research is in sports setting though (29).

MT has been popularized by sport culture and amongst athletes (28). Recent MT research has shown that the construct can be applied across a variety of populations including U.S. college students (31). Although there have been some reservations about targeted interventions to improve MT, most research suggests that MT develops over a long period and can be influenced by both the sporting environment and non-sport experiences (e.g., 1, 10, 17, 36, 47). There is a lack of evidence-based information on how to effectively develop and maintain MT in athletes. It is important to understand effective strategies for promoting MT in order to move towards evidence-based MT training practices. Recent events in which athletes have been hospitalized or died during MT training programs highlight the need for such evidence-based practices even more (14).

Throughout the literature, no matter the context, it is shown that increased MT is important as it correlates with lower levels of perceived stress, fewer depressive symptoms, favorable sleep habits, positive peer relationships, and enhanced psychological well-being (2, 3, 23, 33). Within

an athletic context, there are psychological explanations as to why increased MT enhances overall well-being, including higher self-esteem, improved self-efficacy, reduction in negative emotional states, and intensified feelings of control in a stressful situation (33). Specifically, mentally tough athletes are more consistent than their opponents at remaining determined, focused, and confident under pressure because of their superior coping ability to appraise events as challenges rather than threats (4, 6).

In the context of strength and conditioning (S&C), coaches overwhelmingly support the value of MT while they perceive their role as crucial in supporting its development in their athletes (42). That said, the strength and conditioning coach's (SCCs) perception of their role in developing athlete MT may contribute to their lack of understanding, or conceptualization, of MT as a complex psychological construct (46). For SCCs to fully understand, implement, and harmonize their understanding of MT with their athletes, they must first educate themselves on how to do so. Rather than limiting themselves to purely physiological training to foster MT (5), it is encouraged in the literature that SCCs work on their own MT, model desired behaviors of their athletes' MT, and be purposeful in educating themselves and their staff on how to best build MT (e.g., study MT strategies, attend sport psychology conferences, and seek out professionals for advisement) (18, 46, 47). In recognizing this, it is equally important that athletes fully understand and harmonize their perception of MT with their SCC's. This provides support and highlights the demand for coach-athlete educational MT programming in collaboration with the work of trained professionals in performance psychology and enhancement (e.g., Certified Mental Performance Consultants (CMPC)).

The majority of MT research is cross-sectional with self-assessment being the most common method of data collection which this study aims to address using a longitudinal design (7, 41). In addition, MT research has focused on male sports with a notable lack of female participants (41); therefore, remaining biased, exclusive, and contributing to a widening sex gap in analyzing this construct. This is an issue for many reasons, one of which is that with the lack of MT data involving female participants comes a lack of understanding of how the development of MT can be applied across this population. One of the primary focuses of the current study is to understand and evaluate the extent to which strength and conditioning plays a role in developing MT within female participants which could provide insight into how MT is understood within this context. With this, sports scientists, researchers, coaches, and S&C specialists have called for additional research evaluating MT levels in Division 1 (D1) athletics, specifically women's basketball due to the scarce amount of data in this particular domain (9, 33, 46). Although basketball is the most popular sport in the U.S.A. (38), it has not been included in the MT research as much (41). Therefore, choosing basketball as the sport of interest not only addresses a literature gap but has a potentially large practical significance since our findings may be useful to a large number of people. Lastly, in the limited S&C MT research, coaches were hesitant about sharing their training protocols, which created issues with replication (45). Thus, the authors address the following gaps in the MT literature by using a longitudinal design a) to measure the effectiveness of the off-season S&C protocol on the MT of a D1 NCAA women's

basketball team, while b) investigating possible differences in the perception of that effect between athletes, teammates, and their SSCs through the use of multi-rating.

Therefore, four hypotheses are being tested:

1) Compared to pre-intervention, the post-intervention levels of athletes' MT will significantly increase.
2) The perceptions of the SCC and student-athletes on the effect of the intervention will be significantly different.
3) The perception of the teammate and student-athletes on the effect of the intervention will be significantly different.
4) Perceptions of MT across all three assessors will be significantly different across the full duration of the intervention.

METHODS

Participants

Women basketball players of a D1 NCAA institution were the target population for the study. All participants were members of the same team and only the players who were able to complete the entire summer off-season S&C intervention were invited to participate (i.e., inclusion criteria). To allow for greater participation and retention of the recruited participants, a convenience sample was used. Thus, a random selection of participants did not take place in the initial recruitment, which involved an in-person briefing session by the principal investigator, explaining the purpose and design of the current study to the team. In total, 12 female basketball players agreed to participate in the study (k = 12) following the recruitment session. This research was carried out fully in accordance with the ethical standards of the International Journal of Exercise Science (35).

Data collection was performed using the Mental Toughness Index (MTI). Studies involving participants from different cultures (8, 20, 34, 43, 44) have accumulated evidence that supports the construct validity of the MTI. In past research, reliability estimates for the MTI scores have been ≥ 0.86 (21, 27, 40). The MTI is a self-report MT measure that includes eight items (see Appendix A); specific items include but are not limited to, "I believe in my ability to achieve my goals," "I consistently overcome adversity," and "I can find a positive in most situations." In order, each item of the MTI evaluates the following MT measures: *generalized self-efficacy, emotional regulation, success mindset, buoyancy, overcoming adversity, context knowledge,* and *optimistic style* (18).

Protocol

The study followed a quasi-experimental, one-group, longitudinal design. The research problem was suited for this kind of design since the intervention was performed on all active athletes (i.e., no control group). Data were collected five times using an MT instrument with multi-rating performed to allow for triangulation of scores and greater accuracy of perceived MT levels.

After Institutional Review Board (IRB) approval and signed informed consent from the participants, the MTI was uploaded into individualized survey links which were sent five times (one pre, three during, one post) throughout a summer off-season S&C training regimen led by a Certified Strength and Conditioning Specialist of the National Strength and Conditioning Association (NSCA-CSCS). The off-season S&C protocol was comprised of several training blocks consisting of both strength training and aerobic conditioning. For each of the five assessments, the MTI was completed directly after the last workout of the week for greater reporting accuracy. Therefore, the overall duration of the study lasted approximately six weeks, resembling the duration of the devised S&C protocol.

Due to clear limitations of self-reporting (e.g., over/under-estimating perceived MT; 37), the players were also rated by their SCC and one other teammate (same teammate each time; randomly assigned). In other words, during each assessment, all 12 players rated their own and one teammate's level of MT, followed by being evaluated by their SCC, as well. Multi-rating was used to promote the triangulation of scores, which serves to increase the validation of the self-reported data (41).

Statistical Analysis

The researchers were interested in examining the a) effect of S&C training protocols on perceived MT levels b) possible differences in perception of MT between coach and student-athletes c) possible differences in the perception of that intervention effect between athlete and teammate. Total MT scores were calculated by adding the scores (one through seven) per item (eight items). As a result, the range of possible MT scores could range from eight to 56. A Kruskal-Wallis nonparametric test was used to assess the significance of the relationships between coach, athlete, and teammate responses over time. All statistical analyses were performed using Microsoft Excel with an alpha level of .05.

RESULTS

The summary statistics are presented in Table 1, ($M_{MTIscore}$ = 48.22, SD = 4.13). The results represent the five assessments of the 12 athletes (n = 58), five assessments of the 12 athletes' teammate (n = 58), and five assessments of the athletes' SCC (n = 60). Two athlete absences when collecting data provide reasoning as to why two assessments for athlete and teammate MT assessment are missing. Therefore, the total number of measurements considered is 176, which yielded a response rate of 97.8%. It is noteworthy that ANOVA assumptions for MT scores were checked, and only mean scores are reflected in the tables and figures.

As shown in Table 2 and Figure 1, average MT levels were found to have a significant increase post-intervention: F (1, 23) = 7.27, p = .001, d = 1.03. Therefore, evidence supporting the first hypothesis was found showing a large effect size for this dataset.

Table 1. Summary Statistics for MT Scores (n = 176).

Statistic	Count
Mean	48.22
Standard Deviation	4.13
Standard Error Mean	0.31
Lower 95%	41.31
Upper 95%	48.83
Minimum	25
Maximum	56

Table 2. MT Mean Scores by Time (n = 176).

Level	Mean	St. Dev	Standard Error	Lower 95%	Upper 95%
Pre	44.7222	4.3712	1.2619	41.945	47.500
Second Assessment	47.5000	1.8395	0.5310	46.331	48.669
Third Assessment	48.4444	3.6.23	1.0399	46.156	50.733
Fourth Assessment	47.3750	3.1691	2.5032	41.865	52.885
Post	50.0833	1.6214	0.4680	49.053	51.113

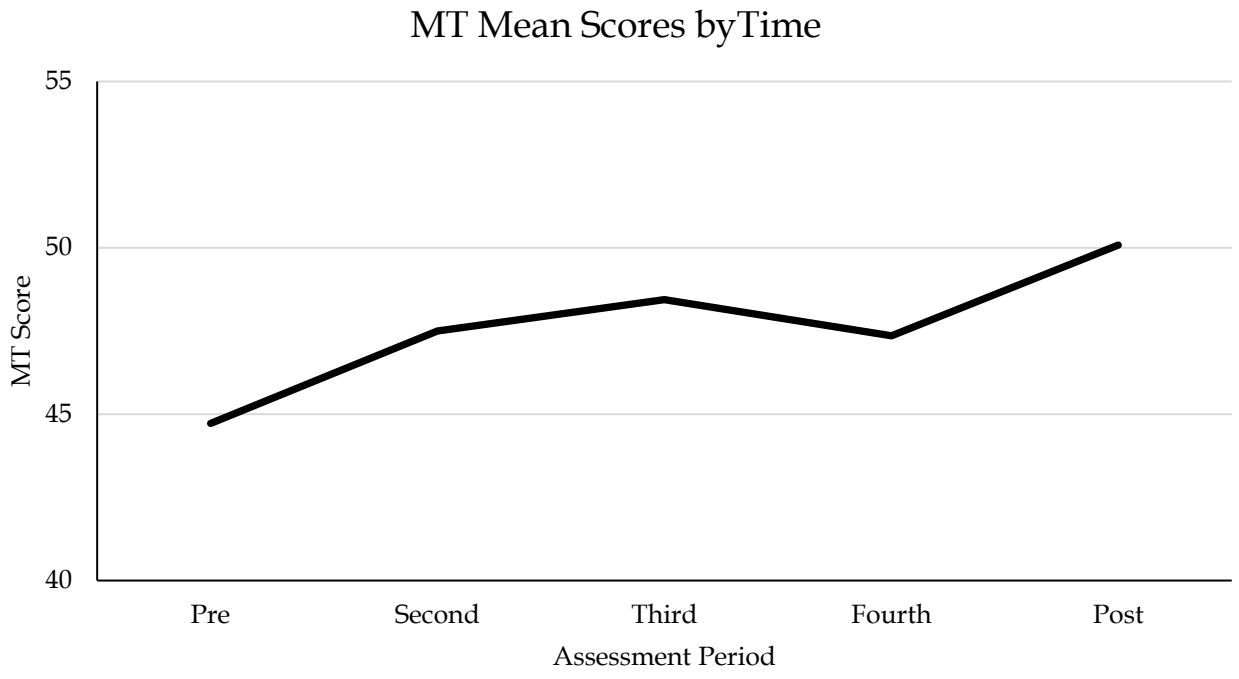

Figure 1. Average MT scores throughout the S&C training regimen.

As shown in Table 3 and Figure 2, the student-athletes perceived the effect of the intervention as more substantial compared to the SCC and statistical significance was observed: F (1, 117) = 49.03, p < .001, d = 2.71; meanwhile, although the student-athletes' teammates perceived the effect of the intervention to be greater than the individual athletes', no statistical significance was found: F (1, 115) = 1.51, p = .221, d = .90. Therefore, evidence was found to support the

second, but not the third hypothesis. Each tested relationship is supported with large effect sizes showing a large magnitude of the differences.

Table 3. MT Mean Scores by Assessor.

Assessor	Mean	St. Dev	Standard Error	Lower 95%	Upper 95%
Athlete (*n* = 58)	49.2288	2.4892	1.0618	46.281	52.177
Teammate (*n* = 58)	51.3818	2.3020	1.0295	48.523	54.240
Coach (*n* = 60)	43.1833	1.9644	0.8785	40.744	45.623

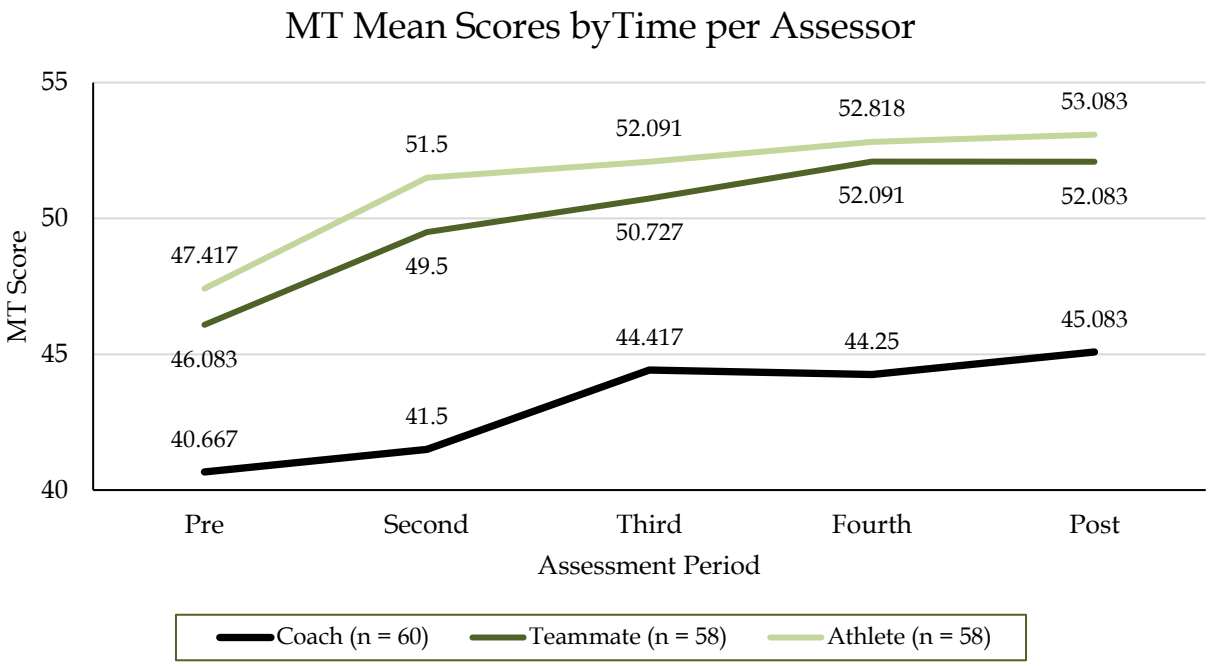

Figure 2. Relationship between athlete, teammate, and coach MT rating over the training protocol.

In addition, Table 4 shows the mean results used to examine the interaction between the assessor and time. Levene's test showed that equal variances were not assumed for this dataset, so a Kruskal-Wallis nonparametric test was used to examine this interaction. The results of the analysis showed a statistical significance between all three assessors over the duration of the S&C protocol (H(2) = 10.095, p = .006). An effect size of .76 was also calculated, which is strong evidence to support the fourth hypothesis. One important aspect to consider, however, is the medium to high effect size for this statistic, which shows a weaker relationship between variables than the other tests.

Table 4. MT Mean Scores by Time by Assessor.

Assessor	Pre	Second	Third	Fourth	Post
Athlete (*n* = 58)	46.083	49.500	50.727	52.091	52.083
Teammate (*n* = 58)	47.417	51.500	52.091	52.818	53.083
Coach (*n* = 60)	40.667	41.500	44.417	44.250	45.083

DISCUSSION

The main purpose of this study was to fill previously noted gaps in the MT literature by a) measuring the effectiveness of the off-season S&C protocol on the levels of MT of a team of NCAA D1 female basketball players and b) investigating possible differences in the perception of that effect between athletes, teammates, and their coaches.

Contrary to previous findings using the MTI with D1 rowers (45), the current results show that the levels of athletes' MT between pre- and post-intervention measurements increased significantly, and a significant difference was found between athlete and coach. With this, no statistical difference was found between athlete and teammate. Unexpectedly, these results indicate a harmonious perception in recognizing this theoretical construct between athletes' MT and teammate's perception of that effect. Therefore, evidence was found to support the first two hypotheses, but the third hypothesis was rejected. Based on the results of this study, it is clear that the summer off-season S&C program positively influenced the overall MT levels of the team, and a more harmonious perception of MT was found between athlete and teammate. One possible explanation for the drop in MT scores during the fourth week may be due to poor sleep hygiene (25).

Building off the noted limitations of prior research (45), researchers in this study had access to specific S&C protocols allowing for a more accurate replication for future research[1]. The current study also measured the dependent variable an additional three times to the pre-post assessment throughout the intervention, therefore, increasing the confidence in the inferences of the results of this study.

Regarding the present limitations of this study, not all eligible student-athletes participated, which may affect the interpretation of the inferences of the results (i.e., international athletes, and those recovering from injury, did not start the training regimen in alignment with the beginning of the study and thus were excluded). Additionally, there were four total missing data points (two athletes failed to complete the distributed survey in non-consecutive weeks) which resulted in a smaller-than-expected n-value (n = 176). Furthermore, the person prescribing and applying the intervention (i.e., the strength coach) was the same person conducting the assessment. Without blinding outcome assessors, this raises the question of possible bias. Moreover, we were not able to measure MT levels more than once before the protocol was applied. Multiple measurements with the same result would have increased our confidence that the MT scores were accurately measured. Lastly, the ability to draw large-scale conclusions from this data is limited due to the use of a convenience sample, decreasing generalizability.

Building off of the current study, there are some future research recommendations to further explore MT as a construct within S&C. First, reproducing the same, or similar, S&C intervention

[1] Due to space limitations, the S&C regimen is available upon request from the corresponding author.

with another Division 1 women's Basketball team to extend external validity is recommended. Future, larger-scale research may also examine the influence of the intervention on key dimensions of MT. In other words, how specifically does the S&C intervention influence an individual athlete's self-efficacy, emotion regulation, attention regulation, success mindset, buoyancy, overcoming adversity, context knowledge, and optimistic style? Furthermore, potential future studies may examine the different physical outcomes/adaptations and levels of performance associated with the intervention (e.g., changes in strength, power, endurance, flexibility, etc.) and the influence of these physical changes as compared to changes in perceived MT. With this, it would be interesting to examine differences between intervention types (e.g., more muscular strength vs. more endurance training) on the specific MT dimensions.

As shown in the present study, safe and effective S&C protocols serve to benefit student-athletes' self-perception of mental toughness increasing over time. SCCs can adopt the same, or a very similar, training protocol in their own weight-rooms knowing that there is evidence that this protocol may positively impact their student-athletes' perceived MT. In terms of the compatibility conclusion, sport psychology professionals could create different education-based MT training for SCCs and athletes to enhance understanding and create a more harmonious perception of MT.

MT is a psychological construct involving several resources and should be developed across various settings. Sport psychology professionals working within the performance domain suggest that there are a variety of ways to build MT, such as a) exposing athletes to challenging situations in a practice environment to simulate game-like competition and b) utilizing a strengths-based approach by focusing on what went well within a training session (16, 26, 47). Beyond this, evidence supports psychological skills training (PST) interventions as a way to increase athlete MT (11). Incorporating such psychological strategies, approaches, and skills training, in addition to a reliable S&C regimen, will serve to continually foster athlete MT development.

Although previous findings suggest that safe and effective physiological MT protocols remain vague (45), the current findings serve as a step forward in defining such protocols and their implications on perceived MT levels. What separates this study from others is 1) the integration of female participants to close the current sex gap in MT literature 2) the longitudinal design 3) the triangulation of assessor MT scores and 4) the available S&C protocol for replication. This is important for a) addressing the need of professional organizations in the field to shift towards empirically-based practices (30) and b) considering specific S&C protocols as measures for increasing MT across various populations and settings.

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