Received: 2 July 2021 | Revised: 16 December 2021 | Accepted: 16 December 2021
DOI: 10.1002/eat.23665

ORIGINAL ARTICLE

International Journal of EATING DISORDERS WILEY

Reducing eating disorder risk among male athletes: A randomized controlled trial investigating the male athlete body project

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Funding information
Association for Applied Sport Psychology, Grant/Award Number: Research Grant; Illinois Institute of Technology Department of Psychology

Action Editor: Tracey Wade

Abstract

Objective: No study to date has investigated an intervention program for male athletes that targets eating disorder risk factors. The purpose of this study was to measure the effects of the Male Athlete Body Project (MABP), an adaptation of the Female Athlete Body Project on body dissatisfaction, drive for muscularity, body-ideal internalization, and muscle dysmorphia.

Method: Participants were 79 male collegiate athletes who were randomized to the MABP ($n = 39$) or an assessment-only control condition ($n = 40$). All participants completed psychometrically validated measures at three time points: baseline, post-treatment (3 weeks after baseline for the control condition), and 1-month follow-up.

Results: Hierarchical Linear Modeling assessed differences between conditions across time. Interaction effects revealed that participation in the MABP improved satisfaction with specific body parts and reduced drive for muscularity and body-ideal internalization at post-treatment compared to a control group. Athletes in the MABP also reported increased body areas satisfaction and reductions in drive for muscularity at 1-month follow-up. Reductions in supplement use were observed at 1-month follow-up only.

Discussion: This study provides preliminary evidence of the efficacy of the MABP in reducing some eating disorder risk factors up to 1 month after the intervention; follow-up study considerations are discussed.

Clinical Trial Registration Number: NCT04077177

Public Significance: This study highlights the importance of eating disorder and body image intervention efforts for male athletes. Findings suggest that male college athletes who attended a 3-session group intervention based on a well-established program for college women experienced an increase in satisfaction with specific body areas and a reduction in some eating disorder risk factors (e.g., drive for muscularity, supplement use, and body-ideal internalization) compared to a control group.

KEYWORDS
athletes, body dissatisfaction, body-ideal internalization, drive for muscularity, eating disorders, intervention, men, muscle dysmorphia

1 | INTRODUCTION

Eating disorders (EDs) are found in higher rates among male athletes (MAs) compared to nonathlete men (Joy, Kussman, & Nattiv, 2016; Sundgot-Borgen & Torstveit, 2004). MAs report unique pressures from the sporting environment (e.g., coaches, uniforms) to change their body weight/shape for performance enhancement (Galli, Petrie, Reel, Greenleaf, & Carter, 2015). In a recent study with 698 college MAs, 35% reported attempting to gain weight and muscle; 41.3% endorsed trying to be leaner and build muscle (Walsh, Petrie, & Chatterton, 2020). Such pressures may lead to body dissatisfaction (BD) and drive for muscularity (DM), which may foster dangerous behaviors including unregulated supplement or steroid use (e.g., Raudenbush & Meyer, 2003). Thus, it is important to develop interventions addressing these ED risk factors among MAs.

1.1 | Dissatisfaction and the body ideals in athletes

MAs may experience BD due to the simultaneous desire to conform to the societal muscular ideal and sport-specific body ideal, which are often incompatible (Petrie & Greenleaf, 2012). Body-ideal internalization (BII) includes placing strong emphasis on muscularity and an athletic build (Schaefer, Harriger, Heinberg, Soderberg, & Kevin Thompson, 2017), which is associated with BD among nonathlete men (Karazsia & Crowther, 2008), international level MAs (Galli & Reel, 2009), and college MAs (Galli & Reel, 2009; Milligan & Pritchard, 2006). BII is also positively associated with eating psychopathology (Greenleaf, Petrie, Reel, & Carter, 2010).

Athletes are likely to consider a body type "ideal" both in terms of performance and appearance (Thompson & Sherman, 2010). Body ideals differ between sports (Petrie & Greenleaf, 2012); the male gymnast ideal (e.g., small, low body fat) differs drastically from that of an offensive lineman in football (e.g., large, mix of muscle and body fat). Athletes who experience BD and strive for sport-specific body ideals may restrict caloric intake (Galli, Petrie, Reel, Chatterton, & Baghurst, 2014), leading to low energy availability (LEA; i.e., inadequate fuel for sport performance, SP). LEA may result in reduced strength or muscle mass, which can hinder SP (Reel & Voelker, 2012). Development of Relative Energy Deficiency in Sport (RED-S; Ackerman et al., 2020) is particularly concerning. RED-S includes maladaptive changes to many bodily systems (e.g., endocrine dysfunction, low bone density, metabolic abnormalities) due to LEA, which may render athletes unable to participate in sport because of increased injury risk, decreased coordination, and impaired judgment. Compared to nonathlete peers, MAs appear to be at unique risk for eating psychopathology and related deleterious psychological and physiological consequences (e.g., RED-S), underscoring the need for an intervention targeting notable ED risk factors in this population (e.g., BD, DM, BII).

1.2 | Muscle dysmorphia

Individuals with muscle dysmorphia (MD; i.e., pathological preoccupation with muscularity) often exhibit compulsive behaviors to increase muscle size/strength, even if they are already muscular (Olivardia, Pope Jr, & Hudson, 2000). MD may impair an individual's functioning; for example, nonathlete men have abandoned lucrative careers that interfered with their exercise routines (Olivardia et al., 2000). MAs score higher than female athletes on measures of MD, and athletes who focused primarily on their appearance had higher MD scores than athletes who focused on performance (Skemp, Mikat, Schenck, & Kramer, 2013). Although currently classified as a form of body dysmorphic disorder, some argue that MD is better conceptualized as an ED (Murray, Rieger, Touyz, & De la Garza García, 2010). MD is associated with steroid abuse among MAs; unregulated performance-enhancing drugs and supplements have perilous physical and psychological consequences (Di Luigi, 2008). Thus, it is imperative to determine whether an intervention aimed at attenuating BD concomitantly reduces MD.

1.3 | Intervention targeting body image and eating disorder risk

Despite evidence of eating psychopathology in MAs, no study to date has examined an intervention aimed at reducing ED risks in this population. It is crucial to investigate effects of prevention programming, since EDs are challenging and expensive to treat (Crow, 2014). The Body Project (BP), a psychoeducational program originally designed for women, may be a promising intervention for MAs. Investigations of the BP have demonstrated reduced ED risk factors and symptoms, even at 2-to-3-year follow-up (Stice, Marti, Spoor, Presnell, & Shaw, 2008). The Female Athlete Body Project (FABP; Becker, McDaniel, Bull, Powell, & McIntyre, 2012), a short-term group intervention based on the Healthy Weight Intervention (e.g., Stice, Trost, & Chase, 2003) similarly reduced ED risk factors including thin-ideal internalization and shape and weight concerns at 1-year follow-up (Becker et al., 2012) and reduced dietary restraint and binge-eating behaviors at 18-month follow-up among female athletes (Stewart et al., 2019). Finally, adaptations of the BP for nonathlete men led to similar decreases in BD and eating psychopathology (e.g., Kilpela et al., 2016). Specifically, nonathlete men in the intervention groups reported reduced BII, DM, and MD (e.g., Brown, Forney, Pinner, & Keel, 2017), BD (e.g., Brown & Keel, 2015) and increased body appreciation (e.g., Almeida, Brown, Campos, Amaral, & de Carvalho, 2020), compared to controls. Thus, evidence of efficacy of the BP for female athletes and nonathlete men separately support investigation of a Male Athlete Body Project (MABP) intervention to target ED risk factors among MAs. However, MAs are a unique population that deserves focused study due to sport-specific factors.

1.4 | The current study

The current study investigated a novel intervention for college MAs which was adapted from the FABP (Becker et al., 2012). To make sure that changes to the content were acceptable and relevant, this intervention was first pilot tested on a small sample of former MAs who competed in high school or college. The aim of this randomized controlled trial was to determine whether the MABP reduced known ED risk factors (e.g., BD, DM, BII, MD) post-intervention in college MAs, and to determine whether these differences were maintained at 1-month follow-up. Based on the existing literature, it was hypothesized that: (1) men in the MABP would experience greater reductions in BD, DM, BII, and MD following treatment than men in an assessment-only control group, and (2) any measured effects in the treatment group would be maintained at follow-up.

2 | METHODS

2.1 | Participants

Division II and Division III college MAs ($N = 112$) were recruited from two Midwestern universities. Ninety-three men completed baseline measures and 79 men ($n = 39$ treatment; $n = 40$ control) completed all study procedures for a retention rate of 70.5% (see Figure 1). Inclusion criteria were: (a) male sex, (b) member of a university-sponsored varsity athletic team, (c) ≥18 years old, and (d) some endorsement of BD (i.e., >1 on the MBSRQ Overweight Preoccupation, Self-Classified Weight, or Appearance Orientation subscales, or scores >5 on the Appearance Evaluation subscale or the Body Areas Appreciation Scale).

2.2 | Procedure

An Institutional Review Board reviewed and approved all study procedures. Athletes were recruited at team practices and/or through emails distributed by a researcher, coach, or the Associate Athletic Director. Potential participants completed an 8-item online screening survey to determine whether they met eligibility criteria. Participants

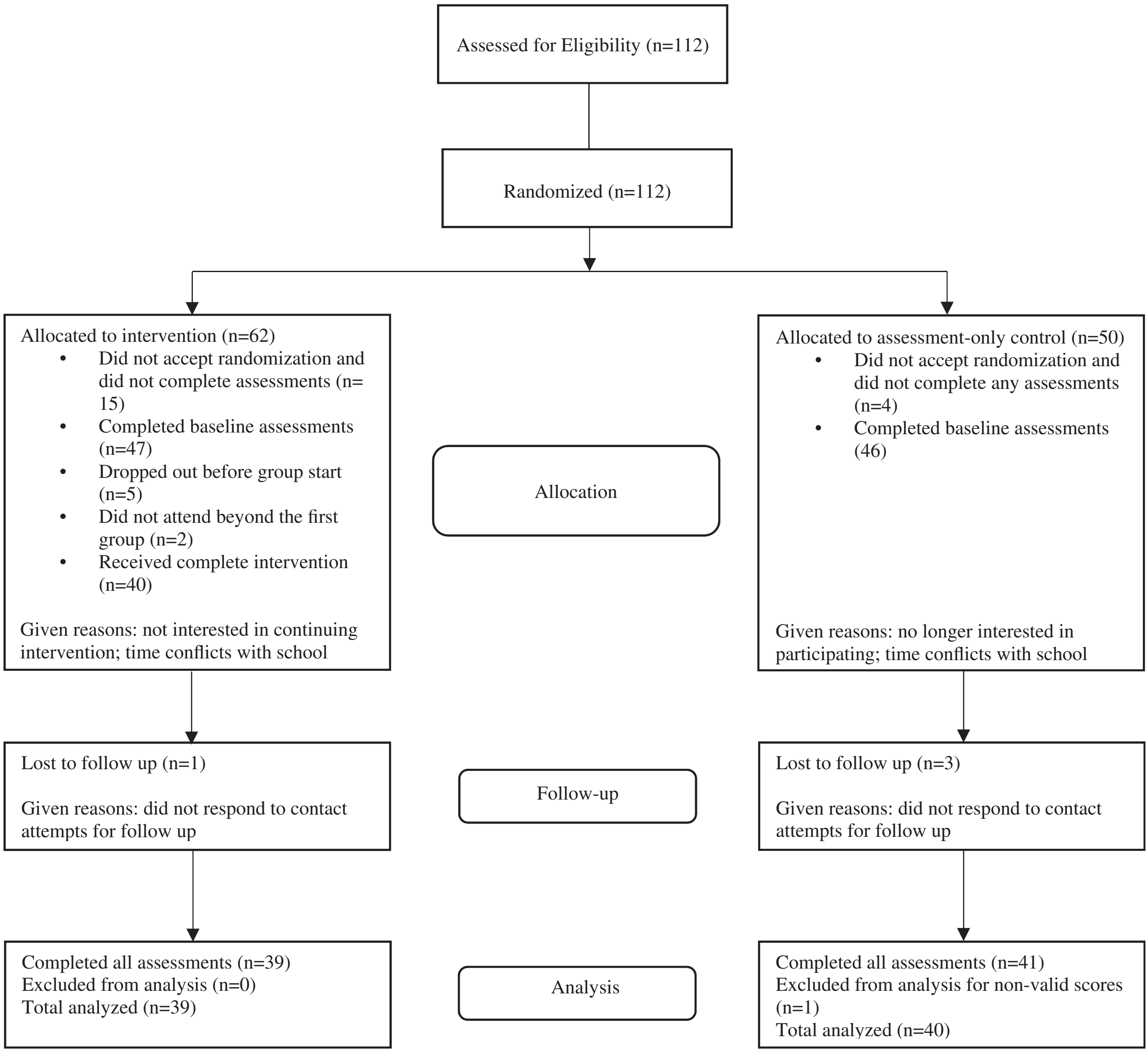

FIGURE 1 CONSORT chart representing participant flow through the study

who met all eligibility criteria and consented to the study were then randomized to one of two conditions: a manualized MABP group condition or an assessment-only condition. Given previous research suggesting that MAs from weight-sensitive sports may have greater BD (e.g., Petrie & Greenleaf, 2012), intervention groups were stratified by sport type such that weight-sensitive sports and non-weight-sensitive sports were in separate MABP groups. Weight-sensitive sports (Ackland et al., 2012) in this study included: cross-country/ track and field, swimming and diving, and wrestling. Volleyball was also included in the weight-sensitive sport category based on recent research (Iuso et al., 2019; Perelman, Buscemi, Dougherty, & Haedt-Matt, 2018). Nonweight-sensitive sports included: soccer, golf, football, baseball, basketball, and tennis. Intervention groups included between two and eight athletes (Stewart et al., 2017) and were co-led by the first author and another doctoral-level clinician.

The timing of assessment was consistent between intervention and control conditions. Participants completed baseline questionnaires after randomization (before MABP session 1), post-intervention questionnaires 3 weeks later (immediately after MABP session 3), and follow-up questionnaires 4 weeks after the post-intervention questionnaires. Participants were compensated for completion of baseline ($15), post-intervention ($15), and follow-up questionnaires ($20) or given course credit.

2.3 | Intervention

MABP content was created by modifying the language of the manualized FABP to be appropriate for men (e.g., using "male" or "men" instead of "female" or "women," replacing the Female Athlete Triad with information about RED-S, and focusing on a muscular-ideal instead of the traditionally female thin-ideal) in three once-weekly, 80-min group sessions.

2.3.1 | Session 1

Participants: (a) defined different "body ideals" (i.e., the traditional muscular ideal and sport-specific ideal) and how each contrasts with the athlete-specific healthy ideal (focus on maximizing physical health, mental health, quality of life, and athletic performance), (b) identified benefits of pursuing their own healthy ideal, (c) learned about the dangerous consequences of RED-S, (d) discussed how gradual lifestyle changes can be implemented to balance energy intake/output and to prioritize nutrient-dense foods, and (e) were assigned homework: to complete food and exercise logs, and a mirror exposure exercise to identify physical and personality characteristics they liked about themselves.

2.3.2 | Session 2

Participants: (a) reviewed homework, (b) set specific goals to improve nutrition without pursuing the traditional or sport-specific ideal and brainstormed the feasibility of their goal, (c) discussed the benefits of exercise for a healthy lifestyle and when exercise becomes unhealthy, (d) learned about sleep and its effects on a healthy body (e.g., food choices; energy; concentration) and SP, and (e) were assigned homework: to write a letter to a younger athlete encouraging him to give up pursuit of the sport-specific body ideal.

2.3.3 | Session 3

Participants: (a) reviewed homework, (b) generated reasons to pursue an athlete-specific healthy ideal, (c) challenged use of "fat talk" in the locker room and engaged in role plays to practice refuting fat talk and body-shaming, (d) discussed ways to make intentional food choices while traveling, and (e) named barriers to and benefits of the athlete-specific healthy ideal and identified long-term team strategies to prioritize health.

Data were collected regarding homework compliance and attendance to determine whether these predicted variables of interest.

2.4 | Intervention compliance and adherence

Of the 39 participants who started the intervention, 92.3% ($n = 36$) attended all three sessions, two missed two sessions, and one missed one session. Homework compliance was similarly high, with 87.2% ($n = 34$) completing all homework assignments, indicating high engagement with group procedures.

Intervention sessions were audiotaped. Four of the nine group audiotapes were randomly selected for treatment adherence and rated by two co-authors who were each trained on the MABP, but did not co-facilitate intervention sessions, using rating forms adapted from previous BP studies. Adherence ratings were above 95% for all sessions (average = 97.9%) representing excellent adherence to the treatment manual. Interrater reliability was ICC = .75, representing acceptable reliability.

2.5 | Measures

Cronbach's alpha for each subscale by time point are reported in Table 2.

2.5.1 | Body dissatisfaction

The Multidimensional Body-Self Relations Questionnaire-Appearance Scales (MBSRQ-AS; Cash, 2000) is a 34-item questionnaire that measures aspects of body image using five subscales: Appearance Evaluation (MBSRQ_AE, satisfaction or dissatisfaction with one's looks), Appearance Orientation (MBSRQ_AO, extent to which an individual pays attention to their appearance or engages in grooming behaviors), Overweight Preoccupation (MBSRQ_OP, fat anxiety or weight vigilance), Self-Classified Weight (MBSRQ_SCW, self-perception of weight from very underweight to very overweight), and the Body Areas Satisfaction Scale (MBSRQ_BASS, satisfaction with specific aspects of one's appearance). Higher scores indicate greater BD for MBSRQ_AO and MBSRQ_OP, whereas lower scores indicate greater BD for MBSRQ_AE and the MBSRQ_BASS (all possible subscale ranges: 1–5). MBSRQ_SCW includes two items, each ranging from 1 = very underweight to 5 = very overweight. These subscales have good internal consistency (Cronbach's alpha = .87 in male college athletes; Galli et al., 2015) and are sensitive to detecting intervention effects (Bhatnagar, Wisniewski, Solomon, & Heinberg, 2013).

2.5.2 | Drive for muscularity

The Drive for Muscularity Scale (DMS) (McCreary & Sasse, 2000) includes 15 items rated on a 1 (always) to 6 (never) scale used to calculate an average score. The DMS has good internal consistency (e.g., Brown et al., 2017) and has demonstrated sensitivity to detecting intervention effects (e.g., Jankowski et al., 2017).

2.5.3 | Internalization of the muscular ideal

The muscular subscale of the Sociocultural Attitudes Towards Appearance Questionnaire-4-Revised (SATAQ-4R; Schaefer et al., 2017) was used to measure muscular BII. This subscale includes four items assessing desire for a muscular figure (possible range: 1–5). In a study on college men, Cronbach's alpha was .85 for this subscale (Klimek, Murray, Brown, Gonzales IV, & Blashill, 2018). The SATAQ-4R is sensitive to detecting intervention effects (Kilpela et al., 2016).

2.5.4 | MD inventory

Participants completed the 27-item MD Inventory, which assesses two components of MD: physique and nutritional concerns (Rhea, Lantz, & Cornelius, 2004). The six subscales are: MDI_Diet (regulating diet to increase muscle size, possible range: 5–30); MDI_Supplement (using nutritional supplements, possible range: 4–24); MDI_Physique Protection (avoidance of being viewed by others, possible range 6–36); MDI_Exercise Dependence (preoccupation with and or maintenance of strict exercise routines, possible range 4–24); MDI_Size/Symmetry (preoccupation with muscle and body shape and size, possible range 5–30); and MDI_Pharmacology (use of steroids or synthetic hormones, possible range 3–18). Higher scores on each subscale indicate greater MD. Reliability estimates ranged from .72 and .94 across multiple samples, including university athletes (Rhea et al., 2004).

2.6 | Data analyses

2.6.1 | Power analysis

There is no generally recognized standard for power analyses for Hierarchical Linear Model (HLM; Castelloe & O'Brien, 2000). Thus, an a priori power analysis for a repeated measures ANOVA was performed using G*Power (Faul, Erdfelder, Buchner, & Lang, 2009), consistent with previous research (Brown, 2016). This indicated that a total sample of 74 was needed for 80% power (alpha = .05) to detect moderate effect sizes ($f^2 = .15$) for the Condition × Time interaction. A medium effect size estimate is comparable to effect sizes reported in a previous BP study of men (Brown et al., 2017). Given that HLM increases power compared to a repeated measures ANOVA, the sample size of 93 was sufficient.

2.6.2 | Hypothesis testing

BMI was calculated from self-reported height and weight at baseline. A two-level HLM was used to examine intervention effects. Less than 1% of the data were missing. Full-information maximum likelihood estimations were used for all models. Repeated measurements of the dependent variable nested within participants were modeled at Level 1, and the intervention condition (MABP or control) was modeled at Level 2. Study hypotheses were supported by a significant cross-level interaction between Condition × Time. Separate models were examined for each dependent variable.

Intent-to-treat analyses were conducted with the Mixed Model module of the Statistical Package for Social Sciences (SPSS, Version 26). Participants who completed any assessments ($N = 93$) were included in analyses (see: Figure 1). Model fitting was conducted using a stepwise approach and resulted in a random intercept, fixed slope model. Time was included at Level 1 as a predictor of the repeated outcome measure. The quadratic effect of time ($time^2$) was retained in 3 of the 13 final models when it improved model fit. Recruitment school (coded 0 = Midwestern University 1 and 1 = Midwestern University 2) was evaluated for inclusion as a covariate and retained for analysis in the MDI- Exercise Dependence model only. The Level 2 (i.e., between-person) predictors in the analyses included experimental condition (coded 0 = control group, 1 = treatment group). Significant interactions were probed with post hoc *t*-tests using the model estimated marginal means and *SE*s. Effect sizes and 95% confidence intervals for between-group standardized mean change scores were calculated according to Morris, 2008 and Fritz, Morris, & Richler, 2012.

3 | RESULTS

3.1 | Baseline characteristics

There were no significant differences between conditions at baseline on demographic variables; participants randomized to the intervention group were more likely to play weight-sensitive sports compared to the control group (Table 1). There were no significant differences between groups at baseline for most dependent variables (see Table 2), indicating that randomization was overall successful. Participants randomized to the intervention group reported lower Physique Protection

TABLE 1 Demographic characteristics and group comparisons

	Intervention (n = 47) M (SD)	Control (n = 46) M (SD)	Total (n = 93) M (SD)	t (p)
Age	19.47 (1.25)	19.48 (1.15)	19.47 (1.19)	0.04 (0.97)
BMI	23.39 (2.84)	24.06 (3.37)	23.72 (3.12)	1.04 (0.30)
	n (%)	n (%)	n (%)	χ^2 (p)
Race				
Asian	4 (8.5)	3 (6.5)	7 (7.5)	1.42 (0.70)
Black or African American	6 (12.8)	8 (17.4)	14 (15.1)	
Other (e.g., biracial)	3 (6.4)	1 (2.2)	4 (4.3)	
White	34 (72.3)	34 (73.9)	68 (73.1)	
Ethnicity				
Hispanic or Latino	5 (10.6)	1 (2.2)	6 (6.5)	2.76 (0.10)
Not Hispanic or Latino	42 (89.4)	45 (97.8)	87 (93.5)	
Sexual orientation				
Bisexual	2 (4.3)	0 (0.0)	2 (2.2)	4.09 (0.13)
Heterosexual	43 (91.5)	46 (100.0)	89 (95.7)	
Homosexual	2 (4.3)	0 (0.0)	2 (2.2)	
Academic class				
Freshman	18 (38.3)	17 (37.0)	35 (37.6)	
Sophomore	16 (34.0)	15 (32.6)	31 (33.3)	
Junior	8 (17.0)	8 (17.4)	16 (17.2)	
Senior	5 (10.6)	6 (13.0)	11 (11.8)	
Sport played				
Baseball	6 (12.8)	9 (19.6)	15 (16.1)	
Basketball	4 (8.5)	3 (6.5)	7 (7.5)	
Football	2 (4.3)	2 (4.3)	4 (4.3)	
Golf	0 (0.0)	1 (2.2)	1 (1.1)	
Lacrosse	0 (0.0)	4 (8.7)	4 (4.3)	
Soccer	7 (14.9)	7 (15.2)	14 (15.1)	
Swimming	4 (8.5)	4 (8.7)	8 (8.6)	
Tennis	1 (2.1)	4 (8.7)	5 (5.4)	
Track and field	7 (14.9)	7 (15.2)	14 (15.1)	
Volleyball	3 (6.4)	1 (2.2)	4 (4.3)	
Wrestling	2 (4.3)	2 (4.3)	4 (4.3)	
Cross country (CC)	1 (2.1)	0 (0.0)	1 (1.1)	
CC, track and field	10 (21.3)	2 (4.3)	12 (12.9)	
Weight-sensitive sport	27 (57.4)	16 (34.8)	43 (46.2)	4.80 (0.03)
Nonweight-sensitive sport	20 (42.6)	30 (65.2)	50 (53.8)	

and Overweight Preoccupation at baseline compared to the control group.

3.2 | Primary analyses

Estimated marginal means for each time point by condition and effect sizes for between-condition effects standardized mean change from baseline to postassessment and baseline to follow-up are reported in Table 2. Model parameters are reported in Table 3.

3.2.1 | Body dissatisfaction

As hypothesized, results for the MBSRQ_BASS reflected a significant interaction effect for Condition × Time. Comparisons of group means revealed that the treatment group reported significantly higher body areas satisfaction at postassessment (p < .01, between-condition d = .61) and follow-up (p < .01, between-condition d = .53); see Figure 2) compared to controls. Contrary to hypotheses, there were no significant interactions of Condition × Time for other MBSRQ subscales.

TABLE 2 Estimated marginal means for dependent variables at each time point by condition

Measure	Cronbach's α T1, T2, T3	Baseline (T1) *M* (*SE*)		Postassessment (T2) *M* (*SE*)		Follow-up (T3) *M* (*SE*)		Between-group effect size baseline to post (95% CI)	Between-group effect size baseline to follow-up (95% CI)
		Tx	Control	Tx	Control	Tx	Control		
Body dissatisfaction									
MBSRQ_AE	.89, .88, .86	4.00 (.091)	3.82 (.092)	4.09*** (.095)	3.73 (.094)	3.99* (.095)	3.70 (.095)	.29 (−.118 to .698)	.18 (−.228 to .588)
MBSRQ_AO	.84, .86, .85	3.24 (.085)	3.21 (.086)	3.12 (.088)	3.29 (.087)	3.15 (.088)	3.21 (.088)	−.34 (−.750 to .070)	.08 (−.326 to .486)
MBSRQ_OP	.76, .78, .77	1.88* (.118)	2.25 (.119)	1.85* (.121)	2.20 (.121)	1.84* (.121)	2.23 (.122)	.03 (−.376 to .436)	−.03 (−.436 to .376)
MBSRQ_BASS	.80, .86, .81	3.87 (.087)	3.69 (.088)	4.01** (.089)	3.66 (.089)	3.90** (.089)	3.60 (.089)	.28 (−.128 to .688)	.20 (−.208 to .608)
MBSRQ_SCW	.80, .76, .79	2.82 (.083)	2.83 (.084)	2.85 (.085)	2.84 (.085)	2.83 (.086)	2.91 (.086)	.04 (−.366 to .446)	−.12 (−.528 to .288)
Drive for muscularity									
DMS	.85, .87, .89	3.03 (.118)	3.03 (.120)	2.57** (.121)	3.06 (.121)	2.77* (.122)	3.14 (.122)	−.60* (−.184 to −1.02)	−.42* (−.008 to −.832)
Internalization: Muscular ideal									
SATAQ_4R	.87, .87, .89	3.92 (.112)	3.97 (.113)	3.52* (.117)	3.87 (.116)	3.55 (.118)	3.72 (.117)	−.39 (−.800, .020)	−.16 (−.568 to .248)
Muscle Dysmorphia									
MDI_Diet	.81, .83, .82	12.5 (.792)	12.2 (.800)	12.6 (.818)	12.9 (.815)	12.2 (.822)	12.0 (.822)	−.11 (−.518 to .298)	−.02 (−.426 to .386)
MDI_Supplement	.80, .75, .79	7.53 (.581)	7.22 (.588)	7.42 (.599)	8.46 (.597)	6.89* (.601)	8.19 (.601)	−.33 (−.740 to .080)	−.40 (−.810 to .010)
MDI_PhysProtect	.78, .90, .85	10.2* (.771)	12.8 (.779)	10.3** (.803)	13.0 (.797)	10.7* (.807)	12.4 (.805)	−.02 (−.426 to .386)	.17 (−.238 to .578)
MDI_ExDepend	.64, .66, .77	14.0 (.656)	13.7 (.663)	13.6 (.679)	14.0 (.676)	13.8 (.683)	13.6 (.682)	−.15 (−.558 to .258)	−.02 (−.426 to .386)
MDI_SizeSym	.85, .82, .87	13.6 (.828)	14.9 (.837)	13.1* (.854)	15.5 (.852)	12.3 (.858)	15.1 (.858)	−.19 (−.598 to .218)	−.26 (−.668 to .148)
MDI_Pharmac	–	3.00 (.027)	3.00 (.027)	3.00 (.029)	3.07 (.029)	3.00 (.030)	3.00 (.030)	−.37* (−.329 to −.411)	0

Abbreviations: DMS, Drive for Muscularity Scale; MBSRQ_AE, Multidimensional Body-Self Relations Questionnaire-Appearance Evaluation; MBSRQ_AO, Multidimensional Body-Self Relations Questionnaire-Appearance Orientation; MBSRQ_OP, Multidimensional Body-Self Relations Questionnaire-Overweight Preoccupation; MBSRQ_BASS, Multidimensional Body-Self Relations Questionnaire-Body Areas Satisfaction Scale; MBSRQ_SCW, Multidimensional Body-Self Relations Questionnaire-Self-Classified Weight; MDI_ExDepend, Muscle Dysmorphia Inventory-Exercise Dependence Subscale; MDI_Diet, Muscle Dysmorphia Inventory-Diet Subscale; MDI_PhysProtect, Muscle Dysmorphia Inventory-Physique Protection Subscale; MDI_Pharmac, Muscle Dysmorphia Inventory-Pharmacology Subscale; MDI_SizeSym, Muscle Dysmorphia Inventory-Size/Symmetry Subscale; MDI_Supplement, Muscle Dysmorphia Inventory-Supplement Use Subscale; SATAQ-4R, Sociocultural Attitudes Towards Appearance Questionnaire-4-Revised, Internationalization: Muscular Subscale.

Notes: Effect sizes represent the between-group standardized mean change scores. Effect sizes were calculated as the [(treatment group mean change) − (control group mean change)] / pooled pretest *SD* as recommended for pre-post-control group designs (Morris, 2008). The effect size 95% CI was calculated using the *SD* of the sampling distribution, sample size of the treatment and control groups at baseline, Cohen's *d*, and the z-score of a normal distribution (Fritz et al., 2012). Of note, calculations could not be performed for baseline to follow-up for MDI_Pharmacology due to invariant mean scores.

*p < .05, **p < .01, ***p < .001; Asterisks at T1, T2, and T3 represent significant differences between each time point assessed by independent samples *t*-tests. Effect sizes that are significantly different from 0 are noted with an asterisk.

TABLE 3 HLM parameter estimates for fixed effects and variance components for model outcome variables

		Fixed effects					Covariance parameters	
		Estimate *(SE)*	*df*	*t*	*p*		Estimate *(SE)*	Wald Z
Body dissatisfaction								
MBSRQ_AE	Intercept	3.81 (.091)	112.9	41.83	.000	Within-person	.090 (.010)	8.94***
	Time	−.059 (.033)	162.6	−1.786	.076	Intercept	.305 (.051)	5.99***
	Condition	.216 (.128)	113.2	1.687	.094			
	Time*condition	.056 (.047)	163.8	1.178	.24			
MBSRQ_AO	Intercept	3.23 (.085)	116.6	38.193	.000	Within-person	.073 (.008)	9.07***
	Time	.003 (.030)	167.2	.086	.93	Intercept	.267 (.043)	6.22***
	Condition	−.009 (.119)	116.9	−.077	.94			
	Time*condition	−.050 (.043)	168.4	−1.186	.24			
MBSRQ_OP	Intercept	2.24 (.117)	109.5	19.061	.000	Within-person	.118 (.013)	8.96***
	Time	−.010 (.038)	163.4	−.266	.79	Intercept	.532 (.085)	6.23***
	Condition	−.359 (.165)	109.7	−2.174	.032			
	Time*condition	−.010 (.054)	164.1	−.179	.86			
MBSRQ_BASS	Intercept	3.69 (.088)	108.8	42.081	.000	Within-person	.051 (.006)	8.93***
	Time	−.024 (.089)	160.65	−.269	.79	Intercept	.303 (.048)	6.31***
	Condition	.174 (.123)	108.8	1.412	.16			
	Time*time	−.010 (.043)	160.0	−.239	.81			
	Time*condition	.284 (.127)	161.1	2.240	.026			
	Time*time*condition	−.112 (.061)	160.3	−1.831	.069			
MBSRQ_SCW	Intercept	2.82 (.089)	95.5	31.703	.000	Within-person	.049 (.005)	9.00***
	Time	.040 (.024)	164.1	1.641	.10	Intercept	.278 (.043)	6.39***
	Condition	.006 (.117)	107.5	.052	.96			
	Time*condition	−.033 (.035)	164.7	−.944	.35			
Drive for muscularity								
DMS	Intercept	3.03 (.120)	111.4	25.336	.000	Within-person	.110 (.012)	8.91***
	Time	.004 (.130)	160.2	.034	.97	Intercept	.547 (.088)	6.20***
	Condition	.001 (.168)	111.4	−.005	1.0			
	Time*time	.026 (.063)	159.5	.415	.68			
	Time*condition	−.799 (.187)	160.7	−4.270	.000			
	Time*time*condition	.305 (.090)	159.7	3.373	.001			
Muscular-ideal internalization								
SATAQ-4R	Intercept	3.97 (.113)	135.6	35.028	.000	Within-person	.183 (.020)	8.96***
	Time	−.081 (.168)	163.1	−.483	.63	Intercept	.407(.071)	5.72***
	Condition	−.047 (.159)	135.6	−.296	.768			
	Time*time	−.020 (.081)	162.0	−.250	.80			
	Time*condition	−.534 (.240)	164.0	−2.231	.027			
	Time*time*condition	.237 (.116)	162.3	2.042	.043			
Muscle dysmorphia								
MDI_Diet	Intercept	12.42 (.788)	112.2	15.756	.000	Within-person	6.56 (.736)	8.92***
	Time	−.059 (.283)	162.2	−.210	.83	Intercept	23.00 (3.82)	6.017***
	Condition	.126 (1.11)	112.4	.114	.91			
	Time*condition	−.069 (.403)	163.1	−.172	.87			
MDI_Supplement	Intercept	7.44 (.579)	108.0	12.849	.000	Within-person	3.11 (.350)	8.88***
	Time	.498 (.195)	160.7	2.554	.012	Intercept	12.81 (2.11)	6.07***
	Condition	.147 (.815)	108.2	.181	.86			
	Time*condition	−.817 (.277)	161.5	−2.945	.004			

TABLE 3 (Continued)

		Fixed effects					Covariance parameters	
		Estimate (SE)	df	t	p		Estimate (SE)	Wald Z
MDI_PhysProtect	Intercept	12.94 (.763)	118.8	16.950	.000	Within-person	7.93 (.891)	8.90***
	Time	−.206 (.311)	162.3	−.664	.51	Intercept	20.07 (3.49)	5.75***
	Condition	−2.77 (1.07)	119.0	−2.578	.011			
	Time*condition	.432 (.442)	163.4	.977	.33			
MDI_ExDepend	Intercept	12.70 (.782)	105.7	16.236	.000	Within-person	4.80 (.539)	8.91***
	Time	−.029 (.242)	162.3	−.119	.91	Intercept	14.39 (2.44)	5.90***
	Condition	.028 (.892)	115.4	.031	.98			
	Study site	2.03 (.844)	90.0	2.402	.018			
	Time*condition	−.066 (.344)	163.4	−.191	.85			
MDI_SizeSym	Intercept	15.05 (.825)	111.2	18.239	.000	Within-person	6.66 (.745)	8.94***
	Time	.116 (.285)	162.7	.407	.68	Intercept	25.66 (4.20)	6.10***
	Condition	−1.50 (1.16)	111.4	−1.297	.20			
	Time*condition	−.311 (.406)	163.6	−.766	.444			
MDI_Pharmac	Intercept	3.02 (.025)	254.0	118.781	.000	Within-person	.035 (.003)	11.27***
	Time	.002 (.021)	254.0	.081	.94	Intercept	—	—
	Condition	−.022 (.036)	254.0	−.610	.54			
	Time*condition	−.002 (.029)	254.0	−.057	.95			

Abbreviations: DMS, Drive for Muscularity Scale; MBSRQ_AE, Multidimensional Body-Self Relations Questionnaire-Appearance Evaluation; MBSRQ_AO, Multidimensional Body-Self Relations Questionnaire-Appearance Orientation; MBSRQ_OP, Multidimensional Body-Self Relations Questionnaire-Overweight Preoccupation; MBSRQ_BASS, Multidimensional Body-Self-Relations Questionnaire-Body Areas Satisfaction Scale; MBSRQ_SCW, Multidimensional Body-Self Relations Questionnaire-Self-Classified Weight; MDI_Diet, Muscle Dysmorphia Inventory- Diet Subscale; MDI_ExDepend, Muscle Dysmorphia Inventory-Exercise Dependence Subscale; MDI_Pharmac, Muscle Dysmorphia Inventory- Pharmacology Subscale; MDI_PhysProtect, Muscle Dysmorphia Inventory-Physique Protection Subscale; MDI_SizeSym, Muscle Dysmorphia Inventory-Size/Symmetry Subscale; MDI_Supplement, Muscle Dysmorphia Inventory-Supplement Use Subscale; SATAQ-4R, Sociocultural Attitudes Towards Appearance Questionnaire-4-Revised, Internalization: Muscular Subscale.
*p < .05; **p < .01; ***p < .001.

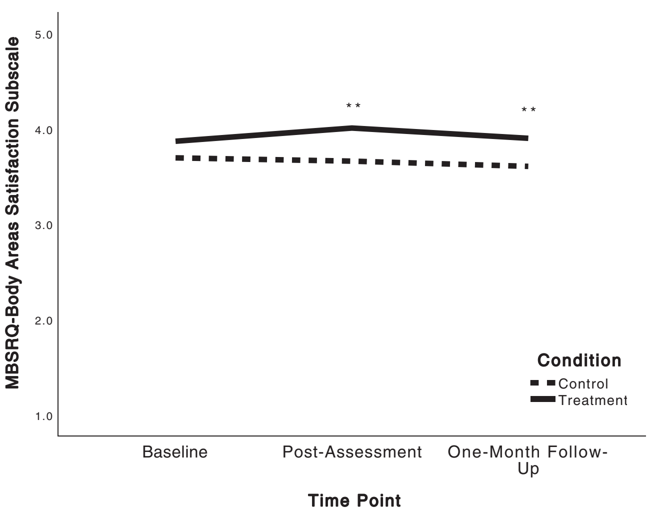

FIGURE 2 Comparing conditions over time on MBSRQ-Body Areas Satisfaction Scale Scores. *p < .05, **p < .01, ***p < .001. *Note:* Figures depict group means at each time point and do not reflect the main effects of Condition or Time. For models with significant interactions, any statistically significant between-group difference by time point is represented with an asterisk

3.2.2 | Drive for muscularity

As predicted, the Condition × Time *and* Condition × Time^2 interaction terms were both statistically significant with a faster decline in scores for the treatment group between baseline and post-assessment compared to controls (see: Figure 3). Follow-up group mean comparison tests indicated that the treatment group reported significantly lower DM at both postassessment ($p < .001$, between-condition $d = -.64$) and follow-up ($p < .05$, between-condition $d = -.50$) compared to the control group.

3.2.3 | Internalization of the muscular ideal

As hypothesized, the Condition × Time *and* Condition × Time^2 interaction terms were both statistically significant. Comparisons of group means revealed that compared to controls, the treatment group endorsed significantly lower scores in BII at postassessment ($p < .05$, between-condition $d = -.46$), but not follow-up (see Figure 4).

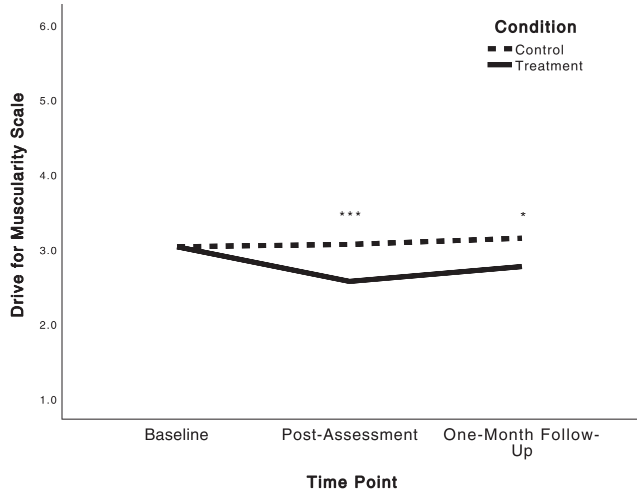

FIGURE 3 Comparing Conditions over Time on Drive for Muscularity Scores. *$p < .05$, **$p < .01$, ***$p < .001$

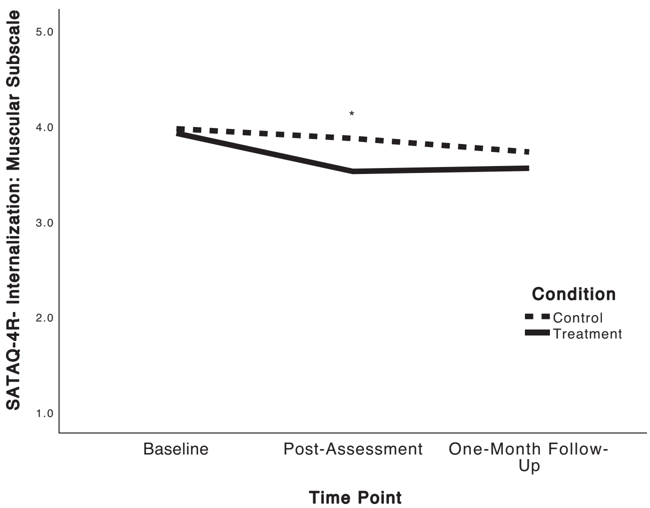

FIGURE 4 Comparing Conditions over Time on Sociocultural Attitudes Towards Appearance Questionnaire-4-Revised, Internalization: Muscular Subscale. *$p < .05$, **$p < .01$, ***$p < .001$

3.2.4 | Muscle dysmorphia

As hypothesized, analysis of performance-enhancing nutritional supplement use (MDI_Supplement) revealed a significant Condition × Time interaction (see Table 3). Follow-up analyses indicated that while there were no between-group differences at postassessment, the treatment group reported significantly lower scores at follow-up than controls ($p < .05$, between-condition $d = -.34$; see Figure 5). Contrary to hypotheses, there were no significant interactions of Condition × Time for MDI_Diet, MDI_Size Symmetry, MDI_Physique Protection, MDI_Exercise Dependence, and MDI_Pharmacology.

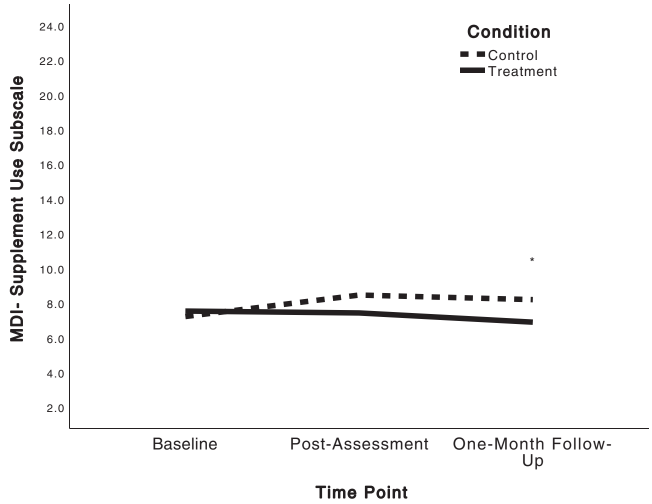

FIGURE 5 Comparing Conditions over Time on Muscle Dysmorphia Inventory: Supplement Use Subscale. *$p < .05$, **$p < .01$, ***$p < .001$

4 | DISCUSSION

4.1 | Summary of findings

To our knowledge, this is the first assessment of a BP program designed for MAs. We hypothesized that there would be significant reductions in BD, DM, MD, and BII at post-assessment, and that any measured effects would remain at follow-up. Hypotheses were partially supported; one of the five BD subscales (i.e., MBSRQ_BASS) significantly improved following treatment, and one of the six MD subscales (i.e., MDI_Supplement Use) significantly decreased following treatment. The improvements in satisfaction with body parts and DM were maintained follow-up for the treatment group. Additionally, the intervention group reported significant reductions at post-assessment for BII and at follow-up for supplement use relative to controls. Thus, similar to previous BP research conducted with female athletes (e.g., Becker et al., 2012; Stewart et al., 2019) and nonathlete college men (Brown et al., 2017; Brown & Keel, 2015; Jankowski et al., 2017), current findings demonstrate that the MABP reduces some ED risk factors among MAs.

The small-to-medium between-condition effect sizes found in the current study are comparable to previous BP studies with nonathlete men (Almeida et al., 2020; Brown et al., 2017; Jankowski et al., 2017). Between-condition baseline-to-post-assessment and baseline-to-follow-up effect sizes (Table 2) also range from small-to-medium and are comparable to but somewhat smaller than previous BP studies which found small-to-large within-condition effect sizes in a sample of athletes (Brown & Keel, 2015) and nonathlete women (Becker et al., 2010).

Results for BD are promising, as the increase in satisfaction for specific body areas indicates that the MABP may have helped MAs shift attention away from body shape, weight, and size. It is possible that participants actively practiced skills learned during the MABP, including denouncing body-shaming "locker room talk" from friends and teammates. Alternatively, similar to nonathlete, college-aged men (De Young, Lavender, & Anderson, 2010), it is possible that because MAs are more focused on gaining muscle, the construct "BD" does not adequately capture men's experiences, thus explaining the nonsignificant findings of the other four BD subscales. Research indicates that female athletes have a "contextual" body image (de de Bruin, Oudejans, Bakker, & Woertman, 2011), meaning that perceived ideal body image differs in sport and daily life contexts. Assessment of contextually dependent body image among MAs may improve understanding of the role that the sporting environment plays in BD. Future research on this topic is needed given that BD is a strong predictor of ED onset (e.g., Petrie & Greenleaf, 2012) it is plausible that by improving BD, EDs may be prevented.

We also observed greater reductions in BII and DM in the treatment group compared to the control group. Thus, it is conceivable that the MABP equips athletes with skills to regulate the "muscle-building mindset" (Galli et al., 2015, p. 64). This is particularly important given that a recent study found that 83% of college MAs desired to gain muscle mass, with many receiving either no guidance or guidance from an unqualified source regarding weight management (Walsh et al., 2020). Both DM and MD are associated with using performance-enhancing supplements that are not regulated by the Food and Drug Administration (e.g., Galli & Reel, 2009); if DM is reduced, so are the concomitant health risks (e.g., death) that may result from these unregulated drugs.

While not directly assessed in the present study, it is possible that exposure to information about RED-S helped athletes to focus on fueling for performance instead of engaging in other muscle-building behaviors. Future research should investigate whether nutrition knowledge (i.e., learning how to intentionally fuel for sport) affects DM behaviors and attitudes in this population and reduces RED-S consequences. Anecdotally, most athletes in the MABP intervention remarked that they had not heard of RED-S before and noted that they found the information regarding adequate fueling for sport to be useful. If the MABP does indeed help to prevent RED-S, there are vast implications for preserving physical health and improving SP. Future research should explore the effects of the MABP on RED-S, with a measure such as the Relative Energy Deficiency in Sport Clinical Assessment Tool (RED-S CAT; Mountjoy et al., 2015).

This study also extends previous research regarding MD among nonathlete men (Almeida et al., 2020; Brown et al., 2017) to MAs by demonstrating that the MABP was successful at reducing one aspect of MD (i.e., supplement use) for the treatment group at follow-up. This suggests that supplement use may be the most salient aspect of MD to MAs and underscores the importance of monitoring energy and nutritional supplement use in this population. Although the effect size was small, decreasing supplement use in this population is important. Multiple health risks and side effects have been documented, including—but not limited to—neurological symptoms such as headaches and gastrointestinal problems (Di Luigi, 2008). The lack of improvement on the other MDI subscales may be attributed to the nonclinical nature of the sample, and floor effects at baseline for MDI_Pharmacology. Future research should evaluate the MABP in a higher risk sample of athletes who meet clinical thresholds for MD.

Among individuals randomized to the treatment group, 15 (24%) did not enroll in the study. Conceivably, these individuals were not comfortable discussing body image in a group of peers or did not enroll because they had low levels of BD and did not think they would benefit from intervention. Thus, attrition may have biased study findings. Finally, some may have dropped out due to the time commitment of the MABP if their sport was in-season at the time. This explanation seems plausible since fewer participants dropped out who were randomized to the control group ($n = 4$; 8%). Any future replications should consider evaluating reasons for dropout before enrollment to better understand athletes' rationale for not enrolling. However, the majority of participants who enrolled completed the study and full homework compliance was high. This pattern suggests that participants who begin are likely to complete the intervention, perhaps indicating satisfaction with the program.

4.2 | Clinical implications

Findings have important clinical implications for interventions with MAs. First, it appears that certain ED risk factors (e.g., DM) may be more relevant to this population than others (e.g., appearance orientation). Regarding early intervention, sport professionals should pay close attention to athletes who discuss their attitudes and behaviors about muscularity and who prioritize this above other aspects of SP. Since DM often involves specific eating behaviors (e.g., consuming weight gain or protein shakes; McCreary & Sasse, 2000), it is beneficial for athletes to learn about nutrition and proper fueling to enhance SP. Sport professionals commonly provide guidance about eating behaviors, yet their general nutritional knowledge is often limited (Torres-McGehee et al., 2012). Therefore, athletic departments should employ or grant access to registered dieticians with sport-specific expertise.

It is possible that the intervention was not long enough to produce other hypothesized changes (Almeida et al., 2020), including appearance-focused components of BD. Although some BP programs include only two sessions (e.g., Almeida et al., 2020), others use four sessions (Stice, Rohde, Gau, & Shaw, 2009). Additionally, college women in the BP requested both a longer version of the program and follow-up booster meetings (Becker & Stice, 2017). Thus, athletes in the MABP may not only have benefitted from additional sessions, they may have desired it. Future research should investigate the optimal number of sessions for meaningful change in BD for MAs.

4.3 | Strengths and limitations

Study strengths include the randomized controlled design, high adherence to the treatment manual, stratification of intervention groups by weight- and nonweight-sensitive sports, inclusion of a follow-up time point to investigate stability of short-term intervention effects, and a high retention rate over the intervention and follow-up. Despite these strengths, several limitations must be acknowledged. First, assessment-only control groups cannot rule out alternative explanations for significant effects, such as expectancy effects. Thus, future research should utilize an attention-control placebo. Second, the sample was predominantly White (73%), limiting its generalizability to non-White athletes who may have culturally specific body ideals in addition to the sport and traditional body ideals of MAs. Third, as mentioned above, it is possible that the MBSRQ did not adequately capture BD in college MAs. Future research should consider incorporating assessments that examine stressors unique to sport, including: The Weight Pressures in Sport Scale for Male Athletes (Galli et al., 2014). Fourth, BMI was calculated using self-reported height and weight, so these numbers may not have been exact. Fifth, the current study utilized several measures, but did not statistically control for the number of measures given to athletes. Additionally, treatment acceptability ratings were not collected from the intervention group, limiting conclusions of study acceptability regarding the content, format, and structure of the intervention. Gaining participant feedback on these aspects of the MABP may provide valuable insights into the program. Finally, healthy eating behaviors (e.g., intuitive eating) as well as body acceptance were not measured. Including measures that assess adaptive eating (e.g., the Eating Competence Satter Inventory; Lohse, Satter, Horacek, Gebreselassie, & Oakland, 2007) and accepting body attitudes such as the Male Body Attitudes Scale (MBAS; Tylka, Bergeron, & Schwartz, 2005),are necessary to determine whether adaptive variables increase following the MABP.

5 | CONCLUSION

In summary, participation in the MABP resulted in adaptive effects on participants' BII, DM, and specific components of MD (MDI_Supplement Use) and BD (MBSRQ_BASS). If replicated in studies with longer-term follow-up, results highlight the efficacy of the MABP for reducing certain ED risk factors and increasing protective factors (e.g., satisfaction with body parts) in college MAs. The study results suggest that funding on prevention efforts was well-spent and that continued intervention and prevention studies may help to increase resources for ED prevention and decrease medical costs in the future. Overall, these results and suggested future directions may facilitate better understanding of the unique appearance-related concerns and associated risks in the sporting environment.

ACKNOWLEDGMENTS

Data collection was supported by the Association for Applied Sport Psychology Research Grant and two internal grants from the Illinois Institute of Technology Department of Psychology. We wish to thank Dr. Carolyn Becker, developer of the Female Athlete Body Project, for training us on the intervention and thus making the study possible.

CONFLICTS OF INTEREST

The authors declare no conflicts of interest.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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How to cite this article: Perelman, H., Schwartz, N., Yeoward-Dodson, J., Quiñones, I. C., Murray, M. F., Dougherty, E. N., Townsel, R., Arthur-Cameselle, J., & Haedt-Matt, A. A. (2022). Reducing eating disorder risk among male athletes: A randomized controlled trial investigating the male athlete body project. *International Journal of Eating Disorders*, 1–14. https://doi.org/10.1002/eat.23665