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ORIGINAL ARTICLE

Eating behavior and reasons for exercise among competitive collegiate male athletes

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Abstract

Purpose Research concerning eating disorders among adolescent and young adult male athletes is limited compared with female counterparts, but increasing evidence indicates that they may be at unique risk for unhealthy exercise and eating behavior. The current study aimed to characterize unhealthy exercise and eating behavior according to competitive athlete status, as well as per sport type.

Method Collegiate male athletes ($N=611$), each affiliated with one of the 10 National College Athletics Association (NCAA) Division I schools in the United States, completed an online survey, reporting on eating and extreme weight control behaviors, and reasons for exercise.

Results Competitive athletes endorsed increased driven exercise and exercising when sick. Baseball players, cyclists, and wrestlers emerged as the sports with the most players reporting elevated Eating Disorder Examination-Questionnaire scores in a clinical range, and basketball players reported the highest rates of binge eating. overall, baseball players, cyclists, rowers, and wrestlers appeared to demonstrate the greatest vulnerability for unhealthy eating and exercise behavior.

Conclusion Findings revealed differences between competitive and non-competitive male athletes. Among competitive athletes, results identified unique risk for unhealthy eating and exercise behavior across a variety of sport categories and support continued examination of these attitudes and behaviors in a nuanced manner.

Level II Evidence obtained from well-designed controlled trials without randomization.

Keywords Male athletes · Adolescent male · Eating disorders · Compulsive exercise · Competitive male athletes

This article is part of Topical Collection on Males and eating and weight disorders.

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Introduction

Eating disorders (EDs) are debilitating illnesses with significant impairment and high mortality rates [1]. Interest in the study of ED with sport and exercise has increased over the past three decades, but investigation of athletes has largely focused on female samples, leaving a comparative void in the literature in males [2]. However, national survey evidence indicates that males comprise approximately one in four presentations of bulimia nervosa and anorexia nervosa [3]. Studies specific to male athletes suggest unique risk for both leanness and muscularity concerns [5] which may increase vulnerability for ED [6]. Accordingly, recent meta-analysis of literature on ED in male athletes underscores the notion that males should be investigated separately according to specific sport environments [7].

Some research indicates elevated ED pathology among athletes compared to non-athletes [9, 10], whereas other studies do not show significant differences in ED scores between these groups [7, 8]. Equivocal findings can be partially explained by varying competition levels [11, 12], as elite status has been shown to increase ED risk in athletes as compared to the general population [9, 10] and to less competitive athletes [13]. Perhaps, as a result of sport-specific body dissatisfaction [15], consistent research evidence indicates that athletes participating in leanness-dependent sports (e.g., distance running) report elevated ED pathology as compared with non-leanness sport counterparts [9–11, 16]. Other work has determined increased ED risk among males who participate in weight class [11, 16–18] or aesthetic sports [5, 19, 20].

While competitive status and sport type indicate associations with pathology, discrepant findings suggest that a more nuanced conceptualization of male athlete ED is necessary. Some research posits that males might be less focused on a drive for thinness, and more in pursuit of leanness/muscularity [6, 21]. Accordingly, drive for leanness/muscularity might encourage driven exercise behavior. Unhealthy exercise activity is now recognized as a key component in the development and maintenance of ED pathology [22] is more common in athletes than in non-athletes [23], and increases with the level of sport competition [24, 25]. Male athletes may demonstrate a unique profile of ED pathology that includes the pivotal symptom of unhealthy exercise (e.g., [26]). For example, among male collegiate athletes, frequency of extreme weight control behaviors (EWCBs) was low, but exercise (37%) and fasting/dieting (14.2%) were primary and secondary means for controlling weight [27]. Other work among male collegiate athletes also found that exercise and dieting were the most commonly reported weight control practices [17]. Taken together, these findings suggest that ED screening among competitive male athletes ought to include assessment of behavior and attitudes related to exercise, specific to sport type.

Current study

With secondary data analysis, the current study aimed to identify possible differences in binge eating, EWCBs (i.e., purging, diet pill, diuretic, or laxative use), and exercise behavior in competitive vs. non-competitive male collegiate athletes. This study was also uniquely able to explore differences in eating and exercise behavior per sport type, over a broad range of sports. Based upon prior work [9, 10], it was hypothesized that binge eating, EWCBs, and unhealthy exercise behaviors would be elevated among competitive athletes, as compared with non-competitive counterparts. Given the nascent evidence to date on nuanced behaviors by sport type, secondary hypotheses remained exploratory.

Method

Participants and procedure

A detailed description of the sample and recruitment is included in prior reports (c.f., [28–30]). Briefly, male participants ($N = 612$), aged 18–26 years, were affiliated with one of the 10 top-ranked National College Athletics Association (NCAA) schools in the United States. Participants were recruited via a social networking website and invited to provide consent and complete an online survey examining athletic participation, eating, and exercise behaviors. This study was conducted in compliance with the Stanford University Panel on Medical Research in Human Subjects and the NCAA.

Measures

Demographics. Participants reported basic information (e.g., age and ethnicity), and self-identified athletic status (competitive vs. non-competitive) and sport-specific participation.

Eating disorder examination questionnaire (EDE-Q; [31]). A 28-item self-report questionnaire, the EDE-Q assesses disordered eating attitudes and behaviors over the previous 28 days. The measure provides a global score and four subscale scores: restraint, eating concern, shape concern, and weight concern. The EDE-Q has demonstrated excellent validity, reliability, and correlations with other ED measures (see [32] for review). Males were scored within a clinical range if they responded with scores > 85th percentile of male university student norms [4]. Participants also answered questions from Project EAT, a population-based study of eating patterns and weight concerns

among adolescents [33]. These questions and items from the EDE-Q were used to determine engagement in binge eating, or EWCBs (i.e., purging, diet pill, diuretic, or laxative use) in the past month, or ever.

Exercise behavior. The EDE-Q has a single item corresponding to driven exercise (item 18: "Over the past 28 days, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape or amount of fat or to burn off calories?"). This item was used as a categorical variable (individuals who endorsed this item for at least 1 day) along with 5 other single-item questions that queried the function of exercise behavior: (1) In general, do you feel driven or compelled to exercise? (driven/compelled) (2) In general, do you feel guilty when you don't exercise? (guilty) (3) In general, do you choose to exercise even when you are sick? (when sick) (4) In general, do you ever exercise in secret, or not want people to know you have exercised? (secret) (5) In general, do you exercise to improve your mood? (improve mood).

Analytic plan

Athletes identified their first priority sport; those competing in more than one sport in the past year ($n = 42$) were included in calculations for each sport. Sport types were included in analyses if the category represented > 5 athletes, resulting in a total of 19 sports categories. Three main sets of analyses were conducted. First, the proportion of individuals reporting binge eating, EWCBs, and exercise behavior questions was calculated per athlete status (competitive vs. non-competitive); Bivariate correlations evaluated associations between athlete status and behaviors, and Pearson's Chi-square tests evaluated between-group differences. Multivariate regression analyses examined relations between athlete status and specific exercise behaviors, adjusting for age and body mass index. Second, EDE-Q global and subscale score means were calculated according to sport type. The proportion of individuals who reported binge eating, each of the EWCBs and exercise behavior questions was also calculated per sport type. For EDE-Q subscale and global scores, determinations were made regarding whether the mean for each sport category fell within a clinical range. Third, to identify between-group differences between members of each sport category and the broader competitive athlete sample (i.e., all other competitive athletes, combined), Mann–Whitney *U* and Chi-squared testing was used to evaluate differences in EDE-Q global and subscale scores, EWCBs, and exercise behavior questions. Significance was defined by $p < .05$ and SPSS v.25 was used for all analyses.

Results

Descriptive statistics

Participants were aged18–26 ($M = 20.99$) years, reporting the following ethnicity: White (77.6%), Asian (9.0%), Hispanic/Latino (5.1%), Black/African-American (4.7%), Other (3.5%), American Indian/Alaskan native (.3%), and not reporting (.3%). Of the entire sample, 429 (70.1%) were competitive athletes (i.e., participating in competitive sports currently or in the past year). The comparison group ($n = 183$; 30.0%) had not engaged in competitive athletics for at least 1 year, but engaged in regular recreational exercise. Competitive athletes participating in each sport type were as follows: swimming (55; 12.8%); rugby (38; 8.9%); rowing/crew (35; 8.2%); lacrosse (32; 7.5%); football (32; 7.5%); ultimate frisbee (31; 7.3%); soccer (24; 5.6%); cycling (24; 5.6%); wrestling (21; 4.9%); ice hockey (20; 4.7%); triathlon (18; 4.2%); basketball (16; 3.8%); running/cross country/track/field (22; 5.2%); volleyball (14; 3.3%); fencing (13; 3.1%); gymnastics (12; 2.8%); cheerleading (10; 2.4%); baseball (8; 1.9%); and water polo (8; 1.9%).

Table 1 Eating pathology and exercise behavior per athlete status

	Competitive athlete ($n = 429$) % (n)	Non-competitive athlete ($n = 183$) % (n)	X^2	p
Eating behaviors				
Binge eating last month	27 (113)	35 (54)	.84	.36
EWCBs last month	3 (12)	4 (7)	.49	.48
EWCBs ever	6 (26)	7 (12)	.06	.80
Exercise behavior				
Driven/compelled	80 (343)	73 (133)	3.51	.06
Guilty	64 (273)	67 (122)	.65	.42
When sick	43 (185)	31 (56)	8.17	.004
Secret	8 (35)	10 (18)	.48	.49
Improve mood	68 (291)	64 (116)	.96	.34
EDE-Q item 18	20 (81)	26 (46)	3.29	.07

EWCB extreme weight control behavior (i.e., purging, diet pill, diuretic, or laxative use), Eating Disorder Examination–Questionnaire (EDE-Q) item 18: "Over the past 28 days, how many times have you exercised in a 'driven' or 'compulsive' way as a means of controlling your weight, shape or amount of fat or to burn off calories?"

Primary analyses

Per athlete status (competitive vs. non-competitive)

Binge eating and EWCBs did not differ by athlete status (Table 1). Competitive athletes were significantly more likely to endorse exercising When Sick (43 vs. 31%, $p = .004$) as compared with non-competitive counterparts. Bivariate correlations between athlete competitive status and exercise variables were significant for exercising when sick ($r = .12$, $p < .05$); no other exercise behaviors demonstrated significant differences between, or correlations with athlete status (Online Appendix A). Using Pillai's Trace, results of MANCOVA analyses indicated a significant effect of athlete status (competitive vs. non-competitive) on reported engagement in exercise behaviors, $V = .04$, $F\ (6, 569) = 3.86$, $p = .001$, $\eta p2 = .04$ when adjusting for age and body mass index. Specifically, after accounting for covariate effects, there was a significant effect of athlete status on driven/compelled exercise $p = .01$, $\eta p2 = .01$, and exercise when sick, $p = .005$, partial $\eta p2 = .01$ (Online Appendix B).

Per sport type

Results for the second set of analyses are shown in Table 2. Baseball demonstrated the highest EDE-Q global scores ($M = 1.46$), followed by cycling ($M = 1.09$) and wrestling ($M = 1.00$). Baseball had the highest restraint subscale scores ($M = 1.95$), followed by wrestling ($M = 1.88$) and cycling ($M = 1.49$). Baseball had the highest weight concern subscale scores ($M = 1.78$), followed by triathlon ($M = 1.10$) and cycling ($M = 1.08$). Baseball demonstrated the highest shape concern subscale scores ($M = 1.58$), followed by Triathlon ($M = 1.42$). Eating concern subscale scores were comparatively low across all sport categories.

Figure 1 illustrates clinical ranges of EDE-Q scores by sport. As per the a priori clinical cutoff, 25% ($n = 2$) of baseball players reported clinical global scores; no other sport demonstrated clinical overall eating pathology in > 20% of athletes in a given category. Thirty-eight percent ($n = 3$) of baseball players, and 24% ($n = 5$) of wrestlers reported clinical restraint, and 20% ($n = 2$) of cheerleaders demonstrated clinical weight concern. Rates of binge eating in the last month were highest among basketball players (50%), followed by football (39%) and running/cross country/track/field (38%) and baseball (38%). Rates of EWCBs in the last month were relatively low, and cheerleaders demonstrated the highest rates of ever engaging in EWCBs (20%).

The driven/compelled exercise item was endorsed by at least 57% of members of each sport category, except for baseball, for which none of them reported this behavior. Cyclists demonstrated the greatest guilt when not exercising (92%), followed by running/cross country/track/field (77%). The categories most likely to report exercise when sick were rowing (66%), and cycling (63%). Gymnasts were the most likely to report secret exercise (50%), followed by rowing (23%). All sport categories reported exercising to improve mood in > 50% of participants. Wrestlers were most likely to endorse driven exercise to influence weight or shape (i.e., EDE-Q item 18) (57%). Of note, all categories endorsed driven/compelled exercise more frequently than the more specific-driven exercise to influence weight or shape, except baseball, with 25% endorsing EDE-Q item 18, but not endorsing driven/compelled exercise in a broader fashion at all.

Comparing sport type to the broader competitive athlete sample

Between-group differences in EDE-Q global and subscale scores between members of each sport category and the broader competitive athlete sample were demonstrated for 7 categories (Table 2): baseball (global: $p = .02$; weight concern: $p < .01$), cycling (global: $p = .02$; restraint: $p = .02$; eating concern: $p = .03$), lacrosse (global: $p < .01$; restraint: $p < .01$; weight concern $p = .01$), rowing (global: $p = .02$), swimming (shape concern: $p = .02$); ultimate frisbee (restraint: $p < .01$); and wrestling (global: $p = .04$; Restraint: $p < .001$; eating concern: $p < .001$). For baseball, cycling, rowing, and wrestling, scores were elevated as compared to the broader athlete sample, whereas for lacrosse, swimming, and ultimate frisbee, athlete reported lower scores than the broader sample.

Significant differences in EWCBs between sport category and the broader athlete sample were demonstrated in four categories: Basketball (binge eating: $p = .02$), rowing (ever EWCB: $p = .03$), running/cross country/track/field (EWCB in the last month: $p < .001$) and ultimate frisbee (binge eating: $p = .01$); with the exception of ultimate frisbee, all scores within sport category were comparatively elevated.

The only sport significantly more likely to endorse driven/compelled exercise than the broader competitive athlete sample was volleyball ($p = .03$); only wrestlers were more likely to endorse driven exercise for thepurpose of weight or shape more than other athletes ($p < .001$). Cyclists were more likely to feel guilty if they did not exercise ($p < .01$) and exercise to improve mood ($p = .03$), while cyclists ($p < .05$), rowers ($p < .01$), and swimmers ($p = .03$) were all more likely than other competitive athletes to exercise when sick. Rowers ($p < .01$) and gymnasts ($p < .001$) were more likely to endorse secret exercise than other competitive athletes.

Discussion

This study examined reported eating pathology and exercise behavior in a large sample of collegiate males, many of whom were currently (i.e., within the past year)

Table 2 Eating pathology and exercise behavior per sport type

Sport type (n)	Swim (55)	Rug (38)	Row (35)	La X (32)	Foot (32)	UF (31)	Soc (24)	Cyc (24)	Track/ CC (22)	Wres (21)	Hock (20)	Tri (18)	Bask (16)	Voll (14)	Fence (13)	Gym (12)	Cheer (10)	Base (8)	WP (8)
Eating pathology *M* (*SD*)																			
EDE-Q Global	.60 (.69)	.76 (.69)	**.97* (.79)**	.42† (.45)	.82 (.69)	.51 (.51)	.56 (.94)	**1.09* (.92)**	.76 (.90)	**1.00* (.71)**	.70 (.71)	.85 (1.00)	.63 (.76)	.74 (1.21)	.77 (.72)	.64 (1.17)	.77 (.71)	**1.46* (1.10)**	.46 (.65)
Restraint	1.01 (1.32)	.91 (.96)	1.35 (1.23)	.48† (.79)	1.08 (1.09)	.42† (.77)	.72 (.98)	**1.49* (1.22)**	1.24 (1.40)	**1.88* (1.18)**	.88 (.91)	1.00 (1.35)	.63 (.83)	.66 (1.06)	.97 (1.19)	.73 (1.32)	.64 (.61)	1.95 (1.60)	.60 (1.00)
Eating concern	.14 (.45)	.25 (.65)	.30 (.67)	.06 (.14)	.19 (.35)	.08 (.15)	.24 (.85)	**.54* (.98)**	.23 (.44)	**.47* (.50)**	.28 (.42)	.23 (.43)	.28 (.37)	.39 (1.04)	.26 (.67)	.38 (1.08)	.20 (.33)	.55 (.85)	.17 (.45)
Weight concern	.56 (.80)	.86 (1.13)	.96 (1.09)	.37† (.51)	.81 (.89)	.54 (.59)	.52 (1.14)	1.08 (1.05)	.67 (.98)	.85 (.81)	.58 (.87)	1.10 (1.27)	.64 (.87)	.84 (1.44)	.68 (.69)	.55 (1.10)	1.02 (1.32)	**1.78* (1.32)**	.40 (.66)
Shape concern	.75† (.89)	1.32 (1.36)	1.28 (1.11)	.76 (.81)	1.19 (1.11)	1.01 (.94)	.78 (1.24)	1.25 (1.11)	.92 (1.13)	.96 (.83)	1.00 (1.09)	1.42 (1.54)	1.03 (1.21)	1.08 (1.53)	1.18 (1.07)	.89 (1.38)	1.20 (1.16)	1.58(1.07)	.70 (.77)
Eating behavior % (*n*)																			
Binge eating, last month	29 (15)	27 (10)	30 (10)	20 (6)	39 (12)	7† (2)	22 (5)	33 (8)	38 (8)	24 (5)	20 (4)	22 (4)	**50* (8)**	21 (3)	31 (4)	17 (2)	30 (3)	38 (3)	14 (1)
EWCBs, last month	4 (2)	0 (0)	6 (2)	0 (0)	0 (0)	3 (1)	0 (0)	0 (0)	**14* (3)**	5 (1)	0 (0)	6 (1)	6 (1)	0 (0)	0 (0)	8 (1)	10 (1)	0 (0)	0 (0)
EWCBs, ever	4 (2)	8 (3)	**14* (5)**	0 (0)	0 (0)	7 (2)	4 (1)	4 (1)	14 (3)	10 (2)	0 (0)	11 (2)	6 (1)	0 (0)	0 (0)	8 (1)	20 (2)	13 (1)	0 (0)
Exercise behavior % (*n*)																			
Driven/ compelled	80 (44)	79 (30)	77 (27)	81 (26)	88 (28)	77 (24)	75 (18)	88 (21)	82 (18)	91 (19)	90 (18)	83 (15)	81 (13)	**57* (8)**	62 (8)	92 (11)	90 (9)	0 (0)	88 (7)
Guilty	56 (31)	76 (29)	66 (23)	47† (15)	63 (20)	68 (21)	58 (14)	**92* (22)**	77 (17)	67 (14)	65 (13)	72 (13)	56 (9)	50 (7)	69 (9)	58 (7)	40 (4)	75 (6)	50 (4)
When sick	**56* (31)**	37 (14)	**66* (23)**	41 (13)	56 (18)	**23† (7)**	29 (7)	**63* (15)**	55 (12)	48 (10)	30 (6)	61 (11)	50 (8)	36 (5)	15† (2)	58 (7)	10† (1)	38 (3)	50 (4)
Secret	2 (1)	3 (1)	**23* (8)**	3 (1)	13 (4)	10 (3)	4 (1)	8 (2)	9 (2)	10 (2)	0 (0)	0 (0)	13 (2)	0 (0)	8 (1)	**50* (6)**	10 (1)	13 (1)	0 (0)
Improve mood	66 (36)	71 (27)	77 (27)	75 (24)	50† (16)	61 (19)	71 (17)	**88* (21)**	77 (17)	57 (12)	65 (13)	83 (15)	69 (11)	71 (10)	54 (7)	75 (9)	50 (5)	88 (7)	63 (5)
EDE-Q item 18	15 (8)	8 (3)	23 (8)	17 (5)	32 (10)	7 (2)	22 (5)	21 (5)	5 (1)	**57* (12)**	20 (4)	17 (3)	38 (6)	14 (2)	15 (2)	8 (1)	40 (4)	25 (2)	0 (0)

Bold with asterisk* represent scores that are significantly elevated in sport category vs. the broader competitive athlete sample; Bold with cross† represent scores that are significantly lower in sport category vs. the broader competitive athlete sample

EDE-Q Eating disorder examination–questionnaire; items in italics represent EDE-Q subscale, *EWCB* extreme weight control behavior (i.e., purging, diet pill, diuretic, or laxative use), *Rug* rugby, *LaX* lacrosse, *Foot* football, *UF* ultimate frisbee, *Soc* soccer, *Cyc* cycling, *Track/CC* running/cross country/track/field, *Hock* hockey, *Tri* triathlon, *Bask* basketball, *Voll* volleyball, *Gym* gymnastics, *Base* baseball, *WP* water polo

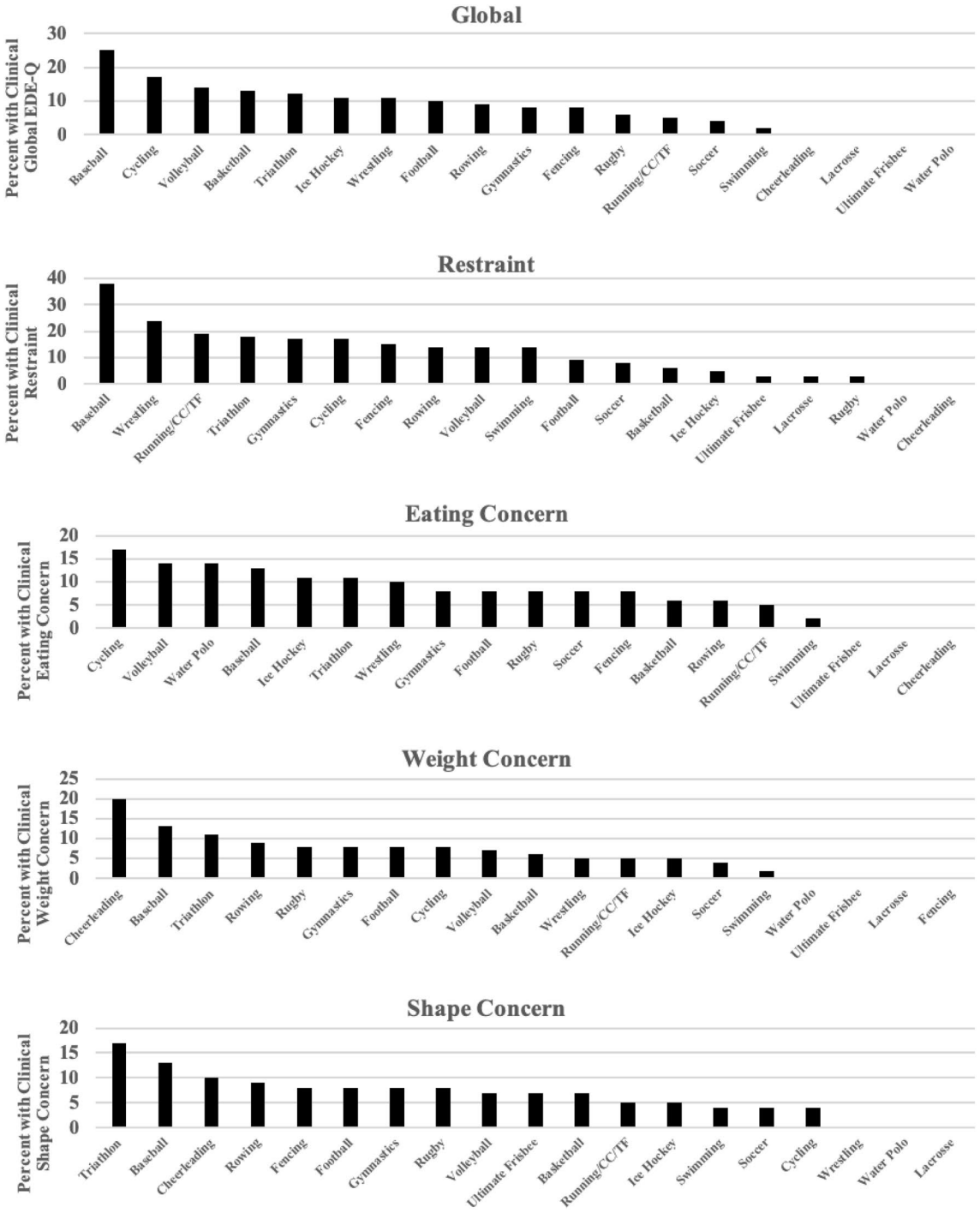

Fig. 1 Percent of athletes with clinical range of EDE-Q global and subscale scores. *EDE-Q* Eating Disorders Examination–Questionnaire, Clinical range refers to > 85th percentile of undergraduate male norms

participating in competitive athletics. Given a wide variety in athletic participation, this study was also uniquely able to examine sport-specific eating and exercise behavior among male athletes, over a broad range of sports. Competitive athletes did not demonstrate differences in binge eating or EWCBs; however, these athletes were more likely to endorse engagement in exercising when sick.

Baseball players, along with cyclists and wrestlers, emerged as the sports with the most players reporting EDE-Q scores in a clinical range and comparing to the

broader athlete sample, these athletes along with rowers demonstrated significantly elevated EDE-Q global scores. Basketball players reported the highest rates of binge eating in the past 28 days, and demonstrated significant differences in elevated binge eating as compared with the broader athlete sample. While rates of EWCBs were low overall, runners/cross country/track field participants reported significantly more EWCBs in the last month, and rowers reported significantly more EWCBs ever. Wrestlers were the only athletes who were significantly more likely to endorse driven exercise to influence weight or shape than the broader athlete sample, and gymnasts and rowers were significantly more likely to report exercising in secret.

A unique feature of the current study was the ability to assess eating and exercise across a wide variety of sport types. Prior work has grouped sports by body type (i.e., weight class) and other qualifiers (i.e., endurance sports) within analyses, while these approaches were ostensibly hypothesis driven, evaluation of eating and exercise pathology in a more nuanced manner by sport is critical to fully understanding for whom ED risk may be elevated among the larger subgroup of collegiate male athletes, before accurately positing possible groupings. Underscoring this premise, findings in the current study identified the highest eating pathology among baseball players, with significantly greater global and weight concern scores than the broader athlete sample. In the current study, the motivation for driven exercise was notable among baseball players, where none of these players endorsed the general driven exercise item, but 25% endorsed EDE-Q item 18 (i.e., driven exercise to influence weight/shape).

This profile of risky behaviors identified in baseball players reflects complexity in the constellation of disordered and exercise behaviors reported across the entire sample, where some distinct patterns emerged. In one such pattern, wrestlers demonstrated significant and clinical levels of restraint; these athletes also endorsed significant global eating pathology, and eating concern as compared with the broader athlete sample. Wrestlers reported the highest percentage of driven exercise intended to influence weight and shape (57%) which was significant as compared with the broader athlete sample, a considerable number of individuals who felt guilty when not exercising (67%), and 10% who endorsed ever engaging in EWCBs. Taken together, these findings support prior evidence of wrestling constituting a higher risk sport [14].

A second pattern emerged among cyclists, for whom global eating pathology was significantly greater than other competitive athletes, and 17% reported EDE-Q global scores within a clinical range. Cyclists also reported significant levels of restraint and eating concern, 33% endorsed binge eating in the last month, 88% endorsed driven exercise, 92% felt guilty when not exercising (significant within the broader sample), and a significant number of individuals (63%) would exercise when sick. This combination of binge eating with excessive exercise suggests that these individuals may be at higher ED risk.

Exercising in secret was most endorsed among gymnasts (50%), and was significant among both these athletes and rowers, compared with the broader athlete sample. While gymnasts endorsed elevated rates of unhealthy exercise behavior, their eating pathology scores, EWCBs, and all exercise questions (aside from secret exercise) remained non-significant as compared with other athletes. Intuitively, secret exercise is maladaptive, but not typically represented in standard ED assessments; future work might identify the sensitivity of this question in indicating increased risk. Finally, a higher incidence of binge eating appeared among athletes, where larger body size is expected and/or required (e.g., basketball, football), underscoring a recommendation for including larger body-type sports among those who may benefit from increased ED screening.

Considering all eating behavior and reasons for exercise, certain categories demonstrated increased proportions of athletes with clinical eating pathology, increased binge eating or EWCBs, and less healthy reasons for exercise. Summarily, it appears that the categories most at risk for overall eating pathology based on the EDE-Q are baseball, cycling, rowing, and wrestling. Considering additional reported EWCBs and reasons for exercise, cyclists, rowers, and wrestlers remain the categories with the most combined risk for eating and unhealthy exercise behavior.

Limitations and future directions

There are several limitations to note. First, as each sport category was limited to representation by > 5 athletes, this study did not include certain sports that may have increased ED risk based on required body type, such as diving ($n = 3$), and equestrian ($n = 3$). Findings should also be interpreted with caution, as they may also be considerably underpowered for the sports with small sample sizes ($n = 8$). Furthermore, 42 individuals participated in a secondary competitive sport, but it is possible that participation in one sport led to sport-specific body dissatisfaction differing from the body ideal of a secondary sport; future work may investigate these individuals separately. These analyses were secondary, and cross-sectional; therefore, findings cannot comment on the temporality of the development of these eating and exercise behaviors. Finally, measures were self-reported, which may reveal less information than if participants were queried in a clinical interview. Despite these limitations, the current study provides a unique opportunity to evaluate sport-specific risk for ED and exercise pathology among potentially vulnerable competitive collegiate male athletes.

Conclusions

This study demonstrated differences in reasons for exercise between competitive and non-competitive male collegiate athletes; competitive athletes were more likely to exercise when driven/compelled, or sick. No differences in EWCBs were found between groups. Findings revealed overall greatest ED and exercise symptomatology among baseball players, cyclists, wrestlers, and rowers. Results support continued examination of these attitudes and behaviors in a nuanced manner, as findings demonstrated notable differences between sport categories.

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Compliance with ethical standards

Conflicts of interest All authors have no conflicts of interest to report.

Ethical approval All procedures in the current study were in accordance with the ethical standards of the institutional research committee (Stanford University Panel on Medical Research in Human Subjects, #9465) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Schaumberg K, Welch E, Breithaupt L, Hübel C, Baker JH, Munn-Chernoff MA, Yilmaz Z, Ehrlich S, Mustelin L, Ghaderi A, Hardaway AJ (2017) The science behind the Academy for Eating Disorders' nine truths about eating disorders. Eur Eat Disord Rev. 25(6):432–450
2. Baum A (2006) Eating disorders in the male athlete. Sports Med 36(1):1–6
3. Hudson JI, Hiripi E, Pope HG Jr, Kessler RC (2007) The prevalence and correlates of eating disorders in the National Comorbidity Survey Replication. Biol Psychiat 61(3):348–358
4. Lavender JM, De Young KP, Anderson DA (2010) Eating disorder examination questionnaire (EDE-Q): norms for undergraduate men. Eat Behav 11(2):119–121
5. Galli N, Petrie TA, Reel JJ, Chatterton JM, Baghurst TM (2014) Assessing the validity of the weight pressures in sport scale for male athletes. Psychol Men Masculin. 15(2):170
6. Murray SB, Griffiths S, Mond JM (2016) Evolving eating disorder psychopathology: conceptualising muscularity-oriented disordered eating. Brit J Psychiat. 208(5):414–415
7. Chapman J, Woodman T (2016) Disordered eating in male athletes: a meta-analysis. J Sport Sci. 34(2):101–109
8. Martinsen M, Bratland-Sanda S, Eriksson AK, Sundgot-Borgen J (2010) Dieting to win or to be thin? A study of dieting and disordered eating among adolescent elite athletes and non-athlete controls. Brit J Sports Med. 44(1):70–76
9. Byrne S, McLean N (2002) Elite athletes: effects of the pressure to be thin. J Sci Med Sport. 5(2):80–94
10. Sundgot-Borgen J, Torstveit MK (2004) Prevalence of eating disorders in elite athletes is higher than in the general population. Clin J Sport Med 14(1):25–32
11. Bratland-Sanda S, Sundgot-Borgen J (2013) Eating disorders in athletes: overview of prevalence, risk factors and recommendations for prevention and treatment. Eur J Sport Sci. 13(5):499–508
12. Byrne S, McLean N (2001) Eating disorders in athletes: a review of the literature. J Sci Med Sport. 4(2):145–159
13. Youngman J, Simpson D (2014) Risk for exercise addiction: a comparison of triathletes training for sprint-, Olympic-, half-ironman-, and ironman-distance triathlons. J Clin Sport Psychol. 8(1):19–37
14. Kiningham RB, Gorenflo DW (2001) Weight loss methods of high school wrestlers. Med Sci Sports Exerc 33(5):810–813
15. Krentz EM, Warschburger P (2011) Sports-related correlates of disordered eating in aesthetic sports. Psychol Sport Exerc 12(4):375–382
16. Schaal K, Tafflet M, Nassif H, Thibault V, Pichard C, Alcotte M, Guillet T, El Helou N, Berthelot G, Simon S, Toussaint JF (2011) Psychological balance in high level athletes: gender-based differences and sport-specific patterns. PLoS One 6(5):e19007
17. Chatterton JM, Petrie TA (2013) Prevalence of disordered eating and pathogenic weight control behaviors among male collegiate athletes. Eat Disord. 21(4):328–341
18. Thiel A, Gottfried H, Hesse FW (1993) Subclinical eating disorders in male athletes: a study of the low weight category in rowers and wrestlers. Acta Psychiat Scand. 88(4):259–265
19. Sundgot-Borgen J, Garthe I (2011) Elite athletes in aesthetic and Olympic weight-class sports and the challenge of body weight and body compositions. J Sports Sci 29(sup1):S101–S114
20. Voelker DK, Petrie TA, Reel JJ, Gould D (2018) Frequency and psychosocial correlates of eating disorder symptomatology in male figure skaters. J App Sport Psychol. 30(1):119–126
21. Lavender JM, Brown TA, Murray SB (2017) Men, muscles, and eating disorders: an overview of traditional and muscularity-oriented disordered eating. Curr Psychiat Report. 19(6):32
22. Hechler T, Beumont P, Marks P, Touyz S (2005) How do clinical specialists understand the role of physical activity in eating disorders? Eur Eat Disord Rev. 13(2):125–132
23. Costa S, Hausenblas HA, Oliva P, Cuzzocrea F, Larcan R (2015) Perceived parental psychological control and exercise dependence symptoms in competitive athletes. Int J Ment Health Addict. 13(1):59–72
24. De La Vega R, Parastatidou IS, Ruiz-Barquin R, Szabo A (2016) Exercise addiction in athletes and leisure exercisers: the moderating role of passion. J Behav Addict. 5(2):325–331
25. Szabo A, De La Vega R, Ruiz-Barquín R, Rivera O (2013) Exercise addiction in Spanish athletes: investigation of the roles of gender, social context and level of involvement. J Behav Addict. 2(4):249–252
26. Torstveit MK, Fahrenholtz IL, Lichtenstein MB, Stenqvist TB, Melin AK (2019) Exercise dependence, eating disorder symptoms

and biomarkers of relative energy deficiency in sports (RED-S) among male endurance athletes. BMJ Open Sport Exerc Med. 5(1):e000439
27. Petrie TA, Greenleaf C, Reel J, Carter J (2008) Prevalence of eating disorders and disordered eating behaviors among male collegiate athletes. Psychol Men Masculin. 9(4):267
28. Darcy AM, Doyle AC, Lock J, Peebles R, Doyle P, Le Grange D (2012) The eating disorders examination in adolescent males with anorexia nervosa: how does it compare to adolescent females? Int J Eat Disord 45(1):110–114
29. Darcy AM, Hardy KK, Lock J, Hill KB, Peebles R (2013) The eating disorder examination questionnaire (EDE-Q) among university men and women at different levels of athleticism. Eat Behav 14(3):378–381
30. Runfola CD, Allison KC, Hardy KK, Lock J, Peebles R (2014) Prevalence and clinical significance of night eating syndrome in university students. J Adolescent Health. 55(1):41–48
31. Fairburn CG (2008) Cognitive behavior therapy and eating disorders, vol 21. Guilford Press, New York, pp 309–314
32. Berg KC, Peterson CB, Frazier P, Crow SJ (2012) Psychometric evaluation of the eating disorder examination and eating disorder examination-questionnaire: a systematic review of the literature. Int J Eat Disord 45(3):428–438
33. Neumark-Sztainer D, Wall M, Guo J, Story M, Haines J, Eisenberg M (2006) Obesity, disordered eating, and eating disorders in a longitudinal study of adolescents: how do dieters fare 5 years later? J Amer Dietetic Assoc. 106(4):559–568