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Disordered eating in male athletes: A meta-analysis

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Abstract

We examined the propensity for male athletes to exhibit symptoms of disordered eating. Using meta-analytic techniques, we examined overall effect size, individual effect sizes for specific sport types, standard of athletic competition, and diagnostic tools from 31 studies. When all studies were considered as a homogeneous group, male athletes did not have symptoms of disordered eating that were significantly different from non-athletic controls. However, significant moderator effects emerged for sport type and measurement: (a) wrestling reported a greater incidence of disordered eating; and (b) studies that reported data from the Eating Attitudes Test yielded a significantly greater incidence of disordered eating in male athletes compared to non-athletes. Although some sports seem to present a higher risk of disordered eating compared to others, the effects are weak and heterogeneous. We make suggestions for the development of the research area, which has been severely hampered by the diagnostic tools that have been available for the study of men.

Disordered eating in male athletes: A meta-analysis

It has been suggested that athletes, especially those involved in sports that emphasise lean body mass and shape, may be at higher risk of experiencing disordered eating than people from the general population (Sundgot-Borgen & Torstveit, 2004). Although some male athletes (e.g. from mass-dependent sports such as wrestling) are thought to be at some risk (e.g. Sundgot-Borgen & Torstveit, 2004), the vast majority of disordered eating research has been conducted with women (e.g. Anshel, 2004; Pollock et al. 2010; Smolak, Murnen, & Ruble, 2000), which has resulted in a paucity of male-specific literature. The aim of this paper is to synthesise the research in disordered eating in male athletes with a view to establishing some priorities for future research.

An eating disorder is defined by behavioural eating symptoms (e.g. binge eating, dieting), psychological symptoms (e.g. body image concerns), and physical symptoms (e.g. weight loss), which can be clinical (e.g. anorexia nervosa, bulimia nervosa) or subclinical (American Psychiatric Association, 2013). Symptoms associated with eating disorders, such as episodes of binge eating or extreme dieting, are considered subclinical when the behaviours are present but insufficiently frequent or severe to be deemed clinical (Anderson & Petrie, 2012; Petrie, Greenleaf, Carter & Reel, 2007). Individuals who display such symptomatic sub-clinical behaviours are said to exhibit *disordered eating* behaviours. Disordered eating behaviours are considered clear risk factors for developing a clinical eating disorder when the behaviour is continued (Kotler, Cohen, Davies, Pine & Walsh; 2001).

Although disordered eating has traditionally been associated with women (Striegel-Moore & Bulik, 2007), research attention has recently begun to focus on men. In their review of disordered eating in athletes, Byrne and McLean (2001) proposed two arguments for why male athletes might be more at risk than non-athletes. First, in addition to the general demands of Western society to be lean, athletes may be under sport-specific pressure to conform to a certain body type. For example, for sports such as gymnastics, lean and muscular bodies are typically seen as an advantage. Second, patients diagnosed with an eating disorder often demonstrate similar characteristics to those that have been observed in high-level athletes. Specifically, perfectionism and the need for high achievement are found in both eating disorder patients (Bardone-Cone, Abramson, Vohs, Heatherton, & Joiner, 2006) and in athletes (Haase, 2011).

Research examining disordered eating in athletes has been equivocal (Hausenblas & McNally, 2004), with considerable ambiguity regarding male athletes. The largest study to date in an elite male sample revealed that Norwegian athletes (*n* = 687) reported more clinical and subclinical eating disorders (8%) than a matched control group (*n* = 629; 0.5%). In the same study, anti-gravitation (e.g. high jump, long jump, triple jump) and “weight” class sport (e.g. combat sports) athletes were at the highest risk, with 22% and 18% reporting a clinical disorder, respectively (Sundgot-Borgen & Torstveit, 2004). There are, however, a number of studies that have reported no significant differences between male athletes and controls (e.g. Martinsen, Bratland-Sanda, Eriksson & Sundgot-Borgen, 2010). Other research has even revealed that male athletes display behaviours that reflect lower levels of disordered eating than their non-athletic counterparts. For example, Croll et al. (2006) reported that male adolescent power sport athletes had a more balanced and nutritious diet than non-athletes. Equally, Fogelholm and Hiilloskorpi (1999) reported that male athletes did not want to lose body mass, as a loss of mass was considered a loss of strength, which suggests that the motivation and behaviours of male athletes might somewhat protect them from developing disordered eating.

Due to the equivocal nature of disordered eating prevalence findings, Hausenblas and McNally (2004) suggested a number of variables that might moderate the relationship between athletes and disordered eating, three of which are directly relevant to the present analysis. The first potential moderator is the competitive standard of the athletic group. In a female sample it was shown that an increase in competitive standard leads athletes to encounter more intense training and greater pressure to maintain a specific body mass, which might lead to a greater likelihood of disordered eating behaviours in athletes who operate at an elite standard (Sundgot-Borgen, 1994). Conversely, disordered eating may in fact be less likely in elite samples. Indeed, Darcy, Hardy, Lock, Hill, and Peebles (2013) found that male recreational collegiate athletes reported higher disordered eating than those competing at higher competitive standards.

Second, sport type has frequently been shown to be the strongest moderator of the relationship between male athletes and disordered eating. Indeed, many studies have reported that athletes competing in sports associated with “leanness” (e.g. anti-gravitation sports such as high-jumping) are most at risk (Hausenblas & Carron, 1999; Sundgot-Borgen & Torstveit, 2004). The final potential moderator relevant to the current paper is the measurement tool that is used to assess eating behaviour (Hausenblas & McNally, 2004). The two measures that are most commonly used are the Eating Attitudes Test (EAT; Garner et al., 1982) and the Eating Disorder Inventory (EDI; Garner, 1991). Although both measures assess symptoms of disordered eating, there are differences between the sub-scales of each measure. These differences relate to how males are thought to experience disordered eating and could help to explain the equivocal findings in the literature. For example, Stanford and Lemberg (2012a) argued that men’s body-related motives are driven more by a preoccupation to increase leanness and muscularity than a desire to lose body mass (which appears associated more with the female motive), and are thus more likely to regulate shape (rather than mass) through excessive exercise and diet. Neither excessive exercise nor body shape are considered in the aforementioned diagnostic tools, which were developed using female samples. However, given that *food preoccupation* and *dieting behaviour* are categories that are assessed within the EAT, the EAT may be a somewhat more sensitive measure of men's eating behaviours.

The purpose of this paper is to apply meta-analytic procedures to investigate whether male athletes are more at risk of disordered eating relative to male controls, and whether there are moderators that might explain some of the inconsistent findings in the literature. We seek to explore three potential moderators: sport type, competitive standard, and measurement tool. Due to the (theoretically and empirically) equivocal research to date, we hypothesise that male athletes – when considered as a single homogenous group – will report levels of disordered eating that are comparable to those of controls. Conversely, we hypothesise that athletes who participate in sports that promote lean body mass and shape will report higher levels of disordered eating. Given the equivocal research on elite athletes, we do not formulate a specific hypothesis regarding competitive standard. Finally, we hypothesise that the global score on the EAT will demonstrate a disordered eating discriminatory capacity that is greater than that of other diagnostic measures because it contains categories that are likely more specific to men's disordered eating (e.g. *food preoccupation*) than other diagnostic subscales (e.g. EDI: *drive for thinness*).

Method

Studies included in the meta-analysis

A study was included in the meta-analysis if: a) it had a group of male athletes and a control group of male non-athletes; and b) the results included means and standard deviations, *F* values, *t* values, *r* values, or percentages for the relevant variables. All studies published before 1st January 2014 were eligible for inclusion in the analysis.

Articles were located using an online search of journal data-bases including: PsycInfo, Psych Lit, Sport Discus, Science Direct, Web of Knowledge, Pub Med, Ingenta-Connect, First Search, and Google Scholar. The key terms used to search for articles included: eating disorders, eating problems, disordered eating, anorexia, bulimia, anorexia athletica, male athletes, male, men, exercise, and sport. On completion of the data-base searches, further electronic searches of key authors were conducted. The indexes for the last 15 years of the *International Journal of Eating Disorders* were also searched electronically. Bibliographies and reference sections of review articles together with each article collected were individually checked. Finally, in cases where studies were unobtainable or data that were relevant to the meta-analysis were not reported, the corresponding author of the study concerned was contacted directly via email or telephone.

Thirty-six studies met the inclusion criteria. Eight of the studies did not report the data required for the analysis and so the corresponding authors were contacted. In the event that the authors did not respond to a voicemail or email, a follow-up request for the data was made two weeks later. As none of the eight authors replied, 28 of the studies used in the meta-analysis reported all the data that were required for analysis purposes. Three of the eight incomplete studies simply reported “non-significant” results. Consequently, p was assumed to be 0.50 and r was assumed to be 0 in these cases (cf. Rosenthal, 1991). Thirty-one studies were thus retained for analysis.

Coding the studies

Participant characteristics were coded according to standard of competition (elite, non-elite) and specific sport. In line with Sundgot-Borgen and Torstveit (2004), sports were categorized into six sport groups: endurance sports (running, swimming, rowing, and cycling), mass-dependent sports (wrestling, karate, and judo), aesthetic sports (figure skating, cheerleading, diving, gymnastics, and bodybuilding), technical sports (bowling, golf, high jump, equestrian, long jump, shooting, and sailing), power sports (discus, javelin, power lifting, shot put, and sprinting), and ball sports (badminton, basketball, football, soccer, table tennis, handball, tennis, and volleyball). Elite athletes were operationalised as those athletes who competed in national (including Division 1 collegiate athletes) or international competitions. Study characteristics were coded according to total sample size, number of participants in each experimental group and in the control group, the *t* statistic (or equivalent) for each comparison in the analysis, and means and standard deviations for each group on the diagnostic measure used, and the dependent variable or subcategory of the measure used.

Statistical analysis

The statistical methods used were those described in Rosenthal (1991). We calculated effect sizes for the 28 studies that met the inclusion criteria and used *Zr* as the measure of effect size (see Rosenthal, 1991). To calculate the significance of each effect size the standard normal deviate *Z* was used. We further calculate the average effect size *Zr* by weighting each study by its individual sample size. The average effect size *Zr* was then converted to a *Z* score for statistical significance. We also calculated heterogeneity estimates, in the first instance as Cochran's *Q* statistic, which is distributed as the χ^2 statistic with $k - 1$ degrees of freedom (where k = number of effect sizes). In response to the suggestion that the Cochran *Q* statistic is a poor predictor of heterogeneity in analyses that contain low study numbers, and in line with recommendations from Higgins, Thompson, Deeks and Altman (2003), we also calculated the I^2 heterogeneity statistic. Finally, moderator variables were tested for significance using *z* score calculations (see Rosenthal, 1991).

In the event that a study had more than one experimental group and only one control group, independent *t*-tests were used for each comparison. A mean of these *t* scores was then calculated before transforming the *t* score to a correlation coefficient using the mean sample sizes to satisfy the assumption of independence. In order to include the most effect sizes in the moderator analyses the individual *t* scores for sport type and competitive level were also transformed into independent correlation coefficients.

Results

We present a summary of all the studies included in the analysis in Table 1, and we present a forest plot for the effect sizes that were included in the overall analysis in Figure 1.

Overall difference between athletes and non-athletes

The comparison between athletes and controls revealed no significant difference for disordered eating, as hypothesised, $r = .07$, $z = 1.30$, $p = 0.19$. This overall r is based on r values ranging between -.47 and .52 with significant heterogeneity, χ^2 (31) = 129.26, $p < .001$, $I^2 = 76.02\%$. The mean total sample of the studies included in this analysis was 345.45.

Sport type

It was hypothesised that athletes from sports emphasising lean body mass and shape would report higher levels of disordered eating than their non-athletic counterparts and that these differences would be more pronounced than in sports that do not emphasise such body types. Separate analyses were conducted for endurance sports (eight effect sizes), mass-dependent sports (nine effect sizes), and aesthetic sports (seven effect sizes). Other sport types were not analysed due to an insufficient number of effect sizes (cf. Rosenthal, 1991).

When endurance athletes were compared to controls no significant difference was revealed for disordered eating, $r = .02$, $z = 0.27$, $p = .79$, and it was marked with significant heterogeneity χ^2 (8) = 34, $p < .001$, $I^2 = 76.47\%$. This overall r is based on r values ranging between -.13 and .55 with a mean total sample size of 178.50. The moderator analysis was also found to be non-significant, $z = .08$.

The comparison between mass-dependent sport athletes and controls revealed no significant difference for disordered eating, $r = .11$, $z = 1.46$, $p = 0.14$. The overall r is based on r values ranging between -.65 and .39. The mean total sample was 175.67. As much of the research has suggested that male athletes competing in mass-dependent sports such as wrestling are at increased risk (Rosendahl et al., 2009; Sundgot-Borgen & Torstveit, 2004), whereas there is little evidence to suggest such risk in martial artists, the analysis was repeated without the martial arts samples. This second comparison revealed a significant disordered eating effect for wrestlers compared to non-athlete controls, r = .14, z = 2.22, p = .03. The overall r was based on r values ranging from .03 to .39, the mean sample size was 251.50, and heterogeneity was not significant χ^2 (6) = 8.8. p = .18, I^2 = 31.82%. However, mass-dependent sports, either including or excluding martial arts, were not found to be significant moderators; z = .10 and z =.53, respectively.

Finally, the comparison between aesthetic sport athletes and controls revealed no significant effect for disordered eating, r = .11, z = 1.62, p = .11. This overall r is based on r values ranging from -.15 and .23. There was significant heterogeneity χ^2 (7) = 14.82. p = 0.02, I^2 = 52.77%. The mean total sample was 181.29.

Competitive Standard

The comparison between elite athletes and controls revealed no significant effect for disordered eating, r = .07, z = 1.14, p = .11. This overall r is based on r values ranging from -.47 and .42. There was significant heterogeneity, χ^2 (11) = 49.18, p < .001, I^2 = 77.63%. The mean total sample was 263.64.

Measurement

The restricted number of studies allowed for three analyses to be conducted with a view to assessing the effect sizes for three dependent variables: the drive for thinness and bulimia subcategories of the EDI, and the total score from the EAT. Of the 12 studies that were included in the analysis and that used the EDI, only the *drive for thinness* subscale data were reported in all cases with the bulimia subscale reported on ten occasions. Similarly, in the 13 studies in which the EAT was used, data from the subscales were reported on four or fewer occasions. For the drive for thinness subscale comparison, no significant difference between athletes and non-athletes was revealed, r = .04, z = .71, p = .48. This overall r is based on r values ranging from -.15 and .52. There was significant heterogeneity χ^2 (12) = 34.77, $p < .001$, $I^2 = 65.49\%$. The mean total sample was 316.50.

The Bulimia comparison was also non-significant, $r = .09$, $z = 1.25$, $p = .19$. This result was not marked with significant heterogeneity χ^2 (10) = 14.86, $p = .06$, $I^2 = 32.71$.

The total EAT comparison revealed a significant disordered eating difference between athletes and non-athletes with athletes appearing to be more at risk, $r = .12$, $z = 2.07$, $p = .04$. This result was again marked with significant heterogeneity, χ^2 (13) = 63.01, $p < .001$, I^2 = 79.37%. The mean sample size was 299.00. The EAT comparison was not significantly different to the effect size produced from the drive for thinness or bulimia analyses; $z = .02$ and .07, respectively.

File drawer analyses

For the probability of the follow-up wrestling comparison to become non-significant, 54 studies with a mean probability of .50 would need to have been stored away. As this number of additional null-finding studies required is higher than the number of studies that were included in the analysis, we can consider it reasonably robust to the file drawer threat. . To become non-significant the EAT analysis would require 159 studies with a mean probability of .50 to be stored away. Thus, the EAT finding is also robust against the file drawer threat.

Discussion

The purpose of this review was to establish whether male athletes were more susceptible to disordered eating compared to male controls and whether there were moderating variables of this susceptibility to disordered eating. To this end, effect sizes were calculated for sport type, competitive standard and diagnostic tools. No significant difference was revealed across standards of competition. There was, however, a significant difference between wrestlers and controls. Regarding diagnostic tools, the total score on the EAT emerged as a significant discriminator between athletes and controls. Conversely, the drive for thinness and bulimia subscales of the EDI were not significant discriminators.

It was hypothesised that athletes participating in sports emphasizing lean body mass and shape would report higher levels of disordered eating than controls. Previous research has suggested that male athletes from mass-dependent sports (Sundgot-Borgen & Torstveit, 2004), aesthetic sports (Krentz & Warschburger, 2011), and endurance sports (Riebl et al., 2007) are more likely to display disordered eating. In the present paper the effect size was significant for wrestling only, with non-significant effect sizes emerging for endurance and aesthetic sports. The finding that wrestlers are more at risk than non-athletes most likely reflects these athletes' desire to achieve a high muscle mass and low body fat mass to compete in a specific "weight" class, which may be below their more natural body mass. Much of the previous literature has focused on mass-dependent sports as a homogenous group, in which wrestling is grouped with sports such as boxing and the martial arts. In this review, however, both studies involving judo athletes produced a negative effect (Filaire et al., 2007; Rouveix et al., 2007) and another involving martial arts produced non-significant results (Costarelli & Stamou, 2009). This difference between sports is informative, as it suggests that different body mass-dependent sports might harbour different degrees of risk regarding eating behaviours and should not be treated as a homogeneous group.

Endurance sports have commonly been cited as high-risk for female athletes (Pollock et al., 2010) but male athletes involved in endurance sports were not significantly more at risk than non-athletes. At first view, the non-significant finding reported here suggests that the risk associated with endurance sports may be unique to female endurance athletes. There are two main problems associated with such an interpretation.

First, sports such as running and swimming are typically operationalised within a single category of "endurance" sports despite the wide variety of activities involved in these sports (e.g. 100-metre run or swim). A more fine-grained analysis of each sport, rather than sport categories, is likely to yield a more sharply focused picture of the relative risks associated with each specific sport activity. Unfortunately, given the lack of data, such an analysis was not possible and more research is clearly warranted here.

Second, the finding that endurance sports are no more at risk of disordered eating than their non-athletic counterparts is inconsistent with research that has considered disordered eating beyond its *prevalence*. Indeed, Atkinson's (2011) interviews with male endurance athletes (long distance runners and triathletes) revealed a number of disordered eating incidences within this athletic group. The lack of consistency or clear evidence from the current meta-analysis might consequently be masking significant instances of disordered eating within each or any of the endurance (or other) sport groups. It is further noteworthy that there is a reluctance for male athletes to disclose eating issues, which will necessarily limit the knowledge gains that might be brought about by questionnaire-based research. In other words, there is a need to consider more in-depth analyses and potentially "to reduce the prevalence of prevalence studies" (Papathomas & Lavallee, 2012, p. 389).

The current analysis revealed no significant difference between athletes of aesthetic sports and controls. In a Norwegian sample of male aesthetic athletes (Sundgot-Borgen & Torstveit, 2004), none of the athletes were diagnosed with a clinical eating disorder and the authors suggested that the male athletes had healthier methods of restricting their body mass for competition. Another possible explanation for what appears to be an exclusively female disordered eating relationship (see Anderson & Petrie, 2012) is that a large number of the aesthetic sport sample in this analysis comprised bodybuilders. Bodybuilders are likely to report low scores on diagnostic tools that operationalise a desire to lose body mass as a risk indicator, as these athletes are judged on their ability to maintain and *increase* body mass and muscularity. Such athletes are likely to report any shape or weight concern only if presented with a scale that reflects a desire for *leanness* and *muscularity* rather than a reduction in body *mass* or a desire for *thinness*.

As hypothesised the meta-analysis revealed a significant difference between athletes and non-athletes for studies that used the total score on the EAT. Conversely, there was no significant difference in studies that used the drive for thinness or bulimia scales of the EDI. A parsimonious explanation is that this measurement-derived discrepancy is a reflection of the EAT being a better predictor for male eating problems than are the other scales. When considered against the *drive for thinness* subscale it should be noted that thinness is associated with body *mass* whereas the drive for leanness in men infers a desire for less body *fat* and yet greater *muscle* mass, or at least a more visible abdominal muscle mass (Leit et al, 2001; Oliviardia, Pope, Borowiecki, & Cohane, 2004). Further, it is worth noting that both the EDI and the EAT were developed with female samples. Although risk factors of eating disorders are largely shared by male and female patients, the EDI and EAT focus on body "weight" and shape concerns that are perhaps more common to females (dieting, thinness) than they are to males. Regardless of how one might interpret the greater discriminatory power of the EAT over the analysed subscales of the EDI, there is a clear need to move toward more male-specific ways of operationalising and measuring men's and boys' disordered eating in the specific context of sport research (see also Woodman & Hemmings, 2008; Woodman & Steer, 2011).

A significant measurement step forward is Stanford and Lemberg's (2012b) Eating Disorder Assessment for Men (EDAM). The EDAM is a preliminary assessment tool that contains items that are more specific to men's symptoms (e.g. binge eating, muscle dysmorphia). In research that compared the EDAM directly to the EDI-3, Stanford and Lemberg (2012a) concluded that the EDI-3 does not capture the construct of *drive for thinness* in males and that males are at risk of achieving a low score on this factor despite exhibiting eating disorder symptoms. As such, EDI drive for thinness items such as “I am preoccupied by the desire to be thinner” should be replaced with “I am preoccupied by the desire to be lean and muscular.” Stanford and Lemberg’s research suggests that researchers would do well to embrace the challenge of using male-specific methods and male-specific research questions for a greater understanding of the male-specific body and eating concerns, which appear markedly different to those of women and girls.

Athletes involved in elite sport were no different to those taking part in sports at a lower standard. Thus, there was no overall support for the position that elite athletes may be more at risk because of the greater competitive pressure to succeed and the more intense training programs (Sundgot-Borgen 1994); equally, there was no overall support for the finding that elite athletes may be less at risk (Darcy et al., 2013). Of course, this null finding clearly warrants further research in light of the aforementioned male-specific arguments (i.e., measurement and specific sports).

There are several key limitations revealed through this meta-analysis, which should be addressed in future research. First, many of the studies did not report whether the research was conducted in or out of season. It has been argued that collegiate wrestlers only develop transient disordered eating, which fluctuates over the course of a season (Dale & Landers, 1999); consequently, the timing of data collection for this sport may have influenced the findings in either direction. Second, despite previous calls for more informative research involving male athletes (Bryne & McLean, 2001; Lock, 2009), there was insufficient data available to investigate age or experience as potential moderators. Finally, as mentioned previously, although the way in which sports were coded was consistent with previous research it was likely too simplistic for meaningful future comparisons and meta-analyses. Specifically, we urge researchers to consider the detail of their sample(s) rather than to categorise individuals within global sports according to simplistic categorisation criteria (e.g. “endurance” sport).

In summary, in the studies contained in the current review, wrestling as a group of sportsmen reported a higher incidence of disordered eating compared to non-athletic controls. Only the EAT differentiated male athletes from non-athletes. The reliance on measurement tools that were developed with women’s and girls’ disordered eating patterns in mind has severely hampered this research field and there is a need to move beyond simple prevalence studies that use such measures. Specifically, we urge researchers to use disordered eating methodologies that are more specifically suitable for men and boys (e.g. Atkinson, 2011; Papathomas & Lavallee, 2012; Stanford & Lemberg, 2012a).

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Table 1: *Characteristics of samples used in the meta-analysis*

Author (Year)	*r* Value	Sport	Elite	Athletic Sample	Control Sample	Dependent Variable
Boroughs & Thompson (2002)	.07	Running/Bodybuilding	N	72	62	Dthin
Brugh et al. (2001)	.38	Wrestling/Non-wrestling athletes	N	261	60	EATtot
Bryne & McLean (2002)	.30	Thin/normal build sports	Y	161	55	Dthin
Callejas & Levine (2003)	.16	Varied	N	67	37	EATtot
Costarelli & Stamou (2009)	.00*	Martial arts	Y	6	8	EATtot
Dale & Landers (1999)	.14	Wrestling	N	85	75	Dthin
Darcy et al. (2013)	-.01	Varied	N	597	64	EDE-Q
Filaire et al. (2007)	.22	Judo/Cycling	N	27	17	EATtot
Fogelholm & Hiilloskorpi (1999)	.08	Varied**	Y	190	61	Dthin
Fulkerson et al. (1999)	.13	Varied	N	174	195	Dthin
Hausenblas & McNally (2004)	.09	Athletics	N	76	98	Dthin
Krentz & Warschburger (2011)	.23	Aesthetic sports	Y	35	35	EATtot
Long-Anderson et al. (1996)	-.15	Bodybuilding	N	68	50	Dthin

Author and Year	*r* Value	Sport	Elite	Athletic Sample	Control Sample	Dependent Variable
Martinsen et al. (2010)	-.08	Varied	Y	389	197	Dthin
Martinsen et al. (2013)	-.01	Varied	Y	274	82	EDE-Q
Moss & Bessinger (1999)	.08	Varied	N	203	340	EATtot
Nattiv et al. (1997)	.05	Varied	N	1502	289	SC-Wc
Nudleman et al. (1988)	-.13	Running	N	20	20	Dthin
Passman & Thompson (1988)	.52	Running/Bodybuilding	N	30	15	Dthin
Petrie (1996)	-.07	Lean/Non-lean sports	N	187	230	Dthin
Ravaldi et al. (2003)	.10	Bodybuilding	N	44	30	EDE-Dr
Riebl et al. (2007)	.42	Cycling	Y	61	63	EATtot
Rosendahl et al. (2009)	.03	Varied	N	366	122	EATtot
Rosenvinge & Vig (1993)	.00*	Swimming	Y	19	20	EATtot
Rouveix et al. (2007)	-.47	Judo	Y	12	17	EATtot
Stanford-Martens et al. (2005)	-.06	Lean/Non-lean sports	N	164	55	Q-EDDtot
Sundgot-Borgen & Torstveit (2004)	.06	Varied**	Y	687	629	Dthin
Theil et al. (1993)	.09	Wrestling/Rowing	Y	84	104	Dthin
Wheeler et al. 1986)	.00*	Running	Y	49	18	EATtot

Author and Year	*r* Value	Sport	Elite	Athletic Sample	Control Sample	Dependent Variable
Wichstrom et al. (1994)	.12	Varied**	N	1802	107	EATfp
Wilkins et al. (1991)	-.20	Varied	N	99	39	Dthin

Note: *r* is Fisher's (1928) transformed *Zr*, where a positive score indicates that the athletic group scored higher than the control group on the diagnostic questionnaire;- a negative score indicates that the control group scored higher; for Elite, Y = yes and N = no; Dthin = the drive for thinness subscale of the Eating Disorder Inventory, EATtot = the total score on the Eating Attitudes Test, SC-Wc = the weight concern subscale of a diagnostic tool developed for the research, EDE-Dr = the dietary restraint subscale of the Eating Disorder Enquiry Questionnaire, Q-EDDtot = total score for the Questionnaire for Eating Disorder Diagnosis, EATfp = the food preoccupation subcategory of the Eating Attitudes Test; * = non-significant results were reported and included in the analysis as $r = 0$ based on Rosenthal's (1991) recommendation. ** = The study contained more than one experimental group allowing for additional effect size *r* values to be calculated and used in the moderator analyses. All reported *p* levels associated with *z* scores are based on two-tailed tests.

Figure 1: Forest plot of the effect sizes that were in the overall analysis.