

The Prevalence of Eating Disorders in Female Aesthetic Athletes

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ABSTRACT

Eating disorders, a spectrum of psychological diseases (e.g., anorexia nervosa, bulimia nervosa, binge eating disorders) that can cause adverse impacts on health, are prevalent in athletes. Female athletes in aesthetic sports, where the thin-ideal body figure is highly valued by judges and audiences, are at highest risk of developing eating disorders. This review paper examines current research on major risk factors, diagnosis, and interventions regarding aesthetic athletes' abnormal eating behaviors and eating disorders. The interconnected influence of social and sport pressures, including parents & coaches' influences, body dissatisfaction, and achievement goals have been found to be the major risk factors. Culture can also exert influence on the development of eating disorders. This paper reviews the screening tools, which primarily consist of self-reported questionnaires, used to identify eating disorders as well as education-based preventions and intervention programs. Finally, the limitations of current research in the field majorly lies in the validation of screening tools and interventions.

Introduction

Eating disorders have been shown to be more prevalent in athletic populations than in the general public. For example, a Norwegian study in elite female athletes (n=522) found that 18% of athletes from 35 sports across sport types (e.g. ballgames and endurance sports) had eating disorders, while in nonathletic control participants (n=448), 15% had eating disorders (Sundgot-Borgen J., 1993). Further, many studies have proposed that aesthetic sports, which focus on the leanness and weight-dependent aesthetics of the athletes, such as gymnastics, figure skating, diving and synchronized swimming (Durme et al., 2012) are more at risk for pathogenic dieting behaviors (Bruin et al., 2007). For example, one study demonstrated that significantly higher percentages of athletes in aesthetic sports have clinical eating disorders (46.7% compared to 19.8% in other sports) (Torstveit et al., 2008). Athletes in this sport group at any level are thought to have higher risks of developing eating disorders (Kong & Harris, 2015).

Some studies have demonstrated a sex difference in eating disorder prevalence. One study found that the prevalence of disordered eating symptoms varied from 0-19% in male athletes and 6-45% in female athletes (Bratland-Sanda & Sundgot-Borgen, 2013). Another study conducted in Spain on both male and female elite athletes (n=646) across sport types, found that 5.1% of all athletes were identified as being at risk for eating disorders, and 75.8% of the 5.1% were females. In addition, female aesthetic athletes (n=81) were found to have the highest rate of eating disorders, with a prevalence of 13.6% (Teixidor-Batlle et al., 2021). This maybe partly because female aesthetic sport athletes show more disturbed thoughts and eating behaviors compared to girls from the general population while male aesthetic athletes did not show this trend (Durme et al., 2012). Based on current studies, women in sports, especially aesthetic sports, have the highest risk of developing an eating disorder.

Finding Risk factors

Petrie and Greenleaf (Petrie & Greenleaf, 2012) proposed a theoretical etiological model of disordered eating development in athletes in 2007 and redesigned it in 2012 (Figure 1). The model aimed to predict the influence of sport pressure and societal pressure in developing disordered eating behavior in the form of dietary restraint and bulimic symptomatology in athletes (Stoyel, et al., 2021). However, the model has some limitations in generalizability, and the research suggests that the model fits better for male than for female athletes, for young athletes under the age of 27, and is more suitable for non-elite athletes (Stoyel, et al., 2020). Nonetheless, the model serves as the foundation for future research on risk factors. The risk factors for female aesthetic athletes are discussed in the following five categories.

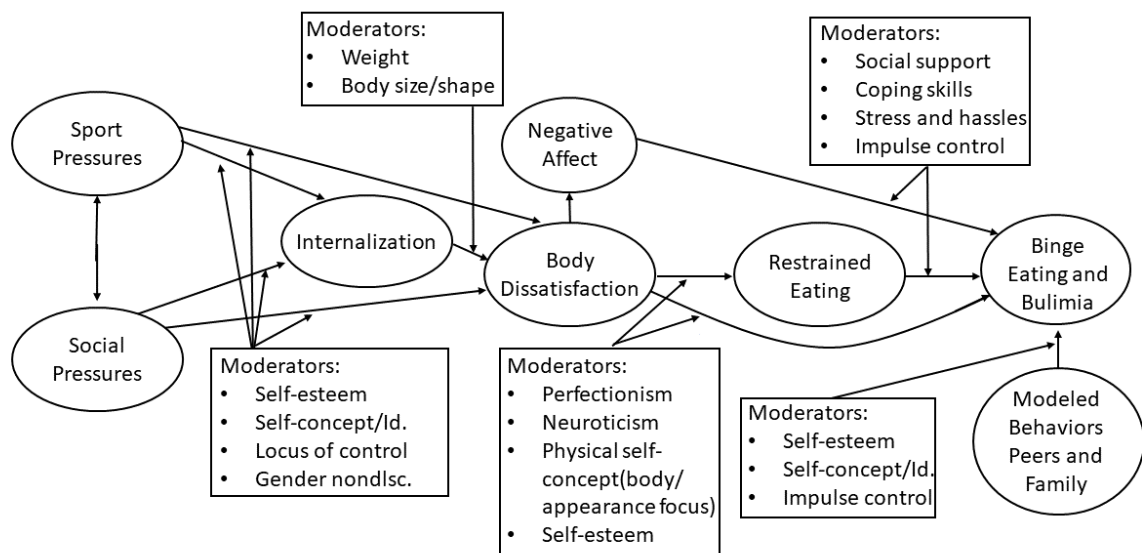


Figure 1. The Biopsychosocial Model of Dietary Restraint model proposed by Petrie and Greenleaf aimed to predict the influence of sport and societal pressures in eating disorder development.

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Parent pressures

Parental influence is found to be one of the major predictors of eating disorders in adolescent elite aesthetic athletes (Francisco et al., 2013). Parents' critical comments, which might result from the "thinness" subculture (i.e., thin-ideal body goals) in aesthetic sports social influence contribute to body image dissatisfaction and therefore disordered eating in athletes overtime (Francisco et al., 2013). This is supported by the finding that adolescents from 8th-12th grade are at higher risk in families where parents show concerns for weight and perceptions for thinness (Ata et al., 2007), and that athletes at lower risks for eating disorders tend to describe their families as warm, open, and supportive (Blackmer et al., 2011). Moreover, research found positive association between a mothers' body dissatisfaction and daughters' body dissatisfaction with female sport participants (Karr et al., 2013), which is in accordance with earlier findings that mothers' attitudes and behavior that relate to disordered eating have a significant influence on daughters, while no relationship was found between

fathers and daughters (Pike & Rodin, 1991). In general, because parents express opinions and values and provide mental and material support for athletic practices, they become one of the major sources of pressure on the athletes (Gaines, 2014).

Coach pressures

Research in young elite dancers and gymnasts suggest that teachers and coaches are viewed as the principal source of influence on young athletes, with more than half (56%) of the gymnasts and 31% of dancers surveyed indicated teachers or coaches as primary influence, and sadly 41.5% of the survey responders reported a negative relationship with their coaches (Francisco et al., 2012). As the adults who spend the most time with the athletes, coaches' values and opinions can greatly influence athletes. Direct comments about weight (e.g., coach remarking "you need to drop five pounds", "you're really fat! You'd better start losing weight!") from coaches have a negative influence on athletes' body satisfaction, especially when the athletes already feel negative about their bodies (Reel et al., 2013). Younger athletes may feel compelled to lose as much weight as possible to improve performance based on their coaches' recommendations, and they tend to show fear when not reaching the ideal figure-not reaching coaches' requirements (Sundgot-Borgen, 1994). Further, regular performance monitoring by coaches seems to increase athletes weight awareness and pressure, and is considered to be one of the primary reasons for developing serious eating problems (Rosendahl et al., 2009). Although critical comments can arise from other aspects of the sport environment, even spectators, the critical comments from coaches carry more weight and have been shown to be the direct and explicit cause of disordered eating (Francisco et al., 2012). Further, coaches' comments have more influence on higher-level athletes who compete in higher divisions, likely because have higher overall expectations, which also further influence athletes' perception in perfectionism (Gaines, 2014).

Body image and dissatisfaction

Across sports types, higher basal metabolic index (BMI) was associated with greater body dissatisfaction, while greater athletic self-efficacy (athletes' belief in their ability to achieve certain performance) was associated with lower body dissatisfaction (Karr et al., 2013). Particularly in lean-sports (sports that require low body fat, including aesthetic sports, endurance sports like running and cycling, and weight-class sports like martial arts), athletes scored higher on body dissatisfaction and have lower desired body weight than non-lean-sport athletes (Reinking & Alexander, 2005). One French study that included female aesthetic athletes demonstrated that most of the athletes who are at risk for developing eating disorders show satisfaction with their appearance and weight. This dissatisfaction indicates a desire for even greater thinness, despite the fact that they perceive themselves thin (Ferrand et al., 2009). Further, easy access to technology and thus the common unrealistic and stereotypical images of the 'perfect' female athlete body type on media and advertising can lead to negative body image in girls in sports and unhealthy lifestyle choices (Koulanova et al., 2021). Moreover, according to research in Australia concentrating on elite athletes, under our current culture's obsession for thinness and physical attractiveness, female athletes might struggle to pursue bodily perfection to a greater extent than their male counterparts.

Sport pressures and achievement goals

In aesthetic sports, the performance is assessed by judges through a set of rules (usually include execution score which assesses the artistry and presentation and could be subjective) and appearance is a main judging factor (Mancine et al., 2020). At the same time, low body weight and/or low body fat is usually associated with

elite performers and perhaps higher subjective scoring (Meng et al., 2020). Therefore, thin physical appearance is believed to be highly-valued in the aesthetic sport environment. This belief among aesthetic athletes may increase their risk for developing an eating disorder. While aiming to improve their performance and mastery of their sports, athletes may try to increase their performance and physical ability by losing weight. The relationship is further proved by the finding that athletes who are no longer willing to achieve higher performance (e.g. stop pursuing higher levels of competition, nearing retirement etc.) tend to avoid disordered eating behaviors (Scoffier-Mériaux et al., 2013). High personal standards and performance goals are therefore significant risk factors, also supported by research findings that Division I athletes who reported to have higher standards are more at risk compared to Division III athletes (Gaines, 2014).

Cultural influences for difference in athletes

While social pressures are similar for females in an athletic environment, female athletes across different cultural backgrounds (culturally ideal figure, food culture, etc.) might experience different levels of pressure and are at different risks for eating disorders. A study conducted in China found low incidence of disordered eating patterns in Chinese female athletes in all types of sports including aesthetics sports. It is suspected that 20 years ago the overall social desires and requirements to improve performance by weight loss were lower in China compared to those more industrially advanced societies (Okano et al., 1998). Another study conducted on female athletes in competition seasons at the same high schools reveals the difference in prevalence of pathogenic eating behaviors in different ethnic groups, where Caucasian and Latina high-school female athletes are at higher risks for developing eating disorders compared to their African-American counterparts (Pernick et al., 2006). A similar result in ethnic differences is found in another study of suburban female high-school athletes (Kirk et al., 2001). The reason for this difference is not investigated, but it is speculated that African-American athletes tend to be more satisfied with their appearance and body, thus engaging less in problematic eating behaviors. Although this study is not exclusively about aesthetics athletes, it suggests that social environment, ethnic background, and national culture, may influence the risk for the development of eating disorders.

Detecting Eating Disorders

Early detection in eating disorders is crucial so that appropriate interventions can be adopted (McNulty et al., 2001). Self-report questionnaires are the main ways to detect eating disorders in athletes. The more frequently used tests include The Eating Attitudes Test (EAT), the Eating Disorder Examination Questionnaire (EDE-Q), and the Eating Disorder Inventory-2 (EDI-2). Other tests that measure risk factors are Weight Pressures in Sport for Females (WPS-F), the Eating Disorders Assessment Questionnaire (CETCA), and Bulimia Test-Revised (BULIT-R), among others. The tests are mostly in forms of Likert scales, and the time required to complete each questionnaire ranges from a few minutes to nearly an hour. Different tests and steps are usually taken because no single screening instrument could yield valid results when detecting eating disorders. Lastly, there are no specific screening tools for female aesthetic athletes.

The Eating Attitudes Test-26 (EAT-26)—First developed by Garner, Olmstedt, Bohr, and Garfinkel in 1972, was originally a 40-item Test, which are later refined and published in its current 26-item form (Garner et al., 1982). It is designed to detect at-risk populations, primarily for adolescents and adults. It evaluates eating behaviors based on three factors: dieting, bulimia and food preoccupation, and oral control (self-restraint and pressure from others' perception on weight loss) (Knapp et al., 2014). Each statement is self-evaluated through a six-level scale. The survey has been validated for use in both clinical and non-clinical settings (eg. in high schools and universities) for first step analysis and has been validated in the general population and in multiple languages.

Eating Disorder Examination Questionnaire (EDE-Q)—Developed from 1987 diagnostic interview Eating Disorder Examination (EDE), it is a self-reported questionnaire assessing eating disorders related to the cognitive subscales: restraint, eating concern, shape concern, and weight concern. The EDE-Q is the “gold standard” in eating disorders diagnosis (see example questions in Table 2). The current 17th version meets the Diagnostic and Statistical Manual 5 (DSM-5) Diagnostic Criteria published by the American Psychiatric Association. The EDE-Q was designed to detect eating disorders in risk groups (i.e., identified with EAT-26). Research has shown the reliability of EDE-Q in general female populations (Berg et al., 2012), but it has not yet been validated in sport populations. (Lichtenstein, et al., 2021).

The Eating Disorder Inventory (EDI)—The 64-question questionnaire is developed to assess psychological and behavioral characteristics of anorexia nervosa and bulimia, which measures drive for thinness, bulimia, body dissatisfaction, ineffectiveness (feelings of general inadequacy, insecurity, worthlessness and the feeling of not being in control of one's life), perfectionism, interpersonal distrust (sense of alienation and a general reluctance to form close relationships—important in developing and maintaining anorexia nervosa), interoceptive awareness (one's lack of confidence in recognizing and accurately identifying emotions and sensations of hunger or satiety) and maturity fears (one's wish to retreat to the security of the preadolescent years because of the overwhelming demands of adulthood) (Garner et al., 1983). Research suggests the test is valid in general populations but is more reliable for women compared to men (Spillane et al., 2004). However, this assessment requires further validation in the athletic population (Pope et al., 2015).

Apart from the questionnaires, self-reported or newly-taken anthropometric measurements (heights, weights, etc.), biochemical parameters related to microelements, self-designed questions, and face to face interviews are sometimes conducted to accompany the tests.

Table 2: Example questions found in the Eating Disorder Examination Questionnaire (EDE-Q 6.0)

	ON HOW MANY OF THE PAST 28 DAYS	No Days	1-5 Days	6-12 Days	13-15 Days	16-22 Days	23-27 Days	Every Day
1	Have you been deliberately trying to limit the amount of food you eat to influence your shape or weight (whether or not you have succeeded)?	0	1	2	3	4	5	6
Questions 13-18: Please fill in the appropriate number in the boxes on the right. Remember that the questions only refer to the past four weeks (28 days). Over the past four weeks (28 days)								
13	Over the past 28 days, how many times have you eaten what other people would regards as an unusually large amount of food (given the circumstances)?							
	ON HOW MANY OF THE PAST 28 DAYS	Not at all	Slightly	Moderately		Markedly		
22	Has your weight influenced how you think about (judge) yourself as a person?	0	1	2	3	4	5	6

Intervention and Prevention

Early identifications of at-risk behaviors and the onset of eating behaviors is particularly important. Since it is hard for athletes at risk to identify the problems themselves, dietary questionnaires, specific screening questionnaires, or clinical interviews are recommended (Coelho et al., 2014). Follow-up physical examinations are used to assess high risk athletes, which includes anthropometric data collection, pulse rate and quality, blood pressure, orthostatic measurements, blood and urine tests, etc. (Salbach et al., 2007).

Eating disorders as well as poor eating behaviors are detrimental to an athlete's health. Eating disorders have serious physical consequences, including delayed puberty, bone growth retardation, and decreased bone deposition. For female athletes in particular, occurrences of eating disorders are usually associated with increase in risks for the Female Athlete Triad and Relative Energy Deficiency in Sport (RED-S). Female athlete triad consists of three components: low energy availability with or without disordered eating, menstrual cycle disturbances, and low bone mineral density (BMD) (Raj et al., 2021). RED-S is a comprehensive term to describe the adverse impacts of energy deficiency on a range of body functions, which can lead to life-long health problems (Mountjoy et al., 2014). RED-S also encompasses negative psychological consequences that include depression, anxiety, and suicide (Nowicka et al., 2013). As the highest prevalence and risks for eating disorders are found in female aesthetic athletes, there is a critical need for effective preventions and interventions.

Another critical element in prevention is education including nutrition, eating practices education, and health consequences for both athletes, coaches and parents. Education needs to include warning signs of eating disorders or female athlete triad, including decline in performance, weight loss, mood changes, frequent illness or injury, fractures, and dissatisfaction with appearance (Javed et al., 2013). Research shows coaches have limited capability to identify eating disorders and practice early interventions, due to the lack of awareness, education, and distant relationship with athletes (Nowicka et al., 2013). But because coaches are identified as a major influence on athletes, whose beliefs and comments are essential especially for weight-dependent sports, it is vital for them to get educated to avoid continuing erroneous beliefs and conduct early intervention, and therefore help the athletes.

The interventions studied are mainly educational programs. The central ideas of these programs are the de-stigmatization of eating disorders, promotion of body satisfaction and self-acceptance, and education about eating behaviors and reasonable training. Few interventions specific to female aesthetic athletes exist, most current interventions are conducted in female athletes across different sport types. More recent interventions focused on changing athletes' mindset and reducing intentions to conduct risk eating behaviors. Although limited in number, many of them show positive outcomes in reducing risk behaviors and mindset. The following interventions are summarized.

Athletes Targeting Healthy Exercise and Nutrition Alternatives (ATHENA) (Elliot et al., 2004, 2006, 2008).; Ranby et al., 2009).

ATHENA is a prevention program aiming to reduce young female athletes' risk behaviors through health and nutrition promotion in learning clusters, in school-based and teamed-centered environments. In 2004 and 2006 studies, it has been shown to cause positive changes in dietary habits and exercise training, with intermediate short-term reduction in risk behaviors. The study in 2008 also finds its long-term influence and beneficial outcomes seem to continue increasing over time. The study in 2009 expands on earlier research by using mediation analyses—how the intervention can change the two specific intentions (unhealthy weight loss and intention to use athletic-enhancing substances) that lead to ultimate risk factors. The limitation is that the ATHENA study has only been tested in a high school setting-and has not been tested in higher division athletic populations.

Athlete-modified dissonance-based prevention (AM-DBP) and Athlete-modified Healthy Weight prevention intervention (AM-HWI) (Becker et al., 2012)

AM-DBP was developed from the dissonance-based prevention (DBP), which are interactive activities that direct participants to speak and act against potentially harmful thinness-ideal standard and therefore reducing cognitive dissonance (the inconsistency between minds and acts). DBP is shown to reduce eating disorders onset by 60% and has been shown to have an effect for at least three years following the prevention program. Healthy Weight prevention intervention (HWI) aims to reduce girls' body dissatisfaction by encouraging them to make small lifestyle changes in eating and exercising and has long-term reduction in eating disorders risk factors. The AM-DBP are developed from the original DBP model, with new discussions of female athlete triad and specific sport-related body image pressure. This study uses a peer-led model, where randomly selected athlete-leaders received instructions and education and then brought to other athletes. The intervention sessions are led by current varsity-level (versus club-level) student athletes. The effectiveness of AM-DBP is compared to AM-HWI. The study evaluates the effectiveness of AM-DBP in these aspects: thin-ideal internalization (perception on certain thin-ideal female beauty standards), dietary restraint (engagement in restrained eating behaviors), bulimic pathology (degree engaged in bulimic behaviors), body dissatisfaction (concerns about their shape), and negative affect. Each of the factors is assessed through developed scales and questionnaires. Both specially-modified programs are found to be effective in reducing eating disorder risk factors, and AM-DBP is more popular (preferred by 80% participants) probably due to less supervision from peer leaders and more nutrition improvements. The 1-year follow-up showed continuing effects for negative affect, bulimic pathology, and shape concern.

Theory of Planned Behaviors-Based (TPB-based) Intervention (Laramée et al., 2017)

The TPB framework aims at reducing specific restrictive dieting behaviors for losing weight. It focuses on comprehensive nutrition education including (1) energy needs in athletes vs sedentary individuals; (2) importance of considering hunger and satiety signals in achieving adequate energy; (3) importance of carbohydrates as a fuel, proteins for muscle repair and function, and the right balance of lipids to maintain good health; (4) strategies to select nutritious food while eating out; (5) identifying the right foods before, during, and after training; and (6) the importance of hydration in sports. Additionally, the TPB-based intervention emphasizes strategies to change eating behaviors. This includes persuasive communication to introduce new positive beliefs mentored by dietitians and active learning through group discussion. This is the only intervention focusing on female aesthetic athletes, but age group is limited to 12-17-year-old teenagers and is limited in sample size. Changes are measured through nutritional knowledge and psychosocial determinants like body attitudes. Intervention groups show more nutrition knowledge mastery (score 60.8% vs 51.4%) and reducing intentions for restrictive dietary behaviors (16% vs 18%) after the 3-week program, and influence continues in the 8 to 13 weeks follow-up.

Bodies in Motion (Voelker et al., 2019).

Bodies in Motion aims to address appearance ideals in particular athletic environments. Based in cognitive dissonance theory, it emphasizes self-awareness of internal thoughts and feelings, and positive influence and support through social media. Participants are asked to identify their social and sport environment, discuss psychological consequences and conduct different mindful self-compassion exercises. The program uses questionnaire-based tools to evaluate the effectiveness through social and sport-related body pressures, internaliza-

tion, body attitudes, eating concerns, and mindfulness and self-compassion. The program includes (1) independent review of the standardized guidebooks and session materials; (1) a video-conference session with the authors who share best practices and answer questions; and (3) independent review of a video-recorded, 75-minute mock session from the Bodies in Motion program. Body pressure shows no significant change after the program, probably due to athletes' continuing intensive interactions with high-risk environment. Although perception towards body pressures does not change, there are improvements in mindfulness in thin-ideals, and the level of risk eating behaviors decreases. No group difference in age, BMI, or any of the baseline outcome measures. Larger sample sizes, prolonged follow-up, and consideration for family influence is recommended for further studies.

Table 1: Summary of clinical studies on eating disorder prevention and intervention

Intervention	Participants	Lasting period and follow-up	Results	Limitations
AM-DBP & AM-HWI Create cognitive dissonance & encourage small life changes through interactive education and discussion sessions	Female college students (N = 168) aged 18 - 22 years, participating in all 9 varsity sports teams Competing at NCAA Division III The majority of the sample are Caucasian (74.4%)	60–80 min over a three-week period. Follow-up after 1 year	Both specially-modified programs are found to be effective in reducing ED risk factors	Unable to randomize entire teams to condition A parallel program that is run annually with sororities on campus Did not conduct any intensive interventions with coaches.
TPB-based intervention Combining nutrition education with a theory-based intervention targeting attitude and its underlying beliefs	Girls aged 12-17 years participating in aesthetic sports (N =70) At local competitive sports communities, high schools, and club.	3 sessions of 60 minutes focusing on nutrition education, and 3 sessions of 60 minutes focusing on behavior change Follow-up after 8-12 weeks	The TPB-based intervention along with nutrition education contributed to maintaining a low score of intention to use such behaviors over time in this at-risk population.	Participants were recruited within a team sports setting Content fidelity was not monitored and intervention appreciation was not assessed The sample size achieved was short of the calculated sample size
Bodies in Motion Educational programs by professionals like psychologists and dieticians	Female collegiate athletes (N = 158), mean age 19.63 years (SD=1.16) From 8 Division I and 1 Division III university athletic departments	A 35-min introductory session followed by four, 75-min sessions No follow-up	Little positive changes, no significant influence on participants.	Limited time Assigned based on demands and availability, not randomization. Adjustment to control family-wise error and fewer athletes in the final

				sample might lead to type 2 error
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Limitations

The majority of research indicates the highest prevalence in female aesthetic athletes, but there are a few studies showing contradicting results, suggesting that eating disorder prevalence rates do not differ by gender nor by sport type. For example, a study conducted in 340 French high-level athletes did not find a sex difference in prevalence of eating disorders in aesthetic sports (Rousselet et al., 2017). And yet another study found no differences in eating disorders between leanness (including aesthetic sports) and non-leanness sports (e.g. fencing, golf) (Martinsen et al., 2010). The research in French high school shows a similar frequency of disordered eating in athletes and non-athletes, while female gender is shown to be an important risk factor (Rosendahl et al., 2009). The difference might be caused by the limited participants and differences in experiment settings.

There are also limitations in the screening tools. Current screening tools and instruments are mostly self-reported questionnaires, and the answers might not reflect participants' real thoughts, actions, or experiences. Another limitation is that although the most widely used screening tools are validated in general populations, research suggests further validations in the sports environment are required due to the specific characteristics of the athletic population. Female Athlete Screening Tool (FAST) is specifically designed according to female athletes' unique special characteristics. The 33-item questionnaire has been validated in Division I collegiate athletes, and further validation in more general female athletic population is expected (Krystock, 2012). Correlation studies have shown the concurrent validity between FAST and the EDI-2 and the EDE-Q (McNulty et al., 2001). However, FAST is not used in the literature reviewed. Further research should consider using FAST as a more accurate screening tool. Also, when screening for risk factors, the sample collected is generally from white population from high socio-economic status; few studies compared athletes of different ethnicities and cultures. However, there is evidence showing the influence of culture, both in the prevalence and risk environment.

Few interventions are tested in female athletes, and sport type is rarely considered. While the most interventions have positive effects, the common limitations in the studies are the incapability to randomize samples and increase sample size, limited competitive levels, and lack of prolonged follow-up. In addition, the interventions are conducted on the athletes' side, few considerations are put into the environmental side, such as interventions for coaches and family members.

Conclusion

In conclusion, most studies have proven that female aesthetic athletes are at the highest risks of developing eating disorders. Parent pressures, coach pressures, body dissatisfaction, thinner body for achievement goals are contributing factors for increasing risks. Although reasons remain unknown, athletes from different cultural backgrounds are found to be influenced differently. While the questionnaires for screening eating disorders are considered valid, specific screening tools for female athletes or aesthetic female athletes should be developed to provide more accurate diagnosis. Several education-based intervention programs have been innovated and tested with positive results but are still limited in number and have not been popularized beyond experiment samples. Further research is needed to investigate eating disorders in female athletes through more diverse samples, and more intervention strategies should be studied with the goal of mitigating eating disorders in aesthetic athletes.

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