



REVIEW

Systematic review of risk factors for eating psychopathology in athletes: A critique of an etiological model

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Abstract

Objective: The theoretical model by Petrie and Greenleaf (2007, 2012) is an admirable attempt to collate the causal factors of disordered eating in athletes. The aims of this systematic review are (a) to provide an overview of the findings from the relevant literature, (b) to assess whether the model is supported by the existing research, (c) to evaluate the different designs, methods, and measures used to test the mediators in the model, and (d) to highlight areas for improvements and future research.

Method: A systematic review of four major online databases identified 37 relevant papers on risk factors of disordered eating in athletes, which were reviewed and critically compared with the theoretical model.

Results: There is a lack of longitudinal research with the relevant mediators in athlete populations, which makes it difficult to determine whether the potential mediators described by Petrie and Greenleaf are causal risk factors rather than simply correlates of disordered eating for athletes. Findings for all the potential mediators are inconsistent, and the range of measures used makes it problematic to draw conclusions.

Conclusions: Future research needs to use gold standard measures and longitudinal designs in order to fully test and possibly update the model.

KEYWORDS

anorexia nervosa, athletes, bulimia nervosa, eating disorder, sport

1 | INTRODUCTION

Eating psychopathology in athletes links the fields of sport, health, and clinical health psychology. Athletes experience pressures unique to the demands of their sport due to the physical and emotional effort required for high levels of competition (Petrie & Greenleaf, 2007, 2012). Like the general population, athletes experience societal pressures to fit a society-determined body ideal. However, for athletes, this societal pressure can be compounded or placed at odds with the pressures of sport, creating a situation ripe for the development of disordered eating (DE; Anderson, Petrie, &

Neumann, 2012; Cooper & Winter, 2017; Greenleaf, Petrie, Carter, & Reel, 2009). Although a number of studies have explored the development of eating pathology in athletes, inconsistency amongst the findings and methodologies has made it difficult to pinpoint causal elements in the development of DE and eating disorders (ED). DE is a collection of disturbed eating patterns and rituals, and unlike an ED, it does not qualify for a clinical diagnosis of anorexia nervosa, bulimia nervosa, or binge ED (see the DSM-V, for diagnostic criteria).

The theoretical model of Petrie and Greenleaf (2007, 2012) collates the research conducted on the causal factors

of DE and pressures unique to competitive athletes (see Figure 1). As Petrie and Greenleaf acknowledge, there is a need to test these mediators with a sporting sample, as the model was created using theory and data from both a general nonsporting sample and previous work on athletes, with mainly only female participants included in both groups. The rationale for choosing this specific model for critique is its comprehensive nature, which gives it the best potential of any theoretical model to become an applied model. Additionally, although a number of models exist to explain the development of ED and DE in the general population and several have applied the model to samples of athletes, this model is the only one specifically designed to include sport pressure as an integral component, in contrast to general clinical models adapted to an athlete population (e.g., Shanmugam, Jowett, & Meyer, 2011). In conducting a review of this particular model, it is hoped that theoretical discrepancies in current research can be exposed, a first step to creating an applied intervention and treatment plan for those athletes suffering from DE and ED. A vast array of studies addresses the subject matter at hand, and this review aims to create a comprehensive overview of how all the relevant findings fit into a solid theoretical foundation.

The model includes eight mediators that Petrie and Greenleaf (2012) describe as “risk factors”; this review also uses these terms interchangeably. The mediators in the model are (a) sport-specific pressures, (b) societal pressures, (c) internalisation, (d) body dissatisfaction, (e) negative affect, (f) restrained eating, (g) modelled behaviours peers and family, and (h) binge eating and bulimia. Although the model also includes moderators, the current review focusses solely on these mediators and on research that specifically investigates them in relation to high-level athletes.

Therefore, the objectives of the current systematic review are as follows:

1 Provide an overview of the existing literature related to the factors in the theoretical model.

2 Assess whether the data from existing literature on DE in athletes support the theory specified in the Petrie and Greenleaf model.

3 Evaluate the quality of different study designs, methods, and measures used to test the mediators from the model and indicate any areas for improvements.

4 Highlight which parts of the model have been adequately tested in research and which areas lack sufficient testing and should be prioritised in future research.

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2 | METHODS

This systematic review began with a key terms search via Ovid-Medline, PsycINFO, JSTOR, and EBSCOhost. The search terms were *disordered eating* or *eating disorder*, *athlete* or *sport*, and *risk*. The initial search returned 689 results. The inclusion criteria specified that articles must use quantitative methodology, be peer reviewed, and have been published after 2000. To be included, studies needed to have one of the mediators from the model as an

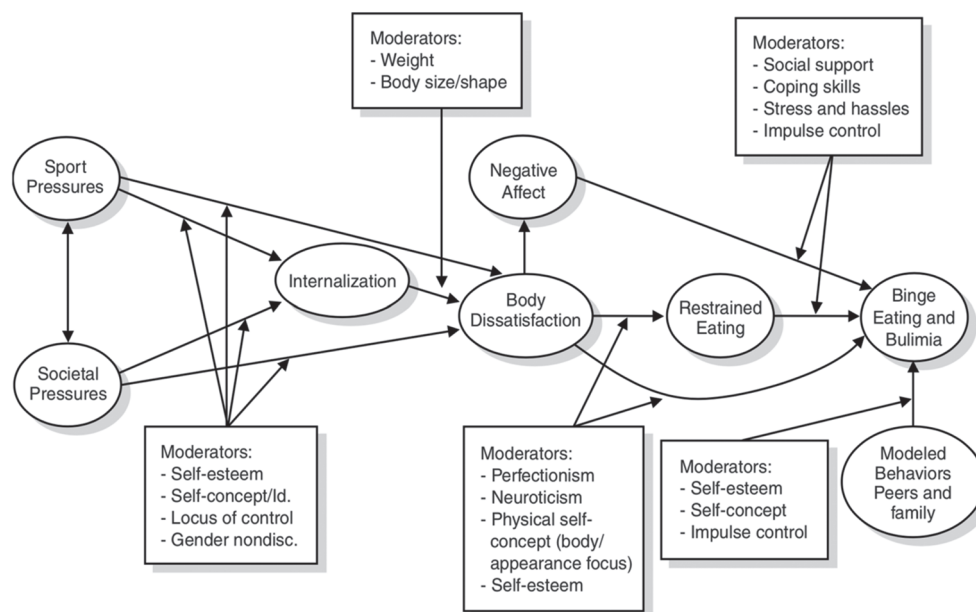


FIGURE 1 Original theoretical etiological model Etiological model showing the interplay of eight risk or causal risk constructs (shown in circles) considered as factors in the development of disordered eating in athletes (Petrie & Greenleaf, 2012)

Etiological model showing the interplay of eight risk or causal risk constructs (shown in circles) considered as factors in the development of disordered eating in athletes (Petrie & Greenleaf, 2012).

independent measure and a dependent measure of DE or ED. See Table 1 for the scales used to measure relevant risk factors and DE or ED. Other reviews and meta-analyses were not included. To ensure that the research included in this review was fully focussed on how the theoretical mediators affected athletes, and not simply frequent exercisers, the inclusion and exclusion criteria were set such that participant samples must include a sample of “high-level” or “elite” athletes, a sample of athletes who train for greater than 10 hr per week or a sample of athletes who represented their country internationally at a junior or senior level. Determinations of what constitutes an athlete is often inconsistent, so this paper followed recommendations by Byrne and McLean (2002) and Kong and Harris (2015). If any criteria were unclear, the authors of the papers were contacted to supply the missing information.

For collegiate athletes, only those in Division I (D1), the most elite athletic division in the National Collegiate Athletics Association (NCAA), were included to ensure a high level of sporting achievement and to control for the wide range of levels found in Division II and Division III universities. All results were imported into Mendeley where results of the search were sorted first by title, then by abstracts, and finally by a full text review of the remaining results. Once

the inclusion and exclusion criteria were applied, 37 papers were included in this review. A quality tool was then used to rate the quality of the remaining research in terms of bias, design, confounders, collection methods, and analysis appropriateness, and the majority of articles were found to be of high quality (Effective Public Health Practice Project, 1998). See Table 2 for quality tool ratings and for related information included in each study.

3 | RESULTS

3.1 | Sport pressures

Petrie and Greenleaf's (2007, 2012) model includes three factors that are hypothesised to affect the prevalence rates of disordered athletes: being an athlete versus a nonathlete, type of sport, (lean vs. non-lean sports; individual vs. team sports), and competition level. Therefore, for this review, the mediator of sport pressure was considered to include these three factors along with a few additional factors outlined below.

The first sport pressure highlighted by the included articles was the mere participation in sport. Byrne and McLean (2002) found athletes to have higher eating pathology than nonathletes, a finding replicated by Krentz and

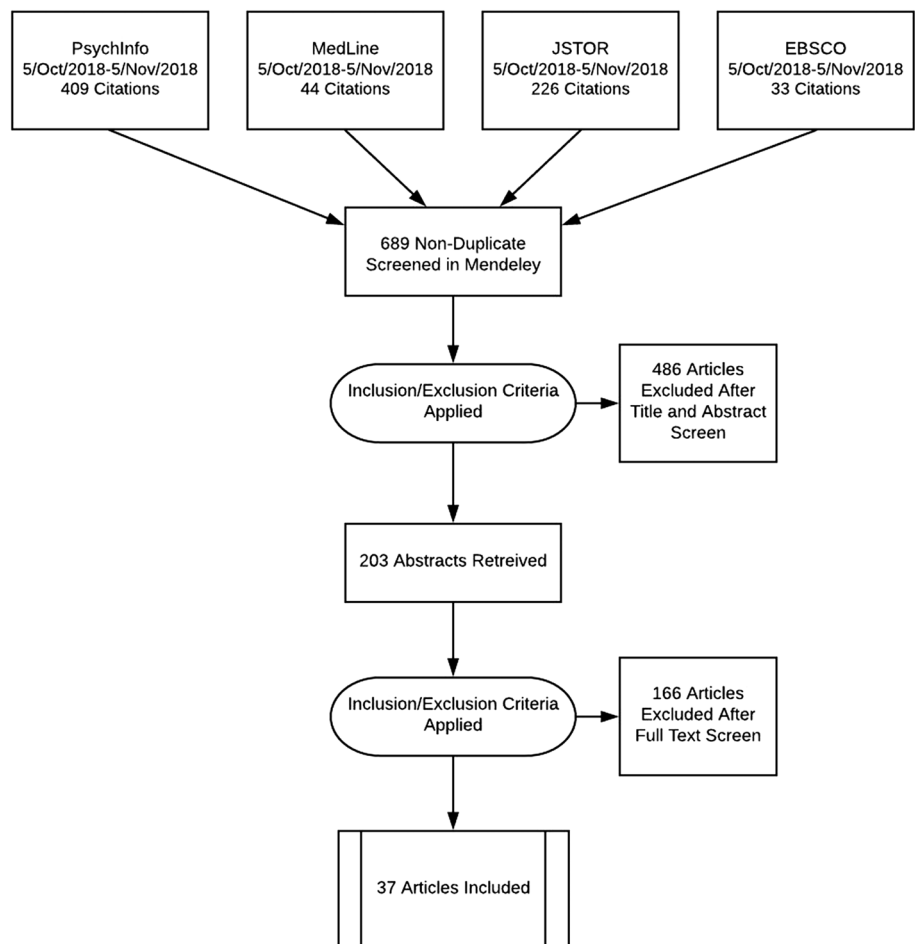


FIGURE 2 Prisma diagram of article selection

Warschburger (2013), Rosendahl, Bormann, Aschenbrenner, Aschenbrenner, and Strauss (2009), and Thiemann et al. (2015). Van Durme and colleagues found the same result with female aesthetic athletes, who demonstrated more eating pathology than controls, but no difference was found in males (Van Durme, Goossens, & Braet, 2012). However, two studies, Wollenberg, Shriver, and Gates (2015) and Reinking and Alexander (2005), failed to find that their

sample of female athletes were at greater risk for developing eating pathology than a nonathlete sample. Similarly, using mixed-gender samples, Rosendahl et al. (2009) found no increased ED risk in elite German high-school athletes and neither did Rouveix et al. in their study of judo athletes compared with nonathlete controls (Rouveix, Bouget, Panafieux, Champely, & Filaire, 2007). In sum, out of nine relevant articles, five found that athletes were at a higher risk, but four others found no difference in DE symptomatology between athletes and nonathletes.

TABLE 1 Measurement tools utilised

Mediator	Measures
Sport pressure	Type of sport: lean versus non-lean; individual versus sport; Being an athlete versus nonathlete control; Level of competition, Coaches' influence
Social pressure	Media, Significant Others; Appearance, Pressure to be Thin; Climate in Social Setting Scale; Appearance Related Social Pressure Adapted for Sport; Social Physical Anxiety; Weight Pressures in Sport Scale; Sociocultural Attitudes Toward Appearance Scale; Appearance Orientation subscale from the Multidimensional Body Self Relations Questionnaire; Beliefs About Attractiveness Scale-Revised
Internalisation	EDI-2 subscale; ATHLETE; Drive for Muscularity; EDE-Q
Body dissatisfaction	EDI-2; Contour Drawing Rating Scale; Difference between current and ideal weight; Choosing Silhouettes; Body Shape Questionnaire; Frankfurt Body Concept Scales; Frankfurt Body Concept Scales; Sport Condition Questionnaire; Figure Rating Scale; Body Parts Satisfaction Scale
Negative affect	Difficulties in Emotion Regulation Scale; Depression Inventory; Patient Health Questionnaire; Children's Depression Inventory; Mood States; Positive and Negative Affect States; Symptom Checklist-90
Modelled behaviours	None
Restrained eating & binge eating and bulimia	EDE-Q subscales; Eating Attitudes Test-26 subscales

Note. There is overlap with many studies looking at more than one risk factor. Abbreviations: EDE-Q, Eating Disorder Examination Questionnaire; EDI, *Eating Disorder Inventory*.

Lean sports are defined as those that rely on a thin physique to be successful, such as horse racing or gymnastics, whereas non-lean sports are defined as those which do not rely on a thin physique for success, such as rugby. Nine studies found that participating in lean sports compared with non-lean sports contributed to eating pathology, either directly or via another mediator, such as increased body dissatisfaction or pressure to be thin (Byrne & McLean, 2002; Francisco, Narciso, & Alarcão, 2012; Kong & Harris, 2015; Krentz & Warschburger, 2011; Milligan & Pritchard, 2006; Reinking & Alexander, 2005; Rousselet et al., 2017; Thiemann et al., 2015; Torstveit, Rosenvinge, & Sundgot-Borgen, 2008). These results suggest that lean sport participants are at greater risk for DE. However, Milligan and Pritchard (2006) found that participating in lean sports was associated with increased DE patterns for male athletes but not for female athletes. In contrast, Rosendahl et al. (2009) found that female elite sport participants were at a greater risk than non-elite female athletes but that this was not the case for their male counterparts. Giel et al. (2016), who focussed on young German athletes in a mixed gender sample, found that participants of weight-class sports, that is, those that classify competition status based on weight, presented a higher ED pathology than those in other sports.

Another cluster of studies examined level of sport participation, for example, national versus international level, as a sport pressure. Three studies (Francisco et al., 2012; Pettersen, Hernæs, & Skårderud, 2016; Voelker, Gould, & Reel, 2014) found that level of competition was not predictive of DE scores. However, one study of high-level male and female gymnasts did find that competing at an international level compared with a national level was associated with higher levels of DE (Tan, Calitri, Bloodworth, & McNamee, 2016). This echoed work by Kong and Harris (2015), who found that DE symptoms were greater amongst elite athletes than amongst those at a recreational level. However, Hopkinson and Lock (2004) found that elite athletes displayed lower levels of DE than recreational level athletes and that the type of sport did not make a difference.

A small number of studies looked into other miscellaneous risk factors that can be categorised under sport pressures. Haase (2009) found that increased social physique

TABLE 2 Overview of included articles

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Anshel (2004)	Cross-sectional	Quasi-experimental	EDI-2 subscales; Food Intake Attitude Survey (developed for this study)	EDI-2	<i>N</i> = 58 female; ballet dancers <i>N</i> = 51 non-dancers <i>M</i> age = 17.1	Pressure from others increased weight control behaviours; Drive for Thinness; Dancers > Non-dancers; Body Dissatisfaction: Dancers < Non-dancers; Bulimia Subscale; Dancers = Non-dancers; EDI-2 Global Score; Dancers = Non-dancers	Strong
Bachner-melman et al. (2006)	Cross-sectional	Quasi-experimental	Brief Symptom Inventory; EDI-2 subscales; Sociocultural Attitudes Towards Appearance; Self-rated single question of attractiveness	EAT-26; EDI-2	<i>N</i> = 458; female; <i>n</i> = 111 aesthetic athletes; <i>n</i> = 31 women with AN; <i>n</i> = 68 nonaesthetic athletes; <i>n</i> = 248 nonathletes controls; ages 13–35 years	Body Dissatisfaction: Nonathlete controls = aesthetic athletes = non-aesthetic athletes. Drive for Thinness: Aesthetic athletes > Other groups; SATAQ and Self-Rated Attractiveness: Aesthetic athletes = non-aesthetic athletes = nonathlete controls	Strong
Bissel (2004)	Cross-sectional	Quasi-experimental	Exposure to thin ideals on TV and magazines in sport and nonsport media; EDI-2 subscales	EAT-26; EDI-2	<i>N</i> = 78; D1 non-lean female athletes; multi-sport; <i>M</i> age = 19	Non-lean athletes exposed thin societal pressures media had lower body image → related to increased disordered eating behaviour	Strong
Byrne and McLean (2002)	Cross-sectional	Quasi-experimental	EDI-2 BD and DT subscales 2; the Bulimia Test-Revised; Restraint subscale of the Three Factor Eating Questionnaire; asked to rate from 0–10 feeling of	Interviewed using Composite International Diagnostic Interview	<i>N</i> = 263 co-ed elite athletes (58% female); <i>n</i> = 263 nonathlete controls; aged 15–36 years	Athletes have higher eating pathology than nonathletes, specifically restraint; Doing lean sports versus non-lean sports → higher eating pathology directly or via mediator; Female	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
de Bruin, Bakker, and Oudejan (2009)	Cross-sectional	Quasi-experimental	sociocultural pressure to be thin/lean Task & Ego Orientation in Sport; Perceived Motivational Climate in Sport; Dieting & weight control frequency; Weight-related coach & peer-pressure	BULIT-R; EDI-2	<i>N</i> = 94 female aesthetic performers; <i>n</i> = 59 gymnasts; <i>n</i> = 35 dancers; M age = 15.1	athletes feel more pressure to fit a lean ideal versus male athletes Aesthetic performers at a greater risk for disordered eating; high ego orientation and perceptions of the performance climate contributed to increased disordered eating for athletes	Strong
Ferrand, Magnan, Rouveix, and Filaire (2007)	Cross-sectional	Correlational	Dutch Eating Behaviour Questionnaire-Restraint Scale; Self-report of eating behaviour, weight control techniques, and desired weight	Dutch Eating Behaviour Questionnaire	<i>N</i> = 33 elite female synchronized swimmers; M age = 17.1	Results focused on factors not relevant for this review	Strong
Francisco, Narisco, and Alarção (2012)	Cross-sectional	Quasi-experimental	Pressure to be Thin and Social Support; Body Dissatisfaction with Contour Drawing Rating Scale	EDE-Q	<i>N</i> = 249 female and male ballet dancers and gymnasts; M age = 15.4	Social support or level of competition did not play a role in disordered eating development; Pressure from coaches was related to higher EDE-Q scores; Ps felt pressure to be thin, sport-related and general body dissatisfaction → elevated levels of disordered eating	Strong
Galli et al. (2014)	Cross-sectional	Quasi-experimental	Appearance Orientation Scale	Q-EDD	<i>N</i> = 203 Male D1 NCAA athletes; M age = 20.3	Appearance Orientation scale results was not found to be significantly related to eating disorder psychopathology	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: N, Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Gapin and Keams (2013)	Cross-sectional	Quasi-experimental	EDI-2 Subscales	Q-EDD	N = 133 male and female rowers in lightweight and open categories; M age = 19.8	Lightweight category athletes showed higher drive for thinness; male athletes had higher rates of disordered eating, but female athletes had higher body dissatisfaction	Strong
Ciel et al. (2016)	Cross-sectional	Quasi-experimental	Frankfurt Body Concept; Patient Health Questionnaire-4 (depression and anxiety)	Structured Inventory for Anorexic and Bulimic Disorders	German co-ed elite athletes N = 1138; age range from 23–25 years	Weight class sports Ps had higher eating disorder pathology versus non-aesthetic sport Ps; Female athletes lower on body acceptance than males; Anxiety associated with higher eating disorder pathology	Strong
Gomes, Martins and Silva (2011)	Cross-sectional	Correlational	EDE-Q subscales; Sport Condition Questionnaire; Sport Anxiety Scale; TEOSQ; Cognitive Evaluation of Sport-Threat Perceptions; Self-Presentation Exercise Questionnaire	EDE-Q	N = 290 co-ed Portuguese elite athletes; M age = 17.8	No sport variables, level of athlete, team or individual or pressure from coaches' comments contributed to disordered eating; eating disorder psychopathology predicted by lower scores in satisfaction of body shape	Strong
Haase (2009)	Cross-sectional	Quasi-experimental	Social physique anxiety Eating Attitudes Test subscales (EAT-26)	EAT-26	N = 137; female athletes in team sports versus individual sports; M age = 19.5	Social pressure → increased disordered eating; Increased social physique anxiety → increased disordered eating when moderated by sport type; and female individual sport participants, who exhibit more social physique	Strong

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TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Herbrich et al. (2011)	Cross-sectional	Quasi-experimental	EDI-2 subscales; The Multidimensional Self-Concept Scale	Structured Inventory for Anorexic & Bulimic Eating Disorders; EDI-2	<i>n</i> = 52 pre-professional ballet dancers versus <i>n</i> = 52 AN patients versus <i>n</i> = 44 nonathlete controls; M age = 16.4	Dancers higher on body dissatisfaction subscale, larger difference between current and ideal weight, higher drive for thinness than controls; Dancers and controls healthier than patients on all scales	Strong
Hopkinson and Lock (2004)	Cross-sectional	Quasi-experimental	EAT-26 subscales; Level of athletic competition	EDI-2; EDE-Q	<i>N</i> = 257 male and female athletes; varsity and recreational level at Stanford (D1); ages between 18–22 years	Female athletes higher on restraint scale and overall eating disorder pathology than male athletes; Elite athletes > disordered eating than recreational level athletes; Sport type not relevant; Weight and shape concern related to increased disordered eating for both levels	Strong
Kerr et al. (2006)	Cross-sectional	Correlational	Surveys were designed by the principal author for the purposes of the study.	Surveys designed specific for this study.	<i>N</i> = 95 female active gymnasts; M age = 14.4	Impact of coaches and teammates increased disordered eating symptoms; gymnasts low on body dissatisfaction compared with norm	Moderate
Kong and Harris (2015)	Cross-sectional	Quasi-experimental	EAT-26 subscale; Figure Rating Scale: current, ideal, sport; General body dissatisfaction and sporting body dissatisfaction	EAT-26	<i>N</i> = 320 elite, recreational, female athletes in lean and non-lean sports; ages 17–30 years	Lean sports and elite level increased eating pathology directly or via mediator (body dissatisfaction or pressure to be thin) compared with non-lean sport	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Krentz and Warschburger (2011)	Cross-sectional	Quasi-experimental	EAT-26; Body dissatisfaction EDI-BD; Contour Drawing Rating Scale (sports-related body dissatisfaction); ATHLETE drive for thinness and performance; Social pressure from sports environment (Appearance-Related Social Pressure adapted to sport)	EAT-26	<i>n</i> = 96 elite athletes from aesthetic sports and <i>n</i> = 96 matched controls; both girls and boys; ages 11 to 18 years	Lean sport participation contribute to eating pathology; Social pressure affected disordered eating mediated by wanting to be leaner for sport performance; Aesthetic athletes and nonathletes measured the same for general body dissatisfaction, but that body dissatisfaction still associated with disordered eating; Sports-related body dissatisfaction did not predict disordered eating	Strong
Krentz and Warschburger (2013)	Longitudinal	Correlational	Contour Drawing Rating Scale; desire to be leaner to improve performance (adapted from ATHLETE); Appearance-Related Social Pressure adapted to sport)	EAT-26	<i>N</i> = 65 aesthetic sport athletes; male and female; ages 11 to 18 years	Aesthetic athletes at higher risk for disordered eating when thought sport performance could improve by changing weight and shape; Body dissatisfaction was not relevant for disordered eating development	Moderate
Milligan and Pritchard (2006)	Cross-sectional	Quasi-experimental	Body Shape Questionnaire	EAT-26		Lean sports contributed to eating pathology for	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Neves et al. (2017)	Longitudinal	Correlational	Body Shape Questionnaire; Media internalisation; the Sociocultural Attitudes Towards Appearance Questionnaire-3 (SATAQ-3); Brunel Mood Scale	EAT-26	<i>N</i> = 176 D1 male and female athletes; lean and non-lean; M age = 19.8	males; Non-lean female athletes at greater risk for disordered eating patterns; Athletes' disordered eating pos. Related to body dissatisfaction for both genders	Weak
Nordin-Bates et al. (2016)	Longitudinal	Quasi-experimental	Perceived Motivational Climate in Sport Questionnaire 2	EAT-26	<i>N</i> = 597, male and female teenage dancers;; M age = 14.7	Aesthetic sport Ps higher on the SATAQ; Disordered eating levels fluctuated depending point in season; Disordered eating predicted body dissatisfaction levels; Neg. mood state associated with lower body dissatisfaction and thus disordered eating	Strong
Petrie et al. (2014)	Cross-sectional	Correlational	Positive and Negative Affective States scale; Body Parts Satisfaction Scale Revised; Dietary Intent Scale; Drive for Muscularity Scale; Social desirability; Marlowe-Crowne Social Desirability	6-item Bulimia Test-Revised	<i>N</i> = 203 Male D1 NCAA athletes;; M age = 20.3	Dietary restraint and drive for muscularity significantly impact bulimia symptomology	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: N, Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Petrie et al. (2009a)	Cross-sectional	Quasi-experimental	Psychological Well-Being; Life Orientation Test-Revised; Reasons for Exercise Inventory; Appearance Orientation subscale from Multidimensional Body Self Relations Questionnaire	Q-EDD	N = 204 D1 female athletes;; M age = 20.2	Appearance orientation and using exercise as a means to increase attractiveness partially, and significantly, explained level of disordered eating symptomology across multiple sports	Strong
Petrie et al. (2009b)	Cross-sectional	Quasi-experimental	Weight Pressures; Mood scale; Beliefs About Attractiveness Scale-Revised; Body Parts Satisfaction Scale-Revised; Appearance Evaluation subscale from Multidimensional Body-Self Relations Questionnaire	Q-EDD	N = 442 female athletes DI;; M age = 19.7	Pressure from others affected the eating disorder symptomology; Lower body dissatisfaction related to increased eating disorder symptomology; Shame and guilt higher in those with eating disorders	Strong
Pettersen, Hemaes and Skårderud (2016)	Cross-sectional	Quasi-experimental	EDI-2 subscales; The sociodemographic variables	EDI-2	Norwegian female junior cross-country skiers and biathletes (n = 262)	Level of competition not predictive of disordered eating scores nor was type of sport; Attendance of an elite high school impacted disordered eating development via drive for thinness, which may be related to social expectations and pressure	Strong
Reinking and Alexander (2005)	Cross-sectional	Quasi-experimental	EDI-2 and its subscales	EDI-2	N = 146 and n = 84 female NCAA D1 athletes (divided into lean and non-lean) and	Athletes = nonathletes for eating pathology; Lean sport participation related to development of an	Moderate

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Rosendahl et al. (2009)	Cross-sectional	Quasi-experimental	Body image and body ideal were measured with male and female silhouettes representing different weight categories	EAT-26	nonathletes <i>n</i> = 62; M age athletes = 19.7 <i>N</i> = 576 elite German high school athletes in grades 5–12 and <i>n</i> = 291 non athletes from regular high schools, co-ed sample	Lean sport participants and elite athletes more vulnerable for disordered eating than non-lean sport and non-elite athletes, but only for females; Athletes had higher body dissatisfaction, linked to disordered eating, if had been dieting	Moderate
Roussellet et al. (2017)	Cross-sectional	Quasi-experimental	EDI-2 subscales; Athlete's dietary habits using 24 hours recall interview, and food frequency; Psychological assessment Variables were collected using the Interview Grid for Multidimensional Assessment of Athletes	EDI-2; interview and somatic assessment	<i>N</i> = 340 French high-level athletes (lean vs. non-lean); minimum age of 12	Athletes with disordered eating had higher scores on the body dissatisfaction subscale and had larger discrepancies between current and ideal weight; Athletes who skipped meals or restrained caloric intake were more likely to show disordered eating symptomology	Strong
Rouveix et al. (2007)	Cross-sectional	Quasi-experimental	Athletic involvement, training regimen, weight history, eating-related behaviours; eating patterns; Weight satisfaction, and state whether they wished to	EAT-26	<i>N</i> = 24 Judo athletes (male and female) and <i>n</i> = 31 non athlete controls; M athlete age = 16.9	Female athletes higher on Global EAT scores vs male athletes. Female athletes showed higher eating pathology than controls and scored higher bulimia	Strong

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TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: N, Gender, and sport	Relevant primary outcome	Quality tool rating (EPHP)
Scoffier et al. (2010)	Cross-sectional		lose or gain weight; EAT-26 subscales; Profile of Mood States Sport Friendship Quality Scale Coach Relationship Quality; French version of the Marsh (1990) Self-Description Questionnaire (SDQ-II) subscales	EAT-26	N = 227 elite adolescent female athletes engaged in various aesthetic sports; M age = 15.8	athletes = nonathletes for mood states Coaches and teammates, through comments or general pressure was related to more disordered eating symptoms; Parent-athlete relationships do affect on disordered eating psychopathology	Strong
Tan et al. (2016)	Cross-sectional	Quasi-experimental	EDE-Q subscales; Beck Depression Inventory	EAT-26; EDE-Q	N = 51 male and female gymnasts; age range 10–25 years	Depression related to heightened disordered eating; Weight and shape concern directly related to increased disordered eating; International gymnasts higher on restraint than national level counterparts	Strong
Thiemann et al. (2015)	Cross-sectional	Quasi-experimental	EDE-Q Subscales; SEDI-2 subscales; Clinical Interview for DSM-IV Axis I Disorders; Patient Health Questionnaire (screening for mental disorders); Sociocultural Attitudes Towards Appearance Scale (SATAQ-3); ATHLETE	EDE-Q; EDI-2	N = 108 German female professional athletes aged 12 to 34 years and N = 108 age-matched female nonathletes	Lean sports compared with non-lean sports at greater risk for eating disorder directly and via increased body dissatisfaction or pressure to be thin; Aesthetic sport athletes higher eating disorder symptomology than nonathlete controls; Aesthetic athletes had a higher drive for thinness; Athletes = controls in dissatisfaction ratings,	Strong

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: <i>N</i> , Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Torres-GcGehee et al. (2011)	Cross-sectional	Quasi-experimental	Body disturbance with sex-specific BMI silhouettes	EAT-26	<i>N</i> = 138 (mean age = 19.88 years). English riding (<i>n</i> = 91) & Western riding (<i>n</i> = 47)	Equestrian riders at risk for developing disordered eating due to the sport-specific pressures; Body dissatisfaction not different between types of equestrian athlete	Moderate
Torstveit, Rosenvinge, and Sundgot-Borgen (2008)	Cross-sectional	Quasi-experimental	Questions regarding menstrual, body weight, training, injury, and dietary history, physical activity patterns, nutritional habits, use of pathogenic weight control methods and self-reported EDs; EDI-2 Subscales; EDE Interview	EDI-2; EDE Interview	<i>N</i> = 938 female athletes (ages 13–39); <i>N</i> = 900 controls (<i>n</i> = 900)	Aesthetic sports contributed to eating pathology; Dietary behaviours was related to disordered eating	Strong
Van Durme, Goossens, and Braet (2012)	Cross-sectional	Quasi-experimental	Sport Competition Anxiety Test; Competitive State Anxiety Inventory-2; Dutch Eating Behaviour Questionnaire; EDI-2 subscales; Children's Depression Inventory	Children's Eating Disorder Examination Questionnaire; EDI-2	<i>N</i> = 68 adolescent aesthetic athletes; age range 11–21 years	Aesthetic sport athletes higher eating disorder symptomatology than nonathlete controls; Female aesthetic athletes more eating pathology than controls, difference was not in male athletes; Weight and shape concern, drive for thinness, bulimic	Weak

(Continues)

TABLE 2 (Continued)

Author (date)	Method	Design	Relevant mediator measure(s)	ED/DE outcome measure	Participant information: N, Gender, and sport	Relevant primary outcome	Quality tool rating (EPHPP)
Voelker, Gould, and Reel (2014)	Cross-sectional	Quasi-experimental	Weight Pressures in Sport Scale-Females; General and sport-related body dissatisfaction--The Contour Drawing Rating Scale	EAT-26; EDE-Q	N = 272 female figure skaters ages 12–25	Level of competition (sub-elite vs elite) not predictive of disordered eating scores, but those scored higher in competition also scored higher on restraint subscale; Weight and appearance linked to disordered eating in females; Both types of body dissatisfaction positively correlated with disordered eating	Strong
Wollenberg, Shriver, and Gates(2015)	Cross-sectional	Quasi-experimental	EAT-26 subscales; Difficulties in Emotion Regulation Scale	EAT-26	540 female NCAA DI college students (n = 389 nonathletes; n = 151 athletes)	Female athletes not at greater risk for developing eating pathology compared with nonathletes; Nonathletes scored higher on the subscale and therefore on the overall EAT score; Athletes had better emotion regulation and a lower rate of disordered	Strong

behaviours, and dieting elevated and related to increased disordered eating behaviours for the female athletes; Nonathlete = aesthetic athletes = non-aesthetic athletes for body dissatisfaction; Higher competition state anxiety related to more disordered eating pathology

Level of competition (sub-elite vs elite) not predictive of disordered eating scores, but those scored higher in competition also scored higher on restraint subscale; Weight and appearance linked to disordered eating in females; Both types of body dissatisfaction positively correlated with disordered eating

Female athletes not at greater risk for developing eating pathology compared with nonathletes; Nonathletes scored higher on the subscale and therefore on the overall EAT score; Athletes had better emotion regulation and a lower rate of disordered

anxiety is associated with increased DE when moderated by sport type and that female individual sport participants who exhibit more social physique anxiety also show increased dieting and bulimic behaviours. In 2017, Neves et al. showed that DE levels fluctuated depending on the point in the season, for instance, competing at championships versus during the off-season, with higher levels of DE found at the precompetition stage. The impact of coaches and teammates, either through their comments or through athlete-perceived general pressure to look a certain way or to perform well, was associated with DE symptoms in three studies (Kerr, Berman, & Souza, 2006; Kong & Harris, 2015; Petrie, Greenleaf, Reel, & Carter, 2009b; Scoffier, Maïano, & d'Arripe-Longueville, 2010). Two further studies found that a high ego orientation and a performance climate—rather than a mastery climate—was associated with higher ED behaviours for athletes (de Bruin, Bakker, & Oudejans, 2009; Nordin-Bates et al., 2016). However, Gomes, Martins, and Silva (2011) found that none of the sport variables, level of athlete, team or individual, or pressure from coaches' comments were associated with DE.

In summary, there is a lack of consistency in the evidence regarding the relationship between sport pressures and DE. The three main sport pressures examined, namely, participation, type, and level, only show relation to DE when gender or sport type or another caveat was accounted for, making it difficult to advance any firm overarching claims about the nature of the relationship between sport pressures and DE.

3.2 | Societal pressures and internalisation of an ideal

For women and girls, the pressure to be thin, and for men, the pressure to be muscular, is far reaching and pervasive (Petrie & Greenleaf, 2007, 2012). These pressures stem from both the media and from people within an athlete's family and social circle (Andersen & DiDomenico, 1992; Grogan, 2016). However, when pressures came from coaches or teammates, these were categorised as sport pressures and discussed in the section above, but the distinction of social factors that exist within or outside sport can be blurry.

Societal pressures have been found to be most detrimental in terms of their relationship to DE symptomology if internalised, as they then affect the athlete's own body satisfaction (Fredrickson & Roberts, 1997; Stice & Shaw, 2002). Thus, internalisation of the thin ideal occurs when any negative discrepancies between one's own body and the body that is perceived as ideal by societal standards are incorporated into the psyche (Petrie & Greenleaf, 2007; Thompson & Stice, 2001). In the general population, there is evidence that internalisation of the thin ideal acts as a mediator between societal pressures and body dissatisfaction (Lester & Petrie, 1995; Stice & Agras, 1998). When determining which of the

included studies incorporated societal pressures or internalisation, studies that measured perceptions of appearance, the pressure to be thin, or the drive for thinness, or those that used scales that have a specific social aspect or mentions of internalisation, were included. Table 1 shows which measurement scales were used in each study.

Examining an athlete's day-to-day social and societal interactions, Anshel (2004), Krentz and Warschburger (2011), Petrie et al. (2009b), Pettersen et al. (2016), and Haase (2009) all found that elements of the social sphere such as not wanting to give a negative impression, wanting to match stereotypical societal expectations, attending elite schools, and experiencing general social pressure in the environment were associated with more DE. Scoffier et al. (2010) showed that a healthy parent-child relationship can act as a protective factor against DE behaviour. The role of gender was assessed with Byrne and McLean's study in 2002, which demonstrated that female athletes felt more pressure than males to fit a lean ideal, but that males in lean sports were still at risk of an ED compared with nonathlete controls. However, Francisco et al. (2012) highlighted that both male and female ballet dancers and gymnasts feel pressure to be thin and that coach pressure was a factor in DE development, but that overall social support was not. Bissell (2004) was the only included study to examine media influence, finding that when non-lean athletes were exposed to media that portrayed societal pressures for thinness, it was associated with increased DE.

Four studies measured social perceptions of appearance. Three studies used the Sociocultural Attitudes Toward Appearance Scale (SATAQ; Calogero, Davis, & Thompson, 2004). Bachner-melman, Zohar, Ebstein, Elizur, and Constantini (2006) found that there were no significant differences in scores amongst aesthetic athletes, non-aesthetic athletes, and nonathlete controls in terms of the measure, nor did they differ in terms of a self-rated attractiveness question. Neves et al. (2017) conducted a longitudinal study with young gymnasts and did not find that the scores on the SATAQ contributed significantly to DE pathology in their sample. However, Thiemann et al. (2015) found that athletes in aesthetic sports scored higher on the SATAQ in terms of both pressure and the internalisation of that pressure. Voelker et al. (2014) used the Weight Pressures in Sport Scale and showed that self-consciousness regarding weight and appearance was linked to disordered eating in female figure skaters.

Work from Petrie, Greenleaf, Reel, and Carter (2009a) and Petrie et al. (2009b) found that appearance orientation and using exercise as a means to increase attractiveness partially and significantly explained the level of disordered eating symptomology across multiple sports for female athletes. Conversely, for male D1 NCAA collegiate athletes,

appearance orientation was not significantly related to ED psychopathology (Galli, Petrie, Greenleaf, Reel, & Carter, 2014).

Several studies found that lean athletes, a population already established to have higher prevalence rates for DE and EDs, had a higher drive for thinness than nonathletes or norm populations (Bachner-melman et al., 2006; Byrne & McLean, 2002; Gapin & Kearns, 2013; Herbrich, Pfeiffer, Lehmkuhl, & Schneider, 2011; Rousselet et al., 2017; Thiemann et al., 2015; Torstveit et al., 2008; Van Durme et al., 2012). Anshel (2004) and also found that ballet dancers reported a higher drive for thinness, which was related to elevated-weight control behaviours compared with nonathletes but found that their overall Eating Disorder Inventory-2 (EDI-2) scores did not differ significantly. Petrie, Galli, Greenleaf, Reel, and Carter (2014) examined the drive for muscularity, an internalisation of an ideal more applicable to men, in a sample of male D1 athletes. This study found that this internalised drive for muscularity was significantly correlated with bulimic symptomology. Krentz and Warschburger (2013) analysed the desire to be leaner so as to improve performance and found that this desire correlated with DE in elite aesthetic sport athletes.

Finally, three papers used the Eating Disorder Examination Questionnaire (EDE-Q) subscales, which measure shape concern and weight concern to determine social pressure and internalisation scores. All three found that the scores on the subscales were associated with increased DE behaviours in their respective samples (Hopkinson & Lock, 2004; Tan et al., 2016; Van Durme et al., 2012).

In summary, many studies showed that social pressures and internalisation were related to DE pathology for athletes; however, as with sport pressures, there were some differences based on gender. With most studies focussing on lean or aesthetic sports, sport type must be accounted for before any robust claims can be made.

3.3 | Body dissatisfaction

As described in the original work by Petrie and Greenleaf, body dissatisfaction occurs when one perceives a negative disparity between one's own body and an internalised ideal, often a thin ideal (Hargreaves & Tiggemann, 2003; Stice & Shaw, 2002). Body dissatisfaction is understood to be key to the development of DE, as seen in the Petrie and Greenleaf model and in other research in nonathlete populations (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004). Of note, it may be the case that athletes are satisfied that their body matches a societal ideal, but not sport-specific ideal, or vice versa (Kong & Harris, 2015).

Ten studies in this area used the body dissatisfaction subscale of the EDI-2. Despite the widespread use of this measure, the samples differed in each case, so comparisons

are difficult. Looking at the relationship between body dissatisfaction and DE in athlete samples compared with nonathlete samples, one study found that athletes and nonathletes did not differ in body dissatisfaction ratings but that body dissatisfaction was still a significant predictor of DE (Thiemann et al., 2015). Similarly, Bachner-Melman et al. (2006), Van Durme et al. (2012), and Byrne and McLean (2002) found that nonathletes, aesthetic athletes, and non-aesthetic athletes did not differ significantly in terms of body dissatisfaction. Yet another study found that dancers had lower body dissatisfaction compared with non-dancers but that both groups had similar global EDI scores, suggesting similar levels of ED symptoms (Anshel, 2004).

Gender also plays a role, with Reinking and Alexander (2005) showing that female lean-sport athletes scored higher on the EDI-2 subscale than non-lean sport athletes and discovered that, in general, athletes had lower body dissatisfaction than published norms. Furthermore, a study that compared male and female athletes found that although males had higher rates of DE, it was the female athletes who had higher body dissatisfaction (Gapin & Kearns, 2013).

Still utilising the EDI-2, Bissel (2004) found that non-lean athletes reported increased levels of body dissatisfaction and ED behaviours when exposed to societal pressures for thinness in the media compared with those who looked at media which did not specifically promote the thin ideal. Finally, Rousselet et al. (2017) and Herbrich et al. (2011) both found that those high-level athletes and pre-professional dancers who had DE symptomology showed higher scores on the body dissatisfaction subscale and displayed larger discrepancies between current and ideal weight; however, the athlete groups had better overall body satisfaction and positive attitudes about themselves than nonathlete patients with anorexia nervosa.

Another seven studies measured body dissatisfaction using drawing scales or silhouettes, some of which allow for the separation between general body dissatisfaction and sport-related body dissatisfaction (Thompson & Gray, 1995). The work of Francisco et al. (2012) found that sport-related body dissatisfaction specific to aesthetic sports as well as general body dissatisfaction was directly linked to elevated levels of DE in dancers and gymnasts and that overall, males were more satisfied with their bodies. Krentz and Warschburger (2011) echoed the results of Bachner-Melman et al. (2006), Van Durme et al. (2012), and Byrne and McLean (2002) finding no differences between aesthetic athletes and nonathletes in terms of general body dissatisfaction. They also found that higher body dissatisfaction was associated with DE, which was more pronounced in the athlete group. Torres-McGehee et al. (2011) did not find that body dissatisfaction differed amongst different types of equestrian athletes or that body dissatisfaction was related to

DE. Additionally, Krentz and Warschburger (2013) found that sports-related body dissatisfaction did not predict DE symptoms in the aesthetic athletes tested. However, Voelker et al. (2014) established that both types of body dissatisfaction correlated with DE when studying female figure skaters, which is consistent with the theory proposed by the etiological model. Finally, Rosendahl et al. (2009) found that athletes showed greater dissatisfaction with their bodies if they had been dieting, which was linked to DE for those participants (Stice & Shaw, 2002).

An additional eight studies measured body dissatisfaction and its relationship to DE with varying tools (see Tables 1 and 2). Giel et al. (2016) found that female athletes scored lower on body-acceptance measures. Gomes et al. (2011) determined that ED psychopathology was predicted by lower satisfaction related to body shape. Kong and Harris's (2015) results showed that athletes in lean sports had higher body dissatisfaction than non-lean athletes and nonathletes, with those at an elite level choosing the leanest body shape as ideal. Kerr, Berman, and Souza (2016) showed that current gymnasts rated themselves as heavier than they wanted to be on scales that the researchers designed specifically for the study. Milligan and Pritchard (2006) used the Body Shape Questionnaire (Cooper, Taylor, Cooper, & Fairbum, 1987) and found that male and female athletes' DE was related to body dissatisfaction levels. Furthermore, research conducted by Petrie et al., 2009b and Petrie et al., 2014 found in both studies that body dissatisfaction in terms of muscularity for males was positively correlated to ED symptoms in high-level collegiate athletes across different sports; however, this result was no longer significant in the 2014 study once physical size and social desirability were controlled for. These findings contrast with the longitudinal study by Neves et al. (2017), which determined that DE predicted higher levels of body dissatisfaction on the Body Shape Questionnaire, indicating that perhaps the directionality indicated in the etiological model should be reconsidered.

In summary, an array of studies has looked into the relationship between body dissatisfaction and eating pathology with results being largely inconsistent between studies. With gender, level, sport type all not controlled for, it is difficult to critically compare findings despite several of the studies using the same or similar tools.

3.4 | Negative affect

Petrie and Greenleaf (2012) discuss negative affect in conjunction with dietary restraint, with both acting as mediators between body dissatisfaction and bulimic behaviours. However, research has shown negative affect to be a valid independent predictor of EDs in athletes due to its relationship with compulsive exercise (Fairburn et al., 2003; Goodwin,

Haycraft, & Meyer, 2016; Plateau, Arcelus, & Meyer, 2017). Petrie and Greenleaf (2007, 2012) discuss how negative affect can also trigger binge eating, thus invoking it as a risk factor for the development of DE, yet they do not give any details of how negative affect should be measured. Therefore, this review has included any studies that examined mood, affect, or emotions, as well as those which measured depression and anxiety.

Six of the ten included articles found that negative emotions and mood, or heightened depression and anxiety measures, were positively correlated with ED/DE pathology in athletes. Wollenberg et al. (2015) found that athletes who had a lower rate of DE were better at regulating their emotions. Tan et al. (2016), Van Durme et al. (2012), and Giel et al. (2016) all found that heightened depression or anxiety symptoms, either state or trait, were related to heightened DE symptoms. Finally, mood state was found to partially contribute to levels of body dissatisfaction, which was in turn related to eating pathology (Neves et al., 2017).

In one of the few studies to look specifically at affect, Petrie et al. (2014) used a 23-item version of the Positive and Negative Affect Schedule (Crawford & Henry, 2004) and found that, once they had controlled for physical size and social desirability, there was no significant association between affect and DE. Similarly, Rouveix and associates (2017) did not find differences in mood states between athletes and nonathletes and found no differences in DE pathology between the groups. Finally, Petrie et al. (2009b) using a five-item mood scale (Stice & Shaw, 1994) found that shame and guilt were higher in those with EDs; however, the other emotions such as anxiety, shame, confidence, and sadness did not differ between groups.

3.5 | Modelled behaviours peers and family

None of the included articles investigated modelled behaviours. In the original chapter, modelled behaviours are defined as partaking in DE behaviours because it is sanctioned as acceptable or encouraged by the larger group, or developing this type of pathology due to exposure to it in the group, and internalising it as normal or expected (Petrie & Greenleaf, 2007).

3.6 | Restrained eating and binge eating and bulimia

The final two mediators suggested by Petrie and Greenleaf invite criticism in that they are deemed to be mediators acting as risk factors when, in fact, certain levels of restrained eating, binge eating, and bulimia are part DE of and clinical EDs. Hence, it is not appropriate to use ED symptoms as a risk factor for DE/ED itself. Restrained eating is

hypothesised to be linked to binge eating and bulimia due to intense hunger leading to binges and the following guilt resulting in purging behaviour (Stice, 2002; Stice & Agras, 1998). However, the original model does not distinguish between restraint and restriction of food intake: Restriction is defined as the behaviour of restricting intake to lose weight or to prevent weight gain, whereas restrained eating encompasses both actual and attempted restriction (Anokhina & Serpell, 2012; Laessle, Tuschl, Kotthaus, & Prike, 1989). Several studies examined dietary restraint as a separate mediator by using the restraint subscale of the EDE-Q; although notably, this subscale contains a mixture of items measuring restriction and restraint.

Tan et al. (2016) found that international gymnasts scored higher on the restraint subscale than their national-level counterparts. Hopkinson and Lock (2004) found that female athletes scored higher on the restraint scale than male athletes. Voelker et al. (2014) found that it was those athletes with better competition results who scored highest on the restraint subscale.

Using a variety of scales (see Tables 1 and 2), Petrie et al. (2014), Rousselet et al. (2017), and Torstveit et al. (2008) found that dietary behaviours were related to bulimic symptomatology and DE in their respective studies. Byrne and McLean (2002) indicated that both male and female athletes differed significantly compared with male and female nonathletes, with athletes scoring higher on dietary restraint.

The Eating Attitudes Test (EAT-26) also consists of relevant ED-related subscales: Dieting, Bulimia and Food Preoccupation, and Oral Control (Garner, Olmsted, Bohr, & Garfinkel, 1982). Rouveix et al. (2007) found that female judo players had significantly higher overall EAT scores as well as higher scores on the bulimia subscale of the EAT than female nonathlete controls. They also had higher overall EAT scores than their male counterparts. Although Wollenberg et al. (2015) found that nonathletes scored higher on the bulimia subscale and on the overall EAT score, in 2015, Kong and Harris highlighted that athletes in lean sports had an increased rate of self-induced vomiting and laxative use compared with non-lean sport participants.

Using the Children's EDE-Q (Decaluwé & Braet, 1999), Van Durme et al. (2012) found that, compared with a norm group, female adolescent athletes showed more dieting behaviour, and using the EDI-2, they showed that these athletes also engage in more bulimic behaviours than adolescent nonathletes. However, Anshel (2004) did not find any significant difference on the bulimia subscale of the EDI-2 when conducting research on dancers and nonathlete controls.

In summary, restraint and binge eating and bulimia behaviours were linked to DE in athletes, but significant

gender and sport type differences exist. However, inconsistency in whether athletes score higher than nonathletes still remains.

4 | DISCUSSION

The theoretical model by Petrie and Greenleaf (2007, 2012) is an admirable attempt to collate the factors that may be linked to DE in athletes. The aim of the current review was to assess research which examined parts of the model to determine to what extent the theory presented in the model has been verified in the existing data. However, several methodological issues complicated this effort.

The lack of longitudinal studies with the relevant mediators in athlete populations makes it impossible to determine whether the potential mediators described by Petrie and Greenleaf are risk or causal risk factors rather than simply correlates of DE/ED. Only three of the 37 papers reviewed were of longitudinal design. The findings with respect to all the potential mediators are inconsistent and equivocal, and the range of measures used makes it difficult to draw overarching conclusions.

Furthermore, the definition of a mediator in this model may need to be revisited. By definition, a mediator is “a variable that reduces the size and/or direction of the relationship between a predictor variable and an outcome variable and is associated statistically with both” (Field, 2009). However, in the depicted model, it is not clear which are the predictor variables and which are the outcome variables. All the factors in the model are termed mediators or moderators, which is statistically unfitting, as this means that no independent or dependent variables are identified. For example, it is not clear whether social and sport pressures are the predictor variables and whether “restrained eating” and “binge eating and bulimia” are mediators or outcomes. If they are mediators, then no outcome—such as the development of DE—appears in the model.

The research investigated showed methodological inconsistency in terms of research design, sample criteria, and measures used. A wide range of questionnaires, terminology differences, and shifting sample inclusion criteria has led to inconsistent findings that not only stall research but also limit progress in applied care and treatment for the athletes affected by DE and EDs (Hausenblas & McNally, 2004). The included studies all had differing samples in terms of gender, age, and type of athlete. Some included controls, whereas others did not (see Table 2). The measurement tools for both predictor and outcome variables varied, as do the measures, with some studies favouring the EDI-2, others the EAT-26, others the EDE-Q, and still others the QEDD, and with some formally assessing for EDs and others examining DE as the primary outcome (see Table 1). The lack of

cohesive methodology means that drawing overall conclusions about what research has determined to be risk factors of DE in athletes is problematic.

Another widespread methodological issue that arose was that a number of studies used subscales of larger measures, such as the body dissatisfaction subscale of the EDI-2, then claimed that high scores of the subscales meant a significant relationship with ED symptomology that was measured by the global score of that same scale. This review reported these measures as reported by the included studies, but this method has questionable validity because when a subscale rating of a scale increases, the global score of course also increases, and this is not evidence of any meaningful relationship.

The current review had several limitations. First, very few studies that examine athletes and DE or EDs cite any underpinning theory, such as the one examined here, as the groundwork for the research. This lack of academic rigor means that it was often up to the author's discretion to determine whether the studies did in fact measure the intended mediators. Furthermore, the current review did not have the scope to include the many moderators depicted in the model. The inclusion of the moderators is something that future reviews and applied research should undertake in order to continue to move the field forward. Additionally, although the search methodology was seen as the practical way forward for this review, in which many search terms were relevant, other search terms and methods could also be considered viable. Finally, as with any review, the risk of bias exists; however, attempts were made to limit bias by following a strict systematic protocol and employing a quality tool.

Looking ahead, longitudinal research is the main priority of the research field if true risk factors of DE in athletes are to be uncovered. Future research must also separate different sport types if there is any hope of the research being consistent enough to be replicated and then put into applied practice. Consideration must be taken in terms of what time of the season the athletes are in when tested, what really constitutes a lean and non-lean sport, and how many years the athlete has been engaged in their sport, as all these factors may influence the impact of sport and societal pressure experienced by an athlete. Detailing what constitutes sport pressures via qualitative exploration or by limiting it to a set of confirmed guidelines is warranted, as it is the only element of the model that is unique to athletes, and it is currently poorly defined. The studies reviewed here included both male and female participants, as male athletes are also susceptible to DE (Galli et al., 2014). However, the original model was created mainly using studies with female participants (Petrie & Greenleaf, 2007). Therefore, future research should be careful to distinguish between male and female

when applying this model and endeavour to determine the fit of this model for both men and women (de Sousa Fortes, Ferreira, de Oliveira, Cyrino, & Almeida, 2015). Finally, consistent measures must be used to allow a coherent story. This author recommends using the best validated and most commonly used measures reported in this paper to begin to create a consistent evidence bank and to begin the quest for the gold standard to use in athletes. Therefore, using the EDI, the Positive and Negative Affect Schedule, the SATAQ, and the EDE-Q would be the recommended places to start testing the model due to their relatively wide use and established validity. All of which will allow for clearer evidence for or against the theoretical model and thus allow the theory to be lifted from page to practice.

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