Prevalence of eating disorders amongst dancers: A systemic review and meta-analysis.

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ABSTRACT

Eating disorders in dancers are thought to be common, but the exact rates remain to be clarified. The aim of this study is to systematically compile and analyse the rates of eating disorders in dancers. A literature search, appraisal and meta-analysis were conducted. Thirty-three relevant studies were published between 1966 and 2013 with sufficient data for extraction. Primary data were extracted as raw numbers or confidence intervals. Risk ratios and 95% confidence intervals were calculated for controlled studies. The overall prevalence of eating disorders was 12.0% (16.4% for ballet dancers), 2.0% (4% for ballet dancers) for anorexia, 4.4% (2% for ballet dancers) for bulimia, and 9.5% (14.9% for ballet dancers) for EDNOS. The dancer group had higher mean scores on the EAT-26 and the EDI subscales. Dancers had a higher risk of suffering from eating disorders in general, anorexia nervosa, and EDNOS, but no higher risk of suffering from bulimia nervosa. The study concluded that as dancers had a three times higher risk of suffering from eating disorders, particularly anorexia nervosa and EDNOS, specifically designed services for this population should be considered.

KEY WORDS: Eating disorders, Anorexia, Bulimia, EDNOS, Review, Meta-analysis, Dance, Ballet, Epidemiology.

Introduction

The lifetime prevalence for anorexia nervosa in women has been estimated to be between 0.3 to 1 per cent, with a greater number suffering from bulimia nervosa (Hoek & Van Hoeken 2003; Preti et al., 2009). However this prevalence appears to be much higher for specific groups of society, such as models (Smethurst, Wales, & Arcelus, 2010), athletes (Sundgot-Borgen & Torstveit, 2004) and dancers (Herbrich, Pfeiffer, Lehmkuhl, & Schneider, 2011; Ringham et al., 2006). Research investigating the aetiology of eating disorders has identified a strong correlation between these disorders and specific personality factors, such a low self-esteem (Arcelus, Haslam, Farrow, & Meyer, 2013), perfectionism (Penniment & Egan, 2012; Ringham et al., 2006), and high self-standards (Gunnard, et al., 2012). The high levels of perfectionism (Nordin-Bates, Cummings, Always & Sharp, 2011; Zoletić & Durakovic-Belko, 2009) and low self-esteem (Benn & Walter, 2011) found among dancers may explain why they appear to be more prevalent among this group of people. However the findings in this area are somewhat mixed and inconsistent. While some authors have found that up to 83% of dancers report some form of lifetime eating pathology (Ringham et al., 2006), others have not found a higher number of eating disorders among dancers when compared to healthy controls (Toro, Guerrero, Sentis, Castro, & Puertolas, 2009). The disparity of the results may be explained by the differences in the populations involved (e.g., students vs professionals), the different type of dancers studied (e.g., ballet vs general), or the different tools used to make a diagnosis.

In order to investigate the rates of eating disorders among dancers, the primary aim of this study was to systematically compile and analyse the current literature examining the rates of eating disorders in the dance population, taking into consideration the great methodological variation, the type of dancers studied and the change in diagnosis over the years.

Methods

Search strategy

A systematic literature search, appraisal and meta-analysis was conducted. The following abstract databases were searched to July 2013: Medline/Pubmed, PsycINFO and Embase. Four full-text collections were searched; Science Direct, Ingenta Select, Ovid Full text, and Wiley-Blackwell Interscience. A broad range of subject headings were used to identify the relevant disorders and diagnoses. For each database search, combinations of the following eight search components were used; Eating Disorders, Eating Problems, Anorexia Nervosa, Bulimia Nervosa, Eating Disorders Not Otherwise Specified (EDNOS), Dance, Dancers, and Ballet. Two investigators selected the studies, extracted the data independently, cross-checked them and resolved disagreements. Studies that included 10 or more participants at the time of analysis were included. Those with less than 10 were considered selected case-series not suitable for ascertainment of prevalence. Reference lists of relevant articles were screened for further potential studies and citation searches were conducted. For all the included studies the following information was recorded: author, year of publication, country, response rates, number of individuals involved in the study, gender, type of dance, setting (whether the population studied were students (from elite or non-elite schools), amateurs or professionals), tools used, diagnosed life time prevalence, point prevalence rate of eating disorders, anorexia nervosa, bulimia nervosa, and eating disorders not otherwise specified (EDNOS). Information from the results of questionnaires used to measure eating psychopathology was also recorded which allowed for determination of caseness as per the Eating Attitude Test (EAT; Garner, Olmsted, Bohr, & Garfinkel, 1982). Mean scores for the Eating Attitude Test (EAT-40 and EAT-26), Eating Disorders Inventory (EDI; Garner, Olmstead, & Polivy, 1983), subscales of the EDI (Drive for thinness [DT], Bulimia [B] and Body dissatisfaction [BD]), and Eating Disorders Questionnaire (EDE-Q; Fairburn & Beglin, 1994) were selected. Information was also recorded from controls, plus a description of the type of controls used (e.g., non-dancers, athletes). The results are reported for; 1) all dancers, and 2) ballet dancers specifically (as a big proportion of studies exclusively selected this type of dancer). See Table 1 for further details.

Table 1 insert around here

Procedure and statistical analysis

Studies meeting the inclusion criteria were examined and study demographics (age, gender, type of dancers, setting) as well as information about eating disorders (prevalence data, mean scores of questionnaires) were recorded. The articles were divided into subgroups of controlled and uncontrolled studies. A study was considered controlled if the prevalence of eating disorders or the results of the questionnaires in dancers was compared to non-dancers. Eating disorder was assessed using structured and semi-structured diagnostic interviews and diagnosed according to the Diagnostic and Statistical Manual of Mental Disorders (DSM; APA, 1952-2000) that was current at the time of the study. In the majority of the studies, the severity of the eating disorders was assessed by self-report symptoms scales (e.g., EAT, EDI, or EDE-Q). In some of these studies, caseness was determined by scores above a specific threshold of the EAT. Here, these individuals will be described as possibly suffering from an eating disorder.

There were two outcomes of interest; 1) the number of dancers diagnosed with an eating disorder at the time of study (point prevalence), and 2) the mean results of the different questionnaires describing eating disorder psychopathology (mean severity). The primary data of the epidemiological studies describing eating disorders in dancers was extracted as raw numbers. For the purpose of this analysis, study design was explored as a dichotomous variable. Risk ratios (RRs) were calculated only for controlled studies, because these calculations derived from comparing the risk of eating disorders in dancers with the risk in the non-dancers group. For those studies describing only mean results of their questionnaires, the effect size for the continuous variables was calculated. An aggregate effect size weighted by sample size was computed to provide an overall effect size across the studies. Homogeneity among studies was computed using the Q statistic and the I^2 statistic. A significant Q statistic suggests that the distribution of effect size around the mean is greater than would be

predicted from sampling error alone, whereas I^2 provides an estimate of the proportion of the variance in the aggregate effect size that is attributable to between-studies heterogeneity (Higgins & Thompson, 2002). Random-effects models were fitted if there was heterogeneity. Risk ratios and 95% confidence intervals (CIs) were calculated. The relative weighted contribution of each study, as well as the risk ratio estimate pooled across all studies, were also assessed. Meta-analysis was performed using the Comprehensive Meta-Analysis software programme-2 for Windows (CMA; Borenstein, Hedges, Higgins, & Rothstein, 2005) according to the Cochrane reviewers' handbook (Higgins & Green, 2011). Significance was set up at p<0.05. As the outcomes of interest were prevalence and severity, not the effect of certain factors such as age or country where the study was conducted, meta-regression analysis and grouping were not used.

Included and excluded studies

Two independent assessors (JA and GLW) identified 91 relevant articles, which were screened in detail. Following this, 50 papers were excluded. The reasons for the exclusions were: non-English publication (with no English abstract; n=7); conference only paper with paper not printed in a peer reviewed journal n=8); inadequate sample size (less than 10 patients; n=3); lack of tools used to measure eating psychopathology (n=28), and not involving dancers but involving aerobic teaches or skaters only (n=3). Out of the 42 papers retrieved for more detailed evaluation, eight were excluded for having no description of eating disorders and/or not using tools to measure eating disorder psychopathology (not identifiable through the abstract). In total 33 studies were reviewed systematically.

Summary of relevant studies

Thirty-three relevant empirical quantitative studies in eating disorders or eating problems in dancers were published between 1966 and 2013. The oldest study was from 1985 (Szmuklet, Eisler, Gillies, & Hayward, 1985) and the most recent one from 2012 (Nascimiento & Fontenelle, 2012). Twenty-three (69.7%) papers included exclusively ballet dancers, nine (27.3%) included general dancers and one

(3%) Turkish dancers (Batur, Kabakci, & Gulol, 2003). Only five papers (16.1%) included men. Those studies were not used to calculate meta-analytical means. Thirteen (39.4%) studies were European: three Italian (Dotti et al., 2002; Ravaldi et al., 2003; Ravaldi et al., 2006), two from the UK (Szmukler, Eisler, Gillies, & Hayward, 1985), two from Germany (Bettle, Bettle, Neumaker, & Neumaker, 1998; Herbrich et al., 2011) and one study from each of the following European countries: Netherlands (Fogelholm, Van Marken Lichtenbelt, Ottenheijm, & Westerterp, 1996), France (Martin & Bellisle, 1989), Spain (Toro et al., 2009), Switzerland (Burckhardt, Wynn, Kreig, Bagutti, & Faouzi, 2011), Portugal (Francisco, Narciso, & Alarcao, 2012), and Belgium (Van Durme, Goossens, & Braet, 2012). Twelve (36.4%) studies were from North America; one from Canada (Piran, 1999) and 11 from the USA. Of the remaining papers, three (9.1%) were Australian (Abraham, 1996; Anshel, 2004; Penniment & Egan, 2012), two (6.1%) were Brazilian (Riberio & da Veiga, 2010; Nascimento & Fontenelle, 2012), one was Taiwanese (Tseng et al., 2007), one was Turkish (Batur et al., 2003) and one was South African (Le Grange et al., 1994). Twelve (36.4%) studies involved professional dancers only: 10 (30.3%) ballet dancers and two (6.1%) general dancers. Three (9.1%) studies included professional and amateur dancers together (two with ballet dancers and one with Turkish dancers) however the authors of these studies present the results separately for professionals and amateurs. The rest of the studies (57.6%, n=19) included students, 14 of them from ballet schools. Among the studies from students, 12 (36.4%) provided eating disorders information from students attending elite dance schools (10 of them from ballet schools) and the rest (21.2%, n=7) from non-elite schools (four from ballet schools). In view of the small number of studies describing males and the low sample size and power in this subgroup, only studies including females were selected for the overall analysis. In view of the large number of studies describing ballet dancers, the results of this population will be shown separately.

Results

General descriptive statistics

The total number of dancers that participated in the studies was 3337. The mean age of participants was 19.5 years (SD=5.76; minimum and maximum mean age was 12.6 and 38 years, respectively). The number of participants included in the studies varied greatly from 13 to 665.

There were considerable differences among the studies in design, group size and methods. Nearly a quarter of the studies (n=8, 24.2%) offered prevalence data on clinical eating disorders using a validated structured interview. Most of the studies used eating disorders questionnaires (mainly the Eating Attitude Test [EAT]) which does not prove a diagnosis but gives information on eating disorder psychopathology. Twenty studies (60.6%) used a control group to compare their results; either healthy controls (n=12, 36.4%), a different group of dancers (n=6, 18.2%), or other athletes (gymnasts, body-builders or gym users; n=2, 6.1%).

Point prevalence of eating disorders

All dancers vs non-dancers

Seven studies used a diagnostic interview in order to identify point prevalence of eating disorders in general. Eight studies used it to identify point prevalence for anorexia, six for bulimia and six for EDNOS. Except for one study, which described the prevalence of eating disorders in general dancers from Taiwan (Tseng et al., 2007), all of the remaining studies included ballet dancers only. The overall prevalence of eating disorders using random effects meta-analysis was 12.0% (95% CI, 10.0-14.2). For anorexia it was 2.0% (95% CI, 0.9-4.3), for bulimia it was 4.4% (95% CI, 3.2-6.2) and for EDNOS it was 9.5% (95% CI, 7.6-11.8). Eleven studies described the prevalence of possible cases of eating disorders among dancers using caseness from the results of one questionnaire. The questionnaire used was the Eating Attitude Test (EAT; 40 or 26), which described caseness when individuals score above 30 for the EAT-40 and above 20 for the EAT-26. These questionnaires have been very popular in this field, as more than half of the studies (n=18, 58%) used them. Some studies used the EAT with the aim of identifying possible cases of eating disorders as this usually needs to be

followed by an interview in order to reach a diagnosis. Most of the studies did not aim to measure the prevalence of eating disorders but to identify a correlation between disordered eating and other variables, such as menstruation or bone density. Seven of those studies included ballet dancers only. The prevalence of possible cases of eating disorders in professional dancers ranged from 0 to 13.6% for males (only 2 studies) and from 7.4% to 50% in females.

Ballet dancers vs non-dancers

Six studies used diagnostic interviews in order to identify current prevalence rates of eating disorders among ballet dancers. The overall number of individuals involved in those studies were 484 ballet dancers, with an overall mean age of 16.7 years (SD=1.13), ranging from 15.6 years to 18.9 years. The maximum number of individuals in one single study was 113 (Ravaldi et al., 2003). All of the individuals were students. The prevalence of eating disorders in ballet dancers ranged from 1.90 to 26.60%. The overall prevalence of eating disorders using random effects meta-analysis was 16.4 (95% CI, 13.1-20.5). Lower prevalence was identified in studies using non-specifically designed eating disorders diagnostic interviews (general DSM interviews). There were also a higher number of cases suffering from eating disorders among students not attending elite ballet schools although this was not statistically assessed. The prevalence for anorexia nervosa ranged from 0.9 to 4.1% and for bulimia nervosa from 0 to 2.7%. The overall prevalence of anorexia nervosa using random effect meta-analysis was 4.0 (95% CI, 2.3-6.7) and for bulimia 2.0 (95% CI, 0.9-4.3). The lower prevalence of BN may be explained by the fact that this disorder tends to develop at a later age. As expected, there was a high number of EDNOS cases (between 8.3 and 22.10%). The overall prevalence of EDNOS among ballet dancers was 14.9 (95% CI, 11.3-19.4). Some of those cases may have been diagnosed as AN or BN under the current DSM-V diagnosis (APA, 2013).

Three studies, which included professional ballet dancers, measured lifetime prevalence of eating disorders (Holderness, Brooks-Gunn, & Warren, 1994; Ringham et al., 2006; Nascimiento & Fontenelle, 2012). The lifetime prevalence found in professional ballet dancers ranged from 15.78 to

82.6%. This large variation can be explained by the number of EDNOS cases found in one of the studies (72%; Ringham et al., 2006). The lifetime prevalence for anorexia nervosa ranged from 3.4 to 31% and for bulimia nervosa from 6.90 to 12%.

Prevalence of possible cases of eating disorders based on questionnaire results

Seven studies described the prevalence of possible cases of eating disorders among ballet dancers using caseness. Four of the seven studies describing caseness included professional ballet dancers and three involved students from elite ballet schools. The prevalence of possible cases of eating disorders in professional dancers was 13.6% for males (one study) and ranged from 10.3 to 73.10% in females.

Insert table 2 around here

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(Figure 1,2,3,4)

Severity of eating psychopathology - mean results of questionnaires

All dancers vs non-dancers

Seven studies used the EAT-40. The mean overall meta-analytical score was 22.73 (SED=0.46). However, there was large variation in the mean scores among the dancers in these studies ranging from 17.9 to 51.2. This variation could be explained by the differences in the populations studied. There was a similar variation of means of the EAT-26 (meta-analytical mean score=3.54, SED=0.07) ranging from 2.37 to 22.90. However this variation cannot be explained by mean age, whether the dancers were students or professionals, or by the country where the study took place. Seven studies used the EDI to identify eating disorder psychopathology. The overall mean EDI was 46.59 (SED=0.60). The mean EDI is rarely used in the eating disorders literature and scores on the different eating disorders risk composite scales (drive for thinness [DT], bulimia [B], and body dissatisfaction [BD]) are more commonly reported. The overall mean for DT was 6.21 (SED=0.21), for

B was 0.82 (SED=0.05) and for BD was 13.06 (SED=0.25). Only three studies used the EDE-Q. The mean score of the EDE-Q was 1.58 (SED=0.07).

Ballet dancers vs non-dancers

Mean EAT-40 scores were available from three studies and seven studies provided mean EAT-26 scores. Total EDI scores and scores on the sub-scales of Drive for Thinness (DT) and Bulimia (B) were available from seven studies. Scores on the EDI Body Dissatisfaction (BD) sub-scale were available from four studies and EDE-Q mean scores were also available from four studies. Some of the studies report mean scores in different subgroups (i.e., primary and secondary students, or dancers attending national, regional and local competitions; Piran [1999], and Thomas, Keel, & Heatherton [2005], respectively) which were analysed separately. The meta-analytical mean score of the EAT-40 was 27.42 (SED=12.5) and for the EAT-26 it was 3.03 (SED=0.07). The mean score for the total EDI was 46.59 (SED=0.60). The DT subscale mean was 15.78 (SED=1.90), the B subscale mean was 10.12 (SED=2.47) and the BD subscale mean was 17.24 (SED=0.31). The EDE-Q meta-analytic mean score was 1.07 (SED=0.58).

Insert table 4 around here

Relative risk of eating disorders in dancers vs non-dancers

Meta-analysis was performed using only studies that provided control data. Studies that provided control data from other athletes such as gym users or gymnast were not included as high levels of eating disorders have already been reported in athletes.

Only five studies had enough information for the meta-analysis to be carried out. They included a total of 948 dancers and 1619 non-dancers. Heterogeneity was low ($I^2 = 0\%$) and the analysis showed that dancers had a higher risk of suffering from eating disorders in general (RR=2.56, z=5.83, *p*=0.0001); in anorexia nervosa (RR= 3.60, z=2.28, p=0.02); and in EDNOS (RR=3.02, z=5.25, *p*=0.0001). The

risk of developing bulimia was not statistically significantly higher in dancers when comparing to non-dancers (RR=1.29, z=1.21, p=0.26).

Only four studies provided enough control data to examine the risk of suffering from an eating disorder in ballet dancers compared to non-dancers. They included a total of 335 ballet dancers and 438 non-dancers. Heterogeneity was low (I^2 = 0%). A statistically significantly higher risk for eating disorders in general (RR=1.78, z=2.70, p=0.007) and for EDNOS (RR=2.12, z=2.90, p=0.004) was found among ballet dancers. No differences were found for anorexia (RR= 3.85, z=1.68, p=0.09) or for bulimia (RR=0.62, z=-0.9, p=0.36).

There were only three studies using control data for the EAT-26 and for the EDI. Meta-analysis was used to compare the mean scores of the questionnaires between all dancers and non-dancers in these studies. The scores in the dancer group were statistically significantly higher for all the questionnaires: EAT-26 (z=13.31, p=0.001), EDI-DT (z=8.61, p=0.001), EDI-B (z=4.79), and EDI-BD (z=6.144, p=0.001). There were not enough control studies to use meta-analysis to compare questionnaires results of just the ballet dancers (as opposed to all dancers) with non-dance controls.

Discussion

The aim of the study was to systematically summarise the available literature in the field of eating disorders and dance. We were able to identify 33 studies describing eating disorder diagnosis or reporting mean values of questionnaires aimed at measuring eating disorder psychopathology. As per any meta-analysis, the study is limited by the amount of studies available in the field. Although the overall number of studies appears to be substantial (n=33) when examining the available data there was a small number of studies that were suitable for a proper meta-analysis. Previous studies could be criticised by the fact that different populations and variables have been compared. This study aimed to compare a group of subjects as homogeneous as possible. As a result, the study is strengthen by the homogeneity of the population selected (female dancers or female ballet dancers)

and the variables collected (only studies that report eating disorders prevalence using strong methodology, such as semi-structured interviews). However, as a result, it has been limited by the small number of studies available and the small populations studied. Therefore the results of the study need to be considered within these limitations.

The overall prevalence of eating disorders in all dancers was found to be 12%, which was slightly lower than the prevalence found in ballet dancers (16.4%). The difference appeared to be particularly related to the high number of EDNOS (14.9%) and anorexia (4%) cases found among ballet dancers. A strength of this analysis is the fact that this group is very homogeneous, all of them are female and ballet students. In that respect it appears that nearly one fifth of ballet dance students suffer from an eating disorder, predominantly from the EDNOS type. When comparing the result of ballet students with non-dancers, we found that ballet students had a significantly higher risk of suffering from eating disorders, particularly EDNOS. In fact they had twice the chance of developing EDNOS when compared to non-dancers. Unfortunately there was not enough information about the type of EDNOS. Research has identified that individuals suffering from EDNOS of anorexia subtype present no significant differences in eating related and general psychopathology when compared to those suffering from anorexia nervosa (Le Grange et al., 2013). In fact, some of the dancers suffering from EDNOS may have been diagnosed with anorexia nervosa under the new DSM-V diagnostic criteria (APA, 2013). Interestingly no significant difference was found in anorexia or bulimia rates. The former may be explained by the rarity of the disease and the low number of studies in the field, while the latter may be explained by the age of the population studied as this disorder tends to appear at a later age.

The results were slightly different when comparing all dancers with non-dancers. The population of dancers that has been involved in these studies is too diverse to reach full conclusions as they incorporate different types of dance (e.g., ballet, jazz, national) and spanning levels from students to professionals. Therefore these results need to be considered with caution and generalisability may be difficult. Nevertheless, our results showed that general dancers had more than twice the risk of

developing an eating disorder and more than three times the risk of developing anorexia nervosa and EDNOS than non-dancers. In spite of the limited number of questionnaire studies that used control data when assessing eating disorder psychopathology, our analysis found a significant difference on the Eating Attitudes Test (EAT-26) and the Drive for Thinness, Bulimia, and Body Dissatisfaction subscales of the Eating Disorders Inventory (EDI). Body dissatisfaction and general body shame has been found to predict an increase in anorexic symptoms but interestingly not bulimic symptoms (Troop & Redshaw, 2012).

Although this study did not compare ballet dancers with all dancers (which would include some dancers who do ballet as well as other dance) due to the limited number of control studies comparing ballet with general dancers, it is interesting that there appears to be a difference in the subscales of the EDI between the two groups, indicating that ballet dancers present with higher levels of drive for thinness, bulimia and body dissatisfaction. Further research in this area will be able to explore the reason for this. For example, do ballet students have a pre-existing elevated risk of developing an eating disorder before they become involved in ballet, or is it a result of the environment? Research into physical injuries in dancers has found that both professional and amateur dancers have a tendency to normalise pain (Markula, 2013). The belief that if no pain is felt, then the dancers are not pushing themselves hard enough appears to be commonplace (Turner & Wainright, 2003). A similar drive to push oneself to achieve the desired 'dancer's body', irrespective of how hard this may be, may possibly play a role in the higher levels of eating disorders seen in ballet dancers.

Limitations and future studies

This analysis has a number of limitations. Notably we were reliant on the quality and non-repetition of primary publications. We sought to ensure data integrity by excluding small studies of less than 10 patients. As a result, the resulting study is limited by the number of available published data for this population and whilst the data were reasonably robust for ballet dancers, the population of other dancers was non-homogenous and mixed. Throughout the years, investigators have used a large

number of different diagnostic and outcome assessment measures, which have reflected numerous definitions of diagnosis. The lack of consistency in the measures used makes comparisons across studies very difficult. Consolidation of measures, standardised definitions and reporting guidelines are critical to the further advancement of the field. The weakness of most of the studies used in this meta-analysis is that they aim to measure eating disorder psychopathology by studying its relationship with other factors, such as menstruation or injuries. The number of epidemiological studies in the field of dance are few, possibly due to the complexity of undertaking such studies and the secrecy of the disorder. However, dance organisations such as Dance UK have started to highlight the need for such studies in order to identify the need for clinical services linked to dancers. Dancers suffering from physical injuries are treated within specialist clinical services. It can be argued then that as eating disorders are found to be considerably more prevalent in this population, dancers should also have access to dance-specific eating disorders services. Advances in technology provide opportunities for the ways in which self-help can be delivered (e.g., Cardi, Clarke, & Treasure, 2013) which could be tailored to dancers. Alternatively, specifically designed preventative programmes, as described in other populations (Beintner, Jacobi, & Taylor, 2012) may reduce levels of eating disorders in dancers. A well-performed epidemiological study in the dance world using diagnostic interviews and controlling for age and type of dance may be able to address the question of whether and how the presentation of eating disorders in dancers differs from non-dancers.

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Table 1: Criteria for searches on eating disorders and dance

Category	Criteria
Study population	Humans All races, ethnicities, and cultural groups All ages
Study settings and geography	All nations
Time period	Published from 1966 through July 2013
Publication criteria	*Included:* - English - Articles in print *Excluded:* - Articles in grey literature or non-peer-reviewed journals or unobtainable during the review period
Admissible evidence (study design and other criteria)	- *AN* must be diagnosed according to DSM I, II, III, DSM III-R, DSM IV, ICD-10, Feighner, or Russell criteria. - *BN* must be diagnosed according to DSM I, II, III, III-R, DSM IV, or ICD-10 criteria. - *EDNOS* or Atypical eating disorders must be diagnosed according to DSM III and DSM IV criteria. - Eligible study designs include outcomes studies; observational studies including prospective and retrospective cohort studies. - Populations must include 10 or more participants (in total) at the time of analysis.

Table 2: Eating disorders in dancers

Year	Author	Country	N	M/F	Mean Age	Type Dance	Setting	Tools	Life time	ED (%)	AN (%)	BN (%)	EDNOS (%)
1985	Szmukler et al.	UK	100	f	15.6	Ballet	Elite students	EAT-26 Clinical Interview	n/a	7	7	n/a	n/a
1994	Le Grange et al.	S Africa	49	f	18.9	Ballet	Elite students	EAT-40 Clinical Interview (DSM-III)	n/a	12.3	4.1	0	n/a
1994	Holderness et al.	USA	50	f	20.9	Ballet	Professionals	EAT-26 Clinical interview (DSM-III)	43	n/a	31	12	n/a
1996	Abraham	Australia	60	f	16.9	Ballet	Elite students	Clinical Interview (DSM-III)	n/a	11.5	1.6	1.6	8.3
2003	Ravaldi et al.	Italy	113	f	16.2	Ballet	Non elite students	EDE	n/a	26.6	1.8	2.7	22.1
2006	Ringham et al.	USA	29	f	19.7	Ballet	Professionals	EDI I& SCID Interview	83	n/a	3.4	6.9	72.3
2006	Ravaldi et al.	Italy	110	f	16.5	Ballet	Non elite students	EDE	n/a	13.6	0.9	1.8	10.9
2007	Tseng et al.	Taiwan	613	f	15.8	General	Elite school students	EAT-26 SCID Interview	n/a	8	0.7	2.5	4.8
2009	Toro et al.	Spain	76	f	14.4	General	Non elite students	EAT-26 & CETCA	n/a	n/a	1.3*	15.8*	n/a
2011	Herbrich et al.	Germany	52	f	16.4	Ballet	Elite students	EDI I SCID Interview	n/a	1.9	0	n/a	73.1
2012	Nascimento & Fontenelle	Brazil	19	f	34.4	Ballet	Professional	Interview (DSM-IV) BITE	15.7	n/a	n/a	n/a	n/a

F: Female, n/a: not available; SCID: Structured Clinical Interview for DSM Axis I Disorders; EDE: Eating Disorders Examination; CETCA: Eating disorders assessment questionnaire; BITE: Bulimia investigation test Edinburgh; *probable anorexia or bulimia nervosa

Table 3: Meta-analytical prevalence of eating disorders and meta-analytical means of questionnaires

	Ballet dancers n=1729	All dancers n=3337
Mean age	20.34 years	18.78 years
Eating disorders	16.4%	12.0%
Anorexia Nervosa	4%	2.0%
Bulimia Nervosa	2%	4.4%
EDNOS	14.9%	9.5%
Mean EAT-40	27.42	22.73
Mean EAT-26	3.03	3.54
Mean EDI	46.59	46.59
Drive for thinness (EDI)	15.78	6.21
Bulimia (EDI)	10.12	0.82
Body dissatisfaction (EDI)	17.24	13.06
EDE-Q	1.07	1.58

EDNOS: Eating disorders not otherwise specified; EAT: Eating Attitude Test; EDI: Eating disorders Inventory; EDEQ: Eating Disorders Examination Questionnaire;

Table 4: Mean scores of the eating disorders questionnaires in dancers

Year	Author	Country	N	M/F	Mean Age	Dance	Setting	Tools	Case-ness for EAT	EAT -40	EAT-26	EDI	DT (EDI)	B (EDI)	BD (EDI)	EDE-Q	Control
1985	Szmukler et al.	UK	100	f	15.6	Ballet	Elite st	EAT-26	16	18.9	n/a	n/a	n/a	n/a	n/a	n/a	No
1986	Schnitt et al.	USA	62	f	22.6	General	Non elite students	EAT-40	8	18	n/a	n/a	n/a	n/a	n/a	n/a	No
1987	Brooks-Gunn et al.	USA	55	f	24.7	Ballet	Prof.	EAT-26	n/a	n/a	3.57	n/a	n/a	n/a	n/a	n/a	No
1987	Evers	USA	21	f	21.4	General	Non elite students	EAT-40	33	21.8	n/a	n/a	n/a	n/a	n/a	n/a	Yes
1988	Hamilton et al. (Chinese)	USA	17	f	24.6	Ballet	Prof.	EAT-26	n/a	n/a	2.45	n/a	n/a	n/a	n/a	n/a	No
1988	Hamilton et al. (American)	USA	19	f	22.3	Ballet	Prof.	EAT-26	n/a	n/a	2.37	n/a	n/a	n/a	n/a	n/a	No
1989	Martin & Bellisle	France	23	f	18.3	Ballet	Elite st	EAT-40	n/a	51.2	n/a	n/a	n/a	n/a	n/a	n/a	No
1994	Le Grange et al.	S Africa	49	f	18.9	Ballet	Elite st	EAT-40	16	17.9	n/a	n/a	n/a	n/a	n/a	n/a	No
1994	Holderness et al.	USA	50	f	20.9	Ballet	Prof.	EAT-26	16	n/a	13.55	n/a	n/a	n/a	n/a	n/a	Yes
1996	Fogelholm et al.	Netherlands	113	f	23.3	Ballet	Prof.	EDI I	n/a	n/a	n/a	25.8	n/a	n/a	n/a	n/a	No
1998	Bettle et al.	Germany	32	m	14.4	Ballet	Elite st	EAT-40	0	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No

Year	Author	Country	N	Sex	Age	Dance	Level	Instrument									
1998	Bettle et al.	Germany	58	f	14.4	Ballet	Elite st	EAT-40	14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	no
1999	Piran (primary school)	Canada	45	f	13.3	Ballet	Elite st	EAT-26 and EDI	13	n/a	9.2	17.1	n/a	n/a	n/a	n/a	No
1999	Piran (secondary school)	Canada	23	f	13.4	Ballet	Elite st	EAT-26	50	n/a	17.3	21.9	n/a	n/a	n/a	n/a	No
2002	Kaufman et al.	USA	21	f	23.2	Ballet	Prof.	EAT-26	n/a	n/a	22.9	n/a	n/a	n/a	n/a	n/a	Yes
2002	Dotti et al. (children)	Italy	75	f	12.6	General	Non elite students	EAT-26, EDI	n/a	n/a	5.13	n/a	1.8	0.16	3.56	n/a	No
2002	Dotti et al. (adolescents)	Italy	36	f	16.1	General	Non elite students	EAT-26, EDI	n/a	n/a	10.92	n/a	5.64	0.81	10.22	n/a	No
2002	Dotti et al. (young adults)	Italy	30	f	20.5	General	Non elite students	EAT-26, EDI	n/a	n/a	9.33	n/a	4.4	1.93	7.27	n/a	No
2002	Dotti et al. (adults)	Italy	19	f	24.5	General	Non elite students	EAT-26, EDI,	n/a	n/a	11.21	n/a	6.37	1.84	9.11	n/a	No
2003	Ravaldi et al.	Italy	113	f	16.2	Ballet	Non elite students	EDEQ	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.6	No
2003	Batur et al.	Turkey	12	m	23.0	Turkish dance	Prof.	EAT-40	n/a	18.2	n/a	n/a	n/a	n/a	n/a	n/a	Yes
2003	Batur et al.	Turkey	12	m	23.0	Turkish dance	Amat.	EAT-40	n/a	12.8	n/a	n/a	n/a	n/a	n/a	n/a	Yes
2003	Batur et al.	Turkey	32	f	22.1	Turkish dance	Prof.	EAT-40	n/a	34.9	n/a	n/a	n/a	n/a	n/a	n/a	Yes
2003	Batur et al.	Turkey	22	f	22.1	Turkish dance	Amat	EAT-40	n/a	30.1	n/a	n/a	n/a	n/a	n/a	n/a	Yes
2004	Anshel	Australia	57	f	17.3	Ballet	Non elite	EDI II	n/a	n/a	n/a	n/a	9.26	2.56	16.56	n/a	Yes

							students							(3.75)	(1.51)	(2.57)	
2005	Thomas et al. (National)	USA	63	f	15.0	Ballet	Elite st.	EDI I	n/a	n/a	n/a	81.9	18.8	13.7	n/a	n/a	No
2005	Thomas et al. (Regional)	USA	64	f	15.0	Ballet	Elite st.	EDI I	n/a	n/a	n/a	72.1	13.8	11.9	n/a	n/a	No
2005	Thomas et al. (Local)	USA	107	f	15.0	Ballet	Non elite students	EDI I	n/a	n/a	n/a	78.5	16.3	13.0	n/a	n/a	No
2006	Ringham et al.	USA	29	f	19.7	Ballet	Prof.	EDI I	n/a	n/a	n/a	43.4	11.27	2.32	12.14	n/a	No
2007	Tseng et al.	Taiwan	613	f	15.8	General	Elite st	EAT-26	n/a	n/a	17.2	n/a	n/a	n/a	n/a	n/a	Yes
2009	Toro et al.	Spain	76	f	14.4	General dance	Non elite students	EAT-26	11.8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No
2010	Ribeiro & Veiga	Brazil	29	m	38.0	Ballet	Prof.	EAT-26 + BITE	14	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No
2010	Ribeiro & Veiga	Brazil	50	f	36.8	Ballet	Prof.	EAT-26 + BITE	10	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No
2011	Herbrich et al.	Germany	52	f	16.4	Ballet	Elite students	EDI I	n/a	n/a	n/a	n/a	20.58	14.06	29.63	n/a	Yes
2011	Nordin-Bates et al.	UK	85	m		General	Elite st	EAT-26	8	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No
2011	Nordin-Bates et al.	UK	261	f	14.4	General	Elite st	EAT-26	7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	No
2011	Burckhardt et al.	Switz.	127	f	16.7	General	Prof.	EAT-40	n/a	12.6	n/a	n/a	n/a	n/a	n/a	n/a	No
2012	Penniment & Egan	Australia	142	f	22.3	General	Non-prof	EDEQ	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.85	No
2012	Francisco et	Portugal	13	m	15.0	Ballet	Elite st.	EDE-Q	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.46	Yes

Year	Author	Country	N	Gender	Age	Type	Category	Measure										
	al.																	
2012	Francisco et al.	Portugal	53	f	14.6	Ballet	Elite st.	EDE-Q	n/a	n/a	n/a	n/a	n/a	n/a	n/a	1.54	Yes
2012	Francisco et al.	Portugal	47	f	14.6	Ballet	Non elite students	EDE-Q	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.69	Yes
2012	Van Durme et al.	Belgium	44	f	14.5	Ballet	Elite st.	EDI-II	n/a	n/a	n/a	n/a	20.8	13.46	29.54	n/a	Yes

F: Female; m: Males; EAT: Eating Attitude Test; EDI: Eating disorders Inventory; EDEQ: Eating Disorders Examination Questionnaire; n/a: not available; Elite St: elite students; Prof.: Professionals; Amat: Amateurs ;Switz: Switzerland