

# Disordered Eating Behavior, Body Image, and Energy Status of Female Student Dancers

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**Background:** Modern culture has stereotyped the female body as one that is continually getting thinner. Internalization of the 'thin' ideal is partly attributable to the inner ideal to be successful combined with the external pressure imposed by media and others. Many individuals attempt to achieve these ideals by behavior modification that imposes health risks. **Purpose:** To investigate disordered eating (DE) behavior and energy status in female student dancers. **Methods:** Volunteer dancers ( $n = 26$ ) aged 19.0 (18.0; 21.0) years, matched by controls ( $n = 26$ ) aged 20.0 (19.0; 21.0) years were recruited. Eating Disorder Inventory-3 (EDI-3) subscales, Three-factor Eating Questionnaire (TFEQ) Cognitive Dietary Restraint (CDR) subscale, and EDI-3 Referral Form behavioral questions assessed DE behavior. Energy status was assessed with a food record and Actiheart monitor. **Results:** Dancers achieved significantly higher scores than controls in all questionnaires, namely: EDI-3 Drive for Thinness [12.0 (3.0; 19.0) vs. 4.5 (2.0; 9.0),  $p = .023$ ], EDI-3 Body Dissatisfaction [16.0 (10.0; 25.0) vs. 6.5 (3.0; 14.0),  $p = .004$ ], and TFEQ-CDR [9.0 (2.0; 15.0) vs. 3.0 (3.0; 7.0),  $p = .032$ ]; dancers used excessive exercise to lose weight (19.2% vs. 0%,  $c^2 = 5.53$ ,  $p = .019$ ), and had lower energy availability (24% vs. 8%,  $p < .05$ ) than controls. The average energy balance (EB) was negative for both groups [dancers: EB = -3896 (-5236; -1222) vs. controls: EB = -2639 (-4744; -789) kJ/day]. **Conclusion:** Female dancers are at risk for DE behavior and many have suboptimal energy status which may be related to their quest to achieve a more desirable appearance; education on healthy weight management practices is needed.

**Keywords:** Subclinical eating disorders, athletes, university, energy balance, energy availability

Western culture has idealized the female body as getting thinner, with the internalization of the 'thin' ideal resulting in behavior modification to achieve these ideals (Thompson, Roehrig, Cafri, and Heinberg, 2005). The inner ideal combined with external pressures imposed by media, coaches and public have the potential to drive artistic or aesthetic athletes to practice disordered eating behaviors (Morse, 2008). Disordered eating describes a pattern of unorthodox eating behaviors that may fulfill some of the formal diagnostic criteria of a clinical eating disorder such as Anorexia Nervosa (Bratland-Sand & Sundgot-Borgen, 2013). These pathogenic body weight control behaviors may involve body weight and body image anxiety, substandard nutrition or insufficient energy intake (or a combination of both), bingeing, vomiting, and exploitation of laxatives, diuretics and diet pills (Torstveit, Rosenvinge, and Sundgot-Borgen, 2008), among others. Furthermore, athletes may inadvertently fail to satisfy their substantial exercise energy require-

ments as a consequence of disordered eating behavior, although other factors such as time constraints, food availability problems or lack of appropriate nutritional knowledge may also contribute (Beals & Manore, 2000). Disordered eating behavior is seen as a risk factor for energy deficit (Nattiv et al., 2007) and performance as well as the cardiovascular, reproductive, skeletal, renal, gastrointestinal, endocrine and central nervous systems may all be negatively affected by undernourishment and/or inappropriate weight loss (Mountjoy et al., 2014).

Data are scarce regarding eating and body weight control behaviors of South African athletes, and lacking altogether when it comes to South African dancers. Therefore, this study will explore disordered eating behavior, use of pathogenic weight control measures, and energy status of a group of female student dancers at a South African University compared with controls. It is hypothesized that student dancers will have a higher risk for disordered eating behavior, impaired body image, and suboptimal energy status compared with controls.

## Methods

### Participants and Study Design

This study formed part of a larger cross-sectional study investigating components of the female athlete triad in

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female university students. Fifty-two volunteer (18–30 years), vocational female student dancers ( $n = 26$ ) and controls ( $n = 26$ ) were recruited. A power calculation based on EDI-Body Dissatisfaction subscale score showed that 15 subjects per group would be sufficient to show significant differences between groups ( $p < .05$ ) with 80% power (Beals & Manore, 2000). Dancers were enrolled at the Tshwane University of Technology, Department of Performing Arts, and controls were enrolled at the North-West University (NWU), South Africa. Dancers participated in African, tap, jazz, contemporary and ballet dance. The available sample population from which dancers of this age group and level of dancing could be recruited was limited due to the voluntary inclusion of participants from a total of approximately 60 vocational dancers. Recruitment was further complicated by the relatively high respondent burden of measurements. Dancers were matched with nonathlete controls of the same race, comparable age and body mass index (BMI). The study commenced during a high-intensity training phase where dancers were not only participating in usual dance classes, but also auditioning and training for productions. Exclusion criteria were pregnancy and lactation, and/or corticosteroid therapy during the 6 months preceding the study. The study was approved by the ethics committee of the NWU, participants gave written informed consent, and anonymity of results was ensured.

## Demographic and Sport Information

Participants completed a structured demographic and sport questionnaire for sociodemographic and training information.

## Weight, Height, and Body Composition

Weight (kg) and height (cm) were measured to the nearest decimal according to the ISAK (International Society for the Advancement of Kinanthropometry) International Standards for Anthropometric Assessment criteria (Marfell-Jones, Olds, Stewart, and Carter, 2006); body mass index (BMI,  $\text{kg}/\text{m}^2$ ) was calculated as weight divided by height squared. Components of body composition (percentage body fat and fat-free mass) were measured by a registered radiographer with dual energy X-ray absorptiometry (Hologic Discovery W, APEX system software version 2.3.1).

## Energy Status Assessment

Energy intake (EI) was assessed with a 5-day weighed food record, using a calibrated digital food scale that weighed to the nearest 0.01 g. Food records were completed on consecutive week and weekend days (including training and nontraining days for dancers). Participants were trained to keep a food record by an experienced dietitian. Dietary data were coded using the Medical Research Council (MRC) Condensed Food Composition Tables for South Africa (Wolmarans, Danster, Dalton,

Rossouw, and Schönfeldt, 2010), captured in an Excel spreadsheet and converted into energy (MRC Biostatistics Unit, Medical Research Council, Cape Town, South Africa). The possibility of over/under-reporting energy intake was calculated using the ratio of mean reported energy intake to basal metabolic rate (rEI:BMR) according to the method of Goldberg (Goldberg, Black, and Jebb, 1991). BMR was calculated with the Actiheart software program using the Schofield equation (Schofield, 1985). As described by Black (2000), a *lower cut-off* of  $<1.11$  represents under-reporting and an *upper cut-off* of  $>2.42$  represents over-reporting (cut-offs for females with a medium physical activity level). Under-reporters were noted but not excluded from analyses as food intake of female athletes has been reported to be low (Beals & Meyer, 2007), while over-reporters were excluded from all energy status calculations.

During the same five days the food record was kept, an Actiheart monitor (CamNtech Ltd, Cambridgeshire, UK) was worn, which uses both heart rate and accelerometry to calculate total energy expenditure (TEE) by totaling resting metabolic rate, activity energy expenditure and dietary induced thermogenesis. The Actiheart has been shown to be valid and reliable during free-living conditions; however, it may underestimate energy expenditure at higher intensities of physical activity (Barreira, Kang, Caputo, Farley, and Renfrow, 2009). Energy balance (EB) is described calorimetrically as the total daily dietary energy intake (EI) minus the total daily energy expenditure (TEE) and it is the remainder of energy reserved in the body once all the physiological systems have performed their daily work (Loucks, Kiens, and Wright, 2011). Energy balance was calculated using the formula:

$$\text{EB} = \text{EI} - \text{TEE}$$

Energy availability is defined as the daily dietary energy intake minus the exercise energy expenditure and is therefore the sum of residual energy subsequent to exercise completion that is required for other metabolic processes of the body (Loucks, Kiens, and Wright, 2011). A negative energy balance is indicative of an energy deficit, while an energy balance of zero is associated with sufficient energy for normal bodily functions only if it is in association with an estimated energy availability  $\geq 45 \text{ kcal}/\text{kg}$  fat-free mass (FFM)/day (Loucks, Kiens, and Wright, 2011).

The average estimated energy availability ( $\text{estEA}$ ) for five days was calculated for all participants. Daily energy expenditure with a metabolic equivalent (MET)  $\geq 4$  was used to calculate average estimated exercise energy expenditure ( $\text{estEEE}$ ). Activities with a MET  $\geq 4$  include moderate-intensity walking and biking on campus, which can substantially contribute to daily energy expenditure even though they are not part of a planned training session (Ainsworth, Haskell, Whitt, Irwin, and Swartz, 2000; Guebels et al., 2014). Low energy availability was set at  $<30 \text{ kcal}/\text{kg}$  FFM/day and is associated with an energy deficit among sedentary women (Loucks, 2007). Energy availability of  $\sim 45 \text{ kcal}/\text{kg}$  FFM/day is indicative of a

healthy energy status (Manore, Kam, and Loucks, 2007). Estimated energy availability was calculated from the following formula (Manore et al., 2007):

$$\text{estEA} = \text{Average energy intake (kcal)} - \frac{\text{Average}_{\text{est}} \text{EEE(kcal)}}{\text{FFM(kg)}}$$

## Disordered Eating Behavior and Body Image

Disordered eating behavior was assessed with the Eating Disorder Inventory-3 (EDI-3) (Garner, 1983) and the Cognitive Dietary Restraint (CDR) subscale of the Three-factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985). The EDI-3 is a self-reported measure intended to assess attitudes, emotions and behaviors typically associated with eating disorders, and has been verified to be an appropriate screening instrument for eating disorders in a nonclinical setting (Garner, Olmsted, and Polivy, 1984). The Drive for Thinness and Body Dissatisfaction EDI-3 subscales have been used as selection criteria when exploring eating disorder pathology in athletes (Sundgot-Borgen, 1993). Possible false negative responses to the EDI-3 were investigated as described by others (De Souza, Hontscharuk, Olmsted, Kerr, and Williams, 2007).

The TFEQ-CDR subscale comprises 21 items that gauge the intent to control food intake to attain or maintain a desired body weight, and is a reliable measurement within the general public (Bardone-Cone & Boyd, 2007). The cut-off points for the TFEQ-CDR subscale, as well as the EDI-3 Body Dissatisfaction and Drive for Thinness subscales are set at  $\geq 9$ ,  $\geq 14$ , and  $\geq 15$ , respectively. In addition, the EDI-3 Referral Forms (EDI-3 RF) five behavioral questions assessing the use of pathogenic weight control measures (PWCM) were completed (including bingeing, vomiting, laxatives, additional exercise for weight loss, and weight loss  $\geq 9$  kg within the preceding 6 months) (Garner, 2004). Participants scoring above the EDI-3 Drive for Thinness and Body Dissatisfaction subscales, as well as TFEQ-CDR subscale cut-off scores or met the EDI-3 RF referral criteria were

identified at increased risk for disordered eating behavior (Torstveit et al., 2008; Vescovi, Scheid, Hontscharuk, and De Souza, 2008).

## Statistics

Statistical analyses were performed using STATISTICA analysis software (StatSoft, Tulsa, OK, USA, Version 9.0). Data were not normally distributed and are expressed as medians and interquartile ranges (25th and 75th percentiles). Outliers were excluded from the  $\text{estEA}$  results. Mann-Whitney  $U$  tests compared continuous variables between dancers and controls. Wilcoxon Matched Pairs test was used to investigate differences between actual and desired body weight of dancers and controls. Categorical data were analyzed with Cross-Tabulations and expressed as percentages of each group. Chi-squared analyses ( $\chi^2$ ) were used to determine differences between groups for categorical data namely percentage of participants scoring above the EDI-3 and TFEQ subscale cut-offs, and use of PWCM. Associations between continuous variables were assessed with Spearman Rank Order Correlation tests. Statistical significance was set at all times as  $p < .05$ .

## Results

Participant characteristics and body composition measurements are summarized in Table 1. Dancers had significantly lower percentage body fat ( $p = .006$ ) and higher percentage fat-free mass ( $p = .010$ ) than controls.

One control and one dancer were identified as possible over-reporters and were excluded from energy status calculations presented in Table 2. Two controls and six dancers were identified as possible under-reporters but not excluded from analyses. A negative energy balance was found in 81% of dancers ( $n = 21/26$ ) and controls ( $n = 21/26$ ).

Individual participants'  $\text{estEA}$  are illustrated in Figure 1. Two outliers (evident in the top portion of Figure 1) were identified as over-reporters and excluded from analyses. Eight percent of controls ( $n = 2/25$ ) and 24%

**Table 1 General Characteristics and Body Composition Measurements of Dancers and Controls**

|                                      | Controls          | Dancers           | <i>p</i> -value |
|--------------------------------------|-------------------|-------------------|-----------------|
|                                      | <i>n</i> = 26     | <i>n</i> = 26     |                 |
| Age (yr)                             | 20.0 (19.0; 21.0) | 19.0 (18.0; 21.0) | .066            |
| Menarcheal age (yr)                  | 14.0 (13.0; 15.0) | 14.0 (13.0; 14.0) | .608            |
| Weight (kg)                          | 55.0 (52.0; 59.4) | 57.6 (53.0; 59.2) | .437            |
| Height (m)                           | 1.6 (1.6; 1.7)    | 1.6 (1.6; 1.7)    | .826            |
| Body mass index (kg/m <sup>2</sup> ) | 20.9 (19.8; 22.0) | 21.2 (19.9; 22.2) | .667            |
| Fat-free mass (kg)                   | 39.0 (35.5; 42.7) | 42.6 (40.3; 46.1) | .010            |
| Percentage body fat (%)              | 28.9 (25.7; 30.8) | 22.8 (19.4; 27.9) | .006            |

*Note.* Continuous data presented as medians (25th; 75th percentiles). Differences between continuous variables assessed by Mann-Whitney  $U$  test. Menarcheal age was determined by the self-reported age of onset of first menstrual cycle.

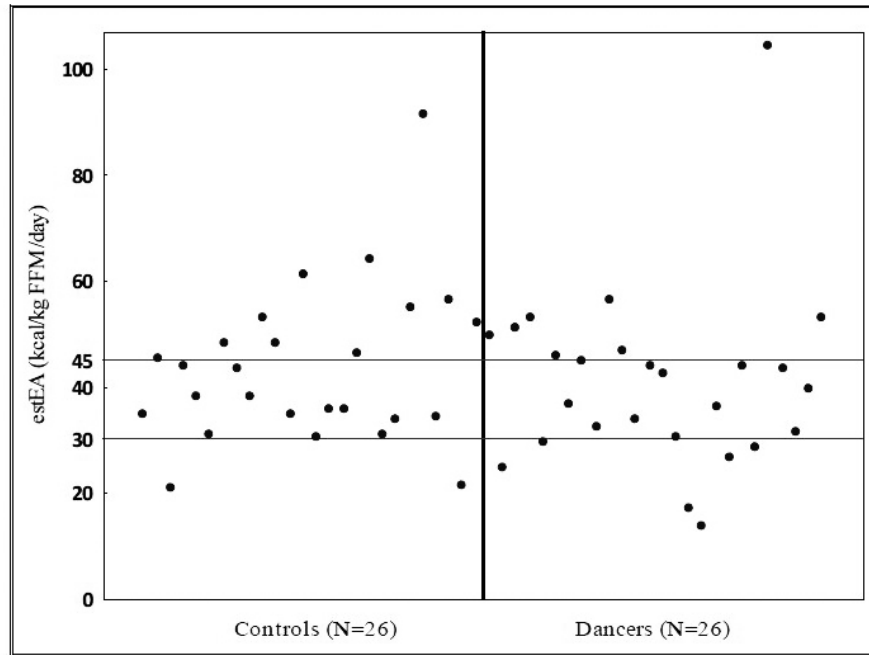


**Figure 1** — Estimated energy availability ( $_{est}EA$ ) of dancers and controls. The lower dashed line represents low estimated energy availability set at  $<30$  kcal/kg FFM/day and the upper dashed line represents healthy estimated energy availability set at  $\geq 45$  kcal/kg FFM/day.

of dancers ( $n = 6/25$ ) were classified with a low  $_{est}EA$ , while 40% of controls ( $n = 10/25$ ) and 28% of dancers ( $n = 7/25$ ) had a healthy  $_{est}EA$  of  $\geq 45$  kcal/kg FFM/day. In the total group, 16% ( $n = 8/50$ ) of participants had a low  $_{est}EA$  of which 63% ( $n = 5/8$ ) were identified as at risk for disordered eating behavior.

EDI-3 and TFEQ-CDR subscale scores are presented in Table 3. Thirty-nine percent of controls ( $n = 10/26$ )

and 69% of dancers ( $n = 18/26$ ) were identified as at risk for disordered eating ( $\chi^2 = 4.95$ ,  $p = .025$ ). One dancer's TFEQ-CDR score is not included due to an incomplete questionnaire. No participants were identified with 'false negative' scores on the EDI-3.

Exploitation of the various PWCM by controls and dancers are represented in Figure 2. No controls in this study used excessive exercise, vomiting or laxatives to

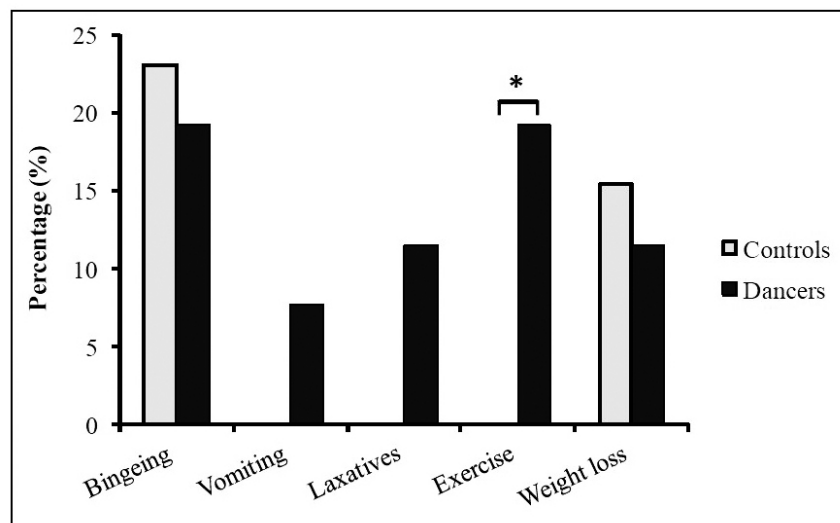


**Figure 2** — Use of pathogenic weight control measures by dancers and controls;  $\chi^2=5.53$ ,  $p = .019$ . Data presented as percentage of each group.

promote weight loss. Bingeing was the most common PWCM used by controls and dancers [19% ( $n = 5/26$ ) vs. 23% ( $n = 6/26$ ), respectively], followed by extreme weight loss of  $\geq 9$  kg within the preceding six months [12% ( $n = 3/26$ ) vs. 15% ( $n = 4/26$ ), respectively]. Use of excessive exercise for weight loss was the only PWCM that differed significantly between dancers and controls ( $p = .019$ ).

Actual body weight was significantly different from desired body weight for dancers [57.6 (53.0; 59.2) vs. 53.0 (50.0; 56.0) kg,  $p = .0004$ ] but not for controls [55.0 (52.0; 59.4) vs. 55.0 (50.0; 58.0) kg,  $p = .264$ ]. Most dancers wanted to change their current body weight for appearance (39%,  $n = 10/26$ ) and sports performance (19%,  $n = 5/26$ ) reasons. Similarly, most controls wanted to change their current body weight for appearance (39%,  $n = 10/26$ ) reasons, but also for health (12%,  $n = 3/26$ ) reasons.

## Discussion

The main findings of this study were that more than two thirds of dancers were identified as at risk for disordered eating behavior. Despite the high percentage with disordered eating behavior, only a small subgroup was identified with low energy availability although most participants had a negative energy balance, and therefore a suboptimal energy status.

### Energy Status

A low energy availability or an energy deficit either in combination with or in the absence of clinical eating disorders or disordered eating, does present a health risk to physically active girls and women (Nattiv et al., 2007). In the current study, the average energy availability was below what is considered a healthy value ( $\sim 45$  kcal/kg FFM/day) for sedentary women but within the ranges recommended for weight loss (30–45 kcal/kg FFM/day) (Manore et al., 2007). The energy availability of the dancers

was comparable to what was calculated in endurance athletes, with most having energy availability between 30–45 kcal/kg FFM/day (Loucks, 2007). Only a small group of the controls and dancers were identified with low energy availability ( $< 30$  kcal/kg FFM/day), which might have been attributed to under-reporting of dietary intake. However, of these participants, 63% ( $n = 5/8$ ) were identified as at risk for disordered eating behavior thereby increasing the likelihood of disordered eating playing a role in their suboptimal energy status. We could not explore this possibility further due to our small sample size; however, others (Gibbs, Williams, Mallinson, Reed, Rickard, and De Souza, 2013) have shown that women with a high dietary restraint have low energy availability.

Surprisingly both controls and dancers had a negative energy balance. Possible reasons for suboptimal energy status among our participants include inaccurate diet records, under-reporting or reduced food intake because of the dietary recording methodology used, increased daily energy expenditure without a concomitant increase in energy intake during a period of strenuous training and rehearsal programs among dancers, and/or deliberate under-eating due to the desire for weight loss.

After closely examining daily energy expenditure data controls spent more time being active at lower intensities and less time being sedentary, while dancers were more sedentary between training sessions. The latter might explain high daily energy expenditure found among controls. Dancers presented with higher energy intake values than observed in some aesthetic athletes (5459–6420 kJ/day), but similar to other aesthetic and weight-class athletes, as well as female athletes with subclinical eating disorders (7119–8314 kJ/day) (Beals & Manore, 2000; Sundgot-Borgen & Garthe, 2011). It seems, therefore, that the negative energy balance and energy availability  $< 45$  kcal/kg FFM/day of participants was probably due to high levels of total energy expenditure which was not matched by energy intake. The observed negative energy balance of participants is similar to what is recommended for a body fat loss of between

**Table 2** Energy Status of Dancers and Controls

|                                                           | Controls            | Dancers              | <i>p</i> -value |
|-----------------------------------------------------------|---------------------|----------------------|-----------------|
|                                                           | <i>n</i> = 25       | <i>n</i> = 25        |                 |
| Resting metabolic rate (kJ/day)                           | 5472 (5269; 5781)   | 5660 (5478; 6001)    | .125            |
| Energy intake (kJ/day)                                    | 7675 (7068; 8686)   | 7736 (6593; 9906)    | .594            |
| Energy intake per kg body weight (kJ/kg body weight)      | 132 (117; 154)      | 132 (109; 172)       | .907            |
| Energy expenditure (kJ/day)                               | 10287 (8525; 11910) | 11851 (9210; 13093)  | .101            |
| Energy expenditure per kg body weight (kJ/kg body weight) | 184 (151; 199)      | 202 (166; 220)       | .109            |
| Energy balance (kJ/day)                                   | -2639 (-4744; -789) | -3896 (-5236; -1222) | .273            |
| Estimated energy availability (kcal/kg FFM/day)           | 38 (34; 50)         | 39 (30; 46)          | .367            |

*Note.* Energy balance = energy intake—energy expenditure. Data presented as medians (25th; 75th percentiles), values represent the average of 5 days. Differences between continuous variables assessed by Mann-Whitney *U* test.

**Table 3 Raw Scores of the Eating Disorder Inventory-3 Subscales and Cognitive Dietary Restraint Subscale of the Three-factor Eating Questionnaire**

|                                          | Controls         | Dancers           | p-value            |
|------------------------------------------|------------------|-------------------|--------------------|
| Eating Disorder Inventory-3              | (n = 26)         | (n = 26)          |                    |
| Drive for Thinness score                 | 4.5 (2.0; 9.0)   | 12.0 (3.0; 19.0)  | .023               |
| Body Dissatisfaction score               | 6.5 (3.0; 14.0)  | 16.0 (10.0; 25.0) | .004               |
| Bulimia score                            | 4.0 (1.0; 5.0)   | 5.0 (1.0; 8.0)    | .341               |
| Perfectionism score                      | 10.0 (5.0; 15.0) | 13.0 (7.0; 17.0)  | .207               |
| Maturity Fears score                     | 9.0 (3.0; 13.0)  | 9.5 (6.0; 13.0)   | .552               |
| Low Self-esteem score                    | 3.5 (1.0; 6.0)   | 3.5 (1.0; 8.0)    | .728               |
| Personal Alienation score                | 5.5 (3.0; 7.0)   | 6.5 (3.0; 9.0)    | .487               |
| Interpersonal Insecurity score           | 6.5 (3.0; 12.0)  | 6.0 (2.0; 10.0)   | .674               |
| Interpersonal Alienation score           | 7.5 (3.0; 10.0)  | 9.0 (7.0; 12.0)   | .094               |
| Interceptive Deficits score              | 7.0 (4.0; 11.0)  | 7.0 (5.0; 11.0)   | .459               |
| Emotional Dysregulation score            | 3.0 (1.0; 8.0)   | 6.0 (2.0; 8.0)    | .459               |
| Asceticism score                         | 4.0 (3.0; 9.0)   | 7.0 (4.0; 9.0)    | .084               |
| Drive for Thinness $\geq 15$ (%)         | 3.8              | 46.2              | .0004 <sup>#</sup> |
| Body Dissatisfaction $\geq 14$ (%)       | 30.8             | 61.5              | .026 <sup>*</sup>  |
| Bulimia $\geq 5$ (%)                     | 34.6             | 53.9              | .163               |
| Three-factor Eating Questionnaire        | (n = 26)         | (n = 25)          |                    |
| Cognitive Dietary Restraint score        | 3.0 (3.0; 7.0)   | 9.0 (2.0; 15.0)   | .032               |
| Cognitive Dietary Restraint $\geq 9$ (%) | 11.5             | 52.0              | .002 <sup>†</sup>  |

Note. Data presented as median (25th; 75th percentiles); <sup>#</sup> $\chi^2 = 12.41$ ; <sup>\*</sup> $\chi^2 = 4.95$ ; <sup>†</sup> $\chi^2 = 9.69$ . Differences between continuous variables assessed by Mann-Whitney *U* test, differences between categorical values assessed by Chi-square test.

0.5–1.0 kg/week (O'Connor & Caterson, 2010). For athletes wanting to lose weight, a gradual rate of weight loss (0.5 kg/week) is, however, recommended corresponding to a daily energy deficit of ~2100 kJ (O'Connor & Caterson, 2010). This moderate daily energy deficit has been associated with body weight loss while preserving FFM and strength, especially if combined with a high protein diet (1.4g/kg body weight) in female athletes wanting to lose weight (Mero et al., 2010).

## Disordered Eating Behavior

Despite the fact that more dancers were at risk for disordered eating behavior in the current study, 39% ( $n = 10/26$ ) of controls were also identified as at risk. The findings are reinforced by other researchers who disclosed that college-aged females, in general, may be more vulnerable to disordered eating because of developmental concerns (Tylka & Hill, 2001), as well as the sociocultural environment (Petrie et al., 2009). Potential factors playing a role include the adaptation to an unfamiliar tertiary environment (such as university) and peer influences substituting parental influences with regard to eating behaviors (Hoerr, Bokram, Lago, Bivins, and Keast, 2002). In addition, women from industrialized countries tend to see themselves as objects of desire

due to media influences which often contributes to poor body image. The latter is associated with a greater risk for disordered eating behavior (Petri et al., 2009). In fact, the main reason for wanting to change body weight in participants in this study was related to appearance. Among controls, there was an unexpected high percentage of binge-eating behavior; and also a large percentage that scored high on the Bulimia subscale, suggestive of purging behavior. Roets (2008) found a lack of eating-related self-regulation among a group of female students from the North-West University. An increased risk for unhealthy lifestyles and even clinical eating disorders may result, supporting our findings among students from the same University.

Female athletes are at an elevated risk for pathogenic eating disturbances when compared with females in the general population (Bratland-Sand & Sundgot-Borgen, 2013). Furthermore, female athletes participating in lean sports are at an increased risk for disordered eating symptoms compared with those competing in nonlean sports (Bratland-Sand & Sundgot-Borgen, 2013; Torstveit et al., 2008), with dancers being particularly more vulnerable to disordered eating attitudes and behaviors (Anshel, 2004; Thomas, Keel, and Heatherton, 2005). Our results support these findings as more dancers than controls scored above the cut-offs of the EDI-3 Body

Dissatisfaction and Drive for Thinness as well as TFEQ-CDR subscales, and more than 50% scored above the EDI-3 Bulimia subscale cut-off. In addition, dancers had a significantly lower desired body weight than controls. It seems, therefore, likely that other risk factors apart from sociocultural pressures compounded risk for disordered eating behavior in dancers. Anshel (2004) found within a group of ballet students that mean scores for the EDI-2 Drive for Thinness, Bulimia, and Body Dissatisfaction subscales were  $9.3 \pm 3.8$ ,  $2.6 \pm 1.5$  and  $16.6 \pm 2.6$ , respectively, which are comparable to this study's findings. Others (Beals & Manore, 2000; Thomas et al., 2005; Ringham et al., 2006) also found similar results with the exception of a higher Bulimia score reported by Thomas and colleagues (2005). Different tools were used to measure disordered eating in these studies which may result in the discrepancies. Beals and Manore (2000) used the original EDI, while Thomas and colleagues (2005) used a 26-item version of the original EDI. Furthermore, dancers in this study participated in a variety of dance styles and there were differences in sample size, age and level of dancing (vocational vs. recreational dancers). It is important to note that in the current study there were no significant differences between dancers and controls on the remaining EDI-3 subscale scores that measure psychopathology. In addition, scores on the subscales were lower than typically found among patients with anorexia nervosa (Herbrich et al., 2011). Thus, dancers in this present study did not have similar characteristics as individuals with psychopathological eating disorders (Petrie et al., 2009) and the pursuit for thinness in this group was thus not associated with psychopathology or reorganization. It is possible that dancers in this study had subclinical eating disorders as the Drive for Thinness, Body Dissatisfaction, and Bulimia EDI-3 subscale scores were similar and even higher compared with what Beals and Manore (2000) found among athletes with subclinical eating disorders. We did not, however, have dancers complete an in-depth interview to confirm this, which is a limitation of the current study.

The discrepancy between actual body weight and desired body weight was significantly greater for dancers than controls in the current study. This is indicative of body dissatisfaction and also supports findings of a higher level of body dissatisfaction, as measured with the EDI-3, in the dance group. Body dissatisfaction experienced by dancers in this study is substantiated by other researchers who concluded that dancers are overly concerned about dieting and their body weight, and tend to be discontent with their bodies (Anshel, 2004; McLean, Barr, and Prior, 2001; Le Grange, Tibbs, and Noakes, 1994). Body dissatisfaction is linked to dance requiring leanness as an aesthetic prerequisite (Hincapié & Cassidy, 2010). Exploitation of PWC, such as self-induced vomiting, excessive physical activity, laxatives, diuretics, diet pills and food restraints, has evolved into customary practice among female college students due to body dissatisfaction and weight concerns (Dyken & Gerrard, 1986). The additional pressure of competing in a lean sport may

explain the large percentage of participants in the current study who used these measures to control their weight. Binge-eating and excessive exercise were the most popular PWCs used by dancers followed by laxative use and self-induced vomiting. The low use of laxatives and self-induced vomiting among ballet dancers is supported by others (Anshel, 2004; Thomas et al., 2005).

## Limitations

It is acknowledged that the results of this study may be biased, as a convenience sample of volunteers was used. Some participants with disordered eating behavior may have elected not to participate while those wanting to lose weight volunteered. Eating disorder pathology could not be assessed in the current study as we did not follow-up with an in-depth interview in those participants who scored high on the EDI-3 and TFEQ subscales. There may, however, be some participants who scored high on these subscales due to reasons not related to eating disorder pathology (Le Grange et al., 2004). In addition, since we only made use of questionnaires, athletes may have given false negative responses trying to manipulate their answers due to the secretive nature of individuals with eating disorders (Wilmore, 2001). Nevertheless, after implementing the method suggested by De Souza and coworkers (2007), no 'false negative' responses were identified. The sample size per group was relatively small and may have resulted in low statistical power. However, because of the specific study population and relatively high subject burden, it was not possible to recruit more participants at the time of the study. Future research should combine two methods of dietary data, such as a 3-day food record together with a food frequency questionnaire, as this will cross-validate information and improve reliability/accuracy of the dietary data obtained. Lastly, we recommend that future studies consider validating the accuracy of the Actiheart to measure TEE in dancers as it may underestimate TEE at higher intensity workloads based on the results of Nichols and colleagues (2010), thereby affecting energy availability estimates and prevalence of low energy availability.

In conclusion, despite limitations of this study, important observations were made regarding disordered eating behavior and energy status of a group of South African female student dancers. This group of dancers is at risk for disordered eating behavior and has a sub-optimal energy status. Equally troublesome was the high percentage of binge eating and purging behavior among nonactive female students who served as control group. From our observations it is clear that female students should be educated about healthy weight management practices to reduce the risk of disordered eating behavior and suboptimal energy status. In addition, the athlete's entourage and healthcare professionals should be educated about healthy eating, health and performance risks associated with energy deficiency, and promotion of healthy and realistic body weight goals. Lastly, athletes with low energy availability should improve their energy

status by increased daily energy intake (~ 300–600 kcal/day), reduced weekly exercise or a combination of both (Mountjoy et al., 2014). We have endeavored to shed light on an area of research that is almost clandestine till the present time, and undoubtedly reveals that much research still needs to be performed to elucidate disordered eating behaviors and PWCM use among dancers and other females in aesthetic sports.

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