

Pathogenic weight control measures and disordered eating behaviour of female student dancers

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LIST OF ABBREVIATIONS

ABS	actual body silhouette
ACSM	American College of Sports Medicine
AN	Anorexia Nervosa
ATP	adenosine triphosphate
ATP-PC	adenosine triphosphate-phosphocreatine
BIA	body image assessment
BMD	bone mineral density
BMI	body mass index
BMR	basal metabolic rate
BN	Bulimia Nervosa
CDR	Cognitive dietary restraint
DE	disordered eating
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
DXA	dual energy x-ray absorptiometry
EA	energy availability
EB	energy balance
ECG	electrocardiogram
ED	eating disorder
EDI3	Eating disorder inventory-3
EDI3-RF	Eating disorder inventory-3 referral form
EDNOS	Eating Disorders Not Otherwise Specified
EE	energy expenditure
_{est} EA	estimated energy availability
_{est} EEE	estimated exercise energy expenditure
FFM	fat-free mass
FHA	functional hypothalamic amenorrhea
FID	feel minus ideal discrepancy
FSH	follicle-stimulating hormone
g	gram

GnRH	gonadotropin-releasing hormone
IBS	ideal body silhouette
IGF	Insulin-like growth factor
IGF-1	Insulin-like growth factor-1
ISAK	International standards for anthropometric assessment
kcal	calorie
kg	kilogram
kJ	kilojoule
LH	luteinizing hormone
MET	metabolic equivalent
min	minute
MRC	Medical Research Council
NWU	North-West University
PWCM	pathogenic weight control measure
ROS	reactive oxygen species
T3	tri-iodothyronine
TEF	thermic effect of food
TFEQ	Three-factor eating questionnaire
TG	triglyceride
Triad	female athlete triad
VO _{2max}	maximal oxygen uptake

KEY DEFINITIONS

Clinical eating disorders: are categorized according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) as Bulimia Nervosa, Anorexia Nervosa and Eating Disorders Not Otherwise Specified.

Disordered eating: consists of restrictive eating behaviour that may not essentially get to the level of clinical eating disorders. Disordered eating describes a pattern of unorthodox eating behaviours that may fulfill a greater or lesser number of the formal diagnostic criteria of a clinical eating disorder.

Pathogenic weight control measures: an extensive range of unconventional eating and weight control conducts and mind-sets. These shoddy behaviours and attitudes may involve body mass and figure anxiety; substandard nutrition or insufficient energy intake (possibly even a combination of both); bingeing; exploitation of laxatives, diuretics and diet pills; and severe body weight control measures such as abstaining from food (fasting), purging (vomiting) and additional exercise over and above the normal training programme.

Energy balance: is described calorimetrically as the daily dietary energy intake minus the total energy expenditure and it is the remainder of dietary energy reserved in the body once all the physiological systems have performed their work for the day.

Energy availability: is expressed behaviourally as the daily dietary energy intake minus the exercise energy expenditure and, therefore, it is the sum of residual dietary energy subsequent to exercise completion that is required for other metabolic processes of the body.

Body image: is regarded as a mental depiction of the contour, size and appearance of the human body and it is manipulated by various dynamics, including ethnic and societal, amongst others.

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Thank You for making me unique, helping me to stand steadfast and giving me the will to accept every day as a new challenge.

Justine Robbeson

SUMMARY (English)

Background: Modern culture has stereotyped the divine female body as one that is continually getting leaner, with the internalization of the ‘thin’ ideal possibly resulting in body dissatisfaction, disturbances in body image and exploitation of extreme weight control measures. These shoddy eating behaviours/attitudes may involve body mass and figure anxiety, sub-optimal nutrition or insufficient energy intake (possibly even a combination of both) and use of pathogenic weight control measures (PWCM). Furthermore, low energy availability can be a consequence of disordered eating (DE) behaviour, but can also inadvertently emerge in the absence of clinical eating disorders, DE behaviours and/or restricted dietary intake. Various researchers have concluded that dancers are overly-concerned about dieting and their body mass, and tend to be discontented with their bodies. Every organ system in the body may potentially be negatively affected as a result of the ensuing undernourishment and/or weight loss related to poor nutritional behaviour. The aim of the study was to investigate the DE behaviour, PWCM use, body image and energy status of a group of University female dancers

Methods: Fifty two volunteer (18-30 years) dancers (n=26) matched by controls (n=26) of the same race, and comparable age and body mass index were recruited. DE behaviour was assessed with the Eating disorder inventory-3 (EDI3), Cognitive dietary restraint (CDR) subscale of the Three-factor eating questionnaire (TFEQ) and EDI3 referral form (EDI3-RF) behavioural questions. Body image was assessed using the Body Silhouette Assessment Scale. Energy status was assessed using a 5-day weighed food record to measure energy intake and Actiheart® monitor to measure energy expenditure.

Results: Dancers presented with significantly higher EDI3-Drive for thinness, EDI3-Body dissatisfaction and TFEQ-CDR raw subscale scores when compared to controls. Furthermore, the majority of dancers scored above the designated cut-off scores for the EDI3-Drive for thinness (46.2%), EDI3-Body dissatisfaction (61.5%), EDI-Bulimia (53.9%) and TFEQ-CDR (52.0%) subscales. Bingeing was the most common PWCM used by both dancers and controls (19.2% vs. 23.1%), followed by weight loss \geq 9kg within the preceding 6 months (11.5% vs. 15.4%). Vomiting (7.7%), laxatives (11.5%) and excessive exercise (19.2%) for weight loss were used only by the dancers. Current body weight was significantly different to desired body weight for the dancers only ($p=0.0004$). The discrepancy between current and ideal body image, also termed Feel Minus Ideal

Discrepancy (FID), was significantly different between dancers and controls, and indicated that controls were content with their body silhouette while dancers were inclined to want to lose weight. A negative energy balance was found in 80.8% of both dancers and controls. The energy availability of 48.0% of dancers and 52.0% of controls was between 30 and 45 kcal/kg fat-free mass/day. A total of 65.4% of dancers and 38.5% of controls reported to be currently trying to lose weight.

Conclusion: Irrespective of the limitations of this study, noteworthy observations were made pertaining to the DE behaviour, body image, and energy status of a group of South African student women dancers. This group of South African university women dancers were vulnerable to DE behaviour, had a propensity to be greatly displeased with their body image, and possessed a low energy status possibly because they were trying to lose weight.

Keywords: Pathogenic weight control, disordered eating, energy status, female dancers

OPSOMMING (Afrikaans)

Agtergrond: Moderne kultuur stereotipeer die volmaakte vroulike liggaam as een wat gedurig slanker raak, met die internalisasie van die “slank” konsep wat liggaamsontenvredenheid kan veroorsaak, versteurings in liggaamsbeeld en uitbuiting van ekstreme liggaamsgewigbeheermetodes. Dié slegte eetgewoontes/houdings mag liggaamsmassa en -figuur angstigheid, onvoldoende voeding of energie inname (dalk ’n kombinasie van albei), en die gebruik van patogeniese liggaamsgewigbeheermetodes insluit. Vervolgens, lae energie beskikbaarheid kan ’n nagevolg van versteurde eetgewoontes (VE) wees, maar kan ook onbewustelik ontstaan in die afwesigheid van kliniese eetversteurings, VE, en/of beperkte dieetinname. Verskeie ondersoeke het bevestig dat dansers oor-besorg oor hulle dieet en liggaamsmassa is en geneig is om ontevrede met hulle liggame te wees. Elke orgaansisteem in die liggaam kan potensiaal negatief geaffekteer word as ’n resultaat van die aanhoudende ondervoeding en/of gewigsverlies wat aan slegte eetgewoontes verwant is. Dié navorsingsprojek het die VE, gebruik van patogeniese liggaamsgewigbeheermetodes, liggaamsbeeld persepsies en energie-status van ’n groep vroulike dans-studente ondersoek.

Metodes: Twee-en-vyftig, vrywillige (18-30 jaar) dansers (n=26) in vergelyking met ’n kontrolegroep (n=26) van dieselfde ras en vergelykbare liggaamsmassa indeks is gewerf. VE is met die Eetversteurnis Inventaris-3 (EVI3), Kognitiewe dieetonderdrukking (KDO) subskaal van die Drie-faktor Eetvraelys (DFEV), en die EVI3 Verwysingsvorm se gedragsvrae bepaal (EVI3-V). Liggaamsbeeld is met die Liggaamsilhoeët Waarderingskaal bepaal. Energie-status is bepaal deur die gebruik van ’n 5-dag geweegde dieetrekord om energie-inname te bepaal en die Actiheart® monitor om energie-verbruik te meet.

Resultate: Dansers het betekenisvolle hoër tellings op die EVI3-Strewe-na-maerheid, EVI3-Liggaamsontenvredenheid en DFEV-KDO rou subskaal in vergelyking met kontroles gehad. Verder het die meerderheid van dansers tellings bo die aangewese afsnypunte vir die EVI3-Strewe-na-maerheid (46.2%), EVI3-Liggaamsontenvredenheid (61.5%), EVI-Bulimia (53.9%) en DFEV-KDO (52.0%) subskale aangeteken. Ooreet-vas siklusse was die mees algemene patogeniese liggaamsgewigbeheermetode wat deur beide dansers en kontroles (19.2% vs. 23.1%) gebruik is, gevolg deur gewigsverlies ≥ 9 kg binne die voorafgaande 6 maande (11.5% vs. 15.4%). Braking (7.7%), lakseermiddels (11.5%), en oormatige oefening (19.2%) vir gewigsverlies is alleenlik deur

die dansers gebruik. Huidige liggaamsgewig het betekenisvol van begeerde liggaamsgewig vir die dansers alleenlik verskil ($p=0.0004$).

Die teenstrydigheid tussen huidige en ideale liggaamsbeeld, asook beskryf as die Gevoel Minus Ideaal Teenstrydigheid (GIT), het betekenisvol verskil tussen dansers en kontroles en het aangedui dat kontroles tevrede was met hulle liggaamsilhoeët, maar dat dansers 'n geneigdheid gehad het om gewig te wil verloor. 'n Negatiewe energiebalans is in 80.8% van beide die dansers en kontroles gevind. Die energiebesikbaarheid van 48.0% van die dansers en 52.0% van die kontrole was tussen 30 en 45 kcal/kg vetvrye massa/dag. 'n Totaal van 65.4% van dansers en 38.5% van kontrole het aangedui dat hulle huidiglik probeer om gewig te verloor.

Gevolgtrekking: Ongeag die beperkinge van die studie, is merkwaardige waarnemings met betrekking tot die VE, gebruik van patogeniese liggaamsgewigbeheermetodes, liggaamsbeeld persepsies en energie-status in 'n groep Suid-Afrikaanse vroulike dans-studente gevind. Dié groep Suid-Afrikaanse vroulike dans-studente was kwesbaar vir VE, het 'n neiging gehad om hoogs ontevrede met hulle liggaamsbeeld te wees, en het 'n lae energie-status besit moontlik as gevolg van die feit dat hulle probeer het om gewig te verloor.

Sleutelwoorde: Patogeniese gewigsbeheer, versteurde eetgewoontes, energie-status, vroulike dansers

Chapter 1:
Introduction

CHAPTER 1: Introduction

This chapter provides the reasoning behind the study. It highlights the dilemma where female athletes become preoccupied with their body size, shape and composition and the ensuing negative consequences of their anxieties. Furthermore, the lack of data in this relevant field of study in South African is emphasized and the aim and objectives of the study clarified.

1.1) Background to the problem

Women, from youth through to the aged, illustrate a tendency for participation in arduous athletic activity either for health motives, competitive motives or a combination of both (Hanekom, 2003). The escalation in the participation of women in sport materialized on account of legislation passed in the USA in 1972 termed “Title IX” (Mottet, 2000). “Title IX” states that any one person, male or female, be presented with equivalent athletic opportunities at any school receiving federal funding (Mottet, 2000). Supporting “Title IX” is the “Amateur Sports Act of 1978” which has served as a driving force to promote the equalization between the number of men and women participating in competitive sport, and it seems as if these laws have produced an increased level of participation of females at high school and college levels (Lopiano, 2000). Synchronized with this escalated sport involvement, the American College of Sports Medicine (ACSM) identified from the literature in the early 1990’s that a number of female athletes were being affected by the assorted interrelated symptoms of disordered eating (DE), amenorrhea and osteoporosis; the communal term referred to as the ‘Female athlete triad’ (Triad) (Yeager *et al.*, 1993; Otis *et al.*, 1997).

High-quality sustenance is an essential component of athletic endeavours as it facilitates the athlete in achieving optimal performance. It is necessary for the body to be well fuelled in order to excel, and nutrition could be the make-or-break between winning and losing in sport (Tietjen-Smith & Mercer, 2008). Regrettably, athletes repeatedly fail to plan for optimal nutritional intake to improve performance (Tietjen-Smith & Mercer, 2008). Further compounding this inadequate intake are the athletes’ misperceptions of nutritional intake’s influence on the body and/or performance (Clark, 2006), occasionally with the resultant consequence of DE behaviours and even a clinical eating disorder (ED) in some (Gottschlich & Young, 2006).

The negative energy balance that is usually associated with DE in athletes can be created by unintentionally limiting energy intake, thereby making one unable to compensate for the amplified energy expenditure (EE) during exercise (Goodman & Warren, 2005). The term “energy balance” is described calorimetrically as the daily dietary energy intake minus the total EE and it is the remainder of dietary energy reserved in the body once all the physiological systems have performed their work for the day (Loucks, 2007). Various downfalls of using the concept of energy balance to manage physical training incorporate that it is an output from the physiological systems of the body; and it is not a very convenient or inexpensive method because it can only be measured by scientists using advanced equipment (Loucks, 2007).

Alternatively, energy availability (EA) is expressed behaviourally as the daily dietary energy intake minus the exercise EE and, therefore, it is the sum of residual dietary energy subsequent to exercise completion that is required for other metabolic processes of the body (Loucks, 2007; Manore *et al.*, 2007). This remaining energy serves as an input to diverse physiological systems of the body (Loucks, 2007) namely, cellular maintenance, thermogenesis, immunity, growth, reproduction and locomotion (Manore *et al.*, 2007). A healthy EA has been shown to be roughly at 45 calories (kcal) per kilogram (kg) fat-free mass (FFM) per day, equivalent to ~188 kilojoules (kJ) per kgFFM/day, with lower values facilitating weight and fat loss; and higher values assisting muscle growth and carbohydrate loading (Loucks & Nattiv, 2005; Loucks, 2007). When referring to the formula used to define EA described by Loucks and colleagues (2011), it is apparent that low EA can result in the absence or presence of DE or restricted energy intake, since an increase in exercise energy expenditure alone has the ability to reduce EA. Concurring with the preceding statement, Nattiv and colleagues (2007) also ascertain that low EA may unintentionally emerge in the absence of clinical EDs, DE behaviours and/or restricted dietary intake. Recently, the ACSM stated that low EA appears to be the key aspect negatively influencing both the reproductive system (ultimately resulting in functional hypothalamic amenorrhea (FHA)) and skeletal health (ultimately resulting in osteoporosis); and that EA can be considered the foundation of the Triad (Nattiv *et al.*, 2007).

Clinical EDs are categorized according to the Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) as Bulimia Nervosa (BN), Anorexia Nervosa (AN) and Eating Disorders Not Otherwise Specified (EDNOS) (Gmitrowicz & Kucharska, 1994). Not all defective eating behaviours fit the

exact criteria or description of the frank EDs of AN and BN (several characteristics of AN and BN may be evident while others may not be present at all), and this places them under the classification of EDNOS (APA, 1994). Some diagnostic criteria for EDNOS include: all the criteria for AN are met except the female has normal menstrual cycles or despite significant weight loss, the person's current weight is in the normal range. all the criteria for BN are met except that binge eating and inappropriate compensatory mechanisms occur at a frequency of < 2 times per week for a duration of < 3 months; the regular use of inappropriate compensatory behaviour by an individual of normal body weight after eating small amounts of food; and repeatedly chewing and spitting out large amounts of food without swallowing (APA, 2000).

Alternatively, DE consists of restrictive eating behaviour that may not essentially get to the level of clinical EDs (Beals & Manore, 2002) and any individual with DE behaviour has an increased risk to develop a clinical ED (Rome *et al.*, 2003). When female athletes become preoccupied with their body size, shape and composition, it could result in a consequential broad range of poor nutritional behaviours (Waldrop, 2005). These behaviours can include inadequate dietary energy intake, restricting high fat and/or protein foods and last but not least, binge eating and/or purging (purging which involves increased exercise, self-induced vomiting and the use of diet pills, laxatives or diuretics) (Waldrop, 2005). Every organ system in the body may potentially be negatively affected as a result of the ensuing undernourishment and/or weightloss related to poor nutritional behaviour (Rome *et al.*, 2003), with several negative health consequences concerning the cardiovascular, reproductive, skeletal, renal, gastrointestinal, endocrine and central nervous systems (Becker *et al.*, 1999; APAWGED, 2000; Golden *et al.*, 2003; Rome *et al.*, 2003). Nattiv and colleagues (1994) found that DE influences as much as two thirds of young female athletes, moreover, Beals and Manore (2002) found comparable values of between 15% and 62% within female collegiate athletes with proportions being dependent on type of sport participation. Hausenblaus and Carron (1999) identified four factors in the literature that are responsible for the development of DE in female athletes, namely: 1) the socio-cultural motive based on the hypothesis that societal norms in Western cultures insist on a slim and physically robust body type, 2) the sport environment motive based on the hypothesis that athletes are subjected to physique and weight demands unique to sport, 3) the exercise and physical activity motive based on the hypothesis that sport involvement and a surplus of physical activity may exhibit a fundamental role in the progression of EDs, and 4) the intra-

individual motive based on the hypothesis that psychological risk traits related to EDs can put particular people at an elevated risk for eating pathologies.

Dance requires a harmonious concoction of vital elements namely bodily structure, physicality, suitable body types and a thorough understanding of motion. For these aspects to be mastered, the dancer requires technique of the highest order as well as a combination of strength, endurance, speed and flexibility (Best, 1985). Modern culture has stereotyped the divine female body as one that is continually getting leaner with a consequential increase in the number of diagnosed EDs among teenager and young adult females, especially in those involved in sport where there is a demand for slenderness (Morse, 2008). Female athletes participating in sport such as dancing, gymnastics, running, wrestling and figure skating, amongst others, show an elevated occurrence of EDs (Fenichel & Warren, 2007). It is the inner concern to accomplish success combined with the external pressure imposed by the media, coaches and public that has the potential to drive athletes involved in artistic or aesthetic events to practice DE behaviours (Morse, 2008).

1.2) Motivation for the study

There is little data published on the Triad and its components in South African female athletes, with published data being primarily focused on long distance or endurance athletes. Micklesfield and co-workers (1995) completed a study that assessed the bone mineral density (BMD) of mature, premenopausal ultramarathon runners and related risk factors for decreased BMD with actual BMD. Hanekom (2003) performed a prospective comparative study of bone structure and menstrual function in adolescent female endurance athletes from five secondary schools in Pretoria. An additional study by Micklesfield and colleagues (2007) looked at the factors associated with menstrual dysfunction and self reported bone stress injuries in female runners in the ultra and half-marathons of the Two Oceans Marathon. Finally, Havemann and associates (2011) principally determined the prevalence of DE behaviour and menstrual disorders in a group of provincial-to-national level student netball players. The only study to date that looked at components of the Triad amongst black South Africans was Prinsloo and partners (2008) who found that 4 out of 32 runners reported menstrual irregularities and 13 runners had an increased risk for DE.

Data are scarce regarding the eating and body weight control behaviours of South African athletes, and lacking altogether when it comes to South African dancers. Therefore, this study will explore and shed more light on the DE behaviour and the use of pathogenic weight control measures (PWCM) of a group of student female dancers at a South African University, as well as investigate their energy status.

It is anticipated that various ethnical differences may arise with regard to body image and DE behaviour within the multi-racial study population. Literature has suggested that prospective cases of EDs are as probable among African as among Caucasian subjects (Le Grange *et al.*, 1998), especially considering that black South African female college students have demonstrated significantly greater ED psychopathology than other races (Le Grange *et al.*, 1998). Additionally, the body image perceptions of black African women is a very complex issue that is influenced by a number of beliefs including: ‘fatness’ that is perceived by some as a precursor of dignity, respect, health, wealth and strength (Puoane *et al.*, 2005), while others associate ‘fatness’ with specific non-communicable diseases and inability to find suitable clothing sizes (Puoane *et al.*, 2010); and ‘thinness’ being stereotyped by some as sign of disease/s while others associate it with a desired physical appearance and ability to find suitable clothing sizes (Puoane *et al.*, 2010). Interestingly, there is available evidence showing that the perceptions of body size that women have do not correspond with their body mass index (BMI) (Puoane *et al.*, 2002). Even if explanations do exist for potential inter-racial discrepancies in results, the common practice of dance may also wield noticeable influences on DE behaviour and body image perceptions within this group of dancers.

1.3) Aim and objectives

1.3.1) Aim

To investigate the DE behaviour, PWCM use, body image and energy status of a group of University female dancers.

1.3.2) Objectives

Objective 1: To evaluate the DE behaviour in a group of female student dancers compared to a control group. This will be estimated by using the Eating Disorder Inventory-3 (EDI3) (Garner, 1983, 2004) as well as the Cognitive Dietary Restraint (CDR) subscale of the Three-factor Eating Questionnaire (TFEQ) (Stunkard & Messick, 1985).

Objective 2: To explore body weight control behaviour and body image perceptions of female student dancers compared to a control group. This will be evaluated by means of the Eating Disorder Inventory-3 referral form's (EDI3-RF) five behavioural questions and the Body Silhouette Assessment Scale (Williamson *et al.*, 1989).

Objective 3: To evaluate current energy and nutrient intakes, total daily EE, estimated energy availability ($_{est}EA$) and energy balance of female student dancers compared to a control group. This will be done by using dietary data obtained from a 5-day weighed food record as well as EE data obtained from the ActiHeart® (CamNtech Ltd, Cambridgeshire UK) monitor.

Objective 4: To compare subjects with a low EDI-drive for thinness score (<7) to those with a high EDI-drive for thinness score (≥ 7) in terms of energy and nutrient intake, body composition, total daily EE and $_{est}EA$. This will be achieved by using data obtained from the EDI3, dietary data obtained from a 5-day weighed food record, body composition data obtained from the Dual energy x-ray absorptiometry (DXA) scan as well as EE data obtained from the ActiHeart® (CamNtech Ltd, Cambridgeshire UK) monitor.

1.4) Research team

Table 1 shows a summary of the individuals involved this study.

Table 1: Team members of the study

Name	Hattie Wright	Chrisna Botha	Justine Robbeson	Rosalyn Ford	Salome Kruger	Magda Uys
Title	Dr	Dr	Miss	Miss	Prof	Mrs
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Specific role in project	Principal investigator	Project coordinator	Project is part of Miss Robbeson's MSc project.	Project is part of Miss Ford's Honors project.	Academic input in interpretation of results and writing of dissertation	DXA scans and interpretation of BMD measurements.
Duration of involvement	4 years	1 year	2 years	1 year	1 year	

1.5) Structure of dissertation

This MSc dissertation is presented in chapter format as follows:

Chapter 1 is the background and motivation to the study, including the aim and objectives as well as a brief overview of the research team.

Chapter 2 is a literature review that sheds light on various sections including dance and its physical/psychological requirements; sport nutrition for dance; DE and PWCM; and EA.

Chapter 3 is a complete description of the methods of the study and explains the role of the student in more detail.

Chapter 4 is an article which explores the disordered eating behaviour, body image and energy status of a group of female student dancers compared to a control group.

Chapter 5 is the concluding remarks of the overall dissertation findings with reference to the set objectives.

This dissertation is written in South African English with the exception of Chapter 4 that is written in American English.

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Chapter 2:
Literature review

CHAPTER 2: Literature review

This chapter provides a comprehensive literature overview of relevant research. It sets a concise and informative scene with regard to dance and the multifaceted integration of aspects that form an integral part of dancers' lives, whether it be training/fitness related, nutrition related or health related.

2.1.1) Introduction to dance

Hanna (2010) uses a very intricate description of dance where it is detailed as a complex sensorimotor performance where the body movement is communicated to the viewer by the use of meaningful, deliberately cadenced, culturally prejudiced, non-verbal proceedings. A parallel definition of dance by Ravelin and colleagues (2006) describes dance as a culturally influenced human resource which involves body movements, steps, expression and interaction. Dance is regarded as one of the human race's ancient and most fundamental modes of expression (Hawkins, 1964). Via the body, man detects and distinguishes the tensions and tempos of the surrounding universe, and using the body as piece of equipment he conveys his emotions to the universe. With his perceptions and sensations as material, he composes his dance; and through this dance he communicates to his comrades and his world (Hawkins, 1964). Nwaru (2008) describes two opposing views to the meaning of dance namely, the formalist view where emotion is not necessarily considered and physicality is of importance together with emphasis on the remarkable things that the human body can do, and the relativist view where emphasis is laid on the content of the dance.

Dance is involved in many aspects of social relations such as courtship desirability and it is a noted ingredient in ceremonies to convey union (Hanna, 2010). Furthermore, dance is a blend of athleticism and artistic ability with a distinctive interaction of physical and aesthetic prerequisites that ultimately have an effect on health (Hincapié & Cassidy, 2010).

“As far back as 1916 Carl Gustav Jung noted the value of dance and movement as a release for the subconscious mind.”

(Fourie & Lessing, 2010)

Ravelin and colleagues (2006) state that dance allows one to experience wholeness at different levels including psychologically, physiologically, socially and religiously. According to them, dance also promotes various human traits such as independence; how an individual accepts, expresses and understands oneself; ascertaining of one’s body image; how an individual conveys and copes with emotions; deliverance from social laws; religious and physiological welfare; and improvement of self-worth and self-assurance, amongst others (Ravelin *et al.*, 2006).

At a more expert level, dancers require skills of a higher order in both the aesthetic and technical side, and they should also present with the psychological skills necessary to cope in crucial situations. In order for this to take place, it is a necessity for dancers to be injury-free and physically in top form (Koutedakis *et al.*, 2005). According to Koutedakis and colleagues (2005), physical fitness is expressed as the capacity of any one person to be able to satisfy the demands of a particular physical assignment. Fitness in dance is a multifaceted integration of aspects including body composition (Claessens *et al.*, 1987; Hergenroeder *et al.*, 1993), joint mobility (Van Gyn, 1986) and cardiorespiratory fitness (Cohen *et al.*, 1982; Clarkson *et al.*, 1985). Moreover, fitness in dance is also conditional to the ability of the dancer to cultivate high levels of muscular tension (Fitt, 1982; Clarkson, 1988).

Female athletes participating in athletic or artistic endeavours that boast aesthetic value or are associated with weight categories, have the added pressure from their coaches and themselves to achieve a lean physique (Morse, 2008). Consequentially, female athletes competing in sport such as dancing, gymnastics, running, wrestling and figure skating, amongst others, have an increased risk for DE behaviour (Fenichel & Warren, 2007). It is recognized that low EA does present a detrimental health risk to physically active girls and women, either in combination with or in the absence of EDs or DE, (Nattiv *et al.*, 2007). Considering the 2007 ACSM Position Stand on the Triad documents EA to be the cornerstone of the Triad, there presents a vital need for early

diagnosis, treatment as well as prevention of sub-optimal values since there exists potential irreversible consequences if low EA evolves into full-scale Triad components (Nattiv *et al.*, 2007). Through assessing the DE behaviour and low EA risk in South African dancers, we are one step closer to resolving the issues of the Triad and its components within our local population, which could in the long run make a valuable contribution to international research. This research can also be practically significant to dancers as well as those people associated with dancers (i.e. teachers, parents and health professionals working with dancers) as it may increase awareness, enhance the possibility of early detection of those at risk, aid intervention, alleviate the health and performance consequences associated with DE behaviour and low EA, and promote prevention through education.

2.1.2) Kinanthropometry of dancers

Body composition can be defined as the internal arrangement of the human body and it is the ratio of fat mass to FFM which is usually expressed as percentage body fat (Koutedakis & Sharp, 1999). Apt body weight and body fat are vital requirements if one has an intention of benefitting performance (Koutedakis & Jamurtas, 2004). Dancers have a tendency towards low waist-to-hip and waist-to-thigh circumference ratios (To *et al.*, 1997). A low waist-to-hip and waist-to-thigh ratio would signify that less fat is accumulated in the abdominal region compared to the gluteal and thigh regions (Friesen, *et al.*, 2011), which is aesthetically ideal for the dance occupation and regarded as ‘feminine’ (Koutedakis & Jamurtas, 2004). Dancers have been shown to possess similar lean body mass values to untrained individuals (Van Marken Lichtenbelt *et al.*, 1995) and it appears to be the bodyweight limitations that are implemented by dancers which prevent an increase in lean body mass, which in-turn possibly assists performance (Koutedakis & Jamurtas, 2004). Body composition in dance is looked at first and foremost in the ballet perspective where characteristic body fat percentage values for female ballerinas vary from about sixteen to eighteen percent (Clarkson *et al.*, 1985; Van Marken Lichtenbelt *et al.*, 1995). It is noted that little data has been published on body composition of other styles of dancers (Koutedakis & Sharp, 1999), and it needs to be considered that any data acquired from ballet dancers may not necessarily be relevant to other forms of dancers due to ballet dancers being regarded as the slimmest (Pacy *et al.*, 1996). It has been found that dancers are mostly ectomorphic individuals (characterised by long and thin muscles/limbs and low

fat storage; usually referred to as slim) with emphasis based on linearity of the body (Bale *et al.*, 1994), nevertheless dancers do not present with the smallest body fat percentage values among active individuals (Brinson & Dick, 1996). The petite physiques of female dancers, even though it is a modern aesthetic prerequisite, can result in numerous well-known medical problems (Koutedakis & Jamurtas, 2004).

2.1.3) Litheness of dancers

As early as the 1980's, muscle suppleness and joint mobility were considered to be essential aspects of optimal physical performance and, therefore, seen as fundamental elements of total fitness (Corbin & Noble, 1980). Muscle suppleness encompasses how flexible, long and pliant various muscles are, while joint mobility relates to the active scope of movement (Koutedakis & Sharp, 1999). When an individual presents with favourable ranges of muscle suppleness and joint mobility, it is usually indicative that there are no adhesions or irregularities pertaining to the joint, over and above no critical anatomical or muscular restrictions (Koutedakis & Jamurtas, 2004). Various attributes have the ability to influence muscle suppleness and joint mobility namely, structure of bony surfaces and/or articular cartilage, fibrous connective tissue and fat content of muscles, amongst others (Koutedakis & Sharp, 1999). Considering that the majority of these attributes are genetically predetermined (Holland, 1968) and that suppleness of the muscles and joints are deemed as valuable predictors of dance success (Srhoj, 2002), it is necessary to have strict auditions within the dance-world to ascertain whether young dancers have the required suppleness before enrolling in a dance school (Nilsson *et al.*, 1993). When comparing the suppleness of muscles and joints within professional dancers versus dance students, no relationships were unveiled regarding the incidence and magnitude of lower-back injuries (Koutedakis *et al.*, 1997) and ankle injuries (Wiesler *et al.*, 1996). Alternatively, it was found that in athletes an inverse association existed between deficient lumbar spine, hamstring and hip flexor suppleness and an increased incidence of lower-back injuries (Harvey & Tanner, 1991), and flexibility disproportions resulted in a higher incidence of injuries (Knapik *et al.*, 1991). It has been suggested by Koutedakis and Jamurtas (2004) that the more 'supple' a dancer is, the greater the ability to endure and resist a stress as opposed to their less flexible counterparts; and it is eminent that 88% of acute dance injuries transpire during flexibility

training (Askling *et al.*, 2002). In Table 2, the various attributes that influence muscle suppleness and joint mobility are listed.

Table 2: Factors that can influence muscle flexibility and joint mobility (Koutedakis & Sharp, 1999)

Joint factors	Muscular factors	General factors
Structure of bony surfaces	Muscle / tendon length	Age
Structure of articular cartilage	Fibrous connective tissue	Gender
Joint-capsule laxity	Elastic connective tissue	Body type
Ligaments	Muscle's fat content	Fitness levels
Synovial fluid	Stretch / relaxation techniques	Body fat
		Environmental temperature
		Psychological stress

2.1.4) Aerobic fitness of dancers

Aerobic fitness, alternatively referred to as cardiorespiratory fitness, refers to the capacity of muscles to function in aerobic situations; and it includes all facets of uptake, transportation and usage of oxygen to release stored energy from muscles (Koutedakis & Jamurtas, 2004). The potential of the muscles to utilize oxygen in metabolism, together with the collective capacities of the cardiovascular and respiratory systems to distribute oxygen to the muscle mitochondria are reverberated in maximal oxygen uptake (VO_{2max}), which is regarded as the most fundamental measure of aerobic fitness (Burke & Deakin, 2006). Dance students have exhibited lower VO_{2max} values in relation to other athletes (Baldari & Guidetti, 2001), and within the dance world VO_{2max} variations, albeit significant or not, exist between the different categories and levels of female dancers (Figure 1). Investigations into the VO_{2max} of contemporary dancers with varying skill levels confirmed that no significant differences are found between dancers at university, graduate and elite rank (Wyon *et al.*, 2002); juveniles dancing in productions or for leisure (Padfield *et al.*, 1993); and intermediate and highly developed dance students (Chatfield *et al.*, 1990). Dahlström and colleagues (1996) did verify that the VO_{2max} is higher in students who major in ballet and modern dance when contrasted against other dance compilations within a professional institution. Additionally, no

significant differences in cardiorespiratory fitness have been verified amidst ballet and contemporary dance students (White *et al.*, 2004) while elite contemporary dancers have displayed VO_{2max} values that are significantly higher than their ballet equivalents (Kirkendall & Calbrese, 1983; Chmelar *et al.*, 1988). It does need to be considered that the spectrum of aerobic capacities expressed by the various authors can be as a result of the conflicting test variables.

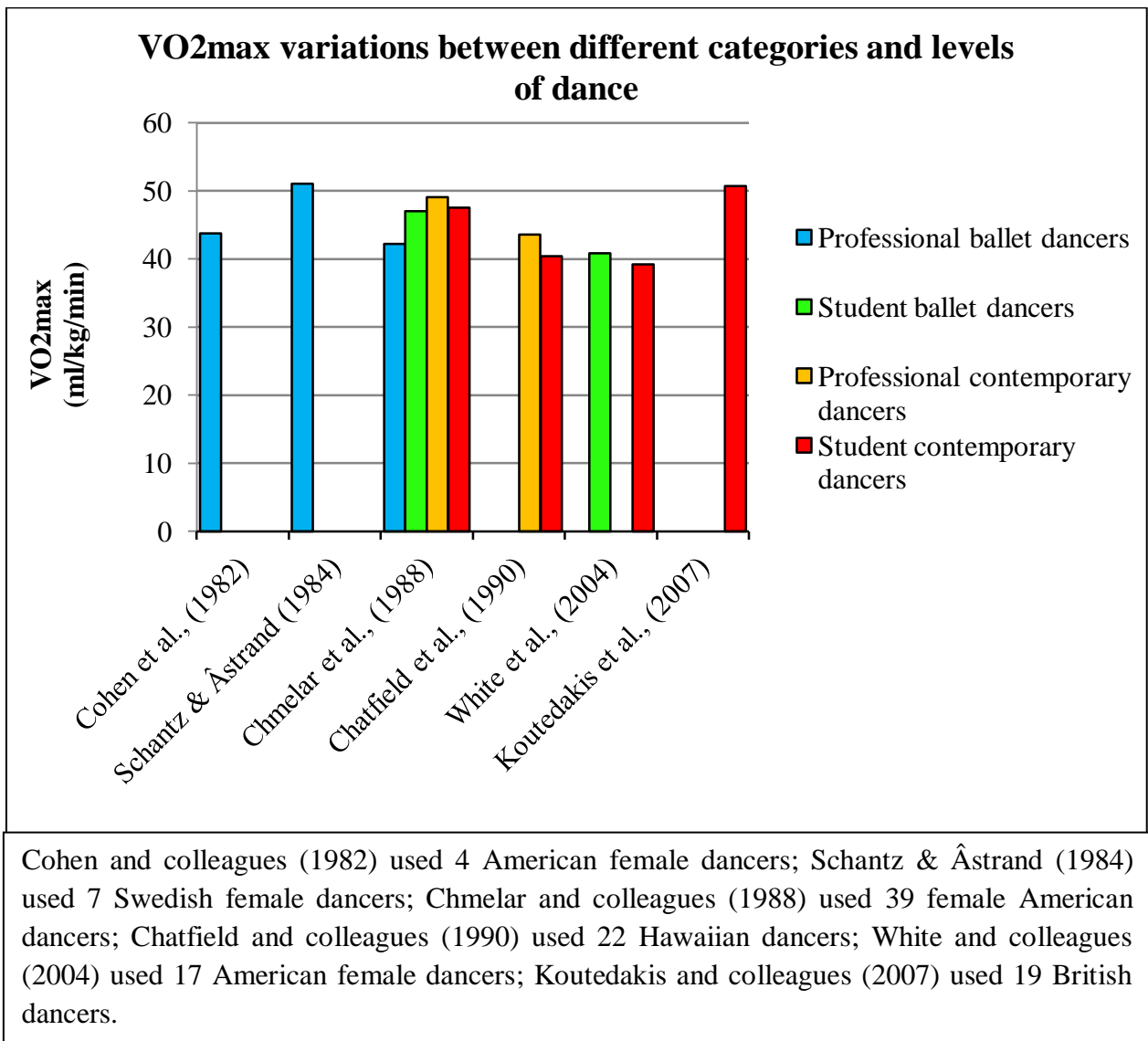


Figure 1: VO₂max variations between different categories and levels of female dancers

2.1.5) Muscular strength of dancers

Strength is the capacity to conquer external resistance or to oppose external forces through the use of body muscles; and it is consequential to the distinctive abilities of muscle cells that translate chemical energy of adenosine triphosphate (ATP) into mechanical work (Koutedakis & Sharp, 1999). Muscular strength is defined as the greatest force that can be exerted in a single deliberate contraction (Koutedakis & Sharp, 1999). Research has indicated that dancers are not as physically conditioned in relation to other athletes alike, such as rhythmic gymnasts (Baldari & Guidetti, 2001), especially with regard to strength (Reid, 1988; Cale-Benzoor *et al.*, 1992; Bennell *et al.*, 1999) and, therefore, rendering dancers more prone to injury (Reid, 1988; Koutedakis & Sharp 2004). Brown and colleagues (2007) found the range of a single repetition maximum for leg press in collegiate female dance students, enrolled in at least one intermediate-advanced or advanced dance technique class, to be between 183.3 ± 30.9 and 227.7 ± 65 kg. In the same group of students, leg curl ranges of between 34.8 ± 4.5 and 40.0 ± 5.7 kg, and leg extension ranges of between 58.7 ± 6.5 and 62.5 ± 9.1 kg were depicted. Chatfield and co-workers (1990) established that no significant differences occurred between intermediate and highly developed dance students, over and above sedentary persons, for both muscular strength and power of the knees and ankles. Additionally, Chmelar and co-workers (1988) ascertained that no significant differences existed between dance students and elite dancers, for both ballet and contemporary categories, for quadriceps and hamstring muscles' peak torque. Contemporary dancers have shown greater scores in muscular endurance in contrast to ballet dancers, yet lower scores in contrast to folk dancers (Thomas, 2003). Various beliefs exist with regard to strength training being a prerequisite for success in dance, namely enhanced muscular strength may weaken a dancer's aesthetic appeal, and strength and strength training have a negative influence on body suppleness, an outcome which in itself demands tedious attention (Koutedakis *et al.*, 2005). Yet, there is research that contradicts these beliefs by announcing that through introducing strength training in male and female dancers, a possibility of decreased risk of injury and enhanced balance exists, among other benefits (Koutedakis & Sharp, 1999).

2.1.6) Energy expenditure of dancers

Dance has been classified as a high-intensity intermittent exercise by various authors (Cohen, 1984; Schantz & Åstrand, 1984; Rimmer *et al.*, 1994; Wyon, 2004). The energy systems that are employed while the individual is physically active rely on an assortment of variables, namely; intensity of the exercise, time-span of the exercise, and duration of rest flanked by exercise periods (Bompa, 1994; Bangsbo, 1996). When assessing dance, one is able to identify various distinctive areas which each have their own metabolic requirements (Wyon, 2005). Dance class is said to comprise of two characteristic segments, namely the warm-up and the centre (Wyon, 2005). The warm-up segment is distinguished by moderate-interval, low-intensity activity periods of four to five minutes (min) duration and a mean heart rate of between 117 to 134 beats per min (Cohen *et al.*, 1982; Wyon *et al.*, 2002), suggestive of the aerobic system being competent enough to satisfy the muscular energy demands (Wyon, 2005). Alternatively, the centre segment of class is distinguished by short-interval, high-intensity activity periods of 10 to 40 seconds duration and longer rest periods of 2 to 5 min long (Wyon, 2005), thereby fulfilling the definition of anaerobic exercise (Hill & Smith, 1991; Gaitanos *et al.*, 1993; Gastin, 2001). Wyon (2005) has stated that there is evidence suggesting dance exploits all energy systems to satisfy muscular requirements for ATP. When exploring the performance aspect of dance, research suggests that intensity of recital is complimentary to that experienced in the centre segment of dance class (Cohen *et al.*, 1982, 1982a; Schantz & Åstrand, 1984), with the exception of a longer exercise duration of 1 to 4 min (Wyon, 2005). The high-intensity of recital, together with heightened levels of lactate (Schantz & Åstrand, 1984) proposes that muscular energy demands during performance are being satisfied by the lactate and aerobic systems (Wyon, 2005). Wyon and Redding (2005) illuminated that differences in energy system utilization during rehearsal and recital do exist and it was also concluded that no change in aerobic fitness occurred during rehearsal while a significant increase occurred in recital period. Dance is a predominantly skill-based form of art and if the ‘physiological dancer’ is perfected and polished to the same degree as the ‘artistic dancer’, the restrictive factor preventing them from performing optimally will likely be their physical conditioning (Wyon, 2005).

2.2.1) Sports nutrition as a backbone for successful performance in dance

The strenuous training and physical demands that dancers endure make it necessary to have significant energy intake, especially if quality performance and sufficient nutrient ingestion are end-goals (Thompson, 1998). Polikandrioti and Tsami (2009) conclude that the body cells require a meticulous combination of macro- and micronutrients in order for the body to function normally, and adequate amounts of these nutrients can be found in a well-balanced diet, which if practiced makes supplementation unnecessary. Health and physical performance can deteriorate if any of the nutrients are deficient for extended periods of time (Polikandrioti and Tsami, 2009).

2.2.2) Nutritional knowledge of athletes

Athletes lead physically active lifestyles and it is well-reported that competitors at different levels of expertise have a poor grasp on sound nutritional knowledge (Wiita & Stombaugh, 1996; Jacobson *et al.*, 2001; Smith Rockwell *et al.*, 2001; Cupisti *et al.*, 2002; Rosenbloom *et al.*, 2002; Burke *et al.*, 2003; Burns *et al.*, 2004). Athletes primarily receive nutritional guidelines and information from their certified athletic trainers, strength and conditioning coaches and/or tutors (Jacobson *et al.*, 2001; Burns *et al.*, 2004). Unfortunately, athletes may not be acquiring reliable nutritional counseling to assist performance and maintain wellbeing (Burns *et al.*, 2004), with female athletes being predominantly at risk of experiencing complications and/or injuries due to poor nutrition counseling or unsatisfactory information relative to their level of participation (Cupisti *et al.*, 2002). Westernized nations, such as ours, are inclined to regard the intake of food somewhat passively, which tends to be as a result of a poor understanding of what in actuality represents optimal nutrition, and how this in turn influences our bodily functions (Polikandrioti & Tsami, 2009).

“A sound understanding of exercise nutrition enables one to appreciate the importance of adequate nutrition, and to critically evaluate the validity of claims concerning nutrient supplements and special dietary modifications to enhance physique, physical performance, and exercise training responses.”

(McArdle & co-workers, 2009)

2.2.3) Energy requirements of dancers

The total daily energy expenditure of an individual is generally comprised of three primary categories namely, the persons's basal metabolic rate (BMR), energy expenditure from physical activity and the thermic effect of food (TEF) (Burke & Deakin, 2006).. With regard to BMR, relatively youthful and fit dancers may require up to 1.6 kcal (~ 6.7 kJ) per kg body weight, keeping in mind that the average woman needs about 15% less energy to support their metabolism than the average man, primarily due to differences in their body mass (Koutedakis & Sharp, 1999). Alternatively, the energy cost of activities/exercise, also referred to as exercise metabolic rate, represents the increase in metabolism in addition to resting levels, following modest or strenuous physical movement/exercise (Koutedakis & Sharp, 1999). There is some literature available on the energy cost of different types of dance (Table 3) providing one with a fairly accurate indication of how much energy the body requires to perform each style.

Table 3: The energy cost of different types of dance

Type of dance	Energy cost (kcal/kg/min)	Energy cost (kJ/kg/min)	Reference
Aerobic dance	0.143	~0.601	Foster, 1975
Ballet dance	0.085	~0.357	Cohen & colleagues, 1982
Disco dance	0.143	~0.601	Leger, 1982
Folk dance	0.181	~0.760	Wigaeus & Kilbom, 1980
Modern dance	0.120	~0.504	Wyon & colleagues, 2002
Square dance	0.083	~0.349	Jette & Inglis, 1975

Numerous of the world's nutrition-related problems result because of the inability to balance energy intake with energy requirements (Maughan & Burke, 2002). Training and competing in sport includes a variety of activity facets, each with their own specific energy requirements (Maughan & Burke, 2002). Athletes are confronted with a gamut of challenges in an attempt to satisfy their own specific energy demands, which extend from endeavours to reach sufficiently high energy intakes that comply with their high energy requirements, to the need of restricting energy intake in order to

attain and/or maintain low body weight and body fat percentages (Maughan & Burke, 2002). With regard to the latter statement, eliminating energy from the diet has become a very popular facet of the lives of dancers (Koutedakis & Sharp, 1999). Professional female ballet dancers have been shown to ingest between 70 to 80% of the recommended daily allowance of energy intake (Benson *et al.*, 1985; Bonbright, 1989, 1990), while dance students have also demonstrated patterns of reduced energy intake, with reported intake values at 66% of their estimated energy requirements (Dahlström *et al.*, 1990).

2.2.4) Optimal nutrition in dancers

Intense training together with a low dietary energy intake or low carbohydrate ingestion may heighten the risk of chronic fatigue, muscular injuries, oxidative stress and weakened immunity (Burke *et al.*, 2004; Gleeson *et al.*, 2004; Nattiv *et al.*, 2007; Yanagawa *et al.*, 2010), which may potentially result in recurrent periods of injuries and sickness (Sundgot-Borgen & Garthe, 2011). An optimal diet provides nutrients in sufficient quantities for tissue maintenance, restoration and development without surplus energy intake (McArdle *et al.*, 2009). Proper nutrition is known to facilitate the enhancement of physical performance, it improves conditioning, it assists recovery after exhaustive exercise sessions, it forms an integral part in injury prevention and it serves a role in the preservation of immunity (Aoi *et al.*, 2006). To follow is a discussion of some aspects that are relevant when it comes to the role of nutritional concepts in supporting dance performance, albeit a direct or indirect influence.

2.2.4.1) The role of adequate hydration in promoting optimal performance

Water is the primary component of the human body, constituting approximately 40 to 70% of a person's body mass depending on various factors such as age, gender and body composition (McArdle *et al.*, 2011). Within the body, water has various essential functions namely, it acts as the key transport and reactive medium and is, therefore, important in the diffusion of gases; it aids in the removal of waste products through urine and feces; it lubricates joints and guards some organs, the intestines and eyes; and it helps regulate body temperature, among other functions (McArdle *et al.*, 2011).

In the course of physical activity, a heightened core temperature increases the quantity of blood transported to the skin in an attempt to cool the body via perspiration (Campbell & Spano, 2011). Evaporation of sweat is the key method for heat dissipation during exercise and it is recorded to be elevated in hotter conditions (Sawka *et al.*, 2007). Furthermore, the degree of perspiration is also manipulated by individual traits such as body mass, genetic makeup and degree of heat acclimatization (Yamamoto *et al.*, 2008). In addition to water, sweat also contains electrolytes that are lost from the body (Sawka *et al.*, 2007), and if both are not restored to ample amounts then water and electrolyte imbalances are imminent with the potential to influence performance and health negatively (Casa *et al.*, 2005; Institute of Medicine, 2005b).

Dehydration may cause dangerous increases in core body temperatures which can result in ‘heat illness’ (Greenleaf & Castle, 1971) associated with heat cramps, heat exhaustion and heatstroke (Wexler, 2002). Milder cases of dehydration which do tend to be more frequent, may result in diminished strength and aerobic endurance with consequential deteriorated performance (Walsh *et al.*, 1994; Bigard *et al.*, 2001; Schoffstall *et al.*, 2001). Dehydration is reported to compromise performance in high-intensity as well as endurance activities (Nielsen *et al.*, 1982; Armstrong *et al.*, 1985). Performance may well deteriorate when an athlete is dehydrated by as little as two percent of their body weight (Cheuvront *et al.*, 2003), with losses in surplus of five percent body weight having the ability to decrease work competency to the extent of 30 percent (Saltin & Costill, 1988).

Hydration is not only involved in the replacement of body fluids but also serves as a means of distributing electrolytes, sugars and amino acids through the body (Campbell & Spano, 2011). In order to preserve homeostasis and sustain optimal athletic performance, replacing water and electrolytes before, during and after exercise is essential (Aoi *et al.*, 2006). Athletes are directed to commence with their events in a well-hydrated state by ingesting sufficient fluids in the days preceding competition, as well as follow good hydration practices post-training in an attempt to counterbalance for the sweat losses (Burke & Deakin, 2006). Fluid intake while exercising eases the increased heart rate and heightened body temperatures that athletes are subjected to during intense activity (Burke & Deakin, 2006). Physical activity can yield increased sweat rates and considerable water and electrolyte losses during prolonged exercise, especially in hot climates (Sawka *et al.*, 2007). The common agreement is to consume water as opposed to nothing during extended periods

of exercise in a warm environment; and fluids containing both carbohydrates and electrolytes may benefit performance (Sawka *et al.*, 2007). The most advantageous composition of drinks which should be ingested during varied exercise conditions is not yet clearly established in the literature (Burke & Deakin, 2006). With regard to post-exercise fluid replacement it is crucial to consume ~150% of body weight lost during exercise, within 6 hours after the completion of exercise in order to attain normal state of hydration (Maughan & Shirreffs, 2008). Koutedakis (1996) states that a frequent fault made by dancers is one where they wait until feeling thirsty before drinking something, but thirst is only a dependable mechanism that averts us from falling prey to severe dehydration, therefore making it necessary for dancers to ingest fluids before feeling thirsty.

2.2.4.2) The role of nutrition in prevention of injury

Taxing physical activity as well as unfamiliar exercises places much stress on the muscles with consequential injuries, emission of muscular proteins and muscle tenderness (Aoi *et al.*, 2006). The suggestive mechanism responsible for the muscle damage proceeding vigorous exercise is an inflammatory reaction caused by phagocyte infiltration which results from a surplus of mechanical strain (Komulainen *et al.*, 1998; Proske & Morgan, 2001), heightened intracellular calcium ion concentration (Tidball, 1995; Gissel & Clausen, 2001) and oxidative stress (Aoi *et al.*, 2004). Oxidative injury under acute post-exercise conditions can be avoided through daily ingestion of antioxidants such as vitamin C, vitamin E, carotenoids and polyphenols (Kanter *et al.*, 1993; Sumida *et al.*, 1997; Kato *et al.*, 2000; Takanami *et al.*, 2000; Márquez *et al.*, 2001; Aoi *et al.*, 2003; Phillips *et al.*, 2003; Aoi *et al.*, 2004), which all form part of a well-balanced diet.

Dietary antioxidants (such as vitamin C and vitamin E) collaborate with the endogenous antioxidant protective systems, resulting in the formation of a coalesced antioxidant system in the working muscle fibres (Powers *et al.*, 2011). It is this mutual relationship between the endogenous and dietary antioxidants which potentially boosts the ability of the muscle fibres to forage reactive oxygen species (ROS) and consequently safeguard from exercise-induced oxidative damage (Powers *et al.*, 2011). There is opposing research that does demonstrate a failure of antioxidants to influence muscle damage and the inflammatory response brought about by taxing physical activity (Warren *et al.*, 1992; Petersen *et al.*, 2001; Beaton *et al.*, 2002), but it is suggested that the

differences could be as a result of varying exercise conditions (Aoi *et al.*, 2006). ROS are produced from the mitochondria and endothelium in the course of exercise which results in the influx of phagocytes into the muscles post-exercise by means of a redox-sensitive inflammatory surge, linking ROS to the onset of muscle damage (Aoi *et al.*, 2006). Considering each type of organelle responds differently to various antioxidants, it is necessary to take several antioxidants simultaneously so that they can provide electrons that inhibit the formation of ROS and prevent the change into a pro-oxidant condition (Aoi *et al.*, 2006). If an athlete sustains a diet that satisfies their energy requirements and is nutritionally sound, then it is reasonable to say that supplementary antioxidants (in addition to those acquired from their diet) are not deemed as necessary (Powers *et al.*, 2011).

2.2.4.3) The role of nutrition in upholding immunity

Pyne (2006) states that physically active individuals who intentionally restrict energy and nutrient intakes for aesthetic or performance motives are more likely to acquire nutrition-related immune system problems. A great concern among clinicians is the blend of shoddy nutritional behaviours and the collective strain of rigorous training on the functioning of the immune system in athletes (Pyne, 2006).

Moderate exercise is believed to promote the functioning of the immune system which serves very valuable in the prevention of inflammatory diseases, infections and cancer; while intense exercise, on the other hand, is associated with a demotion of the immune system that is linked to heightened inflammatory and allergic disorders (Fitzgerald, 1991; Shephard *et al.*, 1994; O'Connor *et al.*, 2001). Exercise-induced suppression of the immune system is demonstrated in various brands of athletes including runners, skiers and swimmers (Noakes, 1992), as well as ballet dancers (Sun *et al.*, 1988).

The mechanism responsible for increased vulnerability to infections post-exercise is explained by an amplified production of immunosuppressive factors that result in a declined quantity and functioning of the circulating natural killer cells and T-cells in combination with lower concentrations of salivary IgA (Gleeson *et al.*, 2004). Vitamin C and vitamin E both have the

potential to support immunity as they share a vital role in T-cell differentiation and preservation of T-cell function (Moriguchi & Muraga, 2000; Peake, 2003; Gleeson *et al.*, 2004) while glutamine has the potential to raise the T-helper and T-suppressor cell ratio (Castell *et al.*, 1996).

Glutamine is regarded as the most copious free amino acid within human muscles and blood plasma and, furthermore, it is exploited at heightened rates by the leucocytes in an attempt to supply energy and most favourable circumstances for nucleotide biosynthesis (Ardawi & Newsholme, 1983, 1994). It has been reported that glutamine is used as the primary fuel source by the immune system (neutrophils, thymocytes, lymphocytes, and macrophages) (Ardawi & Newsholme, 1985; Antonio & Street, 1999; Castell, 2003) and the tissues of the small intestine (enterocytes). Extreme physical activity reduces the glutamine concentration in blood plasma, which is suggested to be associated with a suppressed immune system (Keast *et al.*, 1995) and plasma glutamine levels are exhausted at a rate that is relative to the intensity and time-span of the physical activity (Nieman *et al.*, 1995; Walsh *et al.*, 1998). Physically active individuals who are over-trained, possibly fatigued and who present with negative energy balances have been shown to possess a considerable decrease in the quantity of basal and post-exercise glutamine (Rivier *et al.*, 1994; Walsh *et al.*, 1998).

To preserve immune function, physically active individuals should aim to consume a well-balanced diet in ample amounts to satisfy their energy demands, which should then provide satisfactory quantities of proteins and micronutrients (Gleeson *et al.*, 2004). Athletes who practice energy-restricted eating behaviours may need to consider vitamin supplementation (Gleeson *et al.*, 2004). Additionally, Gleeson and colleagues (2004) have stated that supplementation with glutamine may serve advantageous to boost immune function in clinical settings but it is not confirmed to eliminate post-exercise impairment of the cells involved in immune function.

2.2.4.4) The role of nutrition in reinforcing physical performance

With dance being classified as a high-intensity, intermittent exercise (Cohen, 1984; Schantz & Åstrand, 1984; Rimmer *et al.*, 1994; Wyon, 2004), more attention will be focused on nutrition to enhance this nature of activity. In the domain of sport nutrition, the macronutrients (i.e. carbohydrates, proteins and fats) are frequently talked about in terms of energy production together

with their function in developing skeletal muscle, which in succession can be exercised or stimulated to improve force production (Campbell & Spano, 2011). In relation to exercise performance, the primary role of carbohydrates in the human body is energy production during high intensity exercise, while fat is engaged in energy production during low intensity exercise and protein is responsible for lean tissue accretion and maintenance (Campbell & Spano, 2011).

During short-term, high-intensity anaerobic activities, energy is derived from carbohydrate oxidation by way of glycolysis and readily available muscular ATP phosphocreatine (ATP-PC) (Maughan *et al.*, 1997), with the catabolism of carbohydrates serving as the most rapid source of ATP resynthesis (Campbell & Spano, 2011). The largest carbohydrate reserve in the body is represented by muscle glycogen which has the capacity to store approximately 400 grams (g), liver glycogen follows in second place with an acceptable 90 to 110g and blood glucose contains a negligible amount of 2 to 3g (McArdle *et al.*, 2009).

Irrespective of muscle glycogen content, fatigue onset during spells of high-intensity exercise may potentially result from the associated lactic acid formation and its subsequent accretion within and around the operational muscle fibres (Campbell & Spano, 2011). During the rest periods linking the intermittent intervals of exercise, the muscles work at either removing and/or buffering the lactic acid in an attempt to moderate the imminent harmful effects of the by-product (Campbell & Spano, 2011). The glycogen-depletion associated fatigue coupled with high-intensity, anaerobic type activities is inclined to have a much quicker onset than that of lower-intensity, aerobic type activities (Campbell & Spano, 2011). The exploitation of muscle glycogen occurs hastily early on in exercise and it boasts an exponential relationship with the intensity of activity (Jacobs & Sherman, 1999; Hargreaves, 2006). It is, therefore, essential for athletes to refuel glycogen stores post-competition or training to ensure that adequate energy is available for subsequent exercise (Aoi *et al.*, 2006).

To allow rapid recovery of glycogen stores, a high-carbohydrate eating plan serves as very valuable choice (Saitoh *et al.*, 1993, 1994) with a more effective option being a combination of protein together with carbohydrates (Tarnopolsky *et al.*, 1997, Ivy *et al.*, 2002). During physical activity the provision of carbohydrates to working muscles and the central nervous system may be negatively influenced as a result of the energy cost of the activity surpassing the endogenous carbohydrate

reserves (Burke *et al.*, 2011). It is thus necessary to supply added carbohydrates for activities involving intermittent high-intensity exercise as carbohydrate availability has the capacity to influence short-lived or maintained high-intensity work (Hargreaves, 1999). The carbohydrate guidelines for daily fuel and recovery stipulates values of 5 to 7g per kg body weight per day for moderate exercise programmes with a time-span of approximately 1 hour per day; and 6 to 10 g/kg/day for moderate-to-high intensity exercise with a time-span of 1 to 3 hours per day (Burke *et al.*, 2011).

The scarcity of evidence and citations makes it problematic to form specific recommendations for energy and nutrient intakes for aesthetic athletes (Sundgot-Borgen & Garthe, 2011). Aesthetic sport such as diving, gymnastics and figure skating are renowned for their short intervals of high-intensity exercise that are divided by long rest periods; and total training times that are lengthy (up to 4 hours) with moderate total EE (Deutz *et al.*, 2000). Regarding intensity and duration, these sports may be classed as carbohydrate-dependent sports where individuals should strive for carbohydrate intakes of between 5 to 7 g/kg/day (Burke *et al.*, 2004; ACSM, 2009). It may be necessary for these guidelines to be modified in order to satisfy individual demands such as total energy requirements, special training requirements, as well as insight from training performance (Burke *et al.*, 2011). Burke and colleagues (2011) state that sufficient energy intake is required to maximize glycogen storage and the reckless eating habits of some athletes may impede their abilities to satisfy carbohydrate requirements as well as their ability to capitalize on glycogen storage from this intake. For aesthetic and weight-class athletes, the greatest obstacle to overcome is insufficient energy intake and the associated risks of dietary deficiencies and hormonal disruptions, which makes it necessary to highlight that athletes have an adequate energy intake to prevent menstrual disturbances (Loucks *et al.*, 2011). When on low-energy diets with the ultimate goal of weight loss, several athletes may have carbohydrate intakes as little as 4 g/kg/day, which may be sufficient only for some because of the nature of their exercise (Sundgot-Borgen & Garthe, 2011). The carbohydrate recommendation for athletes who would like to decrease their body weight for performance reasons is a daily intake of 4 to 6 g/kg (Sundgot-Borgen & Garthe, 2011). Recent literature indicates reported carbohydrate intakes of 6.6 ± 2.5 g/kg/day by young female ballet dancers (Soric *et al.*, 2008), $54.7 \pm 7.5\%$ of total energy (~ 3.7 g/kg/day) by female collegiate modern dancers (Friesen *et al.*, 2011), 56.8% of total energy (~ 4.8 g/kg/day) by female dancers enrolled at a Polish ballet school (Lagowska &

Jeszka, 2011), and $56 \pm 3\%$ of total energy (~ 4.2 g/kg/day) by elite female ballet dancers (Doyle-Lucas *et al.*, 2010).

The standard human body incorporates, on average, 10 to 12 kg of protein which is predominantly situated within the skeletal muscle mass (McArdle *et al.*, 2009). While it is accepted that carbohydrates serve as the predominant fuel source during high-intensity activities, protein is regarded as fundamental during high-intensity, intermittent as well as prolonged bouts of activity (Campbell & Spano, 2011). Recent literature markets that proteins are broken down to supply the metabolism even during a single session of high-intensity activity (Bloomer *et al.*, 2005, 2007), and training to some extent does influence the composition of enzymes that play a vital role in metabolism of proteins (Howarth *et al.*, 2007). Available evidence demonstrates that by completing consecutive bouts of intense exercise, protein breakdown and oxidation is encouraged (De Feo *et al.*, 2003). Additionally, executing exercise bouts when glycogen stores are exhausted will furthermore increase the breakdown and use of proteins as a metabolic energy source (Wagenmakers, 1998). Sufficient protein intake is therefore necessary to exploit training-excited adaptations (Campbell & Spano, 2011). Female dancers are regarded as one of the highest risk groups for protein and energy deficiency (Short & Short, 1983; Brownell *et al.*, 1987) and although limited research is available on the protein requirements for individuals involved in intermittent activities, existent recommendations stipulate values of 1.4 to 1.7 g/kg/day (Campbell *et al.*, 2007). Recent literature indicates reported protein intakes of 2.1 ± 0.6 g/kg/day by young female ballet dancers (Soric *et al.*, 2008), $17.3 \pm 4.8\%$ of total energy (~ 1.2 g/kg/day) by female collegiate modern dancers (Friesen *et al.*, 2011), 14.7% of total energy (~ 1.2 g/kg/day) by female dancers enrolled at a Polish ballet school (Lagowska & Jeszka, 2011) and $17 \pm 1\%$ of total energy (~ 1.3 g/kg/day) by elite female ballet dancers (Doyle-Lucas *et al.*, 2010).

Lipids exhibit various key roles in the human body namely, storage of energy, guarding of vital organs, providing thermal insulation against cold, transport vehicles for fat-soluble vitamins and suppression of appetite (McArdle *et al.*, 2009). Various triglyceride (TG) pools exist within the body and which have the capacity to provide fatty acids for the muscles for energy namely, adipose tissue, TGs stored inside the muscle fibres, TG sediments between the muscle fibres, lipoproteins, plasma ketones and ketoacids (Ranallo & Rhodes, 1998). From these various sources, the adipose tissue and

TGs stored within the muscle fibres supply the majority of free fatty acids during activity (Ranallo & Rhodes, 1998). It is reported that fat serves as the chief energy source at rest and during low-intensity activity, however, consecutive spells of high-intensity activity can excite mitochondrial biogenesis which has the capacity to promote, to a degree, fat utilization all through an athlete's day (Campbell & Spano, 2011). Moreover, high-intensity training results in muscular glycogen depletion which is then accordingly replenished through consuming carbohydrates, a macronutrient that if not used to replenish glycogen stores, may otherwise be converted and deposited as body fat (Campbell & Spano, 2011). There is not a specific standard or recommendation for dietary fat intake for athletes, but the general guideline is an intake ranging between 20 to 35% of the daily energy intake, which can also be applied to athletes (Kreider *et al.*, 2004; Institute of Medicine, 2005a). The preservation of energy balance, restoration of intramuscular TG stores and sufficient intake of essential fatty acids is crucial for athletes, giving leeway for slightly higher fat intake than the general population (Venkatraman *et al.*, 2000). Dietary fat intakes of between ~ 26 to 35% of the total daily energy intake have been reported by female dancers (Yannakoulia *et al.*, 2004; Soric *et al.*, 2008; Doyle-Lucas *et al.*, 2010; Friesen *et al.*, 2011; Lagowska & Jeszka, 2011).

2.3.1) Eating disorders, disordered eating and pathogenic weight control measures

DE describes a pattern of unorthodox eating behaviours that may fulfill a greater or lesser number of the formal diagnostic criteria of a clinical ED such as AN (Zanker & Cooke, 2004). The clinical manifestations of DE include three possible EDs, namely; AN, BN and EDNOS (Lebrun, 2006).

There are various tools available to measure an athlete's risk for DE, such as the EDI3 (Garner, 1983, 2004) and the CDR subscale of the TFEQ (Stunkard & Messick, 1985). These tools were used by the master student in her study and will be discussed in more detail in Chapter 3. An additional popular tool used to recognize ED risk and DE behaviour in individuals is the standardized EAT-26 questionnaire (Garner *et al.*, 1982). This instrument comprises of 26 items that are rated on a 6-point Likert-type scale in conjunction with four eating behaviour questions that stipulate a 'Yes' or 'No' response. A total EAT-26 score of 20 or higher and/or a 'Yes' response to any of the behavioural questions classifies one with DE behaviour (Garner *et al.*, 1982). One pitfall of using self-report

questionnaires to identify EDs and DE behaviour is that the reliability and validity of numerous self-report questionnaires have not been firmly established (Fichter & Quadflieg, 2000).

A large portion of female athletes exploit unsafe eating and body weight control behaviours which have a considerable impact on their wellbeing without the psychiatric component of EDs (George *et al.*, 2011). These subclinical EDs, also referred to as PWCM, can involve extended periods of fasting; low energy diets; bingeing; purging; or consumption of diet pills, laxatives and other supplements (George *et al.*, 2011). Hudnall and Kratina (2005) speak of a misperception that exists with regard to DE in the sense that the general public thinks only of severe cases of EDs like those that are frequently engrossed by the media. It is this subjective media publicity on EDs that results in the more ordinary DE practices and less appalling cases of EDs being overlooked (Hudnall & Kratina, 2005).

There is no definite cut-off that defines where the standard practice of dieting and restrained eating halts, and where the pathology of EDs commences (Hudnall & Kratina, 2005). Torstveit & Sundgot-Borgen (2005) recommended the use of an EDI-Drive for Thinness subscale score of ≥ 15 to classify athletes in jeopardy for developing the Triad, but Gibbs and colleagues (2011) opposed the recommendation by stating that a high EDI-Drive for Thinness score is perhaps already linked with clinical pathology and declared that if identifying symptoms of subclinical DE was the concern, then an EDI-Drive for Thinness score of ≥ 7 is more suitable.

2.3.2) Anorexia Nervosa, Bulimia Nervosa and Eating Disorders Not Otherwise Specified

Clinical EDs are indexed according to the DSM-IV as BN, AN and EDNOS (Gmitrowicz & Kucharska, 1994). AN was reported over a century ago in Britain by William Gull (1868) and in France by Charles Laségue (1873). AN is an ED portrayed by a compulsive fear of weight gain, body image distortion, amenorrhea and refusal to sustain body mass above 85% of projected level for height and age (Lebrun, 2006). Various reported symptoms of this disorder include: denial of anxiety, depression and ED pathology (Viglione *et al.*, 2006); lack of apprehension regarding the significance of changes in body size and/or weight loss, and liveliness (Casper, 1998); obsessive-compulsive conduct (Thiel *et al.*, 1995; Crane *et al.*, 2007); perfectionism and psychoridity (Rousset *et al.*, 2004); an inclination towards anxiety, depression and schizoparanoia (Lazaro *et al.*, 1995); and an inclination towards identity and intimacy issues (Holliday *et al.*, 2006).

Table 4: Diagnostic criteria for anorexia nervosa (APA, 1994)

Diagnostic and Statistical Manual of Mental Disorders (4th edition) Criteria for Anorexia Nervosa	
A	Refusal to maintain body weight at or above a minimally normal weight for age and height (eg. weight loss leading to maintenance of body weight less than 85% of that expected or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected).
B	Intense fear of gaining weight or becoming fat, even though underweight.
C	Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight.
D	In post-menarcheal females, amenorrhea, i.e. the absence of at least three consecutive menstrual cycles. (A woman is considered to have amenorrhea if her periods occur only following hormone, eg. estrogen, administration.)
<p><i>Restricting type:</i> During the current episode of anorexia nervosa, the person has not regularly engaged in binge-eating or purging behavior (i.e. self-induced vomiting or the misuse of laxatives, diuretics or enemas).</p> <p><i>Binge-eating/purging:</i> During the current episode of anorexia nervosa, the person has regularly engaged in binge-eating or purging behavior (i.e. self-induced vomiting or the misuse of laxatives, diuretics or enemas).</p>	

BN is an ED portrayed by frequent binge eating episodes that are preceded by compensatory purging behaviours in an attempt to evade weight gain (Lebrun, 2006). Various reported symptoms of this disorder include: depressive symptoms (Anderson, 1998); anxiety (Steere *et al.*, 1990); obsessive-compulsive conduct (Thiel *et al.*, 1995); body image disturbances (Kaye *et al.*, 2002); alcohol misuse (Koeppel & Tuschen-Caffier, 2002); an inclination towards avoidant personality disorder, borderline personality disorder and depression (Ellis, 1994); and elevated neuroticism, harm evasion and poor self-directedness (Diaz-Marsa *et al.*, 2000).

Table 5: Diagnostic criteria for bulimia nervosa (APA, 1994)

Diagnostic and Statistical Manual of Mental Disorders (4th edition) Criteria for Bulimia Nervosa	
A	Recurrent episodes of binge eating. An episode of binge eating is characterised by both of the following: <ol style="list-style-type: none"> 1. Eating, in a discrete period of time (eg. within any two-hour period), an amount of food that is definitely larger than most people would eat during a similar period of time and under similar circumstances. 2. A sense of lack of control over eating during the episode (eg. a feeling that one cannot stop eating or control what or how much one is eating).
B	Recurrent, inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas or other medications; fasting; or excessive exercise.
C	The binge eating and inappropriate compensatory behaviors both occur, on average, at least twice a week for three months.
D	Self-evaluation is unduly influenced by body shape and weight.
E	The disturbance does not occur exclusively during episodes of anorexia nervosa.
<p><i>Purging type:</i> During the current episode of bulimia nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas.</p> <p><i>Non-purging type:</i> During the current episode of bulimia nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics or enemas.</p>	

EDNOS is defined within the DSM-IV as a class of EDs which possess clinical severity but do not satisfy all the diagnostic criteria of either AN or BN (Fairburn & Bohn, 2005). Two subgroups exist within EDNOS, namely the ‘sub threshold’ cases which bear a resemblance to AN or BN but do not fulfill all diagnostic criteria and the ‘mixed’ cases in which clinical manifestations of AN and BN are merged (Fairburn & Bohn, 2005). As described by Fairburn and Bohn (2005), an example of the former case would be an individual who has a body weight slightly above the cut-off limits that define AN or their incidence of binge eating episodes fall short of the BN diagnostic criteria. AN and BN have both been diagnosed in greater numbers among wealthy adolescent and young White adult females in Western, industrialized nations, rather than among other populations (Tsai, 1999), and EDNOS is believed to be the most frequent ED diagnosed in the majority of outpatient settings (Fairburn & Bohn, 2005).

Table 6: Diagnostic criteria for eating disorder not otherwise specified (APA, 1994)

Diagnostic and Statistical Manual of Mental Disorders (4th edition) Criteria for Eating Disorder Not Otherwise Specified	
A	For females, all of the criteris for anorexia nervosa are met except that the individual has regular menses.
B	All of the criteria for anorexia nervosa are met except that, despite significant weight loss, the individual’s current weight is in the normal range.
C	All of the criteria for bulimia nervosa are met, except that the binge eating and inappropriate compensatory mechanisms occur at a frequency of less than twice a week or for a duration of less than three months.
D	The regular use of inappropriate compensatory behavior by an individual of normal body weight after eating small amounts of food (eg. self-induced vomiting after the consumption of two cookies).
E	Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
F	Binge-eating disorder: recurrent episodes of binge eating in the absence of the regular use of inappropriate compensatory behaviors characteristic of bulimia nervosa.

2.3.3) Clarification of disordered eating and pathogenic weight control measures

DE in physically active individuals is portrayed by an extensive range of unconventional eating and weight control conducts and mind-sets (Bonci *et al.*, 2008). These shoddy behaviours and attitudes, also referred to as PWCM, may involve body mass and figure anxiety; substandard nutrition or insufficient energy intake (possibly even a combination of both); bingeing; exploitation of laxatives, diuretics and diet pills; and severe body weight control measures such as abstaining from food (fasting), purging (vomiting) and additional exercise over and above the normal training programme (Johnson *et al.*, 1982; Dancyger & Garfinkel, 1995; Shisslak *et al.*, 1995; Lowe *et al.*, 1996).

Due to body dissatisfaction and weight concerns, the exploitation of body weight loss methods such as self-induced vomiting, immoderate physical activity, laxatives, diuretics, diet pills and food restraints has evolved into customary practices within colleges (Dykens & Gerrard, 1986). McIvor (2002) states that purging by means of self-induced vomiting is a general technique to eradicate energy and frequently, those who purge, interchange between phases of food restraint, bingeing and purging. Individuals who practice bingeing and purging do not usually withdraw from socialization and more often than not portray themselves as normal eaters during social situations (Buckroyd, 1996). Since excessive weight loss is not usually noticeable and the perception of healthy eating exists, the secretive bingeing persists (Buckroyd, 1996). A purge frequently commences with a binge that may possibly generate from stress (Pyle *et al.*, 1981; Hay *et al.*, 1998). A binge is defined by the DSM-IV as consuming unusually large quantities of food within a short period of time, generally in private (APA, 1994) and more often than not it will endure until one experiences abdominal tenderness, falls asleep, is discovered or stimulates vomiting (Ruff *et al.*, 1992). Alternatively, purging may also persist without a binge with the rationale of promoting relaxation and reducing stress (Sacker & Zimmer, 1987). Purging subsequent to bingeing offers physical relief from stomach bloating and tenderness, and it is also regarded as a means to clear the body of energy and the remorse associated with the consumption of food (Sacker & Zimmer, 1987).

Superfluous exercise is reported to contribute to the development and/or preservation of EDs (Eisler & Le Grange, 1990, Sherman & Thompson, 1990; Baum, 1998; Garner *et al.*, 1998). Excessive exercise increases the utilization of energy, represses appetite and enhances physical performance in

sport (Epling & Pierce, 1984; Davis & Fox, 1993). The preliminary weight loss correlated with physical activity offers a positive social reception which results in the enhanced consciousness of an individual's physical appearance that could possibly generate a self-absorbed obsession with the body (Davis *et al.*, 1990). As the individual's body weight declines there is a concomitant increase in physical exercise, with the cycle becoming self-motivating in due course (Epling & Pierce, 1988).

Laxative misuse was defined in the 80's by Mitchell and associates (1986) as laxative use numerous times per week with the primary goal of reducing energy. Moreover, Waller and colleagues (1990) define laxative abuse as current exploitation of laxatives no less than once weekly at double the suggested dosage. To some extent, exploitation of laxatives is comparable to self-induced vomiting given that it can evolve into an addictive cycle because of the false impression of instantaneous weight loss it creates (McIvor, 2002). In reality the short-term weight loss that occurs is caused by dehydration, and as the body commences to rehydrate, the individual's weight increases as a result of water retention which causes anxiety and encourages recurring laxative misuse (Willard *et al.*, 1989). Laxative use is regarded by many individuals as 'cleansing' and it also alleviates the body of bloating and abdominal tenderness (Willard *et al.*, 1989).

Heightened levels of food restraint may stimulate an individual to practice uncontrollable bingeing (Yates, 1991; Gendall *et al.*, 1998). McIvor (2002) states that food restraint usually commences with a 'diet' where the individual regulates the foods that they consume, and it may be characterized by omitting meals every day, liquid diets, carbohydrate-deficient diets or abstinence altogether. The bulk of individuals stop with diet regimens as soon as their perceived 'ideal' weight is attained, but the minority of cases will continually attempt to lower their desired body weight (McIvor, 2002). As food restraint persists, additional food is eradicated from the 'diet' and the individual expends a good deal of time in neurotic thoughts concerned with fear of food and gaining weight (Buckroyd, 1996). Some people experience an overwhelming feeling of supremacy and control over their bodies when exploiting excessive food restraint and the sensation could potentially develop into a motivating factor in itself (Siegel *et al.*, 1988).

The vulnerability of athletes to DE is a grave matter due to heightened physiologic requirements enforced by intense training (Bonci *et al.*, 2008). Athletes tend to exhibit less severe behavioural

symptoms and psychological indicators which are representative of subclinical variants of AN, BN and EDNOS (Wilmore, 1991; Thiel *et al.*, 1993; Sundgot-Borgen, 1994; Smolak *et al.*, 2000; Beals, 2004; Sundgot-Borgen & Torstveit, 2004). Poor nutritional conduct may commence either as a tactic to improve performance through weight loss or by unintentional failure to sustain sufficient EA during high-intensity or high-quantity exercise, and not essentially from psychopathology (Smith, 1980; Rumball & Lebrun, 2004). Athletes may start to practice abnormal eating behaviours in an attempt to strive for the stereotype figure associated with their specific sport, because of so-called performance enhancements and/or socio-cultural pressures that demand leanness or a 'picture perfect' body composition (Sundgot-Borgen, 1994; Rosendahl *et al.*, 2009). It is necessary for many athletes to have increased lean body mass values in combination with a low body fat percentage in order to attain an elevated power-to-weight relation (O'Connor *et al.*, 2006), and a high lean mass to fat mass ratio is sought-after in many sports as it is deemed as visually pleasing (Sundgot-Borgen & Torstveit, 2010). Furthermore, sport which demands horizontal or vertical body movements may regard excess body fat as disadvantageous (Sundgot-borgen & Torstveit, 2010), and there is evidence that elevated fat mass increases the energy demands of an individual which may have a negative impact on performance (Olds *et al.*, 1993).

Ballet dancers are continually pressurized to sustain low body mass and, therefore, exploit behaviours to control their weight (Abraham, 1996). It is conclusive that dancers are overly concerned about dieting and their mass, and tend to be discontented with their bodies (Druss & Silverman, 1979; Le Grange *et al.*, 1994; Anshel, 2004). There is evidence suggesting that the dance school environment in classical ballet encourages striving for leanness to extreme boundaries (Vaisman *et al.*, 1996). Alternatively, the focal point of modern dance is primarily on the individual's understanding of movement and creativity, liberating them from the restraints and bureaucracy of ballet (Clabaugh & Morling, 2004). Literature indicates that DE behaviour is more frequent among ballet dancers (Montanari & Zietkiewicz, 2000; Anshel, 2004; Thomas *et al.*, 2005; Ringham *et al.*, 2006) and little is known about DE behaviours within modern dancers (Schluger, 2010).

DE can influence as much as two thirds of young female athletes (Nattiv *et al.*, 1994) and 15 to 62% of female collegiate athletes (Beals & Manore, 2002). Anshel (2004) found within a group of ballet

students that 29.6% were constantly dieting, 11.1% regularly used laxatives/diuretics/diet pills, 25.9% regularly skipped meals/fasted, 62.9% regularly avoided certain foods and 14.8% regularly practiced self-induced vomiting. Within the same group of ballet students, it was revealed that the mean scores for the EDI2-Drive for Thinness, Bulimia and Body Dissatisfaction subscales were 9.3 ± 3.8 , 2.6 ± 1.5 and 16.6 ± 2.6 respectively (Anshel, 2004). Additionally, Thomas and colleagues (2005) found within a group of ballet students from National schools (n=63), Regional schools (n=64) and Local schools (n=107) that the existing frequency for bingeing ranged between 41.7 to 54.9%, fasting between 1.0 to 6.3%, compulsive exercise between 3.2 to 9.7%, self-induced vomiting between 0.0 to 3.2% and laxative use between 0.0 to 1.6%. Within the same groups of ballet students, it was revealed that the mean scores for the EDI-Drive for Thinness and -Bulimia scores ranged from 13.8 ± 7.8 to 18.8 ± 8.3 and 11.9 ± 5.4 to 13.7 ± 5.7 , respectively (Thomas *et al.*, 2004). More recent literature confirms that Ringham and co-workers (2006) found within a group of ballet dancers enrolled at companies or schools (n=28) that the weekly exploitation of bingeing was 1.8 ± 3.3 times, of vomiting was 2.4 ± 6.0 times, of laxatives was 2.4 ± 6.0 times, of diuretics was 2.3 ± 8.6 times and of diet pills was 2.7 ± 4.8 times. Within the same group of ballet dancers, it was revealed that the mean scores for the EDI-Drive for Thinness, Bulimia and Body Dissatisfaction subscales were 11.3 ± 7.5 , 2.3 ± 3.4 and 12.1 ± 7.0 , respectively (Ringham *et al.*, 2006).

“In the 19th century, fasting for religious reasons and the consequent ‘wasting of girls’ was regarded as a sign of purity, altruism and spirituality which are principles usually coupled with the ideals of womanhood.”

(Hudnall & Kratina, 2005)

2.3.4) Health and performance consequences associated with disordered eating and eating disorders

Health consequences coupled with DE are generally related to the methods of weight control used. When food restraint is severe, the body is stripped of nutrients and the consequential physiological manifestations linked to this starvation are wasting; hair thinning; lanugo on the back, arms and face; dry skin; cold extremities; constipation; lightheadedness; lack of sensation in the extremities; dehydration; and abnormally low blood pressure (Siegel *et al.*, 1988; Buckroyd, 1996; Gilchrist *et*

al., 1998). Additional health effects that have been linked to chronic or severe energy restriction and the resulting weight loss include: decreased BMR; cardiovascular and gastrointestinal disorders; depression; menstrual dysfunction and decreased BMD (Eichner, 1992). Laboratory analyses have demonstrated frequent findings associated with starvation including: hypoglycemia; mild neutropenia; anemia; elevated liver enzymes and sinus bradycardia (Gilchrist *et al.*, 1998).

Stress of either a physical or psychological nature will promote the release of corticotropin releasing-hormone from the hypothalamus of the brain, which then in turn stimulates the release of cortisol from the adrenal gland (Rivier *et al.*, 1986). Regular monitoring of food consumption together with the anxiety of weight, which is typical of restrained eaters, may characterize a stressor that elevates cortisol levels (Berga, 1996; Canalis, 1996). Elevated levels of cortisol seem to be tied with menstrual disturbances and a decreased BMD or bone mineral content (McLean *et al.*, 2001; Van Loan & Keim, 2001). Elevated concentrations of cortisol are coupled to reproductive disturbances by the inhibitory consequence that corticotropin releasing-hormone has on the hypothalamic and thus pituitary secretions that are necessary for normal menstrual function (Barbarino *et al.*, 1989; Berga, 1996). Furthermore, menstrual dysfunction which is associated with decreased exposure to the female reproductive hormones estradiol and progesterone (as in the case of oligomenorrhea and amenorrhea) has been linked with a decreased spinal BMD (Drinkwater *et al.*, 1984; Marcus *et al.*, 1985; Drinkwater *et al.*, 1990; Micklesfield *et al.*, 1995; Tomten *et al.*, 1998) as well as decreased whole-body and appendicular site BMD (Micklesfield *et al.*, 1995; Rencken *et al.*, 1996; Pettersson *et al.*, 1999) in female athletes specifically.

Bingeing frequently results in gastric distention that could possibly cause gastric necrosis and even rupture (Pomeroy & Mitchell, 1992). Oesophageal reflux and subsequent chronic throat irritation may also occur, increasing the risk for oesophageal cancer (Carney & Anderson, 1996). Purging via diuretics, laxative use, enema use or self-induced vomiting significantly increases the risk of dehydration (Carney & Anderson, 1996). Long-term reflux of gastric contents can result in perimyolysis (which is the eroding of teeth enamel); inflammation of the parotid glands; velum damage caused by the use of foreign objects to induce vomiting; dehydration which results in dry skin; electrolyte imbalances; edema; gastrointestinal complications and abnormalities in menstruation (Sherman & Thompson, 1990; Mandel & Kaynar, 1992; Brown & Bonifazi, 1993;

Steinberg, 1999). Laboratory analyses have demonstrated frequent findings associated with self-induced vomiting including: hypokalemia, nonspecific ST wave changes and metabolic alkalosis or acidosis (Gilchrist *et al.*, 1998).

Excessive exercise can have severe consequences for the individual including: lower confidence levels; elevated strictness and obsession; deviations in hormone levels; increased frequency of stress fractures; increased frequency of cartilage, tendon, ligament and muscle tears; menstrual dysfunction; chronic fatigue; dehydration; elevated risk for infectious diseases; mood alterations; upper respiratory tract infections and perhaps death (Yates, 1991; Ogles *et al.*, 1995; Kaminker, 1998; McKenzie, 1999). The consequences on performance when an individual experiences weight loss is conditional to various factors, namely: the extent of weight loss, the initial body fat percentage of the individual and the tactic used for weight loss and recovery (Sundgot-Borgen & Garthe, 2011). It has been noted that the majority of athletes decrease their quantity of strength training during the weight-loss phase preceding competition to support more sport-specific and/or competition training (Sundgot-Borgen & Garthe, 2011). It is this decreased stimulus for muscle development merged with the negative energy balance that may result in a decreased lean body mass, which ultimately weakens the individual as well as their performance (Koutedakis *et al.*, 1994; Koral & Dosseville, 2009). Methodological weaknesses, such as small sample sizes, indeterminate performance levels, vague and uncontrolled diet and recovery tactics, and controversial test parameters relating to a specific performance test, complicate the ability to draw conclusions on the performance effects of excessive dieting (Sundgot-Borgen & Garthe, 2011).

2.4.1) Introduction to energy availability

EA is defined by Loucks and colleagues (2011) as the daily exercise energy expenditure subtracted from the daily dietary energy intake and is, therefore, the sum of residual dietary energy subsequent to exercise completion that is required for other metabolic processes of the body. Normal functioning of the physiological systems of the body is for that reason dependent on sufficient EA (Redman & Loucks, 2005). Energy balance is said to be achieved in young adults at an EA of approximately 45 kcal/kgFFM/day (Loucks & Nattiv, 2005), corresponding to ~190 kJ/kgFFM/day. When EA is decreased below 30 kcal/kgFFM/day, there is a suppression of reproductive function

(Loucks & Thuma, 2003) and bone formation (Ihle & Loucks, 2004), which results in the energy balance being restored but negatively affects reproduction and bone health (Manore *et al.* 2007). The 2007 ACSM Position Stand on the Triad states that low EA appears to be the primary factor that harms reproductive and skeletal health in the Triad and EA can be considered the cornerstone of the Triad (Nattiv *et al.*, 2007).

2.4.2) Origins of low energy availability

Three particular causes of energy deficiency in athletes have been identified namely, obsessive EDs and their associated clinical mental illness; deliberate and rational, but poorly managed endeavours to trim down body size and/or fatness in order to be eligible for and succeed in competitions (which may or may not include DE behaviours); and the unintentional failure of appetite to increase *ad libitum* energy adequately to compensate for the energy used during training and/or exercise (Loucks *et al.*, 2011).

When referring to the formula used to define EA, as described by Manore and colleagues (2007), it is evident that low EA can occur in the absence or presence of DE and/or restricted energy intake, since an increase in exercise EE alone has the ability to decrease EA. A physically active individual has the capacity to induce a negative energy balance when total exercise EE surpasses dietary energy intake (IOC, 2010). If the resultant energy deficit is severe, the body will attempt to compensate by subduing physiological functions which under normal circumstances are necessary for growth, development and wellbeing (IOC, 2010). It is noted that this suppression of physiological functions may ease or eliminate the energy deficit, but will not raise EA (IOC, 2010).

Low EA can be a consequence of DE behaviour, but it can also inadvertently emerge in the absence of clinical EDs, DE behaviours and/or restricted dietary intake (Nattiv *et al.*, 2007; IOC, 2010). An athlete may be ingesting adequate energy to meet the needs of a non-athlete, but involuntarily or unintentionally ingesting insufficient energy to meet the demands of a physically active individual (IOC, 2010). The ensuing low EA is caused by ingesting less energy than required to satisfy the energy costs of daily living over and above that exhausted during exercise (IOC, 2010). Further

aggravating the circumstances of low EA is the fact that young athletes also need to meet additional energy costs of growth (Manore, 2002).

Countless athletes are undernourished on a continual basis as there is no “strong biological drive” to harmonize dietary energy intake with exercise EE (Truswell, 2001). Famine has the tendency to increase hunger while an equal energy deficit caused by physical activity does not (Loucks, 2007). Stubbs and colleagues (2004) have demonstrated how *ad libitum* energy intake is suppressed by prolonged exercise. In eight lean, untrained men occupying a room calorimeter for 7 days, the unintentional failure to concomitantly increase dietary energy intake in order to compensate for increased exercise EE resulted in a ~10 kcal/kgFFM/day reduction in *ad libitum* EA (Stubbs *et al.*, 2004).

Another credible cause of energy deficiency is increased dietary fibre intake. Fibre has been suggested to reduce excess dietary energy intake via three mechanisms namely, it replaces nutrient-dense foods from the diet; it increases chewing which stimulates the secretion of saliva and gastric juices, resulting in a distended stomach and heightened satiety; and it lowers the absorption effectiveness of the small intestine (Heaton, 1973).

Howarth and colleagues (2001) summarized in a review that the majority of fibre-supplementation studies in energy-restricted subjects showed beneficial outcomes on satiety, reduced energy intake and body weight, and, furthermore, these effects were preserved with *ad libitum* energy intake. Howarth and associates (2001) calculated from published *ad libitum* studies that an additional dietary fibre intake of 14g per day was associated with a 10% reduction in energy intake and a mean body-weight loss of 1.9 kg over a period of 3.8 months. Elevated dietary fibre intake has also been revealed to possibly hinder estrogen reabsorption, and the activity and binding capacity of estradiol may be hampered due to the mediocre estrogenic activity of plant lignins and isoflavones (Lebrun, 2001). Considering the abovementioned effect that fibre has on appetite, an elevated dietary fibre intake might pose as a problem in those athletes who have a low EA without DE or an ED. Furthermore, EA can also possibly decrease with a high carbohydrate diet due to reduced dietary energy intake. The reduced energy intake may be consequential to a higher fibre intake with the

aforesaid effects or because of the large amounts (volume) that are required to satisfy energy demands.

Stubbs and co-workers (2004) revealed that a high carbohydrate diet (62%) decreased *ad libitum* EA by ~16 kcal/kgFFM/day when compared to a low carbohydrate diet (37%). Additionally, Horvath and co-workers (2000a, 2000b) also established in 12 male and 13 female endurance-trained runners residing at home, that a 31-day high carbohydrate diet reduced the *ad libitum* dietary energy intake. It was demonstrated that as the carbohydrate content of the diet declined from 67% to 55%, and thereafter to 42%, the *ad libitum* EA increased from 27 to 34 and 39 kcal/kgFFM/day in the women and from 27 to 37 and 42 kcal/kgFFM/day in the men, respectively (Horvath *et al.*, 2000a, 2000b). Since nutritionists and dietitians typically prescribe more whole grains, fruits and vegetables to the general population as well as athletes, it is likely for an increased fibre intake and insufficient volume to have an influence on EA. These foods are essential for health, but one may need to experiment with prescribing more refined carbohydrates during stages of increased exercise EE to prevent decreased EA. It is understood that this reasoning is purely speculative and research on this area is lacking.

2.4.3) A discussion of the interlaced consequences of low energy availability

2.4.3.1) Menstrual dysfunction

Menstrual and ovarian function relies significantly on the rate at which luteinizing hormone (LH) is secreted into the bloodstream by the pituitary gland (Loucks *et al.*, 1989). Dysfunction occurs when a disturbed pulsatile secretion of gonadotropin-releasing hormone (GnRH) by the hypothalamus negatively influences the LH pulsatility (Loucks *et al.*, 1989). The pulsatility of GnRH and LH were initially believed to be disturbed by low EA or exercise stress (Knobil, 1993), but later it was revealed that exercise stress has no implications whatsoever (Loucks *et al.*, 1998). It is noted that pulsatility of LH is strictly dependent on EA and physical activity does not have a suppressing influence over and above the effect of energy cost on EA (Loucks *et al.*, 1998). LH pulsatility is also disrupted less by exercise EE than by dietary energy restriction (Loucks *et al.*, 1998). It is not the GnRH alone that regulates LH pulsatility, but also a certain degree of regulation by neurological pathways which originate in specialized neurons that can sense the availability of oxidized

metabolic fuels (Wade & Jones, 2004). There are various additional proposed mediating factors causing disrupted GnRH secretion, including hormones such as leptins which act on the hypothalamus to increase basal metabolism and decrease appetite (Kalra, 1997); then there are members of the Insulin-like Growth Factor (IGF) family and their binding proteins that are found in the brain, pituitary and ovarian tissue and, therefore, play a part in the regulation of the reproductive hormones GnRH, follicle-stimulating hormone (FSH) and LH (Lebrun & Rumball, 2002); and additionally is psychological stress related to pre-competition anxiety, family conflict or academic deadlines (Rose *et al.*, 2001).

There is a wide spectrum of menstrual irregularities which athletes can develop that are directly related to the athlete's energy intake (Williams *et al.*, 2001; De Souza & Williams, 2004, 2005), including primary amenorrhea, secondary amenorrhea, oligomenorrhea, anovulation and luteal phase deficiency. Amenorrhea that develops purely due to low EA is referred to as FHA (Manore *et al.*, 2007). Inadequate body fat stores have also been proposed to disrupt menstrual cycles in athletes, but research into this hypothesis has revealed that body composition has no influence (Sanborn *et al.*, 1987). Additionally, eumenorrheic and amenorrheic athletes possess body composition ranges that are comparable to sedentary women, so proportion of body fat is improbably responsible for the modifications of LH pulsatility (Loucks & Nattiv, 2005). It cannot be ruled out that factors such as stress and/or low body fat percentage donate to the cause of exercise-induced menstrual disorders, but existing evidence does identify negative energy balance as the primary cause of exercise-induced reproductive dysfunction (Loucks & Nattiv, 2005). An association between cognitive dietary restraint and overt menstrual disturbances, with the prevalence of menstrual disturbances becoming greater across cognitive dietary restraint quartiles has been previously shown (Vescovi *et al.*, 2008).

2.4.3.2) Bone health

Bone is referred to as a dynamic tissue which is in a continuous state of remodeling, a process controlled by osteoclasts (responsible for resorption of old bone) and osteoblasts (responsible for formation of new bone) (Raisz, 1999). The process of remodeling, itself, is controlled by various factors namely; polypeptides, steroid hormones, thyroid hormones, cytokines and growth factors (Raisz, 1999). There needs to be a controlled balance between resorption and formation in order for

bone mass to maintain stability (Miller-Smith & Malanga, 2009) and this process is referred to as bone turnover. A decrease in BMD, also referred to as osteopenia, has been shown to be associated with amenorrhea, DE as well as a low EA of less than 30 kcal/kgFFM/day (Manore, 2002; Loucks & Nattiv, 2005). An energy deficit due to inadequate caloric intake or high EE due to intense exercise may have a detrimental effect on bone remodeling (Nichols *et al.*, 2007) and it is suspected that chronic undernutrition or intense exercise, acts through an estrogen-independent mechanism to impair bone formation (Ihle & Loucks, 2004). When EA diminishes, the rate at which bone proteins are produced decelerates together with insulin levels, facilitating the uptake of amino acids in a linear dose-response way (Loucks *et al.*, 2011). When EA is reduced below 30 kcal/kgFFM/day, there is a rapid plunge in levels of circulating key-hormones that regulate bone metabolism, such as insulin-like growth factor-1 (IGF-1) and tri-iodothyronine (T3) (Zanker & Cooke, 2004; Ihle & Loucks, 2004). Reduced IGF-1 and T3 have been shown to play an active role in disrupted bone turnover (Chevalley *et al.*, 1998; Thong *et al.*, 2000). What is remarkable is that these effects on IGF-1 and T3 occur within 5 days after low EA is initiated, in the absence of decreased estrogen concentrations (Loucks *et al.*, 2011). When EA is low there is also a concurrent low intake of macronutrients and micronutrients (Beals & Manore, 1998; Manore, 1999). With low intakes of certain nutrients especially proteins, calcium, vitamin D and vitamin K, peak BMD cannot be achieved.

2.4.3.3) The influence of menstrual dysfunction on bone health

A primary function of estrogen is to impede bone resorption through a direct action on osteoblasts and indirect influence on osteoclasts (Fitzpatrick, 2001). Low BMD presenting in amenorrheic athletes was initially reported to be the consequence of oestrogen deficiency (Loucks, 2004). When an athlete has amenorrhea and is in a state of hypoestrogenism, there is a decrease in bone formation which results in bone instability (Fitzpatrick, 2001). A state of hypoestrogenism can manifest itself by increasing the incidence of osteopenia, scoliosis, stress fractures and lower peak bone mass (Holschen, 2004). Osteopenia resulting from prolonged absence of menses has also been documented to be associated with an increased risk of stress fractures (Mansfield & Emans, 1993) and it can also give rise to premenopausal osteoporosis (Nelson, 2000). An increase in bone fragility and fracture susceptibility could possibly result in increased pain, reduction in training volume and

intensity, frequent injuries and possibly even the ending of an athletic career (Sundgot-Borgen & Torstveit, 2007). When the term osteoporosis is used to define the component of the Triad, it is actually referred to as secondary osteoporosis because it originates due to or is aggravated by other disorders (Stein & Shane, 2003). Mickelsfield and colleagues (1995) concluded that amenorrhic or oligomenorrhic athletes on average have a lower BMD than eumenorrhic controls while Stein and Shane (2003) agree that low BMD in athletes is a consequence of exercise-induced amenorrhea.

2.4.3.4) Illness and infection

It is established that the body's immune system has strongly cellular Type 1 defences that are directed at intracellular pathogens such as viruses, and humoral Type 2 defences that are directed at extracellular pathogens such as bacteria (Seder & Paul, 1994; Loucks *et al.*, 2011). Available research identifies low EA to be responsible for the hinderence of Type 1 immunity (Loucks *et al.*, 2011). In the three months prior to the Winter and Summer Olympic Games of 2002 and 2004, a survey completed by all competitors of the Swedish teams revealed that those individuals who took part in events that accentuated leanness (compared to individuals participating in non-lean build sporting codes), made more regular efforts to decrease body weight, exercised for longer periods and gave an account of almost twofold more illnesses, for the most part upper respiratory tract infections (Hagmar *et al.*, 2008).

2.4.3.5) Endothelial dysfunction

There presents a grey area in the literature on the short-term and chronic effects of hypoestrogenism on the cardiovascular system in seemingly healthy premenopausal physically active women (O'Donnell *et al.*, 2007). Initial data does propose that women with FHA may be susceptible to a proatherogenic phenotype that is associated with impaired brachial artery endothelium-dependent flow-mediated vasodilation (Zeni Hoch *et al.*, 2003; Rickenlund *et al.*, 2005; Yoshida *et al.*, 2006). The austeriy of endothelial dysfunction in those women presenting with FHA (Zeni Hoch *et al.*, 2003; Rickenlund *et al.*, 2005; Yoshida *et al.*, 2006) is purported to be comparable to that which has been witnessed in postmenopausal women (Blümel *et al.*, 2003) and coronary artery diseased patients (Celermajer *et al.*, 1992). Endothelial dysfunction has been shown to be reversible by the

use of oral contraceptives in women with FHA (Rickenlund *et al.*, 2005). Considering endothelial dysfunction participates in the development of atherosclerosis, either short-term or chronically distressed endothelial function in women with FHA may subject them to an elevated long-term cardiovascular risk (O'Donnell *et al.*, 2007).

2.4.4) Energy availability in athletes

Limited data is available on the EA of athletes that are not retrospectively calculated based on assumed exercise EE (Laughlin & Yen, 1996; Loucks *et al.*, 1998; Kopp-Woodroffe *et al.*, 1999; Thong *et al.*, 2000; Tomten & Høstmark, 2006, Manore *et al.*, 2007). Furthermore, data on the EA of South African dancers is lacking altogether. From the literature it is evident that many researchers who investigated the individual components of EA did not perform direct calculations of EA themselves. Two studies exploring EA in male elite athletes found the EA of male Kenyan runners to be at 34 kcal/kgFFM/day in the week before a race (Onywera *et al.*, 2004) and the EA of professional male cyclists training for the Tour de France to be at 8 kcal/kgFFM/day (Vogt *et al.*, 2005). Recently the mean EA in a group of female recreational runners was found to be 31.2 ± 14.1 kcal/kgFFM/day (Anderson, 2011), and in a group of female endurance runners to be 27.8 ± 9.9 kcal/kgFFM/day (Beals *et al.*, 2012) with 44% and 62% of the groups presenting with low EA, respectively. Figure 2 summarises the findings of studies in adult long distance runners that presented ample information on dietary energy intake, training distance and body composition to enable retrospective estimations of EA. There is an integration of 4 studies of male runners, 25 studies of female eumenorrheic (ER) runners and 12 studies of female amenorrheic (AR) runners (Loucks, 2007). An interesting observation is the EA range of 12 to 29 kcal/kgFFM/day of the athletes presenting with FHA (Loucks, 2007), corroborating the findings of Loucks and colleagues (1998) on the consequences of low EA on menstrual function. Considering dance falls into the same lean sports category as distance running, cycling, swimming, gymnastics and diving (Otis *et al.*, 1997; West, 1998; Smolak *et al.*, 2000), the EA findings in the abovementioned studies may also be comparable to dancers.

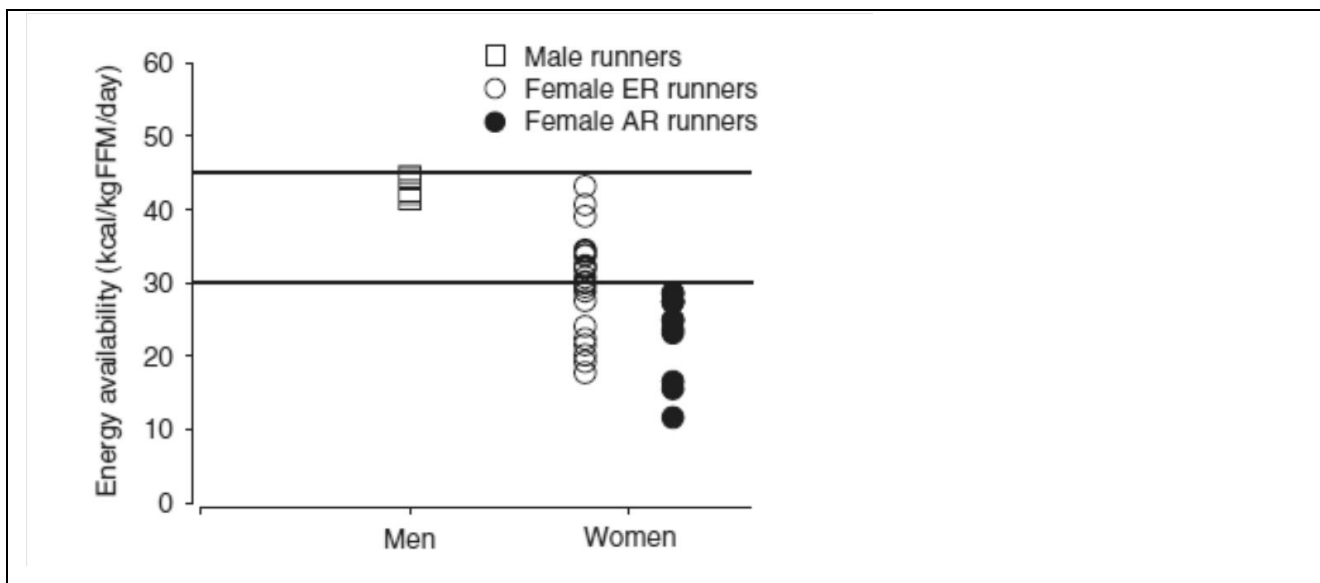


Figure 2: Energy availabilities of adult long distance runners (Adapted from Loucks, 2007)

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Chapter 3: *Methods*

CHAPTER 3: Methods

This chapter provides a detailed explanation of the *modus operandi* used to recruit participants as well as the procedures that were engaged in on their test day. Furthermore, the questionnaires and measurements that were used to gather relevant data are elucidated. The ethics and legal aspects related to the study as well as all the roles fulfilled by the student are also clarified.

3.1) Study design and setting

This study had an observational cross-sectional design and formed part of a bigger parent study, namely the Female Athlete Triad study which investigated the presence of the components of the Triad amongst University female student athletes.

For this study, each subject was engaged in various test procedures on their test day. Figure 3 represents a timeline which explains how the test day of an athlete or control progressed from arrival till departure. Following departure, five days elapsed after which the Actihearts[®] and dietary records were returned.

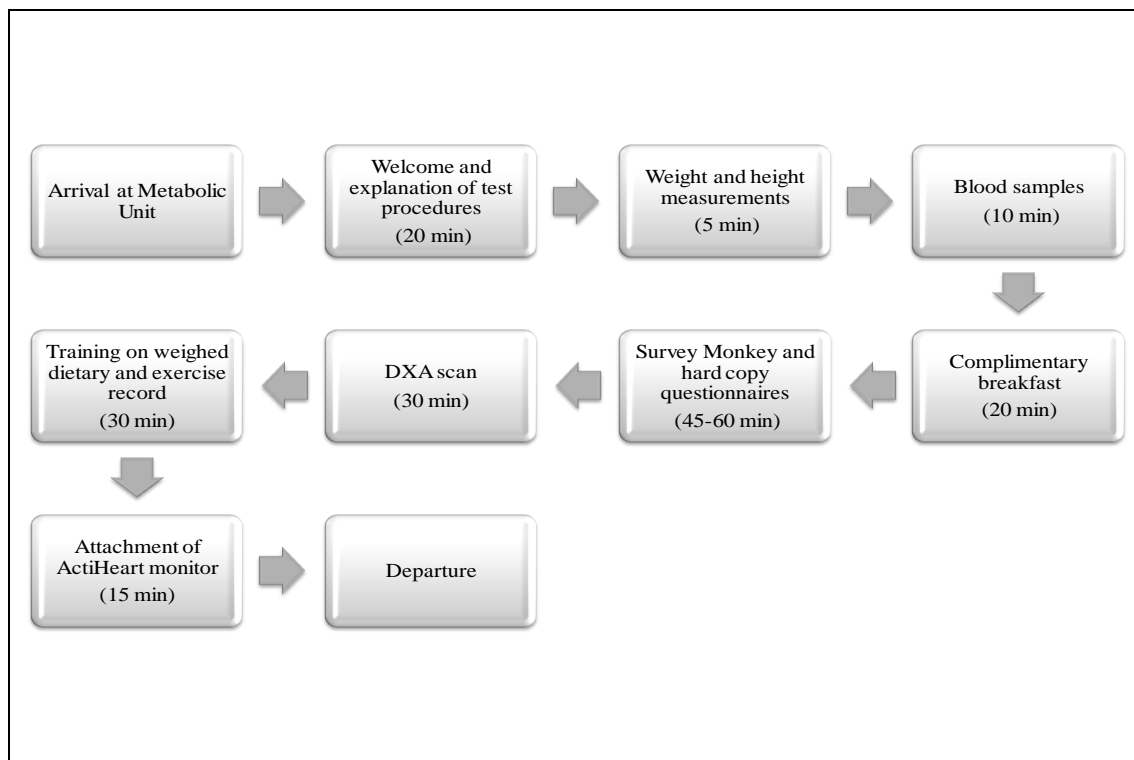


Figure 3: A timeline of the various test procedures and their duration

3.2) Ethics and legal aspects

The study was approved by the Ethical Committee of the NWU (NWU-0044-08-S1). All participants had to sign an informed consent form before they could be included in the study. All participants were notified that their information be treated with confidentiality and anonymity, which was enforced by the provision of subject numbers. Only the subject number of each participant was visible on all forms of documentation. All information obtained as well as results from the various test procedures were provided to participants upon request, and participants were notified that this information not be shared with anyone else without their permission. All participants received an incentive for participation once all necessary data was obtained from them.

3.3) Recruitment process

Information regarding the study was relayed to potential participants by individuals who had a thorough understanding of the nature of the study. Participants were recruited by means of an

informational A5 pamphlet that was handed out in common gathering areas of students, an advert placed in the NWU Potchefstroom campus newspaper (“Wapad”) and radio advertisements that were read live on the NWU Potchefstroom campus radio station (“PUKfm 93.6”). Furthermore, recruitment also took place in the form of meetings with students at hostels and sports practices; and individuals along popular walkways and lunch meeting areas (‘Lover’s lane’, subway and ‘Students Centre’) were also approached. If individuals were interested in taking part in the study, a date was negotiated for their test day.

3.4) Inclusion and exclusion criteria

Volunteer multi-racial female student dancers and non-athlete students (controls) between the ages of 18 and 30 years were recruited for this study. Exclusion criteria were known bone disease; pregnancy; and use of hormone therapy, and/or corticosteroids during the six months preceding the study. All dancers were enrolled at the Tshwane University of Technology, Faculty of Arts (Department of Performing Arts), while controls were enrolled at the NWU, Potchefstroom Campus. Controls were enrolled at the NWU and not Tshwane University of Technology because of logistical and financial reasons. The study commenced during a high intensity training phase where dancers were not only doing their usual dance classes, but also auditioning and training for productions. A total of 29 multi-racial female dancers were recruited via purposive sampling, from which 26 were included in the study. The 3 dancers that were excluded from the study had various questionnaires that were not sufficiently completed in order to attain adequate information to include them in data analyses. A total of 103 multi-racial controls were recruited, from which 26 were tediously selected. Each dancer was matched with a control that had the same race; and a comparable age and BMI.

3.5) Questionnaires and measurements

The following questionnaires were completed by all the subjects: an online demographic, health and sport questionnaire administered through Survey Monkey (Addendum 1); manual DE questionnaires (Addendum 2); as well as a 5-day weighed food record and activity record form (Addendum 3). Additionally, anthropometric and body composition measurements were taken as well as daily and exercise EE measured.

3.5.1) Demographic, health and sport questionnaire

It was required by the subjects to complete an online demographic, health and sport questionnaire from which the following information was obtained: demographics, self-reported ethnicity, tobacco and alcohol use, physical activity, current training and sport participation (for dancers only), history of body weight changes, body image perception, and menstrual function history.

3.5.2) Disordered eating behaviour, pathogenic weight control measure use and body image

DE behaviour was identified with three questionnaires (EDI3, TFEQ and EDI3-RF) that were completed manually and a fieldworker was available at all times if anything was unclear. No talking was allowed during the completion of the questionnaires to limit any possible peer influences on answers. Furthermore, only subject numbers appeared on the questionnaires to ensure confidentiality. All participants were ensured that their results would be treated confidentially and dancers were ensured that their results would not be shared with their coach without prior consent. Subjects' DE behaviour was identified with two instruments namely, the EDI3 and CDR subscale of the TFEQ. The EDI3 (Garner, 2004) consists of ninety-one items rated on a 6-point Likert-type scale and is subdivided into twelve subscales. Three of these subscales measure central ED symptoms namely, drive for thinness, bulimia and body dissatisfaction. The TFEQ CDR subscale (Stunkard & Messick, 1985) consists of twenty-one items that measure the intent to control food intake in order to achieve or maintain a desired body weight. Both the TFEQ and EDI have been documented to be reliable measures within the general public as well as in various ethnic groups (Atlas *et al.*, 2002; Bardone-Cone & Boyde, 2007; Jones *et al.*, 2007). Atlas and associates (2002) found a consistency within results using a sample of 300 Caucasian and 200 African American undergraduates for eating and dieting expectancies, bulimic symptoms, dietary restraint, and disinhibition. Furthermore, Bardone-Cone and Boyde (2007) established internal consistency, temporal stability, and convergent and discriminant validity of a variety of ED measures using a population sample comprising of 97 Blacks and 179 Whites. Lastly, Jones and co-workers (2007) made use of a study population of 384 rural adolescents, of which 57% were African American and 43% Caucasian, and identified that results on body image were consistent with those of urban youth.

The cut-off points for the TFEQ CDR subscale, as well as the EDI-bulimia, body dissatisfaction, and drive for thinness subscales were set at ≥ 9 , ≥ 5 , ≥ 14 , and ≥ 15 , respectively.

Furthermore, the EDI3-RF (Garner, 2004) has five behavioural questions that assess the risk for an ED. The five behavioural questions clarify the frequency of use of PWCM including bingeing, vomiting, laxatives, additional exercise, and weight loss with cut-off scores set at ≥ 2 , ≥ 1 , ≥ 1 , ≥ 5 and ≥ 1 , respectively. Any individual presenting with a score higher than that of the cut-off for any of the behavioural questions was regarded as accountable of exploiting that specific PWCM.

Body image is regarded as a mental depiction of the contour, size and appearance of the human body and it is manipulated by various dynamics, including ethnic and societal, amongst others (Banfield & McCabe, 2002). The body image of the dancers and controls was evaluated by online questions on body image perceptions; and how perceptions of current body weight and BMI relate to perceptions of ideal body weight and BMI. The body image assessment (BIA) tool used in our study was devised by Williamson and colleagues (1989) and uses the self-discrepancy theory as the foundation of the methodology (Higgins, 1987). The BIA serves as a figural stimulus technique for the evaluation of body image disturbances that are related to EDs. Nine silhouettes of female figures form a scale that ranges from very thin (1) to overweight (9), and individuals were asked to identify the figure they currently had (actual body silhouette (ABS)) and the figure they would like to have (ideal body silhouette (IBS)), thereby measuring the individual's estimate of actual or current body size and an estimate of their ideal body size. We determined the discrepancy between ABS and IBS, termed Feel Minus Ideal Discrepancy (FID), to give an indication of body image dissatisfaction and whether participants were trying to lose, gain or maintain weight.

3.5.3) Body composition and anthropometric measurements

Body weight and height measurements were taken according to the International Standards for Anthropometric Assessment (ISAK) by level 1 ISAK accredited fieldworkers (Marfell-Jones *et al.*, 2006). Subjects were barefoot and required to wear minimal clothing. A Precision health scale (UC-300) was used to measure body weight to the nearest gram and a Seca Metrimeasure IP 1465 stadiometer (London, UK) was used to measure height to the nearest millimeter. Body composition

(fat mass, percentage body fat, lean mass and FFM) was assessed with DXA using the Discovery Hologic W system (Vertec Scientific SA (Pty)). All DXA tests were performed by a registered radiographer and subjects exposed to a total whole-body reading of x-ray exposure of 0.008 mGy. It was mandatory for subjects to remove all jewelry and metal-containing underwear, and wear a robe while undergoing DXA measurements. All dancers and controls had their body composition assessed with the same DXA system.

3.5.4) Dietary intake and estimated energy availability

Habitual energy and nutrient intake was assessed with a 5-day weighed food record. It was essential for each subject to complete a 5-day weighed food record using a calibrated digital food scale that weighed to the nearest 0.01g. The food record was kept in a food record log book which also elucidated the technique of keeping a food record while providing a comprehensive example of a food record for one day. Additionally, the entire process of keeping a food record was verbally explained to all subjects by a trained fieldworker to ensure that they had a good understanding of what was expected from them. Upon the return of the food record, each record was checked by a trained fieldworker for clarity and completeness together with the subject. Furthermore, a hand-out with generic sketches of food and beverage portion sizes (Langenhoven *et al.*, 1991; FoodFinderTM3, 2002) was also given to subjects to estimate food portion sizes when a weighed food record was not possible (e.g. eating out at a restaurant). However, they were told that keeping a weighed food record of all foods and beverages consumed was absolutely imperative and the preferred choice of record keeping. The dietary data were coded by using the Medical Research Council's (MRC) Condensed Food Composition Tables for South Africa (Wolmarans *et al.*, 2010) and the day of consumption, time of ingestion and food choices were then captured in an excel spreadsheet. This was then converted into nutrients by the MRC Biostatistics unit and basic analyses were done.

During the same five days that the weighed food record was kept, the subjects wore an Actiheart® (CamNtech Ltd, Cambridgeshire UK) which uses both heart rate and accelerometry to calculate EE accurately. An Actiheart® is a joint movement sensor and heart rate monitor (Brage *et al.*, 2005) which is comprised of two sensors fixed by a short wire. The two sensors were clamped to the electrocardiogram (ECG) electrode pads that were carefully placed on the chests of the dancers. The

Actiheart® combines a uniaxial accelerometer with a heart rate monitor to provide a more precise estimation of physical activity levels and EE than either method individually (Corder *et al.*, 2005; Barreira *et al.*, 2009). The average $_{est}EA$ for the five days was calculated for dancers and controls. All daily EE from each individual’s Actiheart® data that corresponded to a metabolic equivalent (MET) value of ≥ 4 were extracted and used to calculate the average estimated exercise energy expenditure ($_{est}EEE$). Activities with a MET value of ≥ 4 includes activities of daily living such as biking and walking of moderate intensity on campus, which can substantially contribute to the daily energy expenditure even though it is not part of a planned training session, but also all planned exercise of moderate or high intensity (Ainsworth, 2000; Guebels *et al.*, in press).

$_{est}EA$ expressed as kcal/kgFFM/day was determined using the formula (Manore *et al.*, 2007):

$$_{est}EA = \text{Average energy intake} - \text{Average } _{est}EEE / \text{kgFFM}$$

$_{est}EA$ was calculated using various elements namely, the average energy intake that was expressed in kcal and obtained from the 5-day weighed food record; the FFM which was expressed in kg and assessed by means of the DXA scan; and lastly the average $_{est}EEE$ that was expressed in kcal and determined using the Actiheart® data.

3.6) A description of the roles fulfilled by the student

Table 4 is a summary of the roles fulfilled by the student with regard to the various facets of the study.

Table 7: A summary of the roles fulfilled by the student

Facet	Job description
Recruitment (administrative)	<ul style="list-style-type: none"> • Design of an A5 handout pamphlet used for recruitment purposes on NWU Potchefstroom campus. • Design of a recruitment advert for the NWU Potchefstroom campus newspaper, the “Wapad”. • Design of radio recruitment advertisements for live-reading on the NWU Potchefstroom campus radio station, “PUKfm 93.6”.
Recruitment (physical)	<ul style="list-style-type: none"> • Attendance at NWU Potchefstroom hostel meetings for recruitment purposes. • Attendance at NWU Potchefstroom sports practices for recruitment purposes. • Recruitment on NWU Potchefstroom campus along popular walkways and lunch meeting areas (‘Lover’s lane’, subway and ‘Students Centre’).
Other (administrative)	<ul style="list-style-type: none"> • Compiling an electronic version of the demographic, health and sport questionnaire using SurveyMonkey®. • Management of the Triad study Facebook® page. • Preparing documents required for test days: photocopying, printing, labeling, numbering and assembling of subject files. • Ordering, filing and storage of completed documents. • General communication with subjects to relay information regarding test days and follow-up days.

Table 7 (continued): A summary of the roles fulfilled by the student

Facet	Job description
Testing days	<ul style="list-style-type: none"> • Welcome of subjects. • Explanation of test day procedures. • Weight and height measurements. • Attachment of Actiheart® monitors (at NWU Potchefstroom campus, Tshwane University of Technology and NWU Vaal Triangle campus). • Explanation of weighed 5-day dietary and activity record forms.
Follow-up days	<ul style="list-style-type: none"> • Inspection of food records for clarity and completeness. • Reading, powering down and charging of Actiheart® monitors.
Data	<ul style="list-style-type: none"> • Decoding SurveyMonkey® responses for data analysis purposes. • Coding of food records for data analysis purposes.
Other responsibilities	<ul style="list-style-type: none"> • Writing of the dissertation with the input of the study leaders

3.7) Reference list

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Chapter 4:
Article

CHAPTER 4: Article

TITLE: Disordered eating behavior, body image and energy status of university women dancers.

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ABSTRACT

Objective: This study compared disordered eating (DE) behavior, pathogenic weight control measure (PWCM) use, body image perceptions, energy status and the body composition assessment of a group of student women dancers to a control group at two South African universities. **Method:** Fifty two, volunteer women student dancers (n=26), matched by controls (n=26) of the same race, comparable age (18-30 years) and body mass index (BMI) were recruited. Disordered eating behavior was assessed with the Eating disorder inventory-3 (EDI3), Cognitive dietary restraint (CDR) subscale of the Three-factor eating questionnaire (TFEQ), and EDI3 referral form (EDI3-RF) behavioral questions. Body image was assessed using the Body Silhouette Assessment Scale. Energy status was assessed using a 5-day weighed food record to assess energy intake and Actiheart® monitor to assess energy expenditure. **Results:** Dancers had significantly higher EDI3 and TFEQ subscale scores and greater body image dissatisfaction than controls. Dancers and controls made use of similar PWCM, except that more dancers used excessive exercise to lose weight than controls. Energy status was similar between groups. **Discussion:** Although dancers were more at risk for DE behavior than controls, body dissatisfaction, bingeing and purging behavior was also found amongst controls, with a higher incidence of the latter two found in controls.

INTRODUCTION

Modern culture has stereotyped the divine female body as one that is continually getting leaner, with the internalization of the 'thin' ideal possibly resulting in body dissatisfaction, disturbances in body image and exploitation of extreme weight control measures.¹⁻³ Disordered eating describes a pattern of unorthodox eating behaviors that may fulfill a greater or lesser number of the formal diagnostic criteria of a clinical eating disorder such as Anorexia Nervosa.⁴ The underlying causes of disordered eating in females are complex issues that involve intricate relations between social, psychological and physiological factors.⁵⁻⁷ It is the inner concern to accomplish success combined with the external pressure imposed by the media, coaches and public that has the potential to drive athletes involved in artistic or aesthetic events to practice disordered eating behaviors.⁸ These shoddy eating behaviors and attitudes, also referred to as pathogenic body weight control behaviors, may involve body mass and figure anxiety; substandard nutrition or insufficient energy intake (possibly even a combination of both); bingeing; exploitation of laxatives, diuretics and diet pills; and severe body weight control measures such as abstaining from food (fasting), purging (vomiting) and additional exercise over and above the normal training program.⁹⁻¹² Furthermore, athletes may also inadvertently fail to satisfy their substantial exercise energy requirements as a consequence these disordered eating behaviors although other factors such as time constraints, food availability problems or deficiency of apt nutritional knowledge may also play a role.¹³ Disordered eating behavior is seen as a risk factor for developing an energy deficit¹⁴ and the cardiovascular, reproductive, skeletal, renal, gastrointestinal, endocrine and central nervous systems are all at risk to be negatively affected as a result of the ensuing undernourishment and/or weight loss related to poor nutritional behavior.¹⁵⁻¹⁸

It is anticipated that various ethnical differences may arise with regard to body image and disordered eating behavior within the multi-racial study population. Literature has suggested that prospective cases of eating disorders are as probable among African as among Caucasian subjects,¹⁹ especially considering that black South African female college students have demonstrated significantly greater eating disorder psychopathology than other races.¹⁹ These high rates may, however, have been attributed towards cultural and socio-economic factors or may have been a result of methodological artifacts and not eating pathology *per se*.²⁰ Nevertheless, the body image perceptions of African women is a very complex issue that is influenced by a number of beliefs

including: 'fatness' that is perceived by some as a sign of dignity, respect, health, wealth and strength,²¹ while others associate 'fatness' with specific non-communicable diseases and inability to find suitable clothing sizes²²; and 'thinness' being stereotyped by some as sign of disease/s while others associate it with a desired physical appearance and ability to find suitable clothing sizes.²²

Data are scarce regarding the 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 and shed more light on the disordered eating behavior, use of pathogenic weight control measures (PWCM) and body image perceptions of a group of student women dancers at a South African University, as well as investigate how this is associated with their energy status.

METHODS

Participants and study design

Fifty-two volunteer (18-30 years) women student dancers (n=26) and controls (n=26) were recruited via purposive sampling for this observational cross-sectional study (descriptive study with an analytical component). Dancers were enrolled at the Tshwane University of Technology, Faculty of Arts (Department of Performing Arts) and controls at North West University (NWU). Dancers were involved in a variety of dances such as African, tap, jazz, contemporary and ballet. The available sample from which dancers of this age group and level of dancing could be recruited from was small; and recruitment was further complicated by the relatively high respondent burden of measurements. All attempts were made to recruit as least 25 participants per group. A total of 29 multi-racial female dancers were recruited, from which 26 were included in the study. The 3 dancers that were excluded from the study had various questionnaires that were not sufficiently completed in order to attain adequate information to include them in data analyses. A total of 103 multi-racial female controls were recruited, from which 26 were tediously selected for the study. Dancers were matched by non-athlete controls of the same race, as well as comparable age and body mass index (BMI). Both the dancer (DG) and control groups (CG) included 17 Caucasian and 9 African participants. The study commenced during a high intensity training phase where dancers were not only doing their usual dance classes, but also auditioned and trained for productions. Participants that had any known bone disease, were pregnant, lactating, and that used hormone therapy or corticosteroids during the six months preceding the study were excluded. The study was approved

by the ethics committee of the NWU (NWU-0044-08-S1). All participants were informed of the nature of the study orally and in writing, and gave written informed consent. This study was part of a larger cross-sectional study that explored the components of the female athlete triad in student athletes and non-athletes.

MEASUREMENTS

Demographic, health and sport information

Participants completed a structured demographic, health and sport questionnaire for the attainment of socio-demographic information, training load, body image perception, use of body-weight control measures, eating habits, menstrual function history, and self-perceived food security status.

Weight and height

Body weight and height were measured according to the International Standards for Kinanthropometric Assessment criteria.²³ Weight was measured on an electronic scale (PS Upright Weigh-less Scale, SCALES 2000) and height was measured with a stadiometer and recorded to the nearest decimal place.

Body composition

Body composition (i.e. fat-free mass and body fat percentage) was assessed with dual energy X-ray absorptiometry (DXA) (Discovery Hologic W, Vertec Scientific SA Ltd). All DXA measurements were performed by a registered radiographer.

Menstrual patterns

Self-reported menstrual patterns were assessed with a menstrual history questionnaire. Eumenorrhea was classified as having cycles every 26 to 35 days. Primary amenorrhea was defined as the absence of menses by age 15, secondary amenorrhea as the absence of menstrual periods for ≥ 90 days since the onset of menarche, and oligomenorrhea as menstrual periods at intervals of 36 to 90 days or ≤ 10 cycles per year during the preceding 12 months.²⁴ Menstrual irregularity was defined as shorter cycles occurring every ≤ 21 to 25 days during the past 12 months. Participants were categorized as having menstrual dysfunction when they presented with current or history of primary amenorrhea, secondary amenorrhea, oligomenorrhea or menstrual irregularities during the preceding 12 months. Gynecological age was calculated by subtracting the age at menarche from age at the last menstrual period; low gynecological age was defined as two or fewer completed years since menarche.²⁵

Dietary intake, energy balance and energy availability

Habitual nutrient and energy intake (EI) was assessed with a 5-day weighed food record, completed by each individual using a calibrated digital food scale that weighed to the nearest 0.01 gram. The 5-day weighed food record was completed on consecutive week and weekend days for both dancers and controls, while dancers alone had training and non-training days also included. Subjects were educated on how to keep a food record by a dietitian or graduate nutrition student. The food record was kept in a food record log book which also elucidated the technique of keeping a food record while providing a comprehensive example of a food record for one day. Dietary data were coded using the Medical Research Council (MRC) Condensed Food Composition Tables for South Africa;²⁶ and the day of consumption, time of ingestion and food choices were then captured in an excel spreadsheet. This was then converted into nutrients and energy by a biostatistician (MRC Biostatistics unit, Medical Research Council, Cape Town). The possibility of over- and under-reporting energy intake in all individuals was evaluated by calculating the ratio of mean reported energy intake to basal metabolic rate (EI:BMR) according to the method of Goldberg.²⁷ As described by Black²⁸, a *lower cut-off* of <1.11 and an *upper cut-off* of >2.42 (cut-offs for females with a medium physical activity level) was delineated to represent the likelihood of over- and under-reporting energy intake respectively.

During the same five days that the food record was kept, an Actiheart® monitor (CamNtech Ltd, Cambridgeshire UK) was attached, which uses both heart rate and accelerometry to calculate total energy expenditure (TEE). The Actiheart® combines a uniaxial accelerometer with a heart rate monitor to provide a more precise estimation of physical activity levels and energy expenditure than either method individually.^{29,30} Energy balance (EB) was calculated from the following formula:

$$EB = EI - TEE \dots\dots\dots (1)$$

A negative energy balance is indicative of an energy deficit, while an energy balance of zero is associated with sufficient energy for all bodily functions to operate normally.³¹

The average estimated energy availability (_{est}EA) for the five days was calculated for dancers and controls. All daily energy expenditure from each individual's Actiheart® data that corresponded to a metabolic equivalent (MET) value of ≥4 was extracted and used to calculate the average estimated exercise energy expenditure (_{est}EEE). Activities with a MET value of ≥4 includes activities of daily living such as biking and walking of moderate intensity on campus, which can substantially contribute to the daily energy expenditure even though it is not part of a planned training

session.^{32,33} Low energy availability (EA) was delineated at <30 kcal/kg fat-free mass (FFM)/day and is associated with an energy deficit;³⁴ and normal EA as ~45 kcal/kg FFM/day³⁵ which is indicative of a healthy energy status.³⁴ $_{est}EA$ was calculated from the following formula adapted from Manore and colleagues:³⁵

$$_{est}EA = \frac{\text{Average energy intake (kcal)} - \text{Average } _{est}EEE \text{ (kcal)}}{\text{FFM (kg)}} \dots\dots\dots(2)$$

Disordered eating behavior and body image

Disordered eating behavior was assessed with the 91-item Eating disorder inventory-3 (EDI3)^{36,37} and the Cognitive dietary restraint (CDR) subscale of the Three-factor eating questionnaire (TFEQ).³⁸ The EDI3 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 non-clinical setting.³⁹ Three EDI3 subscales, specifically the Drive for Thinness (EDI3-DT), Body Dissatisfaction (EDI3-BD), and Bulimia (EDI3-B) have been shown to foretell the development of eating disorders and have been used as selection criteria when exploring eating disorder pathology in athletes.⁴⁰ Other EDI3 subscales included in our analyses were Perfectionism, Maturity fears, Low self-esteem, Personal alienation, Interpersonal insecurity, Interpersonal alienation, Interoceptive deficits, Emotional dysregulation and Asceticism. Females may have the tendency to adjust their responses in an attempt to fit a normative behavior, with these possible ‘false negative’ responses being identified and suggested by other researchers.^{41,42} A profile which is indicative of a ‘false negative’ response style is represented by a Drive for Thinness subscale score equal to 0 in the presence of all other EDI subscale scores ≤ 2, except for Perfectionism which is ≥9.⁴²

The TFEQ-CDR subscale comprises 21 items that gauge the intent to control food intake to attain or maintain a desired body weight, and has been shown to be a reliable measurement within the general public.⁴³ The cut-off points for the TFEQ-CDR subscale, as well as the EDI3-B, EDI3-BD, and EDI3-DT subscales are set at ≥9, ≥5, ≥14, and ≥15, respectively.^{44,45} Participants scoring above the EDI and TFEQ cut-off scores are at increased risk for DE behavior.^{44,45}

Additionally, the EDI3 referral form’s (EDI3-RF) five behavioral questions that assess the use of pathogenic weight control measures (PWCM) were completed (including bingeing, vomiting, laxatives, additional exercise and weight loss ≥ 9kg within the preceding 6 months).³⁷ Lastly,

participants were divided into groups with an EDI3-DT cut-off ≥ 7 or < 7 as proposed by De Souza and colleagues⁴² to identify those with symptoms of subclinical disordered eating. Participants were compared for energy status using energy availability and energy balance, as a high drive for thinness (≥ 7) has shown to be a proxy indicator for energy deficiency.⁴²

Participants also completed a body weight questionnaire that included a Body Silhouette Assessment Scale, which required them to select a body silhouette (BS) on a scale from 1 (very thin) to 9 (obese), representing their actual (ABS) and ideal body silhouette (IBS) respectively.⁴⁶ We determined the discrepancy between ABS and IBS, termed Feel Minus Ideal Discrepancy (FID), to give an indication of body image dissatisfaction and whether participants were trying to lose, gain or maintain weight. They were also asked the reason for wanting to gain or lose or maintain weight. The body image of participants was further evaluated by looking at the difference between actual body weight and reported ideal/competitive body weight.

STATISTICAL METHODS

Statistical analyses were performed using STATISTICA analysis software (StatSoft, Tulsa, OK, USA, Version 9.0). Data not normally distributed were expressed as medians and inter-quartile ranges (25th and 75th percentiles), outliers were excluded from the _{est}EA results. Mann-Whitney U tests compared continuous variables between dancers and controls, disordered eating groups, those with an EDI3-DT < 7 vs. ≥ 7 , Caucasian and African participants. Wilcoxon matched pairs tests were used to investigate differences between actual and ideal/competitive body weight of dancers and controls. Categorical data were analysed with cross-tabulations and expressed as percentages of each group. Chi-squared analyses were used to determine differences between groups for categorical data namely, training hours per week, smoking, food insecurity status, menstrual pattern changes, number of participants scoring above the EDI3 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 $p < 0.05$.

RESULTS

Socio-demographic information, participant characteristics, and body composition data is summarized in Table 1.

Table 1: Socio-demographic information, characteristics and body composition data of dancers and controls.

	Controls (n=26)	Dancers (n=26)	P-value
<i>Age (yr)</i>	20.0 (19.0; 21.0)	19.0 (18.0; 21.0)	0.066
<i>Menarcheal age (yr)</i>	14.0 (13.0; 15.0)	14.0 (13.0; 14.0)	0.608
<i>Gynecological age (yr)</i>	6.0 (5.0; 7.0)	6.0 (4.0; 7.0)	0.728
<i>Weight (kg)</i>	55.0 (52.0; 59.4)	57.6 (53.0; 59.2)	0.437
<i>Height (m)</i>	1.6 (1.6; 1.7)	1.6 (1.6; 1.7)	0.826
<i>Body mass index (kg/m²)</i>	20.9 (19.8; 22.0)	21.2 (19.9; 22.2)	0.667
<i>Fat-free mass (kg)</i>	39.0 (35.5; 42.7)	42.6 (40.3; 46.1)	0.010
<i>Percentage body fat (%)</i>	28.9 (25.7; 30.8)	22.8 (19.4; 27.9)	0.006
<u>Hours training per week:</u>	Percentage	Percentage	<0.0001 [#]
• < 1 hour	34.6	15.4	
• 1-2 hours	65.4	3.8	
• 3-5 hours	-	7.7	
• 6-8 hours	-	19.2	
• ≥9 hours	-	53.8	
<u>Smoking:</u>			0.042*
• Yes	3.8	23.1	
• No	96.2	76.9	
<u>Food Insecurity:</u>			0.025 [†]
• Yes	7.7	26.9	
• No	92.3	61.5	
• No response	-	11.5	
Continuous data presented as medians (25 th ; 75 th percentiles); Mann-Whitney U test / χ^2 test; [#] $\chi^2=37.15$; * $\chi^2=4.13$; [†] $\chi^2=7.38$			

The percentages of menstrual pattern changes in the CG and DG are illustrated in Figure 1A and 1B. No differences emerged between the groups for menstrual pattern changes (Figure 1A and 1B). When comparing individuals with menstrual pattern changes to those without changes in terms of disordered eating risk, no significant differences were found between the groups for EDI3-B ($p=0.640$), EDI3-BD ($p=0.656$), EDI3-DT ($p=0.708$) or TFEQ ($p=0.339$) subscale scores.

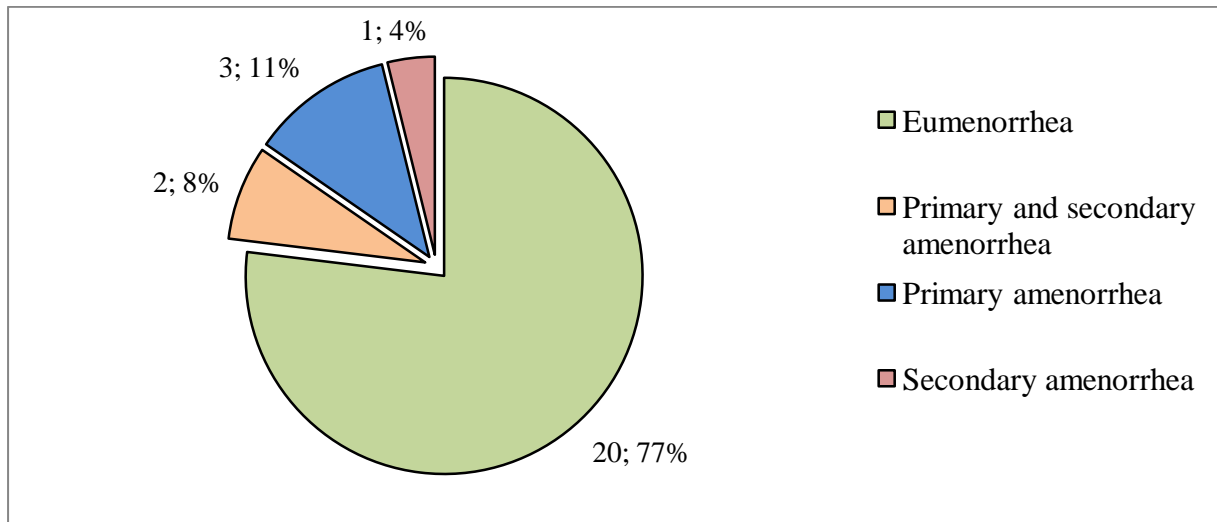


Figure 1A - Menstrual patterns of the control group (n=26). Data presented as number of individuals and percentage of the group.

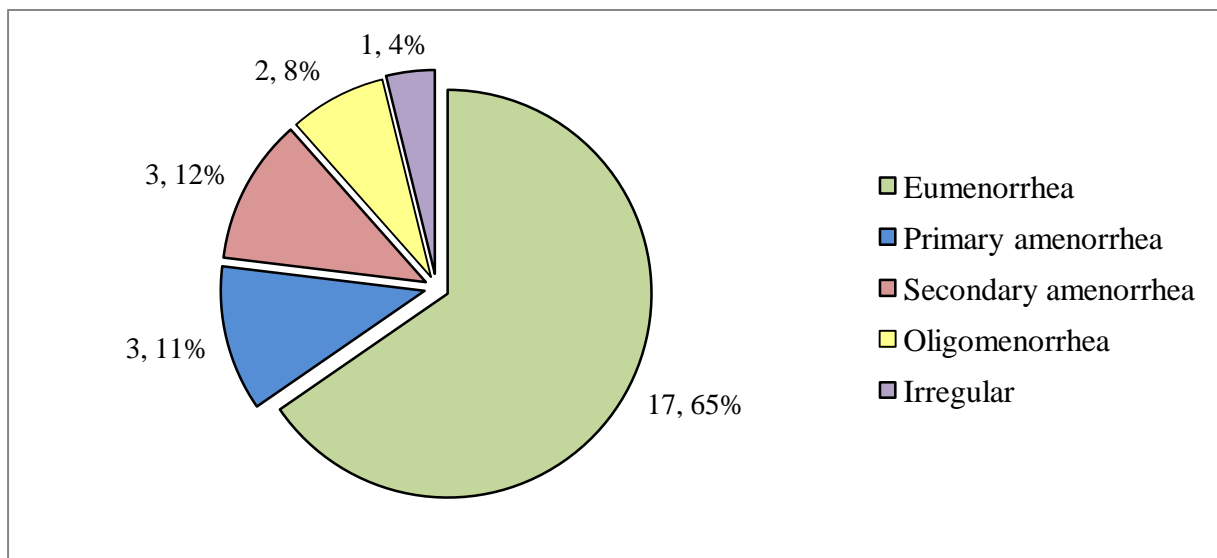


Figure 1B - Menstrual patterns of the dancer group (n=26). Data presented as number of individuals and percentage of the group.

Mean daily energy intake, total energy expenditure, energy balance, macronutrient and micronutrient intakes of participants are presented in Table 2. A negative energy balance was found in 80.8% of dancers (n=21) and controls (n=21). No significant differences were found between the DG and CG for energy and nutrient intake. One control and 1 dancer were identified as possible over-reporters with an EI:BMR ratio of 2.72 and 2.88, respectively. On the other hand, 2 controls and 6 dancers were identified as possible under-reporters with an EI:BMR ratio of 0.60 to 1.09.

Table 2: Mean daily energy and nutrient intakes, total energy expenditure and energy balance of dancers and controls.

	Controls (n=26)	Dancers (n=26)	P-value
<i>Energy intake (kJ)</i>	7675 (7068; 8686)	8063 (7010; 10002)	0.615
<i>Total energy expenditure (kJ)</i>	10297 (8587; 11760)	11895 (9273; 13100)	0.074
<i>Energy balance (kJ)</i>	-2378 (-4632; -775)	-3797 (-4875; -1204)	0.284
<i>Carbohydrate (g)</i>	212.5 (195.4; 263.0)	235.0 (205.1; 276.2)	0.203
<i>gram/kg body weight</i>	3.7 (3.3; 4.7)	4.1 (3.6; 4.9)	0.319
<i>Protein (g)</i>	59.4 (53.5; 67.4)	61.4 (44.4; 86.3)	0.978
<i>gram/kg body weight</i>	1.1 (0.9; 1.3)	1.1 (0.7; 1.7)	0.891
<i>Fat (g)</i>	73.1 (64.9; 89.2)	68.5 (52.2; 88.5)	0.365
<i>gram/kg body weight</i>	1.3 (1.1; 1.5)	1.1 (0.9; 1.7)	0.328
<i>Fiber (g)</i>	12.0 (8.3; 17.3)	13.2 (9.5; 18.5)	0.528
<i>Calcium (mg)</i>	482.1 (385.8; 684.6)	562.7 (333.8; 780.3)	0.375
<i>Iron (mg)</i>	9.3 (8.7; 13.2)	11.5 (8.9; 16.0)	0.238
<i>Vitamin B6 (mg)</i>	1.7 (1.5; 2.8)	2.1 (1.7; 2.8)	0.337
<i>Vitamin B12 (µg)</i>	3.0 (2.7; 4.7)	3.5 (1.8; 4.2)	0.949
<i>Vitamin C (mg)</i>	50.9 (38.4; 87.2)	69.5 (21.5; 141.4)	0.589
Data presented as medians (25th; 75th percentiles); Mann-Whitney U test; values represent the average of 5-days			

The average $_{est}EA$ of the CG (n=25) was 37.9 (34.0; 48.1) kcal/kg FFM/day (~159 kJ/kg FFM/day) and of the DG (n=25) was 39.4 (30.3; 45.4) kcal/kg FFM/day (~165 kJ/kg FFM/day), no differences were found between groups (Figure 2) and outliers were excluded from $_{est}EA$ analyses. The two outliers seen in Figure 2 were identified as the over-reporters and were excluded from dietary analyses. One of the controls and 5 of the dancers presenting with low $_{est}EA$ were identified as possible under-reporters, but were not excluded from analyses as food intake of female athletes has been reported to be low.⁴⁷ Eight percent of the CG (n=2) and 24.0% of the DG (n=6) were classified with a low $_{est}EA$, while 40.0% of the CG (n=10) and 28.0% of the DG (n=7) had a healthy $_{est}EA$ of ≥ 45 kcal/kg FFM/day (excluding outliers). If over-reporters and under-reporters were excluded from analyses, then average $_{est}EA$ of the CG (n=23) was 43.4 (34.0; 52.0) kcal/kg FFM/day (~182 kJ/kg FFM/day) and of the DG (n=19) was 43.7 (35.8; 49.6) kcal/kg FFM/day (~184 kJ/kg FFM/day); and the average EB of the CG (n=23) was -2639.3 (-4632.1; -774.8) kcal/day and of the DG (n=19) -3452.8 (-4710.6; -1065.3) kcal/day, no differences were found between groups for EA (p=0.879) or EB (p=0.578).

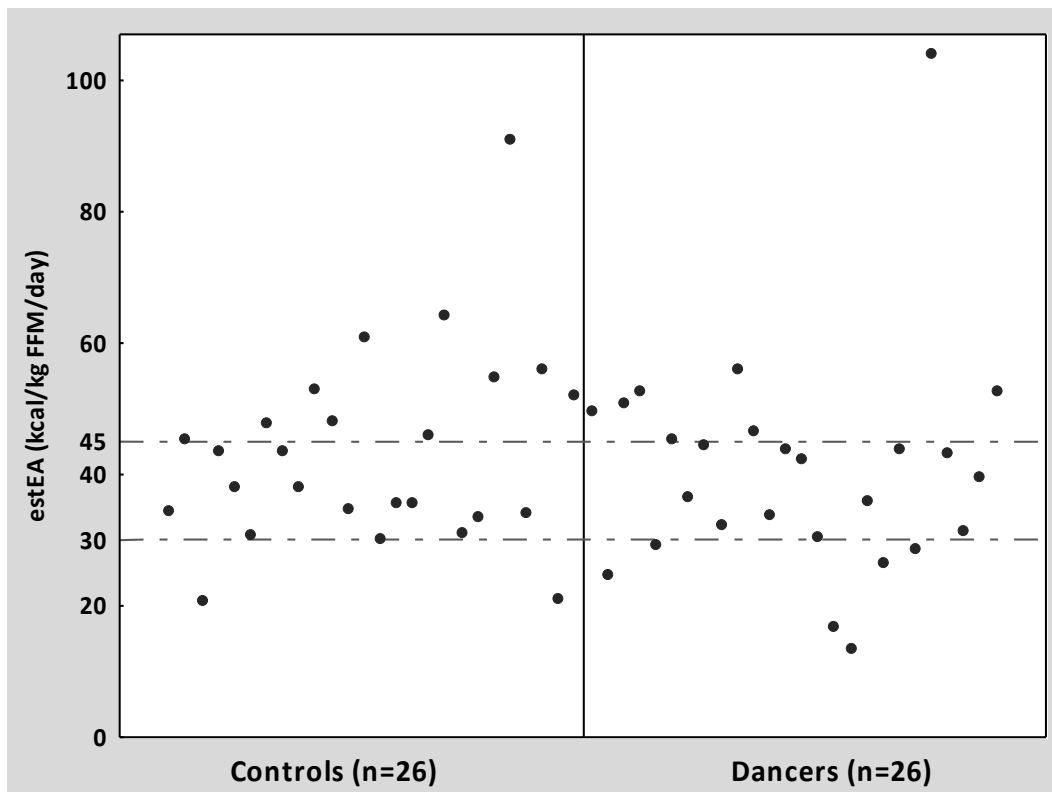


Figure 2 - Estimated energy availability of dancers and controls; Mann-Whitney U test, p=0.372

Raw EDI3 and TFEQ-CDR subscale scores are presented in Table 3. One dancer's TFEQ-CDR score is not included due to an incomplete questionnaire. No participants were identified with 'false negative' scores on the EDI3

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)	
<i>Drive for thinness score</i>	4.5 (2.0; 9.0)	12.0 (3.0; 19.0)	0.023
<i>Body dissatisfaction score</i>	6.5 (3.0; 14.0)	16.0 (10.0; 25.0)	0.004
<i>Bulimia score</i>	4.0 (1.0; 5.0)	5.0 (1.0; 8.0)	0.341
<i>Perfectionism score</i>	10.0 (5.0; 15.0)	13.0 (7.0; 17.0)	0.207
<i>Maturity fears score</i>	9.0 (3.0; 13.0)	9.5 (6.0; 13.0)	0.552
<i>Low self-esteem score</i>	3.5 (1.0; 6.0)	3.5 (1.0; 8.0)	0.728
<i>Personal alienation score</i>	5.5 (3.0; 7.0)	6.5 (3.0; 9.0)	0.487
<i>Interpersonal insecurity score</i>	6.5 (3.0; 12.0)	6.0 (2.0; 10.0)	0.674
<i>Interpersonal alienation score</i>	7.5 (3.0; 10.0)	9.0 (7.0; 12.0)	0.094
<i>Interoceptive deficits score</i>	7.0 (4.0; 11.0)	7.0 (5.0; 11.0)	0.459
<i>Emotional dysregulation score</i>	3.0 (1.0; 8.0)	6.0 (2.0; 8.0)	0.459
<i>Asceticism score</i>	4.0 (3.0; 9.0)	7.0 (4.0; 9.0)	0.084
<i>Drive for thinness ≥15 (%)</i>	3.8	46.2	0.0004 [#]
<i>Body dissatisfaction ≥14 (%)</i>	30.8	61.5	0.026*
<i>Bulimia ≥5 (%)</i>	34.6	53.9	0.163
Three-factor eating questionnaire	(n=26)	(n=25)	
<i>Cognitive dietary restraint score</i>	3.0 (3.0; 7.0)	9.0 (2.0; 15.0)	0.032
<i>Cognitive dietary restraint ≥9 (%)</i>	11.5	52.0	0.002 [†]
Data presented as medians (25 th ; 75 th percentiles); Mann-Whitney U test / χ^2 test; [#] $\chi^2=12.41$; * $\chi^2=4.95$; [†] $\chi^2=9.69$			

Exploitation of the various PWCM by the DG and CG is represented in Figure 3. Bingeing was the most common PWCM used by both the DG and CG (19.2% (n=5) vs. 23.1% (n=6)), followed by extreme weight loss ≥ 9 kg within the preceding 6 months (11.5% (n=3) vs. 15.4% (n=4)). Vomiting (7.7% (n=2)), laxatives (11.5% (n=3)) and excessive exercise (19.2% (n=5)) for weight loss were used only by the dancers. Use of excessive exercise for weight loss was the only PWCM that differed significantly between the DG and CG ($\chi^2=5.53$, $p=0.019$). Twelve (46.1%) of the dancers made use of between 1 and 3 PWCM.

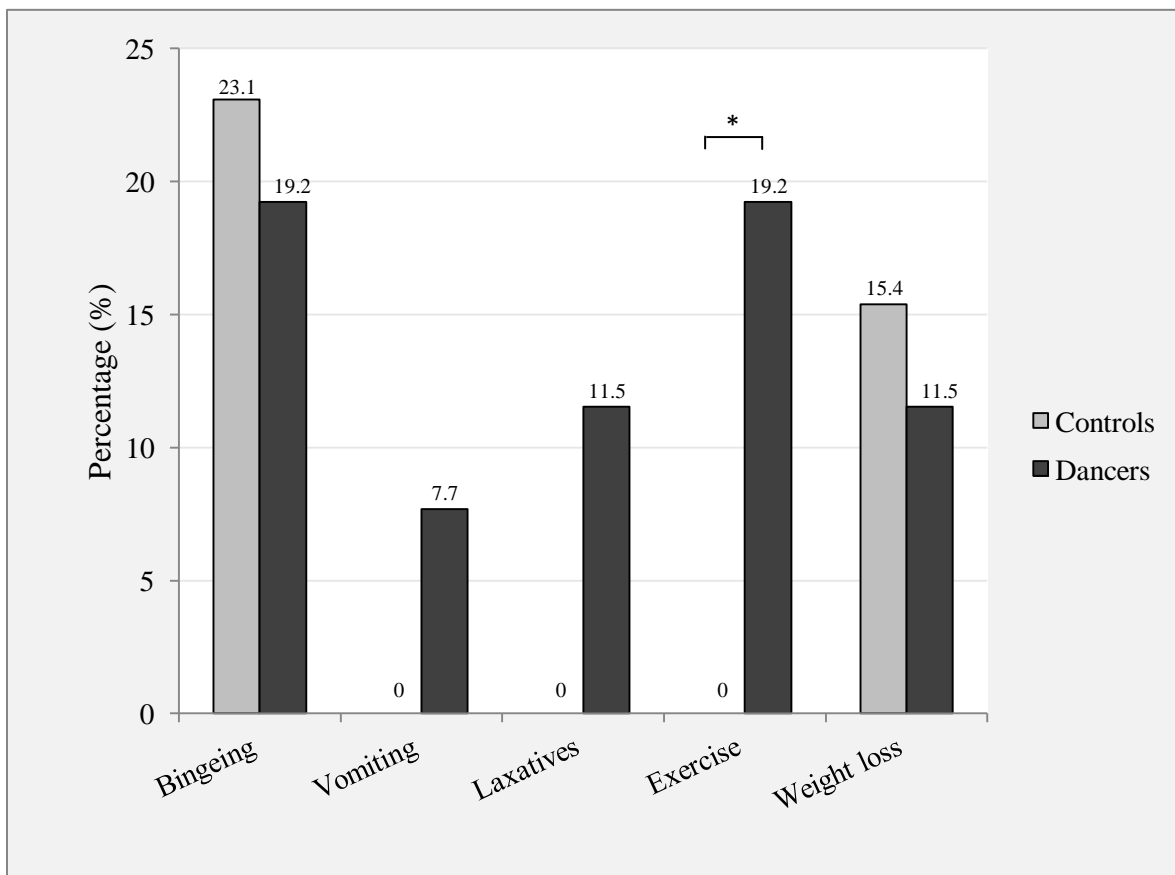


Figure 3 - Use of pathogenic weight control measures by dancers and controls; * $p=0.019$, χ^2 test. Data presented as percentage of each group.

The body silhouette chart response of participants is presented in Table 4. Numerous dancers (42.3% (n=11)) and controls (34.6% (n=9)) perceived themselves as featuring an ABS of more than 4, while the majority of dancers (96.2% (n=25)) and controls (80.8% (n=21)) desired an IBS of 4 or less.

Table 4: Scores on Body Silhouette Assessment Scale of dancers and controls

	Controls (n=26)	Dancers (n=26)	P-value
<i>Actual body silhouette (ABS)</i>	4 (3; 5)	4 (3; 5)	0.920
<i>Ideal body silhouette (IBS)</i>	4 (3; 4)	3 (2; 3)	0.002
<i>Feel minus ideal discrepancy (FID)</i>	0 (-1; 1)	1 (0; 2)	0.012
Data presented as medians (25th; 75th percentiles); Mann-Whitney U test			

Actual body weight was significantly different to ideal/competitive body weight for the DG (57.6 [53.0; 59.2] vs. 53.0 [50.0; 56.0], $p=0.0004$) but not for the CG (55.0 [52.0; 59.4] vs. 55.0 [50.0; 58.0], $p=0.264$). More dancers (65.4% (n=17)) than controls (38.5% (n=10)) reported to be currently trying to lose weight, conversely, more controls (19.2% (n=5)) than dancers (3.8% (n=1)) reported to be currently trying to gain weight ($\chi^2=5.55$, $p=0.136$). Most dancers wanted to change their current body weight for appearance (38.5% (n=10)) and sports performance (19.2% (n=5)) reasons. Similarly, most controls wanted to change their current body weight for appearance (38.5% (n=10)) reasons, but also for health (11.5% (n=3)) reasons.

Participants with an EDI3-DT score ≥ 7 (n=26), which has been reported as a proxy indicator of energy deficiency in exercising women,⁴² had a significantly higher BMI (21.5 [20.8; 23.1] vs. 20.0 [19.4; 21.4], $p=0.002$), EDI3-BD score (16.0 [12.0; 25.0] vs. 6.0 [2.0; 11.0], $p=0.0002$) and TFEQ-CDR score (9.0 [5.0; 15.0] vs. 3.0 [2.0; 4.0], $p=0.00001$). However, no significant differences were found for $_{est}EA$ ($p=0.808$), EB ($p=0.151$), PWCM (bingeing ($p=0.734$), vomiting ($p=0.149$), laxatives ($p=0.074$), excessive exercise ($p=0.158$) and weight loss ($p=0.685$)) or menstrual pattern changes ($p=0.760$).

In Table 5 the differences in disordered eating and food insecurity of Caucasian and African students are shown. Although not significantly different, it was interesting to note that 33.3% (n=6) of African students wanted to gain weight while no Caucasian students wanted to gain weight, and more African students reported food insecurity during the 12 months preceding the study.

Table 5: Disordered eating scores, use of pathogenic weight control measures and food insecurity of African compared to Caucasian students

	African students (n=18)	Caucasian students (n=34)	P-value
Eating disorder inventory-3	(n=18)	(n=34)	
<i>Drive for thinness score</i>	3.0 (0.0; 8.0)	9.5 (4.0; 17.0)	0.010
<i>Body dissatisfaction score</i>	6.5 (3.0; 11.0)	14.0 (6.0; 20.0)	0.065
<i>Bulimia score</i>	4.5 (1.0; 7.0)	3.5 (1.0; 6.0)	0.870
<i>Drive for thinness ≥15 (%)</i>	16.7	29.4	0.313
<i>Body dissatisfaction ≥14 (%)</i>	22.2	58.8	0.012 [#]
<i>Bulimia ≥5 (%)</i>	50.0	41.2	0.542
Three-factor eating questionnaire	(n=18)	(n=33)	
<i>Cognitive dietary restraint score</i>	3.0 (2.0; 5.0)	7.0 (3.0; 11.0)	0.071
<i>Cognitive dietary restraint ≥9 (%)</i>	16.7	39.4	0.095
Pathogenic weight control measures	Percentage (n=18)	Percentage (n=34)	
<i>Bingeing</i>	22.2	20.6	0.891
<i>Vomiting</i>	0.0	5.9	0.294
<i>Laxative use</i>	5.6	5.9	0.962
<i>Weight loss</i>	22.2	8.8	0.178
<i>Excessive exercise</i>	5.6	11.8	0.470
Food insecurity during past 12 months	(n=18)	(n=34)	
<i>Yes</i>	27.8*	11.8*	
<i>No</i>	72.2*	79.4*	
<i>No response</i>	0.0*	8.8*	
Data presented as medians (25th; 75th percentiles); Mann-Whitney U test / χ^2 test ; [#] $\chi^2=6.34$; * $\chi^2=3.41$, p=0.182			

In Table 6, correlations between body composition, body image, disordered eating and energy status for the CG and DG are presented. It is clear that more and stronger associations were found for disordered eating and body image variables in the DG.

Table 6: Spearman rank correlations between body composition, body image, disordered eating and energy status for controls and dancers

	EDI3-DT	EDI3-BD	EDI3-B	TFEQ-CDR	FID	Mean TDEE	Mean energy intake	EB	estEA
Controls									
<i>Fat mass</i>	0.6	NS	NS	NS	0.5	NS	NS	NS	NS
<i>Fat-free mass</i>	NS	NS	NS	NS	0.4	NS	NS	NS	-0.4
<i>Fat percentage</i>	0.4	0.5	NS	NS	NS	NS	NS	NS	NS
<i>Actual body weight</i>	NS	NS	NS	NS	0.5	NS	NS	-0.4	-0.5
<i>BMI</i>	0.5	NS	NS	NS	0.6	NS	NS	NS	NS
<i>EDI3-DT</i>		NS	NS	0.5	NS	NS	-0.4	NS	NS
<i>Mean TDEE</i>	NS	NS	NS	NS	NS		NS	-0.8	-0.4
<i>Mean energy intake</i>	NS	NS	NS	NS	NS	NS		0.5	0.7
Dancers									
<i>Fat mass</i>	0.5	NS	NS	0.5	0.6	NS	NS	NS	NS
<i>Fat-free mass</i>	0.6	NS	NS	NS	0.5	NS	NS	NS	NS
<i>Fat percentage</i>	NS	NS	NS	NS	0.4	NS	NS	NS	NS
<i>Actual body weight</i>	0.7	0.5	NS	0.6	0.7	NS	NS	NS	NS
<i>BMI</i>	0.7	0.6	0.6	0.5	0.8	NS	NS	NS	NS
<i>EDI3-DT</i>		0.8	0.6	0.7	0.8	NS	NS	NS	NS
<i>EDI3-BD</i>	NS		0.4	0.5	0.7	NS	NS	-0.4	NS
<i>EDI3-B</i>	NS	NS		NS	0.4	NS	NS	NS	NS
<i>TFEQ-CDR</i>	NS	NS	NS		0.6	NS	NS	NS	NS
<i>FID</i>	NS	NS	NS	NS		NS	NS	-0.5	NS
<i>Mean TDEE</i>	NS	NS	NS	NS	NS		NS	-0.6	NS
<i>Mean energy intake</i>	NS	NS	NS	NS	NS	NS		0.5	0.9
<p>Data presented as <i>r</i>-values; $p < 0.05$; NS = not significant; EDI3= Eating disorder inventory-3; DT= Drive for thinness; BD= Body dissatisfaction; B= Bulimia; TFEQ= Three-factor eating questionnaire; CDR= Cognitive dietary restraint; FID= Feel minus ideal discrepancy; TDEE= Total daily energy expenditure; EB= Energy balance; estEA= Estimated energy availability; BMI= Body mass index</p>									

DISCUSSION

The main findings in the study were that dancers had significantly higher EDI3-DT, EDI3-BD and TFEQ-CDR raw subscale scores than controls, and the majority of the dancers had a high drive for thinness and/or body dissatisfaction and/or cognitive dietary restraint and/or had purging behavior. The majority (57.7% (n=30)) of participants wanted a smaller body image than their current perceived body image and 51.9% (n=27) reported to be currently trying to lose weight. A low energy status was found amongst 60.0% (15/25) of controls and 72.0% (18/25) of dancers. African students had a lower drive for thinness than Caucasian students, in fact 33.3% (n=6) of African students wanted to gain weight.

Disordered eating and body image

Despite the fact that dancers had a higher prevalence of disordered eating behavior in the current study, 84.6% (n=22) of controls were also identified with disordered eating behavior. The findings are concentered by other researchers who have disclosed that college-aged females in general may well be more vulnerable to disordered eating because of developmental concerns,^{48,49} given that the adaptation to an unfamiliar tertiary environment may be a susceptible time for new enrollees.⁵⁰ Furthermore, the period of adjustment may well result in the development or prolongation of disordered habits because peer-influences substitute parental-influences with regard to eating behaviors.⁵⁰ What was alarming amongst controls was the high prevalence of bingeing behavior and 34.6% (n=9) scored high on the bulimia subscale suggestive of purging behavior.

Numerous studies have suggested that female athletes are at an elevated risk for pathogenic eating disturbances when compared to females in the general population.^{48,51-56} Furthermore, studies have shown that female athletes participating in lean sport are at an increased risk for disordered eating symptoms than those competing in non-lean sport,^{44,57,58} with dancers being particularly more vulnerable to disordered eating attitudes and behaviors.^{59,60} The results support these findings as more than half of the dancers scored high on the EDI3-BD, EDI-B and TFEQ-CDR subscales and almost half scored high on the EDI3-DT subscale. Anshel⁵⁹ found within a group of ballet students that the mean scores for the EDI2-DT, EDI2-B and EDI2-BD subscales were 9.3 ± 3.8 , 2.6 ± 1.5 and 16.6 ± 2.6 respectively, which is comparable to what we found. Others^{60,61} also found similar results with the exception of a higher bulimia score reported by Thomas and colleagues.⁶⁰ Possible

discrepancies in results may be due to the fact that different tools were used to measure disordered eating, Thomas and colleagues⁶⁰ used a 26-item version of the EDI and Anshel⁵⁹ used the EDI2; our dancers participated in a variety of dance styles - not just ballet; sample size was different; our dancers were older; and level at which dancers danced was not consistent between studies.

The discrepancy between actual body weight and ideal/competitive body weight as well as between actual and ideal body image was significantly greater for dancers in the current study. This is indicative of the extent of body image dissatisfaction and also supports findings of a higher level of body dissatisfaction, as measured with the EDI3, in our dance group. Furthermore, the Body Silhouette Assessment Scale revealed that IBS scores were significantly lower for dancers when compared to controls, indicating that dancers desired a smaller body silhouette than controls. This desire for a smaller body silhouette can be linked to the actuality that dance is a sport that requires leanness as an aesthetic prerequisite.⁶² Furthermore, the FID values of dancers indicated body image dissatisfaction as the median value veered from neutral, with dancers being inclined to want to lose weight. These results are supported by the positive associations between FID and body composition as well as disordered eating measures in the dance group. Additionally, it seems that dancers had such a high body dissatisfaction that it translated into a high drive for thinness, cognitive dietary restraint and bulimic behavior thus the body dissatisfaction was severe enough to change behavior and increase the risk for disordered eating.⁶³⁻⁶⁵ Interestingly though, no association was found between mean energy intake and disordered eating variables which may be attributed to their binge eating behavior. This body dissatisfaction experienced by our dancers is substantiated by findings of other researchers who have concluded that dancers are overly concerned about dieting and their body mass, and tend to be discontented with their bodies.^{59,66,67} On the other hand, the FID values of controls indicated that they did not experience body image dissatisfaction as the median value was zero. Furthermore, fewer and/or weaker associations were found between FID, body composition and disordered eating in the control group. From the associations it seems that body fat played a more important role than body size *per se* in terms of body dissatisfaction and drive for thinness amongst controls. Additionally, controls with a high drive for thinness also had a high cognitive dietary restraint and in contrast to the dancers, reduce their daily energy intake in a quest to achieve weight loss.

Due to body dissatisfaction and weight concerns, the exploitation of pathogenic weight control measures such as self-induced vomiting, excessive physical activity, laxatives, diuretics, diet pills and food restraints has shown to evolve into customary practices amongst female college students.⁶⁸ The additional pressure of competing in a sport in which the body image and leanness play an important role to be visually pleasing may explain the large percentage of participants in the current study that used these measures to control their weight. In our study 65.4% (n=17) dancers and 38.5% (n=10) controls reported to be trying to lose weight. Controls reported to make use of less PWCM, with bingeing being the most popular method used by both groups. Similarly popular amongst dancers was the use of excessive exercise for weight loss. No controls used laxatives and self-induced vomiting, and their use was low amongst dancers which supports the findings of others amongst ballet dancers.^{59,60} However, in contrast to Thomas and colleagues,⁶⁰ only a small percentage of dancers from our study reported bingeing (19.2% (n=5) vs. 54.9% (n=59)). Again, differences in results may be due to the use of different measuring tools and other factors described above.

A relationship between cognitive dietary restraint and overt menstrual disturbances, with the prevalence of menstrual disturbances becoming greater across cognitive dietary restraint quartiles has previously been shown.⁴⁵ In the current study we did not find any differences in cognitive dietary restraint or disordered eating behavior between participants with and without menstrual pattern changes. It might be that our sample size was too small to detect significant differences, but due to the cross-sectional nature of the study design, we could not further explore this possible causal relationship.

Similar levels of body dissatisfaction, cognitive dietary restraint and bulimic behavior was found between Caucasian and African students, but a significantly lower level of drive for thinness and smaller discrepancy between current and ideal body image was found amongst African students. In the shifting socio-historical environment of Post-Apartheid South Africa, it has been observed in several surveys among multi-racial groups of young adults,^{19,69-71} that Non-Caucasian South Africans may in actual fact also be vulnerable to eating disorder pathology. The significantly lower drive for thinness in the Africans may be attributable to the fact that several of the African participants wanted to gain weight, possibly striving for the 'fat ideal' which is perceived by some

African women as a sign of dignity, respect, health, wealth and strength.²¹ Food insecurity, although not significant, was higher in African students than Caucasian students and could have possibly formed an integral part of the high scores on some questions of the eating disorders inventory subscales as well as the three factor eating questionnaire's cognitive dietary restraint subscale of African students. Le Grange²⁰ revealed that eating disordered behaviors may be owing to cultural and contextual circumstances as opposed to anxieties about slenderness. Alternatively, the materialization of disordered eating behaviors within black South Africans can be a result of the current socio-political transformation in South Africa that defies traditional gender roles, leaving African women ill-equipped for their new roles and making them more susceptible to disordered eating.⁷² However, we did not follow African students with high scores up with an interview to establish whether these factors did indeed play a role and this should be done in future studies.

Energy status

It is recognized that a low EA or an energy deficit either in combination with or in the absence of clinical eating disorders or disordered eating, does present a detrimental health risk to physically active girls and women.¹⁴ In the current study, the average EA was below what is considered a healthy value but within the ranges recommended for weight loss.³⁵ Furthermore, to our surprise both controls and dancers had a negative EB. This poor energy status might have been due to the fact that 51.9% (n=27) of the total group of students reported to be currently trying to lose weight. Considering dance falls into the same lean sport category as distance running, cycling, swimming, gymnastics and diving,^{5,57,73} the EA findings amongst these athletes may also be comparable to that of dancers. Loucks and co-workers³⁴ reported the mean EA of adult female eumenorrheic or amenorrheic long distance runners from 37 studies (after retrospectively calculating their energy availability based on assumed exercise energy expenditure) to be below 45 kcal/kg FFM/day, similar to what we found. Within the current study, only a small group of controls and dancers were identified with a deficient energy status, which might have been attributed to underreporting of energy intake. However, all of these students also scored high on one or more of the EDI3 and/or TFEQ-CDR subscales increasing the likelihood of disordered eating playing a role in their deficient energy status. In fact, amongst dancers a negative EB was associated with body dissatisfaction. Furthermore, in both the control and dance group, EB was associated with a higher total daily energy expenditure and a lower energy intake. Similarly a low EA was associated with a higher total daily energy expenditure and a lower energy intake for the controls, but in the dancers it was only

associated with a lower energy intake. Low EA (<30 kcal/kg fat-free mass/day) has been recognized as the primary factor that negatively affects both the reproductive system (ultimately resulting in functional hypothalamic amenorrhea) and skeletal health (ultimately resulting in osteoporosis) in female athletes, collectively termed the female athlete triad (Triad).¹⁴ It is necessary for female students to be informed and educated on the negative health consequences of a poor energy status and where necessary provide dietary reform, especially since training and/or performance modifications may seem ‘impractical’ to those dancers striving for excellence. However, if deemed necessary, dancers with a deficient energy status and health-related consequences should reduce training load or even refrain from training until energy and health status has recovered.¹⁴

In the current study no association was found between a high drive for thinness (EDI-DT ≥ 7) and energy balance or EA and was, therefore, not a proxy indicator of energy deficiency as suggested by De Souza and colleagues.⁴² This might be due to the fact that we used different methods to identify an energy deficiency, namely energy balance and EA, compared to their method of assessing the ratio between measured resting energy expenditure to predicted energy expenditure (REE:pREE<0.9). The lack of association may also be attributed to the fact that we had athletes and low active controls in our group – they only studied exercising women. Lastly, it might be that a type 2 error occurred when we calculated energy balance and energy availability as we made use of indirect measurements.

Limitations

It is acknowledged that the results of this study may be biased as a convenience sample of volunteers was used, thus some students with disordered eating may have elected not to participate. A further inherent limitation to a study of this nature is the reliance on self-reported menstrual function, however daily urine analysis to assess menstrual function accurately was not possible in this study due to financial constraints and logistic reasons. Eating disorder pathology could not be assessed in the current study as we did not follow those participants that scored high on the EDI3 and TFEQ subscales up with an interview. There may, therefore, be some athletes that scored high on these subscales due to reasons not related to disordered eating pathology.²⁰ Additionally, since we only made use of questionnaires, ‘false negative’ responses may have occurred by athletes trying to manipulate their answers due to the secretive temperament of eating disorders.⁷⁴ However, we did

make use of the method suggested by De Souza and co-workers⁴² to identify possible ‘false negative’ responses and did not find any. Lastly, the sample size per group was relatively small and may have resulted in low statistical power, however, due to the specific study population and relatively high subject burden it was not possible to recruit more participants at the time of the study.

In conclusion, despite limitations of this study important observations were made regarding disordered eating behavior, body image, and energy status of a group of South African student women dancers. This group of South African university women dancers is at risk for disordered eating behavior, have a tendency to be greatly discontented with their body image, and have a sub-optimal energy status. Equally troublesome was the high prevalence of binge eating and purging behavior amongst the control group. We have endeavored to clarify an area of research that has presented as almost clandestine till the present time, and undoubtedly reveals that much research still needs to be performed to elucidate the disordered eating behaviour, body image and PWCM use of South African dancers.

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Chapter 5:
Concluding remarks

CHAPTER 5: Concluding remarks

The purpose of this dissertation was to investigate the DE behaviour, PWCM use, body image and energy status of a group of University female dancers compared to a control group. For each objective as set in Chapter 1 a brief discussion and conclusion will follow.

Objective 1: It was found that DE behaviour was common in both dancers and controls, but the prevalence was higher in dancers. This is possibly due to the reality that college-aged females in general are more vulnerable to disordered eating (Kirk *et al.*, 2001; Hoerr *et al.*, 2002; Tylka & Hill, 2004), irrespective of organized sport participation, with dancers being more prone probably due to the aesthetic demands of the sport.

Objective 2: The discrepancy between actual body weight and ideal/competitive body weight, as well as between actual and ideal body image was significantly greater for dancers in the current study, which is indicative of the great extent of body image dissatisfaction. This body dissatisfaction experienced by our dancers is substantiated by research that concludes that dancers are too concerned about dieting and their body mass, and tend to be discontented with their bodies (Druss & Silverman, 1979; Le Grange *et al.*, 1994; Anshel, 2004). It was found that a total of 65.4% dancers and 38.5% of controls reported to be trying to lose weight, possibly owing to the actuality that they were dissatisfied with their current figures. Due to body dissatisfaction and weight concerns, the exploitation of PWCM has shown to evolve into customary practices amongst female college students (Dykens & Gerrard, 1986). The greater extent of body dissatisfaction within our dancers is explanatory of the higher use of PWCM than controls. The significantly higher use of excessive exercise in our dancers when compared to controls is likely to be attributed to the fact that exercise forms a customary part of dancers' lives and, therefore, they found it easier to initiate and continue the practice where controls were more unaccustomed to exercise and, therefore, did not exploit excessive exercise or found it difficult to make it a habitual endeavour. This is, however, purely speculative as we did not ask these questions specifically. Available evidence does suggest that female athletes are at an elevated risk for pathogenic eating disturbances when compared to females in the general population (Macleod, 1998; Thompson & Sherman, 1999; Berry & Howe, 2000; Kirk *et al.*, 2001; Crissey & Honea, 2006, Kerr *et al.*, 2006; Muscat & Long, 2008).

Objective 3: In the current study the energy availability of 72.0% of dancers and 60.0% of controls was below what is considered a healthy value but above the cut-off which is considered as having a deficient energy status (Manore et al., 2007). Thus most participants had a sub-optimal energy status which is typically recommended when wanting to lose weight. In fact, both controls and dancers had a negative energy balance with this poor energy status possibly being ascribed to the fact that 52.0% of the total group of students reported to be currently trying to lose weight. Every organ system in the body may potentially be negatively affected as a result of the ensuing undernourishment and/or weight loss that is related to poor nutritional behaviour (Rome *et al.*, 2003). Undernutrition and extreme weight loss have several negative health consequences concerning the cardiovascular, reproductive, skeletal, renal, gastrointestinal, endocrine and central nervous systems (Becker *et al.*, 1999; APAWGED, 2000; Golden *et al.*, 2003; Rome *et al.*, 2003). Therefore, our dancers and controls are vulnerable to the negative health consequences associated with a poor energy status.

Objective 4: No association was found between a high drive for thinness (EDI-DT ≥ 7) and energy balance or energy availability and drive for thinness was, therefore, not a proxy indicator of energy deficiency in the current study as suggested De Souza and colleagues (2007). This is possibly owing to differences in methodology and type of subjects.

In conclusion, irrespective of the limitations of this study, noteworthy observations were made pertaining to the disordered eating behaviour, body image, and energy status of a group of South African student women dancers. This group of South African university women dancers is vulnerable to disordered eating behaviour, has a propensity to be greatly displeased with their body image, and possesses a low energy status. Similarly perturbing, is the elevated prevalence of bingeing and purging amongst the control group. We have endeavoured to elucidate an area of research that has presented as almost clandestine up to date, and unquestionably reveals that much research still needs to be performed to clarify the disordered eating behaviour, body image and PWCM use of South African dancers.

5.1) Recommendations for future research

To further explore DE behaviour and ED pathology amongst South African female dancers, it is recommended that a larger sample size be included. This will be possible if subject burden is lower, thus, only concentrating on questionnaires to screen for those at an increased risk for DE behaviour, and not recording energy intake and energy expenditure. Furthermore, those at risk for DE behaviour should be followed-up with a clinical interview to diagnose possible ED's, and also to clarify whether questionnaires such as the EDI and TFEQ are appropriate to identify black dancers with a high risk for DE behaviour.

5.2) Reference list

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Addendums

Addendum 1:

Online demographic, health and sport questionnaire

The Triad Project

Online Demographic, Health and Sport Questionnaire

Dear participant

Please note: We kindly ask that you complete this form as thoroughly as possible. You are welcome to take your time to complete the form. Your **honest input** in this questionnaire is of utmost importance so we can give you the best and appropriate feedback.

Please be assured that all details provided in this questionnaire will remain **completely confidential** and will not be linked to you as an individual at any stage of the research project.

We will provide feedback to you in person after analysis of the data and **we will not share** any results with **the coach or trainer** unless you give specific consent for this.

Demographic Information

Participant Number: _____ Date: _____

Study year or number of years at Sporting Academy (check one):
 1st 2nd 3rd 4th Honours Masters

Race (check one):
 Black White

Where do you live?
 Flat House
 Town house Student house
 Hostel Informal housing
 Other, please specify _____

How many people live with you?
 I live alone
 Give number of people _____

How is your studies funded? (Tick all the relevant boxes)
 Parents/family Academic (or other) scholarship
 State/government grant Financial loan
 University bursary Your own money by working part-time
 Other, please specify _____

Who pays for your daily living costs, including food? (Tick all the relevant boxes)
 Parent/family Bursary
 Scholarship Grant
 Yourself Other, please specify _____

Primary source of nutrition information/education (check only one):
 Magazines Textbooks Friends Dietitian
 Doctor Health food store Parents Athletic trainer
 Television Radio Coach Sports Nutrition seminar
 Other medical professionals University course

Athletes ONLY: At what level are you currently competing in your sport? (Mark all relevant)
 University
 Provincial
 National
 Other, please specify _____

Socio-economic information

What level of financial stress have you experienced the last 12 months? (check 1 box):
 No response Little/none Moderate High/severe

Have you ever experienced any of the following events during the last 12 months? (check where applicable):

	No response	Yes	No
Household break in	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Major intra-family conflict	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Major personal injury/illness	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Separation from family	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Food unavailability / uncertainty of next meal	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Lifestyle information

Do you currently smoke or use tobacco?

Yes No

Have you smoked in the past?

Yes No

If **yes**, please give more information:

a) For how long have you been smoking/using tobacco? _____

b) How many cigarettes do/did you smoke per day? _____

c) How many times a day do/did you use tobacco (excluding cigarettes)? _____

Do you use alcohol?

Yes No Sometimes

If **yes / sometimes**, please give more information regarding alcohol use:

How often do you use alcohol?

Daily Weekly Monthly Yearly post event/game

What do you usually drink?

Wine Beer Spirits

Athletes ONLY:

Do you use alcohol during season?

Yes No

How often do you use alcohol?

Daily Weekly Monthly Yearly post event/game

What do you usually drink?

Wine Beer Spirits

PHYSICAL ACTIVITY QUESTIONNAIRE (ALL subjects complete)

Activity at work/ campus

1. Does your work involve vigorous-intensity activity that causes large increases in breathing or heart rate like (carrying heavy loads, digging or construction work) for at least 10 minutes continuously?

YES NO (*if no go to Q4*)

<p>2. In a typical week on how many days do you do vigorous intensity activities as part of your work/ on campus?</p> <p>Number of days _____</p>
<p>3. How much time do you spend doing vigorous-intensity activities at work/ on campus on a typical day?</p> <p>Hours: Minutes _____ (eg. 3 hrs 20 min)</p>
<p>4. Does your work involve moderate-intensity activity that causes small increases in breathing or heart rate such as brisk walking (or carrying light loads) for at least 10 minutes continuously?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (<i>if no go to Q7</i>)</p>
<p>5. In a typical week, on how many days do you do moderate intensity activities as part of your work/studies?</p> <p>Number of days _____</p>
<p>6. How much time do you spend doing moderate-intensity activities at work on a typical day?</p> <p>Hours: Minutes _____ (eg. 3 hrs 20 min)</p>
<p>Travel to and from places</p> <p>7. Do you walk or use a bicycle for at least 10 minutes continuously to get to and from places?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (<i>if no go to Q10</i>)</p>
<p>8. In a typical week, on how many days do you walk or bicycle for at least 10 minutes continuously to get to and from places?</p> <p>Number of days _____</p>
<p>9. How much time do you spend walking or bicycling for travel on a typical day?</p> <p>Hours:Minutes _____ (eg. 3 hrs 20 min)</p>
<p>Recreational Activities (Including exercise/training for sport)</p> <p>10. Do you do any vigorous-intensity sports, fitness or recreational activities that cause large increases in breathing or heart rate like (running or football) for at least 10 minutes continuously?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (<i>if no go to Q13</i>)</p>
<p>11. In a typical week, on how many days do you do vigorous intensity sports, fitness or recreational (leisure) activities?</p> <p>Number of days _____</p>
<p>12. How much time do you spend doing vigorous-intensity sports, fitness or recreational activities on a typical day?</p> <p>Hours: Minutes _____ (eg. 3hrs 20min)</p>

<p>13. Do you do any moderate-intensity sports, fitness or recreational activities that cause a small increase in breathing or heart rate such as brisk walking (cycling, swimming, volleyball) for at least 10 min continuously?</p> <p><input type="checkbox"/> YES <input type="checkbox"/> NO (<i>if no go to Q16</i>)</p>
<p>14. In a typical week, on how many days do you do moderate-intensity sports, fitness or recreational (leisure) activities?</p> <p>Number of days _____</p>
<p>15. How much time do you spend doing moderate-intensity sports, fitness or recreational (leisure) activities on a typical day?</p> <p>Hours: Minutes _____ (eg. 3hrs 20min)</p>
<p>Sedentary behaviour</p> <p>16. How much time do you usually spend sitting or reclining on a typical day?</p> <p>Hours: Minutes _____ (eg. 3hrs 20min)</p>

Non-Athletes go to page 5

ATHLETES ONLY:		
CURRENT Sports Participation		
<p>If you participate in a competitive sport please identify what season you are currently in (choose one).</p> <p><input type="checkbox"/> Pre-season <input type="checkbox"/> In season <input type="checkbox"/> Playoffs/Championships/Production <input type="checkbox"/> Off-season</p>		
<p>What was the highest sporting level you have ever reached?</p> <p><input type="checkbox"/> Regional/ University <input type="checkbox"/> National/ Company <input type="checkbox"/> International <input type="checkbox"/> not applicable</p>		
<p>Please list the sport/s you are currently are involved in: (A) at your University and (B) outside of the University (<i>activities you do on your own, not part of your organized training</i>). For each sport you list, please check the hours per week you spend training and/or competing in your sport and the total number of years you have participated (including pre-university if applicable)</p>		
Section A: University Sports		
Sport	Hours per week	Nr. of years
1.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
2.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
3.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
Section B: Outside University Sports and/or Activities (in addition to organized training at university)		

Sport	Hours per week	Nr. of years
1.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
2.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
3.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	
4.	<input type="checkbox"/> 1-2 <input type="checkbox"/> 3-5 <input type="checkbox"/> 6-8 <input type="checkbox"/> ≥ 9	

Current Sport / Activity			
Please list each sport or activity in which you are currently participating on a very regular basis. For each activity, please indicate the average length of each training or practice session, the number of sessions per week, and the average intensity of your training.			
Sport	Length of training/practice session	Sessions per week	Intensity of sessions
1.	<input type="checkbox"/> < 30 minutes <input type="checkbox"/> 30 – 60 minutes <input type="checkbox"/> 60 – 90 minutes <input type="checkbox"/> 90 – 120 minutes <input type="checkbox"/> 120 – 180 minutes <input type="checkbox"/> ≥ 180 minutes	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> Very easy <input type="checkbox"/> Easy <input type="checkbox"/> Moderate <input type="checkbox"/> Hard <input type="checkbox"/> Very hard
2.	<input type="checkbox"/> < 30 minutes <input type="checkbox"/> 30 – 60 minutes <input type="checkbox"/> 60 – 90 minutes <input type="checkbox"/> 90 – 120 minutes <input type="checkbox"/> 120 – 180 minutes <input type="checkbox"/> ≥ 180 minutes	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> Very easy <input type="checkbox"/> Easy <input type="checkbox"/> Moderate <input type="checkbox"/> Hard <input type="checkbox"/> Very hard
3.	<input type="checkbox"/> < 30 minutes <input type="checkbox"/> 30 – 60 minutes <input type="checkbox"/> 60 – 90 minutes <input type="checkbox"/> 90 – 120 minutes <input type="checkbox"/> 120 – 180 minutes <input type="checkbox"/> ≥ 180 minutes	<input type="checkbox"/> 1 <input type="checkbox"/> 6 <input type="checkbox"/> 2 <input type="checkbox"/> 7 <input type="checkbox"/> 3 <input type="checkbox"/> 8 <input type="checkbox"/> 4 <input type="checkbox"/> 9 <input type="checkbox"/> 5 <input type="checkbox"/> 10	<input type="checkbox"/> Very easy <input type="checkbox"/> Easy <input type="checkbox"/> Moderate <input type="checkbox"/> Hard <input type="checkbox"/> Very hard

EVERYONE MUST COMPLETE

Past Sport and Physical Activity Participation

1. Did you participate in sport before university? <input type="checkbox"/> Yes <input type="checkbox"/> No 2. If you are currently a student athlete, for which club or Province did you compete before coming to the university? _____					
If YES , please list the sports or activities you played in the past: (A) In high school (e.g. organized sport) and (B) Outside of high school in your free time (e.g., club, team). For each sport you list, please check the hours per week you spend training and/or competing in your sport and the number of years you have participated.					
Section A: High School Sports					
Sport	Hrs/wk	Wks/mnth	Mnth/yr	Number of yrs	Yrs (ie. 1999-2000)
1.					

2.					
3.					
4.					
Section B: Outside School Sports (teams, clubs) and/or Activities (in addition to organized sport at school)					
Sport					
1.					
2.					
3.					
4.					

Body Weight Information		
How long have you been at your current weight? _____	What was your <i>lowest</i> weight since you left high school? _____ kg <input type="checkbox"/> Uncertain	What was your <i>highest</i> weight since you left high school? _____ kg <input type="checkbox"/> Uncertain
What is your current weight? _____ <input type="checkbox"/> Uncertain	What year was your lowest weight? _____ <input type="checkbox"/> Uncertain__	What year was your highest weight? _____ <input type="checkbox"/> Uncertain
What is your desired weight? _____		
Did you experience changes in your weight (>2.5 kg) within the last year? <input type="checkbox"/> YES <input type="checkbox"/> NO		
If you checked YES , specify the changes <input type="checkbox"/> weight gain <input type="checkbox"/> weight loss <input type="checkbox"/> weight gain and weight loss		
<u>Gained</u> : <input type="checkbox"/> 0-2 kg. <input type="checkbox"/> 2.1-3 kg. <input type="checkbox"/> 3.1-4 kg. <input type="checkbox"/> 4.1-4 kg. <input type="checkbox"/> 5.1-6 kg. <input type="checkbox"/> ≥ 6 kg		
<u>Lost</u> : <input type="checkbox"/> 0-2 kg. <input type="checkbox"/> 2.1-3 kg. <input type="checkbox"/> 3.1-4 kg. <input type="checkbox"/> 4.1-4 kg. <input type="checkbox"/> 5.1-6 kg. <input type="checkbox"/> ≥ 6 kg		
Are you satisfied with your current weight? <input type="checkbox"/> YES <input type="checkbox"/> NO		
In the past , I used to think of myself as... (check one) <input type="checkbox"/> very underweight (more than 5 kg) <input type="checkbox"/> slightly underweight (2.5-5 kg) <input type="checkbox"/> at an "ideal" weight <input type="checkbox"/> slightly overweight (less than 5 kg) <input type="checkbox"/> moderately overweight (5-10 kg) <input type="checkbox"/> very overweight (more than 10 kg)		
Presently, I think of myself as... (check one) <input type="checkbox"/> very underweight (more than 5 kg) <input type="checkbox"/> slightly underweight (2.5-5 kg) <input type="checkbox"/> at an "ideal" weight <input type="checkbox"/> slightly overweight (less than 5 kg) <input type="checkbox"/> moderately overweight (5-10 kg) <input type="checkbox"/> very overweight (more than 10 kg)		
Which of the following are you currently trying to do about your weight? (check one) <input type="checkbox"/> lose weight <input type="checkbox"/> gain weight <input type="checkbox"/> maintain weight <input type="checkbox"/> I am doing nothing		
If you are trying to change your weight, what is the primary reason? (check one) <input type="checkbox"/> Sports performance <input type="checkbox"/> Appearance <input type="checkbox"/> Health <input type="checkbox"/> None <input type="checkbox"/> Other (explain):		
Do you feel pressure to achieve/maintain a lean body shape? <input type="checkbox"/> YES <input type="checkbox"/> NO		

If you checked YES, from whom do you feel pressure? (check all that apply)

- Yourself Coach Friends Parents Media Training partners None
 other (explain):

On a scale from 1 to 10, please rate the intensity of pressure you feel to achieve/maintain a lean body shape? (1 = least pressure, 10 = most pressure)

- 1 2 3 4 5 6 7 8 9 10

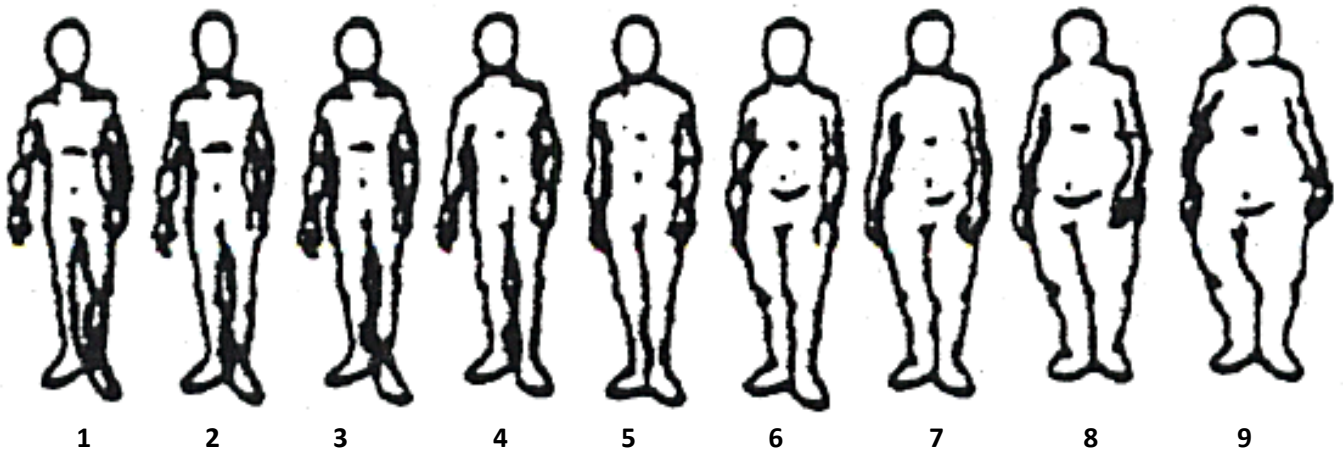
ATHLETES ONLY:

What do you consider to be your "ideal or competitive" weight? _____ kg.

Do you gain or lose weight regularly to meet the demands or weight requirements for your sport?

- YES NO

If you checked YES, how many times per year do you make weight (lose weight to compete) for your sport? _____ times/year



In the picture above, how do you think your body outline looks like (1-9)? _____

In the picture above, what outline drawing would you prefer to look like (1-9)? _____

Body weight control

Please indicate whether you have ever used any of these methods to control your body weight (check all that apply). Also specify **how many times** (per week and/or month) and the **length of time** (months and/or years) you used each method.

Method	Number of times per week	Nr of times per month	Nr. of months per yr	Nr. of yrs
<input type="checkbox"/> fasting				
<input type="checkbox"/> skipping meals				
<input type="checkbox"/> commercial weight loss programs				
<input type="checkbox"/> liquid supplements (i.e. slim fast)				
<input type="checkbox"/> very low calorie diet (<1200 Kcal or <5 000 kJ/d)				
<input type="checkbox"/> self-induced vomiting				
<input type="checkbox"/> laxatives or diuretics				
<input type="checkbox"/> diet pills or “fat-burning” supplements				
<input type="checkbox"/> additional exercise beyond training for sport				
<input type="checkbox"/> low-fat diet/high carbohydrate diet				
<input type="checkbox"/> high protein/low carbohydrate diet e.g. Atkins diet				
<input type="checkbox"/> vegetarian diet				
<input type="checkbox"/> nutritional counselling (e.g. with a dietician)				

Menstrual History

Have you ever had a menstrual period?	<input type="checkbox"/> YES <input type="checkbox"/> NO
How old were you when you had your first menstrual period?	_____ years
Since you’ve started to menstruate, on average how many times per year do you get your menstrual period?	<input type="checkbox"/> 10-13 times per year <input type="checkbox"/> 6-9 times per year <input type="checkbox"/> 4-6 times per year <input type="checkbox"/> 1-3 times per year
Have you ever gone for more than 3 months without having a menstrual period?	<input type="checkbox"/> YES <input type="checkbox"/> NO

If you checked YES for the previous question...	
Was this due to pregnancy? <input type="checkbox"/> YES <input type="checkbox"/> NO	
If YES, answer the following questions:	
a. How many pregnancies have you had up to date? Number: _____	
b. Were there any complications with your pregnancy/ies? <input type="checkbox"/> YES <input type="checkbox"/> NO	
c. If, yes describe here:	
d. Do you have a history of severe postpartum bleeding? <input type="checkbox"/> YES <input type="checkbox"/> NO	
If you have gone for more than 3 months without having a menstrual period but it was not due to pregnancy, please answer the following questions:	
a. How old were you when you first missed ≥ 3 menstrual periods?	_____ years
b. How many months or years did you go without a menstrual period?	_____ months OR _____ years
c. Did you see a doctor during this time period?	<input type="checkbox"/> YES <input type="checkbox"/> NO
d. Did your doctor prescribe some form of contraception to regulate your menstrual periods?	<input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> N/A
e. Were the time before you started to skip your periods a very stressful time or did a stressful event take place?	<input type="checkbox"/> YES <input type="checkbox"/> NO
f. Do you take any of the following medications?	
a. Antipsychotics	<input type="checkbox"/> YES <input type="checkbox"/> NO
b. Tricyclic antidepressants	<input type="checkbox"/> YES <input type="checkbox"/> NO
c. Calcium channel blockers	<input type="checkbox"/> YES <input type="checkbox"/> NO
d. Methyldopa	<input type="checkbox"/> YES <input type="checkbox"/> NO
e. Reserpine	<input type="checkbox"/> YES <input type="checkbox"/> NO
f. Digitalis	<input type="checkbox"/> YES <input type="checkbox"/> NO
g. Chemotherapeutic drugs	<input type="checkbox"/> YES <input type="checkbox"/> NO
How many menstrual periods have you had	
a. In the past 12 months? _____	
b. In the past 6 months? _____	
ATHLETES ONLY! If you participate in sports or activities competitively, did you have your first menstrual period before or after you began training for your sport or activity?	<input type="checkbox"/> Before <input type="checkbox"/> After <input type="checkbox"/> Not applicable

Current Menstrual Status	
Currently, how would you describe your menstrual cycle? In order to determine the number of days your cycle lasts, begin with the first day of bleeding and count the number of days until the next month when you began bleeding again (A normal cycle length is $\pm 26 - 35$ days)	
<input type="checkbox"/> I am very regular (every 26-35 days)	
<input type="checkbox"/> I am somewhat regular (every 21-25 days)	

- I am very irregular (every 36-45 days)
- I do not have a menstrual cycle (no cycle for longer than 3 months)

When was your last cycle? _____

If you do not have a menstrual cycle, choose all the possible reasons that could be the cause:

- Training intensity
- Contraceptive use
- Reproductive disorder
- I don't know
- Other, please specify _____

How would you describe your menstrual bleeding over the last few months

- the same as always
- lighter than usual
- heavier than usual
- No cycle for > 3 months

Do you currently use contraception/birth control (e.g., oral contraceptive pills, rings, implants, injections)?

- YES, nr. of yrs_____
- NO
- Not applicable

If **YES**, what are you using them for?

- Birth control
- Regulate cycle
- Both
- other

If **NO**, have you used contraception/birth control (e.g., oral contraceptive pills, rings, implants, injections) in the past?

- YES, nr. of yrs_____
- NO- never used
- N/A

If **YES**, what did you use them for in the past?

- Birth control
- Regulate cycle
- Both
- other

Have you ever been to a gynaecologist?

- YES
- NO

If you checked **YES** for the previous question, was any reproductive disorder identified/diagnosed?

- YES
 - NO
- If **YES**, please give more details: _____

Do you currently monitor your menstrual cycle?

- YES
- NO

If you checked **YES** for the previous question, how many months or years have you monitored your menstrual cycle?

Nr. _____ years OR Nr. _____ months

ATHLETES ONLY:

Does your menstrual cycle/bleeding change with your training?

- YES
- NO
- Not applicable

If you checked YES, choose all that apply:

- Longer cycle (>35 days)
- Skipping a cycle
- Shorter cycle (<21 days)
- Heavier bleeding
- Lighter bleeding
- Absence of 3 or more consecutive cycles

Does your menstrual cycle change during your *competition* season?

- YES
- NO
- Not applicable

If you checked **YES**, choose one of the following:

- Longer cycle (>35 days)

- Skipping a cycle
- Shorter cycle (<21 days)
- Heavier bleeding
- Lighter bleeding
- Absence of 3 or more consecutive cycles
- Other, please specify: _____

Medical

Have you ever been diagnosed with any of the following? (check all that apply)

- scoliosis heart problems osteoporosis low bone mass constipation
- anorexia nervosa bulimia nervosa mononucleosis diarrhoea
- Diabetes mellitus, please specify: _____
- Gastro intestinal problems, please specify: _____
- Thyroid problems, please specify: _____
- None

If you were diagnosed, which conditions were you treated for? (check all that apply)

- scoliosis heart problems osteoporosis low bone mass constipation
- anorexia nervosa bulimia nervosa mononucleosis diarrhoea
- Diabetes mellitus, please specify: _____
- Gastro intestinal problems, please specify: _____
- Thyroid problems, please specify: _____
- None

How often do you get sick per year (e.g. common cold and/or influenza)?

- 0 1-2 3 >3

Do you currently use any medication for above mentioned condition/s or chronic medication for any other condition?

- Yes No

If yes, list the medication/s and for which condition/s: _____

Injury & Medical Assessment

1. Have you experienced injuries in your *lifetime*? Yes No
 2. If **YES**, please check the injuries below
 3. For each injury you checked, please complete additional questions regarding the injury.

Injury	Please check if the injury was diagnosed by a physician.	When did the injury occur? Date (mo/yr)	What were you doing when the injury occurred?	If you were playing a sport when the injury occurred, what sport were you playing?	Did the injury occur during practice or competition? (Practice can mean either training with a team or on your own.)
Anterior Cruciate Ligament (ACL)					
<input type="checkbox"/> Contact	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Non-Contact	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
Stress Fracture					
<input type="checkbox"/> Tibia	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Femur	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Foot	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Spine	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition

Other					
<input type="checkbox"/> Sprain, strain, dislocation	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Tendinitis, tendinosis, bursitis	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Broken bone	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Meniscal or Posterior Cruciate Ligament (PCL) injury	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition
<input type="checkbox"/> Iliotibial (IT) band syndrome	<input type="checkbox"/>	___/___	<input type="checkbox"/> Sport <input type="checkbox"/> Other		<input type="checkbox"/> Practice <input type="checkbox"/> Competition

Eating Habits

- Are you a vegetarian? YES NO
 If YES, please indicate type: vegan lacto/ovo lacto other _____
 Do you limit/restrict the **amount** of food you eat to control your weight? YES NO
 Do you limit/restrict the **types** of food you eat to control your weight? YES NO
 If **YES**, please check the groups of food you limit/restrict.
 dairy (milk, cheese) red meat other meat/protein (chicken, turkey, fish, eggs)
 carbohydrates rich foods (breads, pasta, rice, potatoes, mageu)
 sweets (ice cream, cookies, candy)
 fats (butter, oil, cream sauces, salad dressings, mayonnaise, etc.)
 fast food (hamburgers, hot dogs, quarter loaf, fries etc)
 sweetened beverages (soda, juices, energy drinks etc)
 alcoholic beverages
 Do you currently experience changes in your appetite? YES NO
 If YES, please indicate the direction of change. increase decrease

ATHLETES ONLY:
Are you hungry before your workouts? <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
Are you thirsty before your workouts? <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
Do you feel less hungry after a hard training session? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> I don't know
Do you feel less hungry during season than during your off-season? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> I don't know
When practice/training is shorter or less intense, do you usually compensate by eating less? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> I don't know
When practice/training is longer and more intense or you train twice a day or compete, do you usually compensate by eating more? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> I don't know
When practice/training is shorter or less intense, do you usually train more on your own? <input type="checkbox"/> YES <input type="checkbox"/> NO <input type="checkbox"/> I don't know
If you get injured or sick and need to take some time off from training and competition, do you get worried about food and weight gain? <input type="checkbox"/> YES <input type="checkbox"/> NO
On a scale from 1 to 10, please rate the intensity of your worries about food and weight gain when you are injured or sick. (1 = least worry, 10 = most worry) <input type="checkbox"/> 1 <input type="checkbox"/> 2 <input type="checkbox"/> 3 <input type="checkbox"/> 4 <input type="checkbox"/> 5 <input type="checkbox"/> 6 <input type="checkbox"/> 7 <input type="checkbox"/> 8 <input type="checkbox"/> 9 <input type="checkbox"/> 10

Do you take dietary/sport supplements? <input type="checkbox"/> YES, daily <input type="checkbox"/> YES, but not every day <input type="checkbox"/> NO
Please check all the dietary supplements you use. <input type="checkbox"/> multi vitamin/mineral <input type="checkbox"/> iron <input type="checkbox"/> calcium <input type="checkbox"/> zinc <input type="checkbox"/> magnesium <input type="checkbox"/> vitamin E <input type="checkbox"/> B-complex vitamins <input type="checkbox"/> vitamin C <input type="checkbox"/> vitamin A <input type="checkbox"/> herbals (eg. echinacea, ginseng) <input type="checkbox"/> Immune enhancers (eg. Vitamin C + zinc) <input type="checkbox"/> other (please specify): _____
Please check all the sports supplements you currently use? <input type="checkbox"/> protein powder/drink <input type="checkbox"/> Amino acids <input type="checkbox"/> sports bars (PVM, USN) <input type="checkbox"/> HMB <input type="checkbox"/> creatine <input type="checkbox"/> glutamine <input type="checkbox"/> sports drinks (eg. Energade, Powerade, Game) <input type="checkbox"/> energy drinks (eg. Red Bull, Play) <input type="checkbox"/> recovery drinks (Endurox, USN, Bionic, Cytomax) <input type="checkbox"/> liquid meal supplements (eg. Fusion, Ensure) <input type="checkbox"/> sodium bicarbonate or citrate <input type="checkbox"/> caffeine <input type="checkbox"/> Pro-hormones (andro, DHEA) <input type="checkbox"/> anabolic steroids <input type="checkbox"/> fat burners (ephedrine, green tea, ma huang, aminolique) <input type="checkbox"/> other (please specify): _____
Do you take any chronic medication? <input type="checkbox"/> YES <input type="checkbox"/> NO If yes, please list the names:

Personal Well-Being

In general, how would you describe your stress level this month?

the same as always higher than usual less than usual

Please indicate (tick) if you experienced any of the following **life events** during the past month.

Life Event	YES	Life Event	YES
Death of a close family member or friend		First or final year in university	
Pregnancy		Serious illness or injury	
Parents remarried or divorced		Any personal problems	
Family or personal financial difficulties		Major change in personal habits	
Frequent arguments with your siblings		Change in living environment	
Major disagreements with your parents		Failure in a course	
Beginning or ending a job		Poor result on an exam or assignment	
Problems with your boss or teacher		Preparing for a final exam period	
Outstanding personal achievement		Start a new relationship	
Change in sleeping habits		Vacation	
Change in university environment		Family reunion	
Started a diet		Negative feedback from coach	
Poor performance in a competition/game		Playoffs/Tournaments	
Change in recreational or sport activities		Acceptance/rejection from college/university application	
Relationship ended with boyfriend/girlfriend		Suspension from school	
Suspension from your sport/activity		Sudden weight gain (> 3 kg)	
Large increase in amount of training		Sudden weight loss (> 3 kg)	

THANK YOU VERY MUCH FOR TAKING THE TIME TO FILL OUT THIS QUESTIONNAIRE

Please take a moment to fill in any questions you may have skipped.

Addendum 2:
Disordered eating questionnaires

Cognitive dietary restraint subscale of the Three-factor eating questionnaire

These are questions regarding your feelings and attitude towards food and your own body, there are no right or wrong answers, please complete the questions as honestly as possible.

Please check the answer that most applies to you for each of the following questions.

1.	When I have eaten my quota of kilojoules, I am usually good at not eating anymore. <input type="checkbox"/> True <input type="checkbox"/> False
2.	I deliberately take small servings as a means of controlling my weight <input type="checkbox"/> True <input type="checkbox"/> False
3.	Life is too short to worry about dieting. <input type="checkbox"/> True <input type="checkbox"/> False
4.	I have a pretty good idea of the number of kilojoules in common food. <input type="checkbox"/> True <input type="checkbox"/> False
5.	While on a diet, if I eat food that is not allowed, I consciously eat less for a period of time to make up for it. <input type="checkbox"/> True <input type="checkbox"/> False
6.	I enjoy eating too much to spoil it by counting kilojoules or watching my weight. <input type="checkbox"/> True <input type="checkbox"/> False
7.	I often stop eating when I am not really full as a conscious means of limiting the amount that I eat. <input type="checkbox"/> True <input type="checkbox"/> False
8.	I consciously hold back at meals in order not to gain weight. <input type="checkbox"/> True <input type="checkbox"/> False
9.	I eat anything I want, any time I want. <input type="checkbox"/> True <input type="checkbox"/> False
10.	I count kilojoules as a conscious means of controlling my weight. <input type="checkbox"/> True <input type="checkbox"/> False
11.	I do not eat some foods because they make me fat. <input type="checkbox"/> True <input type="checkbox"/> False
12.	I pay a great deal of attention to changes in my figure. <input type="checkbox"/> True <input type="checkbox"/> False

Please circle **one** response for each of the following questions.

Sample Question:

How likely are you to take small helpings as a means of controlling your weight?

1 2 3 4

Rarely Sometimes Usually Always

13.	How often are you dieting in a conscious effort to control your weight? 1 2 3 4 Rarely Sometimes Usually Always
14.	Would a weight fluctuation of 2.5 kg affect the way you live your life? 1 2 3 4 Not at all Slightly Moderately Very much

15.	Do your feelings of guilt about overeating help you to control your food intake? 1 2 3 4 Never Rarely Often Always
16.	How conscious are you of what you are eating? 1 2 3 4 Not at all Slightly Moderately Extremely
17.	How frequently do you avoid 'stocking up' on tempting foods? 1 2 3 4 Almost never Seldom Usually Almost always
18.	How likely are you to shop for low kilojoule foods? 1 2 3 4 Unlikely Slightly unlikely Moderately likely Very likely
19.	How likely are you to consciously eat slowly in order to cut down on how much you eat? 1 2 3 4 Unlikely Slightly unlikely Moderately likely Very likely
20.	How likely are you to consciously eat less than you want? 1 2 3 4 Unlikely Slightly unlikely Moderately likely Very likely
21.	On a scale of 0-5, where 0 means no restraint in eating (eating whatever and whenever you want, whenever you want it) and 5 means total restraint (constantly limiting food intake and never 'giving in'), what number would you give yourself? Please circle the applicable number. 0 Eat whatever you want, whenever you want it 1 Usually eat whatever you want, whenever you want it 2 Often eat whatever you want, whenever you want it 3 Often limit food intake, but often 'give in' 4 Usually limit food intake, rarely 'give in' 5 Constantly limiting food intake, never 'giving in'

Eating disorder inventory-3

Thoughts about your body, your eating patterns, your feelings...

Please check **one** response for each of the following questions.

Sample Question:

I think that my stomach is too big.

Always Usually Often Sometimes Rarely Never

1.	I eat sweets and carbohydrates without feeling nervous <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
2.	I think that my stomach is too big. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
3.	I wish that I could return to the security of childhood. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
4.	I eat when I am upset. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
5.	I stuff myself with food. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
6.	I wish that I could be younger. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
7.	I think about dieting. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
8.	I get anxious when I have intense feelings. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
9.	I think that my thighs are too large. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
10.	I feel ineffective as a person. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
11.	I feel extremely guilty after overeating. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
12.	I think that my stomach is just the right size. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
13.	Only outstanding performance is good enough in my family. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
14.	The happiest time in life is when you are a child. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
15.	I am open about my feelings. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
16.	I am terrified of gaining weight. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
17.	I trust others. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
18.	I feel alone in the world. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
19.	I feel satisfied with the shape of my body. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
20.	I feel generally in control of things in my life. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never

21.	I get confused about what emotion I am feeling. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
22.	I would rather be an adult than a child. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
23.	I can communicate with others easily. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
24.	I wish I were someone else. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
25.	I exaggerate or magnify the importance of weight. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
26.	I can clearly identify what emotion I am feeling. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
27.	I feel inadequate. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
28.	I have gone on eating binges (overeating) where I have felt that I could not stop. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
29.	As a child, I tried very hard to avoid disappointing my parents and teachers. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
30.	I have close relationships. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
31.	I like the shape of my buttocks. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
32.	I am preoccupied with the desire to be thinner. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
33.	I don't know what's going on inside me. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
34.	I have trouble expressing my emotions to others. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
35.	The demands of adulthood are too great. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
36.	I hate being less than best at things. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
37.	I feel secure about myself. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
38.	I think about bingeing (overeating). <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
39.	I feel happy that I am not a child anymore. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
40.	I get confused as to whether or not I am hungry. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
41.	I have a low opinion of myself. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
42.	I feel that I can achieve my standards. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
43.	My parents have expected excellence of me. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
44.	I worry that my feelings will get out of control. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
45.	I think my hips are too big. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never

46.	I eat moderately in front of others and stuff myself when they're gone. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
47.	I feel bloated after eating a small meal. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
48.	I feel that people are happiest when they are children. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
49.	If I gain a pound, I worry that I will keep gaining. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
50.	I feel that I am a worthwhile person. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
51.	When I am upset, I don't know if I am sad, frightened, or angry. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
52.	I feel that I must do things perfectly or not do them at all. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
53.	I have the thought of trying to vomit in order to lose weight. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
54.	I need to keep people at a certain distance (feel uncomfortable if someone tries to get too close). <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
55.	I think that my thighs are just the right size. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
56.	I feel empty inside (emotionally). <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
57.	I can talk about personal thoughts or feelings. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
58.	The best years of your life are when you become an adult. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
59.	I think my buttocks are too large. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
60.	I have feelings I can't quite identify. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
61.	I eat or drink in secrecy. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
62.	I think that my hips are just the right size. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
63.	I have extremely high goals. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
64.	When I am upset, I worry that I will start eating. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
65.	People I really like end up disappointing me. <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
66.	I am ashamed of my human weaknesses <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
67.	Other people would say that I am emotionally unstable <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
68.	I would like to be in control of my bodily urges <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
69.	I feel relaxed in most group situations <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
70.	I say things impulsively that I regret having said <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never

71.	I go out of my way to experience pleasure <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
72.	I have to be careful of my tendency to abuse drugs <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
73.	I am outgoing with most people <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
74.	I feel trapped in relationships <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
75.	Self-denial makes me feel stronger spiritually <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
76.	People understand my real problems <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
77.	I can't get strange thoughts out of my head <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
78.	Eating for pleasure is a sign of moral weakness <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
79.	I am prone to outbursts of anger and rage <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
80.	I feel that people give me the credit I deserve <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
81.	I have to be careful of my tendency to abuse alcohol <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
82.	I believe that relaxing is simply a waste of time <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
83.	Others would say that I get irritated easily <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
84.	I feel like I am losing out everywhere <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
85.	I experience marked mood shifts <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
86.	I am embarrassed by my bodily urges <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
87.	I would rather spend time by myself than with others <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
88.	Suffering makes you a better person <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
89.	I know that people love me <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
90.	I feel like I must hurt myself or others <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never
91.	I feel that I really know who I am <input type="checkbox"/> Always <input type="checkbox"/> Usually <input type="checkbox"/> Often <input type="checkbox"/> Sometimes <input type="checkbox"/> Rarely <input type="checkbox"/> Never

Addendum 3:

5-Day dietary and activity record form



5-Day Dietary and Activity Record Form

Participant Number: _____

Dear Participant,

Thank you very much for taking part in this study. Please record your dietary intake as well as your physical activities/exercise training for the 5 days/dates that are stipulated on the form.

DIETARY INFORMATION:

It is essential that you eat as you normally do, don't change your eating patterns or choices just because you are keeping a record. When filling in the form, please consider the following points and refer to the example on the next page:

Record the **approximate time** that you ate/drank the food/beverage and remember to stipulate if it was a snack or a meal.

Please give a **detailed description of the food/beverage** consumed:

- record the type of food/beverage and use brand names if possible (e.g. *Sunflower* oil, *Tussers* cheese);
- state how the food was prepared (steamed, boiled, fried, roasted etc.);
- record if the meat was fatty or lean, and if it was crumbed;
- specify the part of the chicken, and state if it was eaten with or without the skin;
- when eating mince, estimate in terms of cups, tablespoons or ladle spoons (refer to pictures in handout);
- state what type of milk or yoghurt was used (2%/low-fat, full cream or skim/fat free);
- record the type of cheese used (cheddar, feta, low-fat cottage cheese, fat free cottage cheese etc.). Describe the portion size, either in tablespoons if grated or slices (thin, medium or thick);
- when eating canned food, state whether it is canned in oil, water or tomato;
- record the type of margarine used as well as the quantity (e.g. 1 tsp) OR describe as a thin scraping, medium or thick (can see tooth marks). *This applies to all spreads used;*
- remember to mention any sauces eaten with any of your meals and estimate the quantity in terms of tablespoons or cups;

- remember to record any additions to food such as cream, sugar, butter etc;
- When using sports drinks or energy products, specify the *brand name*, the exact amount and if possible, place the label in the envelope.

When recording the **quantity or amount** of food consumed, consider the following points:

- always record the *cooked* amount;
- **weigh the food item** and write down the grams (g) – this is the **PREFERRED option**;
- if weighing is not possible, use household measures or the picture addendum to help estimate the portion size (250ml, ½ cup, 1 teaspoon etc.):
 - also mention if it is a heaped or level spoon and what type of spoon (i.e. teaspoon, tablespoon, dessert spoon etc. – refer to pictures);
 - when describing sausage, use dimension (e.g. 15 cm) OR refer to pictures for quantities in grams;
 - when describing fruit, estimate in terms of small, medium or large;
 - when describing food that you are uncertain about, please use the pictures of top view/cross section to guide you.

ACTIVITY/EXERCISE:

It is essential that you train as you normally do, don't change your training program just because you are keeping a record. Please **do not record your typical daily activities** such as cleaning, climbing the stairs or walking to class. Only record extra exercise (e.g. a run, spinning class, aerobics, tennis etc.) and training.

When filling in the form, please consider the following points and refer to the example on the next page:

Specify the type of exercise (e.g. running, cycling etc.)

Write down the duration of exercise in minutes;

Rate how hard you perceive your workout (see back).

EXAMPLE RECORD FORM

Time	Meal/Snack	Type of food or fluid	Brand/Preparation	Quantity (cup, tsp, tbsp, ml)	Type of activity/workout	Duration (min)	RPE (1 – 5)
08h00	Breakfast	Soft porridge	ACE Cooked with water	80 grams (1 full bowl)	Cycling (spinning class)	45 minutes	4
		Coffee with low-fat milk and sugar	Ricoffee 2% low-fat milk	200 grams (1 full mug) 14 grams (2 heaped teaspoons sugar)	Tennis	30 minutes	3
10h30	Snack	Banana		110 grams (1 large)			
13h15	Lunch	<u>Chicken-mayonnaise sandwich</u>		1 sandwich			
		Brown bread, no margarine	Albany	90 grams (2 medium slices)			
		Chicken with mayonnaise	Cooked breast without skin, Nola mayonnaise	120 grams (1 medium breast) 14 grams (2 heaped teaspoons mayo)			
16h00	Snack	Coke, regular		1 can (340 ml)			
		Peanuts, salted	Simba	50g			
20h00	Supper	Rice	White long grain rice (Shoprite brand) - cooked	100 grams (3/4 full bowl)			
		Beef stew with carrots, cabbage and onion	Cooked	215 grams (3 heaped serving spoons)	Running	45 minutes	3
		Green beans	Steamed, no fat	180 grams (1 cup)			

Day 1: Date _____

Time	Meal/Snack	Type of food or fluid	Brand/Preparation	Quantity (cup, tsp, tbsp, ml)	Type of activity/workout	Duration (min)	RPE (1 – 5)

Day 2: Date _____

Time	Meal/Snack	Type of food or fluid	Brand/Preparation	Quantity (cup, tsp, tbsp, ml)	Type of activity/workout	Duration (min)	RPE (1 – 5)

<u>Borg RPE scale</u>	(Rating of Perceived Exertion)
6	No exertion at all
7	Extremely light
8	
9	Very light
10	
11	Light
12	
13	Somewhat hard
14	
15	Hard (heavy)
16	
17	Very hard
18	
19	Extremely hard
20	Maximal exertion

Addendum 4:
Author guidelines

AUTHOR GUIDELINES

ORIGINALITY

The journal accepts for review manuscripts that have not been published or are not currently elsewhere under review.

CONTENT TYPES

Manuscripts published by IJED include: (1) Original Articles; (2) Brief Reports; (3) Critical analysis and Synthesis (reviews, articles on methodology or theoretical articles); (4) Commentaries; (5) Clinical Case Reports; (6) “An Idea Worth Researching;” and (7) Letters to the Editor. All word limits relate to the body of the text (i.e., not including abstract, references, tables or figures). These are maximum lengths, and authors are encouraged to keep their reports as short as possible while communicating clearly. The review criteria will include appropriateness of length.

To summarize, the article types are:

(1) Empirical Articles reporting substantive research that is novel, definitive or complex enough to require a longer communication.

Word Limit: 7,000 words maximum

Abstract: 250 words maximum

References: 40 maximum

Figures/Tables: a maximum of 8 essential tables/figures, overall

(2) Brief Reports of research that can be communicated relatively succinctly, including straightforward research designs, pilot studies and replications.

Word Limit: 1,500 words maximum

Abstract: 200 words maximum

References: 20 maximum

Figures/Tables: a maximum of 2 essential tables/figures, overall

(3) Critical Analysis and Synthesis articles introduce novel theoretical frameworks, address

methodological issues of broad application, summarize novel clinical ideas within a theoretical and research framework (previously known as Clinical Forum papers), or critically review the status of a given research area and propose new directions for research and/or practice. Narrative and meta-analytic review papers are also welcomed if they address such issues.

Word Limit: 7,000 words maximum

Abstract: 250 words maximum

References: 100 maximum

Figures/Tables: no maximum, but should be appropriate to the material covered

(4) Commentaries are written only at the invitation of the Editors, when multiple perspectives on or critical appraisal of an article would assist in placing that article in context.

Word Limit: 800-1,500 words maximum, excluding abstract, references, tables and figures

Abstract: no abstract

References: 5 maximum, using the footnote format rather than the journal's standard format

Figures/Tables: none

(5) Clinical Case Reports detail key elements of cases where there is novelty in the presentation, pathology or treatment, and where that novelty will inform clinicians and researchers about rare presentations or novel ideas. This category will often be appropriate to rare biological or psychological presentations.

Word Limit: 3,000 words maximum, excluding abstract, references, tables and figures

Abstract: 150 words maximum

References: 20 maximum

Figures/Tables: a maximum of 2 essential tables/figures, overall

(6) "An idea Worth Researching" is a format where authors propose ideas that may not yet have adequate empirical support or be ready for full empirical testing, but hold great promise for advancing our understanding of eating disorders. Authors are encouraged to write a piece that is bold, forward looking, and suggestive of new and exciting avenues for research and/or practice in the field.

Word Limit: 1,500 words maximum, excluding abstract, references, tables and figures

Abstract: no abstract

References: 5 maximum, in footnote format

Figures/Tables: a maximum of 2 essential tables/figures, overall

(7) Letters to the Editor should address key issues raised by articles in the previous edition of the journal. To facilitate such dialogue, letters need to be submitted within one week of the edition of the journal that they refer to.

Word Limit: 500 words maximum

Abstracts: no abstract

References: 3 maximum, in footnote format.

Figures/Tables: None

PREPARATION OF MANUSCRIPT & MANUSCRIPT FORMAT

General Format

Manuscripts must be typed in English and double-spaced throughout, with margins of at least one inch at the top, bottom, and both sides of each page. All manuscripts are subject to copyediting; however, it is the primary responsibility of the authors to proofread thoroughly and ensure correct spelling and punctuation, completeness and accuracy of references, clarity of expression, thoughtful construction of sentences, and legible appearance prior to the manuscript's submission. Preferred spelling follows Webster's New Collegiate Dictionary or Webster's Third New International Dictionary. The manuscript should conform to accepted English usage and syntax. Use headings to indicate the manuscript's general organization. Do not use a heading for the introduction. In general, manuscripts will contain one of several levels of headings. Centered upper case headings are reserved for Methods, Results, and Discussion sections of the manuscript. Subordinate headings (e.g., the Participants or Procedure subsection of Methods) are typed flush left, underlined, in upper case and lower case letters. The text begins a new paragraph. Number all pages of the manuscript except the figures (including title page and abstract) consecutively. Parts of the manuscripts should be arranged in the following sequence:

Number all pages of the manuscript except the figures (including title page and abstract) consecutively. Parts of the manuscripts should be arranged in the following sequence:

(1) Title page. (numbered 1) Titles should be short and specific, conveying the main point of the article. The title page should include the full names, titles, and affiliations of all authors, and an abbreviated title (Running Head) that should not exceed 50 characters, counting letters, spacing, and punctuation. The Running Head should be typed in upper case letters centered at the bottom of the title page. Each page of the manuscript (excluding figures) should be identified by typing the first two or three words of the full title in the upper right-hand corner above the page number. No running head is required for letters to the editor.

(2) Abstract. (word maximum varies by article type) For article types requiring an abstract, the abstract should be typed as a single paragraph on a separate page, numbered 2. Type the word "Abstract" in upper and lower case letters, centered at the top of page 2. Provide the following information in the form of a structured abstract, using these headings: **Objective:** briefly indicate the primary purpose of the article, or major question addressed in the study. **Method:** indicate the sources of data, give brief overview of methodology, or, if review article, how the literature was searched and articles selected for discussion. For research based articles, this section should briefly note study design, how participants were selected, and major study measures. **Results:** summarize the key findings. **Discussion:** indicate main clinical, theoretical, or research applications/implications. The *Journal* will continue to use unstructured abstracts for case reports.

(3) Text. Begin the text on page 3 and be sure to identify each page with the short title typed in the upper right-hand corner above the page number. Type the full title of the manuscript centered at the top, and then begin the text. The full title appears on page 3 only. Indent all paragraphs. The maximum length for article submissions is specified for each manuscript type. Authors are advised that content be conveyed as concisely as possible.

(4) References. Begin on separate page, with the word "References" typed in upper and lower case letters, centered at the top of the page.

(5) Appendices. Typed each appendix on a separate page labeled "Appendix A, B", etc., in the order in which they are mentioned in the text.

(6) Footnotes. Start on separate page.

(7) Tables. Tables should be double-spaced, including all headings, and should have a descriptive title. If a table extends to another page, so should all titles and headings. Each table should be numbered sequentially in Arabic numerals and begin on a new page. Be sure to explain abbreviations in tables even if they have already been explained in-text. Consider the tables and figures to be self-contained and independent of the text. They should be interpretable as stand-alone entities.

(8) Figure captions. Start on separate page. Each figure caption should have a brief title that describes the entire figure without citing specific panels, followed by a description of each panel. Figure captions should be included in the submitted manuscript as a separate section. Be sure to explain abbreviations in figures even if they have already been explained in-text. Consider the tables and figures to be self-contained and independent of the text. They should be interpretable as stand-alone entities. Axes for figures must be labeled with appropriate units of measurement and description.

(9) Acknowledgements/Disclosure of Conflicts. Start on a separate page. Any possible conflict of interest, financial or otherwise, related to the submitted work must be clearly indicated in the manuscript. Acknowledge significant contributions that do not warrant authorship; list sources of support (e.g., federal, industry, or other funding).

Informed Consent

The Methods section should include a statement that the research was reviewed and approved by an institutional review board, and that participation involved informed consent.

Presenting Statistical Data in Text

For additional detail regarding statistical requirements for the manuscript see [IJED Statistical Formatting Requirements](#). For more detailed background information on statistical analyses and their rationale authors are referred to [IJED Statistical Reporting Guidelines](#).

References

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software product that we recommend to our journal authors to help simplify and streamline the research process. Using EndNote's bibliographic management tools, you can search bibliographic databases, build and organize your reference collection, and then instantly output your bibliography in any Wiley journal style. If you already use EndNote, you can [download the reference style](#) for this journal. To learn more about EndNote, or to purchase your own copy, [click here](#) . If you need assistance using EndNote, contact endnote@isiresearchsoft.com , or visit www.endnote.com/support

Except as noted for Commentaries, “Ideas Worth Researching” and Letters to the Editor, referencing follows the Vancouver method of reference citation. In this system, references are numbered consecutively in the order in which they are first mentioned in the text. Identify each reference in text, tables, and legends by Arabic numbers. All references cited should be listed numerically at the end of the paper. Prepare citations according to the style used in Index Medicus and the International list of periodical title word abbreviations (ISO 833).

All reference citations in the text should appear in the reference list. When there are less than seven authors, each must be listed in the citation. When seven or more authors, list the first six followed by et al. after the name of the sixth author. Representative examples are as follows:

Journal Article: 1. Endicott J, Spitzer RL. A diagnostic interview: The schedule for affective disorders and schizophrenia. *Arch Gen Psychiatry* 1978;35:837-844.

Book Chapter: 2. Fairburn CG, Cooper Z. The eating disorders examination (12th ed). In: Fairburn CG, Wilson GT, editors. *Binge eating: nature, assessment, and treatment*. New York: The Guilford Press, 1993, p. 317-331.

Book: 3. Tudor I. *Learner-centeredness as language education*. Cambridge: Cambridge University Press; 1996.

Preparation of figures. To ensure the highest quality print production, your figures must be submitted in TIFF format according to the following minimum resolutions:

- 1200 dpi (dots per inch) for black and white line art (simple bar graphs, charts, etc.)

- 300 dpi for halftones (black and white photographs)
- 600 dpi for combination halftones (photographs that also contain line art such as labeling or thin lines)

Vector-based figures (usually created in Adobe Illustrator) should be submitted as EPS. Do not submit figures in the following formats: JPEG, GIF, Word, Excel, Lotus 1-2-3, PowerPoint, PDF.

Graphs must show an appropriate grid scale. Each axis must be labeled with both the quantity measured and the unit of measurement. Color figures must be submitted in a CMYK colorspace. Do not submit files as RGB. All color figures will be reproduced in full color in the online edition of the journal at no cost to authors. Authors are requested to pay the cost of reproducing color figures in print. Authors are encouraged to submit color illustrations that highlight the text and convey essential scientific information. For best reproduction, bright, clear colors should be used.

Supplementary materials. Supplementary materials will be made available to readers as a link to the corresponding articles on the journal's website.

ADDITIONAL GUIDELINES FOR COPYEDITING OF MANUSCRIPTS FOR INTERNATIONAL JOURNAL OF EATING DISORDERS

The *Journal* Editor and Associate Editors propose additional guidelines for manuscript copyediting in order to enhance consistency in the organization of printed material, and to bring *IJED* style in line with other major scientific publications. The key elements follow.

1. Some authors use terms such as “anorexics” or “bulimics” as personal pronouns, referring to groups of individuals by their common diagnosis. Language of this type should be replaced with such terms as “individuals with anorexia nervosa”, “people with bulimia nervosa”, or “participants with eating disorders”.
2. The term “participants” should be used throughout the article instead of “subjects”.

3. Standard rules will continue to govern the use of capitalization in Headings and Subheadings. However, when a minor word in a Heading or Subheading actually has special or unique meaning, the rule should be overridden.
4. When referring to gender, “males and “females” should be used in cases where the study samples include both children (below age 18) and adults; when the participants comprise adults only, the terms “men” and “women” should be used. In articles that refer to children (i.e., below the age of 13), “boys” and “girls” should be used.
5. In articles that refer to genetic material, the names of genes should be spelled out in full the first time they appear in the text, after which an italicized abbreviation can be substituted.
6. The word “data” is plural; therefore, text should follow accordingly (for example, “The data show...the data are ... the data were...”).
7. For information on how to present p values and other standard measurements see [IJED Statistical Formatting Requirements](#)