AN ABSTRACT OF THE THESIS OF

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in Physical Education presented on April 7, 1989

Title: An Investigation of the Nutritional and Physiological Status and Characteristics of Eating Disorders of Female Ballet Dancers and Distance Runners

Abstract approved: Zella H. [signature]

Purpose: The purpose of this study was to investigate and compare the nutritional and physiological status and characteristics of eating disorders among female non-endurance (ballet dancers) and endurance (distance runners) athletes.

Methods of Research: Twenty-five female subjects, 14 ballet dancers from the School of Ballet Oklahoma and 11 distance runners from Emporia State University and Emporia High School Cross Country teams participated in the study. The factors measured were caloric intake, estimated aerobic capacity (VO_2 max), body composition, and assessment of characteristics of eating disorders. Caloric intake was obtained by a three-day dietary recall/record (DINE). The Queen's College Step Test determined estimated VO_2 max. Body composition was obtained by five skinfold measurements and Jackson

and Pollock's regression equation (1978). The Eating Disorder Inventory (EDI) assessec the cognitive and behavioral dimensions characteristic of the eating disorders. Of the 14 ballet dancers, 11 were matched to the 11 distance runners according to similiar percentage body fat. The data from the remaining three ballet dancers was dropped from t-test analysis. An independent t-test assessed the matching of groups based on percentage body fat. T-tests were used to determine if differences existed between groups in caloric intake (kcal/day) and estimated VO_2 max at the .05 level of significance. Using the data from all 25 subjects a multivariate t-test (utilizing Hotellings t^2) and follow-up univariate t-tests assessed if differences existed between groups in EDI subscale scores. Correlation techniques were utilized to assess relationships of caloric intake, percentage body fat, and EDI subscale scores.

Conclusions: There was no significant difference of caloric intake between the ballet dancers and distance runners according to the three-day dietary recall/record. However, both groups exhibited a low caloric intake. There was a significant difference between the estimated VO_2 max values of ballet dancers and distance runners according to the Queen's College Step Test. The difference can be accounted for by the training regimens. Of the eight EDI subscales only perfectionism was significantly different between ballet dancers and distance runners.

It was concluded that caloric intake being equal, the training regimen of the groups was the contributing factor in maintaining a low percentage body fat.

Furthermore, it can also be concluded that an activity which is based upon sound training principles and nutrition can foster the dance "look" and ideal body weight of a distance runner without entering into the realm of the eating disorders.

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Approved for the Major Department

James L Wolfe

Approved for the Graduate Council

An Investigation of the Nutritional and Physiological Status and Characteristics of Eating Disorders of Female Ballet Dancers and Distance Runners

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A Thesis

Presented to

the Division of Health,

Physical Education, Recreation, and Athletics

Emporia State University

In Partial Fulfillment

of the Requirements for the Degree

Masters of Science

By

DawnElla M. Braley

April, 1989

Acknowledgements

The writer expresses appreciation to:

Dr. Joella Mehrhof

For chairing her first thesis and for contributing her knowledge and experience.

Dr. Loren Tompkins

For his undying confidence and support!

Dr. Susan Kovar

For helping me develop and execute this thesis.

Dr. Tes Mehring

For her expertise in an unfamiliar field and her encouragement.

A special thank you to Dr. Norris Russell, Dr. Betty Edgely, and Woody Moore for their influence and support in my educational pursuits.

Also, the young ladies of School of Ballet Oklahoma, Emporia State University, and Emporia High School Cross Country teams, who devoted their time and energy in my behalf.

I am especially grateful to my parents, they were just a phone call and a hug away.

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Chapter 1

Introduction

Although diet is an essential contributer to maximal athletic performance, the vital role of nutrition in the training, performance, and health status of athletes is frequently overlooked. Williams (1977) believes there is no area of nutrition where faddism, misconceptions and ignorance are more obvious than in athletics. Often coaches, instructors, trainers, and even team physicians dispense misleading nutritional information. Athletes themselves will change their eating habits if a change has been demonstrated to be advantageous to performance. Athletes consider factors such as percentage of lean body mass, aerobic capacity, training schedules, and adjust caloric intake to meet the challenge of competition. The ballet dancer, however, has not caught up with this body of knowledge and is still bound by the desire to continually maintain the dance "look" or image (Peterson, 1982). This desire dictates, throughout the entire span of the dancer's career, the quantity and frequency of food intake.

The ballet world is possibly the most obsessively weight-conscious sub-culture in our country today. The emphasis that dominates in ballet is the preception of the ideal body as long-necked, long-legged and small-breasted. Ballet style and choreography dictate this aspect of physicality more than ever before. It is not uncommon to find a dance company audition in which students with the improper "look" are eliminated from consideration before dancing begins (Lowenkopf & Vincent, 1982). Many ballet dancers during interviews conducted by Druss and Silverman (1979) related this "look" was "the requirement of the profession."

The ballet dancer is unquestionably part of a sub-culture in which dieting and weight control are of central significance. One cannot consider the body norm for the ballet dancer to be comparable to that of the general population; the ballet's concept of ideal weight is approximatetly ten pounds lighter than the normal population of 12- to 17-year-olds (Benson, Gillien, Boudet, & Loosli, 1985).

In spite of their unorthodox nutritional practices, dancers are able to garner the necessary forces to perform explosive sequences, as well as to prolong temporally uniform phrases of balance and imbalance. Exact classification of ballet dance as an aerobic or anaerobic activity is difficult because the dance is characterized by quick bursts of energy interspersed with steady state activity. Thus, the research regarding the physiological status of dancers is sparse yet fairly consistent. Values of maximum oxygen consumption are in the range of non-endurance athletes (Burkett, Fernall, & Walters, 1985; Butts, 1982; Wilmore & Brown, 1983; Dale, Gerlach, Martin, & Alexander, 1979).

Distance running, however, is an endurance activity based on the use of a variety of methods which guarantee the development of a basic, as well as a sport-specific endurance component (Jarver, 1980). Values of maximum oxygen consumption are in the range of endurance athletes.

Distance running is another population where a lean body composition is important. Running is one of the most expensive sports as far as energy is concerned. A runner weighing 65 kilograms expends approximately 100 calories per mile. Distance runners who run 10 miles per day need an additional 15 calories per kilogram of weight (1.5 kcal/kg/mile) in their diets to balance the caloric expenditure. Despite the high quantity of calories used during training runners are still concerned with maintaining weight. In a survey conducted by Clark, Nelson, and Evans (1988), 73 percent of the elite middle- and long- distance female runners already considered lean reported weighing slightly more (2 kg) than desired at the time of the survey. These women had a mean body mass index (BMI) of 19. A BMI of 21 corresponds to the 50th percentile of weight for 19-year-old women. Several investigations have also shown that female distance runners tend to have considerably less body fat than sedentary females (Wilmore & Brown, 1974; Malina, Harper, Avent, & Campbell, 1971; Pipes, 1977; Wells, 1985).

The advantage of a healthy minimal level of fatness in athletic performance, and the strong negative aesthetics and moral connotations of overfatness in our society, combine to create strong pressures to maintain and reduce body fatness. Some researchers have speculated that the media's emphasis on physical fitness and leanness may promote preoccupation with low or extremely low body weight and may even result in the development of eating disorders (Calabrese et al, 1983).

Anorexia nervosa and bulimia are two eating disorders common among teenagers. Anorexia nervosa, the most widely studied disorder, occurs at 0.24 (Theander, 1970) to 1.6 (Kendall, Hall, Harley, & Babigan, 1973) per thousand people. However, Borgen and Corbin (1987) reported that as many as 20% of female athletes in sports that emphasize leanness, including ballet and distance running, have some type of eating disorder. Ten percent of all athletes surveyed were either exceptionally preoccupied with weight or had tendencies toward eating disorders.

There has been some attempt to differentiate between persons having anorexia nervosa and those with anorexic attitudes. In a study conducted by Thompson and Schwartz (1982) college women with anorexic-like eating attitudes showed no overt signs of psychological dysfunction on other psychometric tests. This study supports the idea that anorexic attitudes do not necessarily translate into anorexia nervosa. They believe there exists either a continuum or several categories of anorexia nervosa. Fairbanks (1987) further supports this continuum theory by stating athletes usually do not have the clinical psychiatric disease, but are entering into a realm of eating disorders that may lead to poor development, depression, and altered moods.

Statement of the Problem

The medical consequences of inadequate nutrition in high-performance athletes, such as ballet dancers and distance runners have received wide recognition and public attention. In a recent survey conducted by Druss and

Silverman (1979), ballet dancers listed weight and diet as their chief concerns and admitted to a mean daily intake of only 1,000 calories, despite the fact that they exercise six hour a day, six days a week. Ballet is a discipline in which training and technique do not require high energy expenditure (Cohen, Segal, Witriol, & McArdle, 1982). This poses an additional dilemma. The incidence of anorexia nervosa in a group of professional ballet dancers was 1 in 20. This is 100 times that of the general population (Garner & Garfinkel, 1981-82).

Distance running, on the other hand, is an endurance activity. Someone training for competition in distance running could easily expend twice the calories per unit of body weight per minute that a dancer expends (Kirkendall & Calabrese, 1983). They too have nutritional concerns similiar to the ballet dancers. Nutritional surveys (Deuster et al, 1986; Clark, Nelson, & Evans, 1988) indicate low caloric intake for distance runners. This population has also been linked to disordered eating patterns (Clark, Nelson, & Evans, 1988; Yates, Leehey, & Shisslak, 1983).

This study was designed to investigate and compare the nutritional and physiological status and characteristics of eating disorders among female non-endurance (ballet dancers) and endurance (distance runners) athletes. The specific objective was to examine the similiarities and differences of caloric intake, estimated maximum oxygen consumption (VO_2 max), and characteristics of eating disorders based upon matched percentage body fat.

Research Question and Hypothesis

The question of importance to this research was: Are there significant differences between the ballet dancer and distance runner in caloric intake, estimated VO_2, and Eating Disorder Inventory subscale scores? Statements of the substantive hypothesis (null form) for this research were: (1) There is no significant difference between caloric intake of ballet dancers and distance runners according to a three-day dietary recall/record. (2) There is no significant difference between estimated VO_2 max of ballet dancers and distance runners according to the Queen's College Step Test. (3) There is no significant difference between Eating Disorder Inventory subscale scores of ballet dancers and distance runners.

Significance of Study

The obvious concern with the body image of both ballet dancers and distance runners may be less complete than it first appears. Both are extremely concerned with body composition and caloric intake, thus weighing considerably less than their expected body weight. The major difference between the two athletes is their type of training. The runner may vary a workout by doing sprints or by changing pace, but nonetheless the regimen involves running for a prolonged period of time, thus developing the ability to consume and utilize oxygen. The ballet dancer's workout is characterized by brief periods of high energy activity with alternate rest periods. Aerobic exertion may be prolonged, but typically the dancer's workout is anaerobic.

Although the training regimen of the ballet dancer and distance runner is significantly different, their eating habits are quite similiar. The low caloric intake despite the high caloric expenditure is the similiarity reported in the literature (Cohen, Potosnak, Frank, & Baker, 1985; Benson, Gilliean, Boudet, & Looslie, 1985; Deuster, Kyle, Moser, Vigersky, Singh, & Shoomaker, 1986). This similiarity of eating habits and the results of the training regimen are of major importance to the professionals working with these populations. By providing nutritional information, education and counseling, coaches, instructors, trainers and physicians can develop the "look" and endurance for performance without sacrificing sound nutrition.

Through this research the importance of nutrition education and sound training regimens will become evident. Knowledgable professionals can determine suitable caloric levels based on age, body composition, and activity level which will allow the female athlete/dancer to maintain optimal performance without comprising nutritional integrity.

Definition of Terms

The following are definitions of terms which were used in this study:

Aerobic Capacity - A measurement of the maximal rate at which oxygen can be consumed (Fox, Bowers, & Foss, 1988).

Anorexia-Like Eating Attitudes - A condition simulating anorexia nervosa, but not warranting clinical diagnosis or requiring any treatment.

Anorexia Nervosa - An eating disorder characterized by a preoccupation with food and body weight, behavior toward losing weight, peculiar patterns of handling food, weight loss, intense fear of gaining weight, body image distortions, and amenorrhea (Bruch, 1966).

Basal Metabolic Rate (BMR) - The minimum level of energy required to sustain the body's vital functions in the waking state (McArdle, Katch, & Katch, 1981).

Body Composition - A measurement which divides the body into two principle tissue components: fat and lean body weight (Noble, 1986).

Bulimia - An eating disorder characterized by an episode of binge-eating that is sometimes followed by vomiting, a fear of not being able to stop eating voluntarily, great concern about weight, self-criticism, depressive mood after binge eating, and rapid weight fluctuations within a normal weight range (Halmi, 1983).

Distance Runner - Female high school or collegiate athlete competing in events equal to and or greater than 800 meters.

Eating Disorders - An encompassing definition of the psychopathological behavior of over-controlling eating and/or overeating.

Percentage Body Fat - Percent of body composition that is comprised of fat.

Maximal Oxygen Consumption (VO_2 max) - The maximal rate at which oxygen can be consumed per minute; the power or capacity of the aerobic or oxygen system (Fox, Bowers, & Foss, 1988).

Skinfold Measurements - Determination of fat-pad thickness at various anatomical sites for the purpose of predicting total body fat percentage (Noble, 1986).

Chapter 2

Review of Related Literature

Many athletes operate under the false assumption that adequate training procedures are sufficient to optimize athletic performance. Evidence has accumulated that nutritional status can significantly influence performance, yet this information has not seemed to have reached many athletes. Studies (Benson, Gillien, Boudet, & Looslie, 1985; Clark, Nelson, Evans, 1988; Clement & Asmundson, 1982) have indicated that ballet dancers and distance runners are two groups of athletes who have not caught up with this body of knowledge and are subsiding on a diet low in calories in order to maintain a lean body composition.

The relationship between caloric intake and physical training are important concepts for the ballet dancer and distance runner in the maintenance of a lean body composition. In order to understand the effects of ballet dancing and distance running training, it is necessary to characterize the activities. One method, direct assessment, studies the amount of oxygen consumed during the activity. As a result, the relative energy cost in terms of calories per kilogram of body weight per minute or in milliliters of oxygen per kilogram of body weight per minute (VO_2) can be documented. A second method, indirect asssessment, allows for predicting VO_2 max values based upon the linear relationship of heart rate and oxygen consumption (Fox, Bowers, & Foss, 1988).

Nutritional habits of female athletes who maintain low levels of body fat vary radically, depending upon the discipline. It has been reported that the caloric consumption of distance runners is significantly greater than that of non-athletic controls, whereas in female ballet dancers it is significantly less. However, both activities, despite the differing levels of energy expenditure, are notably low calorie consumers in regards to their activity. The extreme pressures to conform to this lean body type have been associated with characteristics of eating disorders (Borgen & Corbin,1987).

This chapter includes a review of the literature pertinent to the nutritional and physiological status and characteristics of eating disorders among female non-endurance (ballet dancers) and endurance (distance runners) athletes. Areas examined are: caloric intake of ballet dancers and distance runners, aerobic capacity of ballet dancers and distance runners, body composition of ballet dancers and distance runners, basal metabolic rate (BMR), and eating disorders in ballet dancers and distance runners.

Caloric Intake of Ballet Dancers and Distance Runners

Energy requirement is essentially a question of energy intake versus energy expenditure. Any excess intake of food energy over and above the daily need will be stored as fat (Astrand & Rodahl, 1986). Athletes in heavy training programs do not match their caloric intake to their caloric expenditure. Therefore, such athletes will gradually lose body fat. Very high levels of physical training can produce low levels of body fat (Nelson, 1982).

Energy requirement is directly proportional to body size and degree of physical activity. As a guide, sedentary, middle-aged people need about 35 calories per kilogram body weight per day (Astrand & Rodahl, 1986). This corresponds to about 2,500 calories per day for a 70-kg person. Caloric intakes reported in the literature for female athletes range from 1,200 to 2,135 kcal/day (Marcus, Cann, & Madvig, 1985; Stein, Schluter, & Diamond, 1983).

Recommendations for the energy needs of ballet dancers are 30 kcal/lb of ideal dance weight during growth spurt, and 15 kcal/lb of ideal weight after the growth spurt. Estimated net caloric outputs for entire ballet classes average 200 kcal/hr (Cohen, Segal, Witriol, & McArdle, 1982). The mean caloric intake of ballet dancers reported in the literature range from 1,673 to 1,890.2 kcal/day (Cohen, Potosnak, Frank, & Baker, 1985; Benson, Gillien, Boudet, & Looslie, 1985). Other studies indicate that mean caloric intake range from 67% to 71.6% of the Recommended Dietary Allowances (RDA) for the reference woman of similiar height, weight, and age (Evers, 1987; Calabrese et al, 1983).

It has been reported that caloric consumption of distance runners is significantly greater than non-athletic controls (Blair et al, 1981). While Clement and Asmundson (1982) revealed mean caloric intakes of 2,026 kcal/day for women running 10 km/day. Deuster, Kyle, Moser, Vigersky, Singh, and Shoomaker (1986) reported a mean caloric intake of 2,397 $\pm$ 104 kcal/day. This caloric intake, although above the RDA for sedentary women, appears low for women running 10 miles/day. If one assumes a caloric expenditure of an 80 kcal/mile run for a 50-55 kg woman, the cost of running 10 miles/day would add 800 kcal/kg to the total daily energy requirements. To maintain energy balance, the caloric intake of distance runners should approach 2,600 kcal/day or 54 kcal/kg. Although Clark, Nelson, and Evans (1988) did not request food records to compute caloric intake, 78% of the female runners reported knowing their intake. When asked if they ate less than they deserved, given the extent of their training, 67% of the runners responded "yes."

The literature revealed that caloric consumption of both ballet dancers and distance runners was low considering caloric expenditure. The mean caloric intake values of ballet dancers ranged from 1,000 to 1,890.2 kcal/day. Distance runners reported a mean caloric intake ranging from 2.026 to 2,397 ± 104 kcal/day.

Aerobic Capacity of Ballet Dancers and Distance Runners

During prolonged heavy physical work the individual's performance capacity depends largely on the ability to take up, transport and deliver oxygen to the working muscles. The maximal oxygen consumption (VO_2) is theoretically a good measure of cardiorespiratory performance, since it integrates several processes concerned in the transfer of oxygen from the environment to the active tissues. Maximal oxygen consumption has been used extensively as a criterion of performance capacity of endurance athletes (de Vries, 1980).

Maximum oxygen consumption values in athletes vary according to the type of sport, although endurance athletes typically have the highest values. Based on sex and age (20-29 years) mean VO_2 max values for the United States general population of women is 35-40 ml/kg/min (Katch & McArdle, 1977). Elite female athletes have been shown to possess a VO_2 max of 59.1 ml/kg/min (Wilmore & Brown, 1974). Rusko, Havu, and Karvinen (1978) reported a mean VO_2 max of 68.2 ml/kg/min in female cross country skiers. Non-endurance athletes have lower VO_2 max values. Maksud , Cannistra, and Dublinski (1976) reported a mean VO_2 max of 41.02 ml/kg/min for a group of female collegiate non-endurance athletes (volleyball, basketball, and field hockey.)

The VO_2 max has been studied by various groups looking at students and professionals in various styles of dance. Novak, Magill, and Schutte (1978) published the first data on VO_2 max in dancers. Female dancers studied during a treadmill test had a mean VO_2 max of 41.5 ml/kg/min as compared with control values of 36.8 ml/kg/min. Guzman (1979) reported that the Stockholm Opera Ballet revealed mean VO_2 max values for females at 48.0 ml/kg/min. The data of Cohen, Segal, Witriol, and McArdle (1982) on professional ballet dancers recorded values of 43.73 ml/kg/min. They concluded, that the isometric component, along with the sprint or burst component of ballet, produced VO_2 max values in the range of non-endurance athletes. Schantz and Astrand (1984) showed the mean oxygen uptake of professional ballet dancers during class was about 40% of VO_2 max. Thus, the relatively low VO_2 max values of the dancers were expected because none of the dancers were engaged in endurance training. Mostardi, Porterfield, Greenburg, Goldberg, and Lea (1983) classified the ballet dancer as a non-endurance athlete despite the higher than normal cardiorespiratory capacity, 48.6 ml/kg/min. Cohen, Segal, and McArdle (1982) monitored the heart rate response during stage performance of professional ballet dancers. Mean peak heart rates were 184 beats/min or 94% of the maximum age-predicted heart rate. They categorized ballet stage dancing as a high intensity, brief-duration exercise utilizing both anaerobic and aerobic pathways.

In other cardiovascular data, the echocardiograms of professional dancers were studied by Cohen, Gupta, Lichstein, and Chadda (1980). The data showed significantly greater septal thickness, left ventricular wall thickness, left ventricular and diastolic internal dimensions, and left ventricular mass index as compared with sedentary controls. They concluded that the combined isometric and isotonic requirements of dance produced cardiac adaptions seen in both strength and endurance athletes. In contrast, Heath et al (1982) studied cardiovascular variables in dancers and runners. In this study dancers were matched with endurance trained athletes in terms of training frequency, duration and relative intensity. The runners had significantly higher VO_2 max values. There were no differences in end diastolic dimensions and the thickness of the septum and posterior wall. These results indicated that dancers do not have as high VO_2 max values as endurance athletes. However, dancers do manifest cardiorespiratory endurance capacities which place them above other athletic populations.

The athletes with the highest VO_2 max values include distance runners (Wells, 1985; Saltin & Astrand, 1967). Maximal oxygen consumption of young female distance runners range from 49.3 ml/kg/min to 50.8 ml/kg/min (Burkett, Fernhall, & Walters, 1985; Butts, 1982). Wilmore and Brown (1983) reported a mean VO_2 max of 59.1 ml/kg/min for female distance runners, which is considerably higher than values for other females. Dale, Gerlach, Martin, and Alexander (1979) categorized study subjects into four groups: marathoners, distance runners, athlete controls, and sedentary controls. The physical fitness profiles based on treadmill exercise test showed improved cardiac performance and recovery times among all athletes compared with sedentary controls. The predicted oxygen uptake (ml/kg/min) of the marathoners, distance runners, athletic controls, and sedentary controls were 43.2, 42.5, 34.2, and 25.5, respectively. Knowlton, Miles, Sawka, Critz, and Blackman (1978) noted a 9.1% increase of VO_2 max for distance runners involved in an intense eleven week training program. Before training the VO_2 max was 50.1 ml/kg/min, after eleven weeks of training it increased to 54.8 ml/kg/min.

Non-endurance athletes, such as ballet dancers, have demonstrated lower VO_2 max values. The literature revealed VO_2 max values ranging from 41.5 to 51.0 ml/kg/min for ballet dancers. On the other hand, endurance type athletes as represented by the distance runner have the highest VO_2 max values ranging from 49.3 to 51.3 ml/kg.min.

Body Composition of Ballet Dancers and Distance Runners

Certain groups of athletes have demonstrated body composition which differ substantially from other types of athletes and non-athletes. The general trend is that athletes who participate in long duration activities such as distance running have lower percentages of body fat than do athletes who participate in activities which do not require long duration and continuous efforts, such as football or basketball (Dolgener, Spasoff, & St. John, 1980). Aesthetics and appearance can be aspects of performance influenced by body composition in such activities as diving, gymnastics, and ballet (Drinkwater, 1986).

Differing techniques for determining body norms of ballet dancers result in varying data. Cohen, Segal, Witriol, and McArdle (1982) report the ballet's concept of ideal weight is approximately 10 pounds lighter than the general population. The body composition of the performing dancer is an important factor, as the body image projected to the audience is of such great importance. A ballet dancer's baseline weight may easily be 25% less than the usual estimates of ideal body weight, thus one cannot consider the body norm of the ballet dancer to be comparable to that of the general population (Lowenkopf & Vincent, 1982).

Novak, Magill, and Schutte (1978), using the skinfold technique of Sloan and Weir, determined that 12 female dancers carried 20.5% of body weight as fat. Dolgener, Spassoff, and St. John (1980) reported extensive anthropometric data on females in both ballet and modern dance, professional and students. The average ballet dancer was 164.1 cm tall, weighed 51.1 kg, and carried 22.1% of fat. Cohen, Potosnak, Frank and Baker (1985) assessed percent body fat according to the Jackson and Pollock method and a non-population-specific regression equation. The dancer's had a low percent body fat, 12.86%. Calabrese et al (1983) assessed body composition of 34 professional ballet dancers by hydrostatic weighing. Density was converted to percent fat using Brozek's equation. Hydrostatic weighing revealed the dancers to be at 16.9% fat. A comparison of ballet dancers and runners was made, using skinfold measurements (Heath et al, 1982). No differences were found between the groups, with 12.2% fat recorded for runners and 13% fat for the dancers.

Plowman (1974) states that long distance runners are small and lean; they thus have less to carry and more musculature working for them. Dale, Gerlach, Martin, and Alexander (1979) categorized study subjects into four groups: marathoners, distance runners, athlete controls, and sedentary controls. The runners differed significantly in percentage body fat from the non-runner controls. The percentages of body fat (calculated by skinfold measurements and the Siri formula) for the marathoners, distance runners, athlete controls, and sedentary controls were 18.09%, 18.39%, 19.88%, and 21.88%, respectively. The training data suggests that percentage body fat was the result of endurance training. Butts (1982) found the mean percent body fat, as determined from hydrostatic weighing, for young runners was 15.4%. Wilmore and Brown's (1974) subjects were hydrostatically weighed. Siri's equation was used to estimate relative fat from body density. The mean relative body fat for national and international distance runners was 15.2%, which is approximately 50% of the value normally found for females of this age.

Several methods of determining percentage body fat were found in the literature. Thus, comparison should be based on the use of similiar methods. Considering this, percentage body fat values of ballet dancers ranged from 12.86% to 22.1%. Distance runners had similar values ranging from 12.2% to 18.39%.

Basal Metabolic Rate

There is a minimum level of energy required to sustain the body's vital functions in the waking state. This energy requirement is called the basal metabolic rate (BMR) (McArdle, Katch, & Katch, 1981). Basal metabolic rate is the energy requirement of an awake person during absolute rest. The BMR reflects the body's heat production. It is measured under stringent laboratory conditions and requires the subject: (1) had not eaten in 12 hours; (2) had a restful night's sleep; (3) performed no strenuous exercise after sleeping; and (4) was reclined in a comfortable, nonstressful environment (20 to 27^{o} C) for 30 minutes prior to measurement (Brooks & Fahay, 1984; McArdle, Katch, & Katch, 1981). Once these conditions have been met oxygen consumption is measured for a 10-minute period. From this value heat production can be calculated based on the fundamental principle that when one liter of oxygen is utilized in the oxidation of organic nutrients approximately 4.8 calories are liberated (Vander, Sherman, & Luciano, 1985).

The stringent laboratory conditions are needed because of the factors which affect the metabolic rate. These factors include: (1) age; (2) sex; (3) height, weight, and surface area; (4) growth; (5) pregnancy, lactation, and menstruation; (6) infection or other disease; (7) body temperature; (8) recent ingestion of food; (9) prolonged alteration of food intake; (10) muscular activity; (11) emotional state; (12) sleep; (13) environmental temperature; and (14) circulating levels of various hormones (Vander, Sherman, & Luciano, 1985).

Faculative thermogenesis is heat production not accounted for by the BMR, the thermic effect of food, and/or physical activity. When food is ingested, the portion of energy not required for metabolism is stored as fat or dissipated as heat. Humans vary in their efficiency of utilizing food energy. Food energy is stored as unneeded energy in adipose tissue or lost as heat. This phenomenom accounts for the individual differences in fat deposition among people with seemingly identical caloric intake (Brooks & Fahey, 1984).

Eating Disorders Among Ballet Dancers and Distance Runners

Anorexia nervosa, the most widely studied eating disorder, occurs at 0.24 (Theander, 1970) to 1.6 (Kendall et al, 1973) per thousand people. Another line of research focuses upon differences between women and various eating disorders, most specifically bulimic and restricting anorectic patients (Garfinkel, Moldofsky, & Garner, 1980). Others have described a separate condition known as bulimia nervosa (Russell, 1979). Anorexia athletica is a term used to describe eating disorders among athletics (Smith, 1980).

Research labels anorexia nervosa as a psychological disorder (Bruch, 1966), an appetite behavioral disorder (Halmi, 1983), an eating disorder (Abraham & Llewellyn-Jones, 1984), and/or an illness (Crisp, 1980). From a psychological viewpoint, Bruch (1966) has formulated the concept that this "relentless pursuit of thinness" is in itself a late symptom reflecting three pre-illness features of disturbed psychological functioning: (1) disturbance of body image; (2) disturbance in accuracy of perception of cognitive interpretation of stimuli, such as hunger and fatigue; and (3) a paralyzing sense of ineffectiveness. Abraham and Llewellyn-Jones (1984) stated anorexia nervosa and bulimia were not illnesses in themselves. Anorexia nervosa and bulimia become illnesses when they interfere with the person's physical or mental comfort; or disorganize their lives to a marked degree; or so distort their lives that close relatives are also disturbed and help is sought.

One population apparently at risk for anorexia nervosa, anorexic attitudes, and excessive thinness is ballet. The ballet world is possibly the most weight-conscious sub-culture in our country today. Results of a study by Garner and Garfinkel (1980) indicate that serious cases of anorexia nervosa and possible milder variants of the disorder were overrepresented in dance students. Dancers, especially female ballet dancers, may be at a substantially higher risk for anorexia nervosa than the general population. One study reported the prevalence for anorexia nervosa in ballet students at 6.5% (Garner & Garfinkel, 1980).

Brooks-Gunn, Warren, and Hamilton (1986) studied ballet dancers in four national and regional companies. One-third of the dancers reported having an eating problem. They also revealed a significant relationship between amenorrhea and reported eating problems. Fifty percent of the amenorrheics reported anorexia nervosa while 13% of the controls reported anorexia nervosa. The more competitive environments had the greatest frequency of disordered eating (Garner & Garfinkel, 1980; Hamilton, Brooks-Gunn, & Warren, 1985). Different ideal body images are evident among the dance disciplines. On the average, student ballet dancers are slightly thinner and have higher Eating Attitude Test (EAT) scores than modern dance students.

This suggests substantial differences in expected rates of abnormal eating attitudes and anorexia nervosa between the groups. Abraham, Mira, Beumont, Sowerbutts, and Llewellyn-Jones (1983) studied four groups of young women (students, ballet school students, anorexia nervosa patients, and bulimia patients.) The incidence of disordered eating and weight losing behaviors was higher among the ballet school students than the students. This would support Borgen and Corbin's (1987) research, which shows sports or activities that emphasize leanness have a higher incidence of disordered eating.

Another group which emphasizes leanness is distance running. In the survey conducted by Clark, Nelson, and Evans (1988) 13% of the 115 elite middle- and long-distance runners reported a history of anorexia nervosa. Twenty-five percent reported undesired binge eating and 9% stated they binged and purged. Obligatory running is considered by Yates, Leehey, and Shisslak (1983) to be a possible analogue to anorexia nervosa. This view focused on the many similiarities in hyperactivity, peculiar diet habits, abnormal menses, introversion, social isolation, and depression. Weights and Noakes (1987) did not fully agree with these findings, but believed it is the better athletes who are more likely to exhibit the physical and psychological features of anorexia nervosa. However, other authors (Nash, 1987; Bluementhal, O'Toole, and Chang, 1984) suggested there is no connection between the two groups.

Anorexia nervosa and various eating disorders have been associated to populations which emphasize leanness. Several studies reveal the high incidence of eating disorders in the female ballet dancer. Another population which has been linked to eating disorders is distance running.

<u>Summary</u>

Caloric intake, the physical demands of training (measured by VO_2 max), and basal metabolic rate are nutritional and physiological variables which affect the body composition of ballet dancers and distance runners. These groups, in their pursuit of the ideal body composition, have been associated with eating disorders and eating disorder-like attitudes.

Research has indicated that both the ballet dancer and distance runner are low calorie consumers despite the high caloric expenditure of the two distinct activities. It has been reported that caloric consumption of distance runners is significantly greater than that of non-athletic controls, whereas in female ballet dancers it is significantly less.

Maximum oxygen consumption (VO_2 max) values vary according to the type of sport with endurance athletes having the highest values. Despite the higher than normal cardiorespiratory capacity of ballet dancers, the dancers have been classified as non-endurance athletes. Distance running, an endurance activity, has recorded the highest VO_2 max values of all athletes. Distance runners have higher VO_2 max values compared to ballet dancers due to the nature of the activity.

Athletes who participate in long duration activities such as distance running have lower percentages of body fat than athletes who participate in activities which do not require long duration and continuous efforts. Aesthetics and appearance are aspects of ballet which influence a low percentage of body fat. Despite the differing factors which influence low percentage body fat of both groups, research documents similar body fat values.

Preoccupation with weight and tendencies towards eating disorders are evident in ballet dancing and distance running. Both are activities which emphasize leanness. Several studies indicate the prevalence for anorexia nervosa in ballet dancers. The incidence of eating disorders in distance runners is also documented.

A great deal of research has focused on the nutritional and physiological status of the ballet dancer and the distance runner. However, only one study compared the two groups. This research will compare the caloric intake, estimated VO_2 max, and characteristics of eating disorders between the two groups. These findings will provide dance instructors and coaches with the information pertinent to the prescription of training regimens in pursuit of the dance "look" and ideal body weight of a distance runner without entering into the realm of the eating disorders.

Chapter 3

Methods and Procedures

This study investigated and compared the nutritional and physiological status and characteristics of eating disorders among female non-endurance (ballet dancers) and endurance (distance runners) athletes. It was the specific purpose of this study to determine the similiarities and differences of caloric intake, estimated VO_2 max and characteristics of eating disorders between the two groups based upon matched percentage body fat.

Population and Sampling

The subject pool used for this study consisted of 25 females. The non-endurance athletes were ballet dancers with the School of Ballet Oklahoma, located in Oklahoma City, Oklahoma (n=14). The age of these dancers ranged from 11 to 21 years. They represented the top portion of the dance company. The endurance athletes were members of Emporia State University's Cross Country Team and Emporia High School's Cross Country Team, both located in Emporia, Kansas (n=11). The age of these runners ranged from 16-22 years. Of the 14 ballet dancers, 11 were matched to the 11 distance runners according to similiar percentage body fat. Equal (n=11) and unequal (n=14 and n=11) cell sizes were used for statistical analysis. The Institutional Review Board for Treatment of Human Subjects of Emporia State University evaluated the research project and approved the use of human subjects.

Design of the Study

The research was classified as fixed-effect action research due to the fact that no treatment was applied to the ballet dancers or distance runners. The experimental design controlled the majority of the extraneous variables in the experiment. So that if differences in caloric intake, estimated VO_2 max, and Eating Disorder Inventory subscale scores may be attributed to the differing training regimens and the pursuit of leanness.

The extraneous variables which may have affected the internal validity of the study were: (1) The time lapse between the testing periods allowed for extraneous events to occur. The week between the testing periods provided opportunities for the subjects to read and/or view material which could change their participatory attitude (ie, reading articles concerning anorexia nervosa); (2) Subjects were volunteers from intact groups. By utilizing volunteers from an intact group, the researcher assumed the subjects represented the entire population of ballet dancers and distance runners; and (3) Instability of the instrumentation may have existed upon reliance on self-report. The 3-day dietary recall/record and the EDI are scores based on the subject's self- report.

The preceding extraneous variables may affect the internal validity of the study, but steps were followed to reduce this affect. The researcher remained flexible in scheduling all testing periods for all subjects. The purpose of the study were clearly stated and test-retest methods were employed to restrict researcher bias. The honesty and rapport developed with the subjects and the use of code numbers were steps employed to increase subject's honesty.

External validity was based on the assumption that the group of ballet dancers studied represented the entire population of ballet dancers at the School of Ballet Oklahoma. In addition, the distance runners studied represented the entire population of distance runners at Emporia State University and Emporia High School. Thus, the results of this study can be generalized to aspiring professional female ballet dancers as compared to high school and collegiate distance runners.

Variables

The factors measured were caloric intake, estimated VO_2 max, body composition, and assessment of characteristics of the eating disorders. Factors describe the nutritional and physiological status of each subject. Caloric intake was obtained by a three-day dietary recall/record (DINE). The Queen's College Step Test, a submaximal test, was used to determine estimated VO_2 max. Body composition was obtained by five skinfolds: abdomen, ilium, tricep, subscapula, and thigh. Percentage body fat was determined by using the regression equation developed by Jackson and Pollock (1978). The Eating Disorder Inventory (Garner, Olmstead, & Polivy, 1983) assessed the cognitive and behavioral dimensions characteristic of eating disorders.

Validity of Instrumentation

The testing involved in this study was conducted at separate locations. The ballet dancers completed testings on-site in Oklahoma City, Oklahoma. The distance runners completed the testing in the Human Performance Lab on campus at Emporia State University.

Nutritional Survey. Fewer than 3% of college athletes have had a course in nutrition. Furthermore, fewer than 7% of high school and college coaches have had a formal course in nutrition. Nutritional surveys are valuable tools in educating the athlete and coach . M. Gagliardi (personal communication, October 27, 1988) lists five reasons for utilizing nutritional surveys: (1) track deficiences and excess nutrients; (2) track potential food allergies; (3) track energy (kcal) intake; (4) identify disease orientated high-risk eating patterns; and (5) need for supplementation.

Despite the reported valuable use of nutritional surveys, several criticisms are valid. The major criticisms of the data obtained from nutritional surveys were: (1) the dietary recall/record method; (2) the nutrient comparison standard; and (3) the data base (Benson, Gilliean, Bourdet, & Loosli, 1985; Calabrese, 1985; Calabrese et al, 1983; Short & Short, 1983). M. Gagaliardi (personal communication, October 27, 1988) also cited the inability to judge portion size, not reporting bad foods, and memories of old food habits interfering with recent intake as other limitations of nutritional surveys.

Much has been written on the disadvantages of using 24-hour recall.

However, Gersovitz, Madden, & Smicklas-Wright (1978) concluded that the 24-hour recall and the seven-day dietary record provided about equally accurate estimates of mean intake, although recall was prone to over-reporting of low intakes and under-reporting of high intakes. In most cases, a three-day (weekday) record was kept because of reports that validity declines considerably before the end of a seven-day period (Gersovitz, Madden, & Smiciklas-Wright, 1978). A three-day record was the procedure used for several large nutritional assessment studies (Schorr, Sanjur, & Erickson, 1972; Musgrave, 1980).

The Diet Inventory of Nutritional Experiences (DINE) is a diet recording and analysis system that uses an individual's own food choices as a basis to learn and understand nutrition (Dennison, Frauenheim, & Leighton, 1983). The DINE System: Nutrient Analysis and Diet Improvement Software Package was developed by a group of multidisciplinary scientists from State University of New York at Buffalo and a national team of experts. The objectives of the project were to develop a software program that: (1) was user friendly for both professional and consumer use; (2) had program adequancy for integration into diversified nutritional interventions; and (3) was valuable and reliable for use as a dependent measure of nutritional behavior by researchers (Dennison, 1986). M. Gagliardi (personal communication, October 27, 1988) states that the DINE System was one of the better nutritional software packages available on the market.

Queen's College Step Test. Aerobic capacity is a measurement of an individual's ability to consume and utilize oxygen. The terms aerobic capacity, maximum oxygen uptake and/or consumption, and VO_2 max are often used interchangably.

Maximal oxygen consumption can be determined by a variety of work tasks that activate large muscle groups as long as the exercise is of sufficient intensity and duration to engage maximum aerobic energy transfer. Ideally, any test of VO_2 max should meet at least the following general requirements: (1) the exercise must involve large muscle groups; (2) the rate must be measurable and reproducible; (3) the test conditions must be such that the results are measurable and reproducible; (4) the test must be tolerated by all healthy individuals; and (5) the mechanical efficiency (skill required to perform the task should be as uniform as possible in the population to be tested (Astrand & Rodahl, 1986). Furthermore, a levelling-off or peaking-over in oxygen uptake should be achieved to ensure that the subject has reached their maximum capacity for aerobic metabolism (McArdle, Katch, & Katch, 1981). The measurement of VO_2 max requires going not only to the exercise load that elicits VO_2 max, but at least one step beyond to assure that a true maximal value has been reached (deVries, 1980).

The aerobic power in terms of VO_2 max can be determined with a reasonable degree of accuracy through direct measurement, however it is rather time-consuming, requires fairly complicated laboratory procedures, and demands a high degree of cooperation from the subject (Astrand & Rodahl, 1986; McArdle, Katch, & Katch, 1981). In view of these considerations, a number of tests have been devised to predict the VO_2 max from performance measures such as endurance running, or from easily obtained heart rates during or immediately after exercise (Cooper, 1968; Wyndham, 1967).

The most common test for predicting VO_2 max uses the exercise or post-exercise heart rate with a standardized regime of submaximal exercise performed either on a bicycle, treadmill, or step-test. These tests make use of the essentially linear relationship between heart rate and oxygen consumption for various intensities of light to moderately heavy exercise. The slope of this line (rate of heart rate increase) reflects the individual's aerobic fitness (Astrand & Rodahl, 1986; deVries, 1980; McArdle, Katch, & Katch, 1981). It is generally accepted that the fit individual will have a lower heart rate elicited by a given work load than an unfit individual.

The accuracy of predicting VO_2 max from submaximal exercise has been limited by the following assumptions underlying these procedures: (1) work intensity; (2) similiar maximum heart rates for all subjects; (3) assumed constant mechanical efficiency; and (4) day-to-day variations in heart rate (Astrand & Rodhal, 1986; McArdle, Katch, & Katch, 1981).

The heart rate in recovery from a standardized bout of stepping has been a practical and effective way to classify people in terms of aerobic fitness

(McArdle, Katch, Pechar, Jacobson, & Ruck, 1972). The basic assumption underlying the use of step tests has been that given the same amount of work to accomplish, the subject with the lower heart rate immediately following the test was in better physical condition and therefore has a higher VO_2 max (Pollock, Wilmore, & Fox, 1984).

The Queen's College Step Test is a secondary modification of the original Harvard Step Test, which was deemed too strenuous for a large percentage of the population. The Queen's College Step Test consists of continuous bench stepping (16 1/4" height) for three minutes. The rate for women is 22 steps per minute. At completion of stepping, pulse rate is measured for 15 seconds, beginning 5 seconds after exercise has ended. Recovery heart rate is then converted to beats per minute (15 second X 4). McArdle, Katch, Pechar, Jacobson, and Ruck (1972) developed a regression equation used to estimate VO_2 max (ml/kg/min) from the heart rate recovery score: VO_2 max = 65.81 - (0.1847x), where x = step test pulse rate (beats per minute). In terms of accuracy of prediction, McArdle, Katch, and Katch (1981) stated one can be 95% confident that the predicted VO_2 max will be within about $\pm$16% of the true VO_2 of the subject tested. Thus using VO_2 max as the criterion, a correlation of -.75 was obtained between the first heart rate recovery score and VO_2 max expressed in ml/kg/min. A reliability coefficient of .92 was reported.

Body Compositions: Skinfolds. The measurement of lean body and fat mass has developed with the increase in sports participation and the prescription of exercise. Quantification of body fat has also been related to the treatment of obesity and to the assessment of nutritional status. Different levels of evaluation have been proposed depending on expertise and need.

Hydrostatic weighing and water displacement are two of the most accurate methods of measuring body density currently available for assessing the body's total fat content (Brodie, 1988; Jackson & Pollock, 1985; McArdle, Katch, & Katch, 1981). When proper laboratories are unavailable, alternate but simple procedures to predict body fatness can be used. Two of these procedures, the measurement of subcutaneous skinfold fat and the measurement of girths and circumferences are used to predict body fatness. However, more emphasis has been placed on the use of skinfold thickness measurements to estimate human body composition. This approach is based upon two assumptions. The first of these assumptions is the thickness of the subcutaneous adipose tissue reflects a constant proportion of the total body fat. The other approach is to select sites for measurement which represent the average thickness of subcutaneous adipose (Lukaski, 1986). Neither of these assumptions have been proven true. Lukaski (1986) also stated, because a double fold (two layers of skin and subcutaneous tissue) is measured, any factor that affects the reproducibility and validity of the skinfold thickness measurement increases the error of predicted body composition value. However, research has shown that skinfold variables provide more accurate estimates of hydrostatically measured body density than height-weight ratios (Jackson & Pollock, 1985). Body compostition, particularly in athletes, has been determined as a better guide for determining the desirable weight than the standard height-weight-age tables because of the high proportion of muscular content of total body composition (Astrand & Rodahl, 1986).

The use of skinfolds and skinfolds combined with other anthropornetric measures have been used in regression analysis. The technique of regression analysis has meant that numerous researchers have been able to predict body density and hence body fat, from skinfolds (Brodie, 1988; Jackson & Pollock, 1978; McArdle, Katch, & Katch, 1981; Hall, 1977; Sinning, 1978). These have been validated against criterion methods such as hydrostatic weighing or whole body potassuim.

Body composition prediction equations have been termed either population-specific or generalized. Population-specific equations were developed from relatively small, homogeneous samples, and their application is limited to that subsample (Hall, 1977; Sinning, 1978). The generalized equations were developed on a large heterogeneous sample using regression models that account for age and the non-linear relationship between skinfold fat and body density (Jackson & Pollock, 1978). It has been found that population-specific equations tend to be inaccurate if the population to which they are applied are different from the one from which the equation was derived (Katch & McArdle, 1973; Wilmore & Benke, 1970). Therefore, generalized equations are used when there are no population-specific equation available.

The biggest problem associated with anthropometric measurements is the inability to obtain reproducible results. Katch and Katch (1980) noted reproducibility of test scores can be high as a result of careful site location, high quality of training and repeated measuring until values become consistent. In general, a precision of within 5% can be attained by properly a trained and experienced individual (Lukaski, 1986). Site locations based on surface measurement, and markings based on photographic information are essential. Particular attention must be paid to the angle of the skinfold measurement (Brodie, 1988). Test-retest reliability should be established as a matter of course for each tester. Edwards, Hammon, Healy, Tanner, and Whitehouse (1955) found that the pressure exerted by the caliper had a significant effect on the skinfold measurements and the consistency with which the measure was repeated. Keys (1956) recommended a caliper pressure of 10 g/mm as caliper pressure over 15 g/mm may cause subject discomfort.

Eating Disorder Inventory. The Eating Disorder Inventory (EDI) is a measure of eight attitudinal and behavioral dimensions relevant to anorexia nervosa and bulimia. The first three subscales (Drive for Thinness, Bulimia, and Body Dissatisfaction) assess attitudes and/or behaviors related to eating and body shape. Although disturbances in these areas are central to anorexia nervosa, they may also exist in other groups of dieters. The remaining five subscales of the EDI (Ineffectiveness, Interpersonal Distrust, Perfectionism, Interoceptive Awareness, and Maturity Fears) measure traits which have been identified as fundamental aspects of the psychopathology of anorexia nervosa. Within, the clinical populations, the EDI may be useful in identifying subtypes of anorexia nervosa. In non-clinical populations, the EDI has been used as a screening instrument to indicate which individuals are likely to be preoccupied with their weight (Garner & Olmstead, 1984).

Two groups of subjects participated in the validation of the EDI. The criterion group consisted of three subsamples of females: primary anorexia nervosa (AN) patients, restricters, and bulimics. The female comparison (FC) group consisted of three independent subsamples of female university students from first- and second-year psychology courses. Garner, Olmstead, and Polivy (1983) showed no significant mean subscale score differences within criterion groups across the three validation samples.

The final version of each subscale was required to have a coefficient of internal consistency (Cronbach's alpha) above .80 for the AN samples. The average item-total correlation was .63 (SD=.13) indicating substantial within scale common variance among items. Criterion-related validity was established by comparing the self-report EDI patient profiles with the clinical judgements of experienced clinicians familiar with the patients' psychological presentation (Garner, Olmsted, & Polivy, 1983). Normative data for four distinct groups of patient and normal subjects have been documented. The four groups were anorexia nervosa patients, female college students, female high school students, and male college students (Garner & Olmstead, 1984).

As with all psychometric measures, it is inappropriate to infer strictly from EDI scores that an individual meets the criteria for diagnosis of a formal eating disorder. While the EDI may have utility as a prognostic or screening instrument, several cautions must be employed. First, because the EDI is a self-report instrument it is vulnerable to distortion due to response style bias and inaccurate reporting by the respondent. Moreover, the defensive structure of the patient may invalidate or distort self-evaluation data. Secondly, the EDI was emperically refined based on the capability in differientiating between a criterion group and non-clinical samples. Thus, it may lack external validity. Thirdly, the EDI should not be considered to represent an exhaustive sampling of psychopathological characteristics of anorexia nervosa. Fourthly, while some of the psychological dimensions assessed by the EDI may have primary significance, the presence or magnitude of others may simply be by-products of the disorder. Finally, the EDI should not be employed as the sole means of screening or diagnosing anorexia nervosa. Clinical diagnosis must confirm the EDI score (Garner & Olmstead, 1984).

The use of specific equipment was necessary in order to carry out evaluation of caloric intake, aerobic capacity, body composition, and assessment of characteristics of the eating disorders. The equipment used for the collection of data in each phase of testing is listed in Appendix A.

Procedures and Methodology of Data Collection

During the first meeting the subjects were briefed by the researcher on the purpose of the study and testing procedures. Prior to data collection a signed consent form (see Appendix B) was obtained from each subject.

Three copies of the Dine Food Record form (see Appendix C) and the Personal Information Questionnaire (PIQ) (see Appendix D) were distributed to each subject. Detailed and standarized instructions for completing the DINE Food Record form were explained. Subjects were instructed to complete the 3-day dietary recall/ record during the week (Monday through Friday), not during the weekend. After the instructions were given and serving portions discussed, the subjects had an opportunity to ask questions regarding food recall/recording. Before leaving the meeting subjects made an appointment with the researcher for the physiological testing. Subjects were reminded to complete the three-day dietary recall/record and PIQ before returning for the phsyiological testing and administration of the Eating Disorder Inventory (see Appendix E).

The completed three-day dietary recall/record and PIQ forms were collected from the subject when they returned for the physiological testing. The researcher then recorded the subject's age and code number on the Physiological Testing Form (see Appendix F).

Body composition was the first component undertaken. The researcher

researcher. The researcher then led the subject through a series of stretches (see Appendix H). Subjects were given a demonstration of the four count stepping pattern followed by a short practice session. The four count stepping pattern consisted of: (1) right foot up; (2) left foot up; (3) right foot down; and (4) left foot down. A 16 1/4 inch stepping bench was used for the test and a metronome set at 88 beats per minute (each foot stepping at the "click") was used to establish cadence.

Upon completion of the three-minute work bout the subject remained standing while the heart rate was counted for a 15 second interval, beginning five seconds after termination of stepping procedure. All subjects' recovery heart rates were determined by the primary investigator with the use of a stethoscope and stopwatch. The recovery heart rate was then converted to beats per minute by multiplying the value obtained from the 15 second count by four. All scores were recorded.

In order to convert the raw data to estimated VO_2 max (ml/kg/min), the following regression equation was used: VO_2 max = 65.81 - (0.1847 X), X = step test recovery pulse rate (beats/min). The standard error of estimating VO_2 max from this equation is 2.9 ml/kg/min (Appendix I). Before leaving the subjects repeated the series of stretches.

Subjects were then administered the Eating Disorder Inventory (see Appendix E). Subjects were given a pencil and test booklet. The researcher then went over the format of the test, explaining the response choices and the item order. Subjects were asked to respond to each question honestly and to ask for assistance if they had any questions. Once the test was completed the subjects were instructed to turn in all test materials to the researcher.

The score of the EDI was calculated following the completion of the first meeting. All scores were hand tabulated by the researcher and double-checked. Subjects were told the EDI score only if specifically requested. Confidentiality was maintained through the use of code numbers.

Data Analysis

Once all data had been collected tabulations began. Foods listed on the three-day dietary recall/record forms were coded according to the DINE Food Dictionary. Food codes were keyed into a IBM computer and caloric intake was tabulated. The mean caloric intake for each individual was recorded on the Physiological Testing Form (see Appendix F). The Eating Disorder Inventory was scored according to the scoring key. The final score was then transferred to the Physiological Testing Form. The sum of the the five skinfolds were used in Jackson and Pollock's regression equation to determine percentage body fat. In order to convert the raw data (pulse rate, beats/min) to estimated VO_2 max McArdle, Katch, Pechar, Jacobson, and Ruck's regression equation was used. Both percentage body fat and estimated VO_2 max scores were recorded on the Physiological Testing Form.

Parametric statistics were employed to complete statistical analysis of the data. Data was analyzed with inferential statistics, dependent and dependent t-tests on groups, multivariate t-tests (utilizing Hotellings t^2), and Pearson product moment correlations. The Eating Disorder Inventory (EDI) does not nave a composite score, thus the Hotellings t^2 analyzed an artificially comprised composite EDI score. Each null hypothesis for the t-test was non-directional and two tailed. An alpha level of .05 was selected for the rejection of the null hypothesis.

Substantive Hypothesis (Null Hypothesis)

(1) There is no significant difference between caloric intake of ballet dancers and distance runners.

Statistical Hypothesis

Null Hypothesis: $M_1 = M_2$

Alternate Hypothesis: $M_1 = M_2$

M_1 = the mean caloric intake of ballet dancers

M_2 = the mean caloric intake of distance runners

(2) There is no significant difference between estimated VO_2 max of ballet dancers and distance runners.

Statistical Hypothesis

Null Hypothesis: $M_3 = M_4$

Alternate Hypothesis: $M_3 = M_4$

M_3 = the mean estimated VO_2 max of ballet dancers

M_4 = the mean estimated VO_2 max of distance runners

(3) There is no significant difference between Eating Disorder Inventory (EDI) score of ballet dancers and distance runners.

Statistical Hypothesis

Null Hypothesis: $M_{5x} = M_{6x}$ Where x = subscale

Alternate Hypothesis: $M_{5x} = M_{6x}$

M_5x = the mean EDI subscale score of ballet dancers

M_6x = the mean EDI subscale score of distance runners

A rejection of null hypothesis number one would indicate a significant different caloric intake between ballet dancers and distance runners. Differing caloric intakes would indicate that one group is able to consume more calories and remain lean. A rejection of null hypothesis number two would indicate a significant different estimated VO_2 max between ballet dancers and distance runners. Higher VO_2 max values would correspond to the nature of the training regimen. A rejection of null hypothesis number three would indicate a significant different EDI subscale score between ballet dancers and distance runners. Differing EDI subscale scores would indicate a group with a higher incidence of the characteristics of the eating disorders.

The results of this study would determine similiarities and differences of eating habits, as determined by caloric intake, and the results of the training regimen, as determined by estimated VO_2 max values. A rejection of the number three null hypothesis may indicate one group consumed fewer calories with a significantly lower estimated VO_2 max and a higher EDI score as compared to the other group. These findings would provide dance instructors and coaches the information pertinent to the prescription of training regimens in pursuit of endurance and non-endurance qualities and the dance "look" and ideal body weight of a distance runner without entering into the realm of the eating disorders.

Chapter 4

Analysis of Data

The purpose of this study was to investigate and compare the nutritional and physiological status and characteristics of eating disorders in female non-endurance (ballet dancers) and endurance (distance runners) athletes. The project investigated the performance of subjects from sample population on selected nutritional and physiological tests.

A group of 14 ballet dancers and 11 distance runners was used to perform a 3-day dietary analysis, skinfold measurements, the Queen's College Step Test, and to complete the Eating Disorder Inventory (EDI). An independent t-test assessed the matching of groups based upon percentage body fat. Equal cell size (n=11) was thus determined through this matching of groups according to percentage body fat. The scores of the dietary analysis and the Queen's College Step Test were subjected to dependent t-tests to determine if a significant differences occured at the .05 level. A multivariate t-test (utilizing Hotellings t^2) and follow-up univariate t-tests examined the EDI subscales. Correlational techniques were utilized to assess relationships of caloric intake, percentage body fat, and EDI subscale scores. The computer program, SPSS, was used to analyze data.

T-Test Analysis of Data

Of the 14 ballet dancers, 11 were matched to the 11 distance runners according to similiar percentage body fat. The remaining three ballet dancers were dropped from t-test analysis because there was no appropriate match, nor three more distance runners. T-test analysis consisted of equal cell size (n=11.) Mean percentage body fat of ballet dancers was 17.27 with a standard deviation of 3.32, while for distance runners it was 18.29 with a standard deviation of 4.35. There was no significant difference between the groups acording to matched percentage body fat. Statistics pertaining to the t-test analysis are summarized in Table 1.

Table 1

T-Table for Percentage Body Fat

Source	Mean	Standard Deviations	df	t
Ballet Dancer	17.27	3.32	20	-.62
Distance Runner	18.29	4.35	20	

$p = .544$

Mean Caloric intake of ballet dancers was 1719.45 caloric intake (kcal/day) with a standard deviation of 497.37. Mean caloric intake of distance runners was 1908.45 kcal/day with a standard deviation of 644.66. The statistical test indicates the difference of caloric intake between groups was not significant. Therefore, null hypothesis number one (H_0): $M_1 = M_2$ was accepted, and the alternate hypothesis (H_A): $M_1 = M_2$ was rejected. Statistics pertaining to the t-test analysis for caloric intake are summarized in Table 2.

Table 2

T-Table for Caloric Intake (kcal/day)

Source	Mean	Standard Deviations	df	t
Ballet Dancer	1719.45	497.37	10	-.79
Distance Runner	1908.45	644.66	10	

The ballet dancer's performance on the Queen's College Step Test produced a mean VO_2 max score of 38.41ml/kg/min with a standard deviation of 3.19. Distance runner's performance yielded a mean VO_2 score of 43.18 ml/kg/min with a standard deviation of 4.32. Statistics pertaining to the t-test analysis for estimated VO_2 max are summarized in Table 3.

Table 3

T-Table for Estimated VO_2 Max (ml/kg/min)

Source	Mean	Standard Deviations	df	t
Ballet Dancer	38.41	3.19	10	-5.24
Distance Runner	43.18	4.32	10	

$p < .001$

A dependent group t-test value of -5.24 was obtained from the Queen's College Step Test data. This indicates a significance of less than .001. Therefore, the null hypothesis number two (H_o): $M_3 = M_4$ was rejected and the alternate hypothesis (H_A): $M_3 = M_4$ was accepted.

Multivariate T Anaylsis and Univariate T Analysis of Data

A fixed effects model of a multivariate t was used to statistically analyze the eight Eating Disorder Inventory (EDI) subscales: drive for thinness (DT), bulimia (B), body dissatisfaction (BD), ineffectiveness (I), perfectionism (P), interpersonal distrust (ID), introceptive awareness (IA), and maturity fears (MF). The fixed effects model was used as a design in which the selection of subjects is random, but the assignment of those subjects to groups is predetermined. The purpose of the mulitvariate t was to determine if there was a composite EDI score difference between groups. Hotellings t^2 indicated no significant differences. Table 4 shows the Hotellings t^2 results for total subscale EDI scores.

Table 4

Hotellings t^2 for EDI Subscale Scores

Source	t	Approximate F	Significance of F
Hotellings t^2	.72185	.72185	.253

Follow-up univariate t-tests were calculated on the eight EDI subscales. There was no difference between groups in seven of the eight EDI subscales: DT, B, BD, I, ID, IA, and MF. Thus, the following null hypothesises were accepted: (H_0): $M_{5DT} = M_{6DT}$; (H_0): $M_{5B} = M_{6B}$; (H_0): $M_{5BD} = M_{6BD}$; (H_0): $M_{5I} = M_{6I}$; (H_0): $M_{5ID} = M_{6ID}$; (H_0): $M_{5IA} = M_{6IA}$; and (H_0): $M_{5MF} = M_{6MF}$. Therefore, the following alternate hypothesis were rejected: (H_A): $M_{5DT} = M_{6DT}$; (H_A): $M_{5B} = M_{6B}$; (H_A): $M_{5BD} = M_{6BD}$; (H_A): $M_{5I} = M_{6I}$; (H_A): $M_{5ID} = M_{6ID}$; (H_A): $M_{5IA} = M_{6IA}$; and (H_A): $M_{5MF} = M_{6MF}$. There was a significant t value found in the perfectionism subscale between groups. Therefore, the null hypothesis (H_0): $M_{5P} = M_{6P}$ was rejected and the alternate hypothesis (H_A): $M_{5P} = M_{6P}$ was accepted.

Follow-up univariate t-tests were calculated on the eight subscales. The t-test for the perfectionism subscale was 3.40 with a probability of .007. Table 5 shows the statistics for the t-test analysis of the perfectionism subscale.

Table 5

EDI Perfectionism Subscale T-Test

Source	Mean	Standard Deviations	df	t
Ballet Dancer	8.55	2.95	10	3.40
Distance Runner	5.45	2.98	10	

$p = .007$

<u>Correlations</u>

Correlational techinques were used to describe relationships between EDI subscale scores and the dependent variables, caloric intake and percentage body fat. The resulting coefficient was tested against the hypothesis H_0: $r_{xy} = 0$ to adjust for sample size. Only those coefficients which resulted in a significant conclusion are reported. Table 6 shows the magnitude and direction of the correlation coefficients (r).

Table 6

Correlations of EDI Subscale Scores
and Dependent Variable

Correlations	DT	BD	I	P	IA	MF
% fat				-.4762		.4131
kcal/day	-.5155	-.4472	-.3967		-.4545	
B	.5532					
BD	.6652					
I	.7927					
ID	.4701					
IA	.7242					

A negative relationship was indicated between caloric intake and the following EDI subscales: drive for thinness (DT), body dissatisfaction (BD), ineffectiveness (I) and introceptive awareness (IA). A negative relationship was also indicated between percentage body fat and perfectionism. A negative value of r indicates that high values of one variable are associated with low values of the other variable. For example, low caloric intake would relate to a high drive for thinness or visa versa. A postive relationship was indicated between drive for thinness and the following EDI subscales: bulimia (B), body dissatisfaction (BD), ineffectiveness (I), interpersonal distrust (ID), and introceptive awareness (IA). Also, the correlational techniques reveal a positive relationship between percentage body fat and maturity fears. A postive value of r indicates a tendency of high values of one variable to be associated with high values of the other variable. For example, a high drive for thinness relates to a high occurence of bulimia or visa versa.

Summary

The results of the independent t-test showed no significant difference between groups according to matched percentage body fat (distance runners to ballet dancers). A t-test indicated no significant difference of caloric intake between ballet dancers and distance runners. Thus, null hypothesis number one was accepted and the alternate hypothesis was rejected. There was a significant difference in estimated VO_2 max between matched groups. Thus, null hypothesis number two was rejected and the alternate hypothesis was accepted.

A fixed-effect model of the multivariate t was used to analyze the composite Eating Disorder Inventory (EDI) score. Hotellings t^2 indicated no significant differences between the composite score. Perfectionism was the only subscale that showed a significant difference between groups.

Correlation techniques were used to describe relationships between EDI subscale scores and the dependent variables, caloric intake and percentage body fat. A negative correlation existed between caloric intake and the following EDI subscales: DT, BD, I, and IA. A negative correlation between percentage body fat and perfectionism was also reported. A postitive correlation existed between drive for thinness (DT) and the following EDI subscales: B, BD, I, ID, and IA. Also a positive correlation existed between maturity fears (MF) and percentage body fat.

Chapter 5

Discussion, Conclusions and Recommendations

This study was designed to investigate and compare the nutritional and physiological status and characteristics of eating disorders among female non-endurance (ballet dancers) and endurance (distance runners) athletes. The sample population was comprised of 14 female ballet dancers and 11 female high school and collegiate distance runners. All subjects were evaluated through a three-day dietary recall/record, the Queen's College Step Test, and the Eating Disorder Inventory (EDI). These tests were used to obtain group mean caloric intakes, estimated VO_2 max values, and to assess characteristics of the eating disorders according the the EDI subscale scores, respectively. T-tests, multivariate t-tests (utilizing Hotellings t^2), and univariate t-tests were used to determine if significant differences occured in the data base. Correlation techniques were used to assess relationships between variables.

Discussion

The results of this study exemplify the major difference of these two groups despite their similiar body composition. As reported in the literature, ballet is regarded as a non-endurance type activity (Cohen, Segal, Witriol, & McArdle, 1982; Mostardi, Porterfield, Greenburg, Goldburg, & Lea, 1983), while distance running is classified as an endurance type activity (Wells, 1985; Saltin & Astrand, 1967). The mean VO_2 max values of both the ballet dancer and the distance runner in this study were consistent with those values reported in the literature. Furthermore, the results were consistent with those of Heath et al (1982), who specifically compared endurance athletes with ballet dancers. Both studies indicated endurance athletes have significantly higher VO_2 max than the ballet dancers.

The major divergence of training regimens is manifested in the ballet dancers who are trying to maintain the "look" while training in a predominately non-endurance fashion. To maintain this "look" the ballet dancer must either add an endurance component to the training program or restrict calories. It is important to note that dance instructors do not advocate other types of aerobic training to a dancer's program because of it's effect on the look of the muscle (D. Holladay, personal communication, January 26, 1989).

These caloric values would seem to support Borgin and Corbin's statement (1987), that both activities, despite the differing levels of energy expenditure, are notably low caloric consumers in regards to their activity. Although these caloric intakes seem inadequate relative to energy output, there are several possible explanations as to why these values may be adequate. First, dietary intakes may have been underreported. As reported in the literature the reliance upon dietary recall is questioned (Benson, Gilliean, Bourdet, & Looslie, 1985; Calabrese, 1985). Subjectively, the underreporting of caloric intakes seem implausible because of the recorded low percentage body fat levels. Secondly, the dietary analysis was completed during the week, thus records of weekend binges could have gone unreported.

Alternatively, training may increase efficiency of digestive and/or energy metabolism. This alternative is an important concept because basal metabolic rate (BMR) and faculative thermogenesis may account for individual differences in fat deposition among people with seemingly identical caloric intake. Differing BMR's and/or faculative thermogenesis may account for the wide range of caloric intakes (928 kcal/day to 2871 kcal/day) and the similiar percentage body composition of both groups. Furthermore, measuring BMR would also explain the metabolic adaptations to chronic food restriction and the ability to maintain weight.

Perfectionism was the only EDI subscale to show a significant difference between groups. The researcher observed this characteristic in the classes viewed and when talking with the ballet dancers. This observation is in agreement with Druss and Silverman (1979) who stated that, "it is the wish (of the ballet dancers) to achieve a kind of perfectionism, the desire to do things perfectly and to achieve the special momentary bliss accompanying the perfectness, that motivates dancers. They must be 'perfect,' to be 'very good' is not enough."

Seven of the 21 ballet dancers did not complete the three-day dietary recall/record, thus their results were scored but not used for further analysis. Subjectively, the researcher believes the dietary analysises were not completed because the subjects were uncomfortable completing the forms due to the conclusion of possible extremely low caloric intakes. This belief is in conjuction with the high EDI subscale scores for the subjects not completing the dietary analysis. As indicated in the literature, persons exhibiting characteristics of the eating disorders are protective of their behavior.

Correlations were tabulated to describe relationships between EDI subscale scores and the variables of caloric intake and percentage body fat of the combined groups. The technique reported a negative relationship between a low caloric intake and the following EDI subscales: drive for thinness, body dissatisfaction, ineffectiveness, and interoceptive awareness. Drive for thinness indicates excessive concern with dieting, preoccupation with weight, and entrenchment in an extreme pursuit of thinness (Garner & Olmstead, 1984). In this pursuit of thinness, runners who have overeaten may run a few extra miles and the dancers may use the option of taking another dance class in an effort to eliminate excessive calories. This correlation does not discount these options, but supports a relationship based upon a low caloric intake in pursuit of the drive for thinness. Body dissatisfaction reflects the belief that specific parts of the body associated with shape change or increased fatness at puberty are too large (Garner & Olmstead, 1984). Thus, a low caloric intake would be a means of decreasing those body shapes perceived as large. Ineffectiveness assesses feelings of general inadequacy, insecurity, worthlessness, and the feelings of not being in control of one's life (Garner & Olmstead, 1984). Controllings one's caloric intake is an effort to have control over one's life. As indicated by these correlations unrealistic body images and feelings of ineffectiveness relate to a low caloric intake. Furthermore, coaches and instructors who are in these specific teaching/coaching postions often can foster idealistic body images and feelings of control and self-worth. Introceptive awareness reflects one's lack of confidence in recognizing and accurately identifying emotions or viseral sensations of hunger (Garner & Olmstead, 1984). This inability to acurately identify hunger would predispose tendencies of low caloric intake.

Also reported was a negative relationship between percentage body fat and perfectionism. Perfectionism indicates excessive personal expectations of superior achievement (Garner & Olmstead, 1984). Both groups were from highly competitive environments in their respective domains, and as the literature reports these environments are condusive to high expectations from the individuals and by the individuals themselves. Coaches and instructors should respect these expectations, but should help foster a healthy attitude by developing realistic body images. There was a positive relationship between caloric intake and maturity fears. Maturity fears measures one's wish to retreat to the security of adolescent years because of the overwhelming demands of adulthood (Garner & Olmstead, 1984). A low caloric intake would suppress the body changes associated with adulthood and serve refuge for maturity fears. The lifespan of a dancer is somewhat short, thus through restricting one's caloric intake the individual may be able to maintain the "look" of the dancer for an extended length of time.

The technique also reported a positive relationship between drive for thinness (DT) and the following EDI subscales: bulimia (B), body dissatisfaction (DB), ineffectiveness (I), interpersonal distrust (ID), and introceptive awareness (IA). As stated, drive for thinness indicates excessive concern with dieting, preoccupation with weight, and entrenchment in extreme pursuits of thinness. Due to this preoccupation with weight, bulimia would be an avenue for the pursuit of thinness. Feelings of body dissatisfaction would incorporate a drive for thinness to decrease large body parts. As seen in the literature the ballet dancer's ideal body is of long-necked, long-legged, and small-breasted. If a dancer did not possess the ideal body countless hours of viewing oneself in the mirror would predispose the dancer to feelings of body dissatisfaction and a drive for thinness. Ineffectiveness reflects an individuals feelings of loss of control of one's life. The pursuit of thinness is a method of control. This drive for thinness alienates an individual and is mirrored by interpersonal distrust. Lastly, introceptive awareness is the loss of the ability to identify hunger signals, a product of this preoccupation with weight. In conclusion, those persons responsible for training/educating ballet dancers and distance runners should recognize and conceptualize the importance of these correlations and support a healthy environment which fosters feelings of effectiveness, trust, and appreciation for one's own body and achievements. Body expectations and images should be reflective of the level of competition and based upon sound training regimens and nutrition. Furthermore, attitudes and emotions of individuals should be of utmost importance in the wake of their relationship with the eating disorders.

Conclusions

(1) No significant difference was found to exist between the ballet dancer and distance runner according to a three-day dietary recall/record. However, both groups exhibited low caloric intakes which could be attributed to basal metabolic rate, faculative thermogenesis, underreporting of dietary intake, and/or a characteristic of the eating disorders.

(2) A significant difference existed at the .05 level between the estimated VO_2 max values of ballet dancers and distance runners according to the Queen's College Step Test. As supported in the literature this difference can be accounted for by the differing training regimens.

(3) Of the eight Eating Disorder Inventory subscales only perfectionism was significantly different at the .05 level between the ballet dancer and distance runner. The drive for perfectionism is indicated in the literature as a motivating factor for ballet dancers.

(4) Although the EDI did not reveal cases of anorexia nervosa, the correlations revealed characteristics of eating disorder-like attitudes. As supported in the literature activities that emphasize leanness have a higher incidence of disordered eating.

Recommendations

On the basis of the results of this study, the following areas are suggested recommendations for further investigation.

(1) The power of the statistical analysis was hindered due to the small sample size. Increasing sample size would increase power.

(2) Replicating this study with direct measurements would allow for more precise analysis of data. Direct measurement of VO_2 max, percentage body fat through hydrostatic weighing, and the inclusion of basal metabolic rate levels would allow a more precise interpretation of caloric intake, percentage body fat, and the relation of the eating disorders.

(3) Completing data retrevial for distance runners during the training season would allow for a more precise comparison of groups.

(4) A similiar study should be done comparing national ballet dancers with elite distance runners to address the topic of pressures to perform and competition.

(5) A similiar study should be done comparing ballet dancers and distance runners to gymnasts, another population which emphasizes leanness.

(6) A study seems warranted utilizing the Eating Disorder Inventory more completely in analyzing the characteristics of the eating disorders and the use of Garner and Olmstead's (1983) comparison groups.

(7) A study should be done which looks at the psychological aspect of the activities and addresses the question: Do individuals dance/run to legitimize their desires for controlled eating or do individuals fascinated by

the activity adopt eating disorder-like attitudes to perform?

(8) Not only should this study be replicated and revised, but more importantly the data used. Dance instructors, coaches, and other professionals working with these groups need to conceptualize and utilize the principles of training and nutrition in the pursuit of the dance "look." This desired body image and ideal weight of the ballet dancer and the distance runner may be achieved without entering into the realm of the eating disorders.

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APPENDIX A

EQUIPMENT USED

EQUIPMENT

DINE FOOD RECORD
(1) Recording Forms
(2) DINE Food Dictionary
(3) IBM Computer

QUEEN'S COLLEGE STEP TEST
(1) 16 1/4" stepping bench
(2) Metronome
(3) Stopwatch
(4) Recording Forms
(5) Conversion Chart for Determining VO_2 Max
(6) Weight Scale
(7) Stethoscope

BODY COMPOSITION
(1) calibrated Lange skinfold caliper
(2) Jackson and Pollock Regression Equation
(3) Recording Forms

EATING DISORDER INVENTORY
(1) Questionnaire
(2) Scoring Key
(3) Profile Forms
(4) Pencil

APPENDIX B

Informed Consent Form

INFORMED CONSENT

I, DawnElla M. Braley, am asking for your participation in a study designed to investigate and compare the nutritional and physiological status and characteristics of eating disorders in ballet dancers and distance runners. The specific objective of this study is to determine the similiarities and differences of caloric intake, VO_2 max, body composition, and EDI score based upon matched percentage body fat.

As a subject in this study, your presence will be required for two meetings. The first general meeting will last approximately one hour. The second meeting will last approximately 20 minutes.

During the first meeting the testing procedures will be discussed. The DINE Food Record forms and Personal Information Questionnaire (PIQ) will be distributed at this time. Detailed and standarized instructions regarding the three-day dietary recall/record will be administered. You will be asked to complete these forms before returning for the physiological testing. Before leaving you will be adminstered the EDI.

During the second meeting body composition and aerobic capacity will be determined. Body composition will be calculated by using skinfold measurements. This evaluation will require no physical exhertion and will produce no physical discomfort to you as a participant. Determining aerobic capacity will require some phsyical exhertion which might induce temporary discomfort and/or muscle soreness in the lower extremities. A series of stretching exercises will be performed before and after the test to reduce this affect. The risk of physical harm to you as the subject is minimal.

Your permission to use the data described is requested for the purpose of conducting research for a thesis. All information will remain confidential. Results will be presented in a manner which will not allow individual identification. DawnElla M. Braley, the primary investigator, will possess the list matching code numbers to the names of the participants. Following the completion of the statistical analysis, this list will be destroyed. If you have any further quesions in reference to this research, please contact DawnElla M. Braley at (316) 343-1200, extension 5835, or at home (316) 343-3367. Please call collect.

"I have read the above statements and have been fully advised of the procedures to be used in this project. I have been given sufficient opportunity to ask questions I have concerning the procedures and possible risks involved and I assume them voluntary, I likewise understand that I can withdraw from the study at any time without being subject to reproach."

____________________ ____________________

Date Subject

APPENDIX C

DINE Food Record

DINE Food Record

NAME ______________________ ICL ________ Hgt. ________ Wgt. ________

DATE ____________ Sex ________ Frame ________ IBW ________

Age ________ Act. ________

Meal	Item No.	Code	Portion	Food Description	Amount
M	1		.		
	2		.		
	3		.		
	4		.		
	5		.		
	6		.		
	7		.		
	8		.		
	9		.		
	10		.		
	11		.		
	12		.		
	13		.		
	14		.		
	15		.		
	16		.		
	17		.		
	18		.		
	19		.		
	20		.		
	21		.		
	22		.		
	23		.		
	24		.		
	25		.		
	26		.		
	27		.		
	28		.		
	29		.		
	30		.		
	31		.		
	32		.		
	33		.		
	34		.		
	35		.		

APPENDIX D

Personal Information Questionnaire (PIQ)

PERSONAL INFORMATION QUESTIONNAIRE (PIQ)
CODE NUMBER ___________

1. What is your age? __________

2. Do you know how many calories you should eat per day?
   Yes _____ No _____

3. How tall are you in feet and inches?
   _____ Feet
   _____ Inches

4. What is your body frame size? __________
   Body frame size can be estimated by placing the thumb and middle finger around the wrist and squeezing.
   Small frame - fingers overlap
   Medium frame - fingers just touch
   Large frame - fingers do not touch

5. Your desirable weight range is __________ to __________ lbs.

6. Please pick a single weight valued that you would be comfortable at and reasonably easy to achieve.
   "Ideal" body weight = ____________ lbs.

If you answered YES on Question 2 answer Question 7.

7. What is the amount of calories you should consume per day?
   ____________ calories/day

8. What was your age of menarche? __________ years old

9. Do you have regular menstrual cycles?
   Yes _____ No _____
   If no, which condition is charateristic of your cycle?
   _____ A. Primary amenorrhea - total lack of menstruation in a female of reproductive age.
   _____ B. Secondary amenorrhea - cessation of menstruation after menarche has occured.
   _____ C. Oligomenorrhea - fewer number of menstrual cycles, longer menstrual cycle length
   _____ D. Polymenorrhea - shorter than normal menstrual cycle length

10. Brief description of a weekly training regimen.

APPENDIX E

Eating Disorder Inventory

EDI

David M. Garner, Ph. D.
Marion P. Olmsted, M.A.
Janet Polivy, Ph. D.

Name Date

Age Sex Marital status

Present weight Height

Highest past weight (excluding pregnancy) (lbs)

How long ago? (months)

How long did you weigh this weight? (months)

Lowest past adult weight (lbs)

How long ago? (months)

How long did you weigh this weight? (months)

What do you consider your ideal weight? (lbs)

Age at which weight problems began (if any)

Present occupation

Father's occupation Mother's occupation

PAR Psychological Assessment Resources Inc
P.O. Box 998 Odessa Florida
Telephone (813) 968-3003

INSTRUCTIONS

This is a scale which measures a variety of attitudes, feelings and behaviors. Some of the items relate to food and eating. Others ask you about your feelings about yourself. THERE ARE NO RIGHT OR WRONG ANSWERS SO TRY VERY HARD TO BE COMPLETELY HONEST IN YOUR ANSWERS. RESULTS ARE COMPLETELY CONFIDENTIAL. Read each question and fill in the circle under the column which applies best to you. Please answer each question *very* carefully. Thank you.

	ALWAYS	USUALLY	OFTEN	SOMETIMES	RARELY	NEVER
1. I eat sweets and carbohydrates without feeling nervous.	○	○	○	○	○	○
2. I think that my stomach is too big.	○	○	○	○	○	○
3. I wish that I could return to the security of childhood.	○	○	○	○	○	○
4. I eat when I am upset.	○	○	○	○	○	○
5. I stuff myself with food.	○	○	○	○	○	○
6. I wish that I could be younger.	○	○	○	○	○	○
7. I think about dieting.	○	○	○	○	○	○
8. I get frightened when my feelings are too strong.	○	○	○	○	○	○
9. I think that my thighs are too large.	○	○	○	○	○	○
10. I feel ineffective as a person.	○	○	○	○	○	○
11. I feel extremely guilty after overeating.	○	○	○	○	○	○
12. I think that my stomach is just the right size.	○	○	○	○	○	○
13. Only outstanding performance is good enough in my family.	○	○	○	○	○	○
14. The happiest time in life is when you are a child.	○	○	○	○	○	○
15. I am open about my feelings.	○	○	○	○	○	○
16. I am terrified of gaining weight.	○	○	○	○	○	○
17. I trust others.	○	○	○	○	○	○
18. I feel alone in the world.	○	○	○	○	○	○
19. I feel satisfied with the shape of my body.	○	○	○	○	○	○
20. I feel generally in control of things in my life.	○	○	○	○	○	○
21. I get confused about what emotion I am feeling.	○	○	○	○	○	○
22. I would rather be an adult than a child.	○	○	○	○	○	○
23. I can communicate with others easily.	○	○	○	○	○	○
24. I wish I were someone else.	○	○	○	○	○	○
25. I exaggerate or magnify the importance of weight.	○	○	○	○	○	○
26. I can clearly identify what emotion I am feeling.	○	○	○	○	○	○
27. I feel inadequate.	○	○	○	○	○	○
28. I have gone on eating binges where I have felt that I could not stop.	○	○	○	○	○	○
29. As a child, I tried very hard to avoid disappointing my parents and teachers.	○	○	○	○	○	○
30. I have close relationships.	○	○	○	○	○	

	ALWAYS	USUALLY	OFTEN	SOMETIMES	RARELY	NEVER
31. I like the shape of my buttocks.						
32. I am preoccupied with the desire to be thinner.						
33. I don't know what's going on inside me.						
34. I have trouble expressing my emotions to others.						
35. The demands of adulthood are too great.						
36. I hate being less than best at things.						
37. I feel secure about myself.						
38. I think about bingeing (over-eating).						
39. I feel happy that I am not a child anymore.						
40. I get confused as to whether or not I am hungry.						
41. I have a low opinion of myself.						
42. I feel that I can achieve my standards.						
43. My parents have expected excellence of me.						
44. I worry that my feelings will get out of control.						
45. I think that my hips are too big.						
46. I eat moderately in front of others and stuff myself when they're gone						
47. I feel bloated after eating a normal meal.						
48. I feel that people are happiest when they are children.						
49. If I gain a pound, I worry that I will keep gaining.						
50. I feel that I am a worthwhile person.						
51. When I am upset, I don't know if I am sad, frightened, or angry.						
52. I feel that I must do things perfectly, or not do them at all.						
53. I have the thought of trying to vomit in order to lose weight.						
54. I need to keep people at a certain distance (feel uncomfortable if someone tries to get too close).						
55. I think that my thighs are just the right size.						
56. I feel empty inside (emotionally).						
57. I can talk about personal thoughts or feelings.						
58. The best years of your life are when you become an adult.						
59. I think that my buttocks are too large.						
60. I have feelings that I can't quite identify.						
61. I eat or drink in secrecy.						
62. I think that my hips are just the right size.						
63. I have extremely high goals.						
64. When I am upset, I worry that I will start eating.						

FOR OFFICE USE ONLY

DT	B	BD	I	P	ID	IA	MF

APPENDIX F

Physiological Testing Form

PHYSIOLOGICAL TESTING FORM

CODE NUMBER____________

DATE ____________ AGE ____________

BODY COMPOSITION

Scapula _____ _____ _____ _____

Tricep _____ _____ _____ _____

Ilium _____ _____ _____ _____

Abdomen _____ _____ _____ _____

Thigh _____ _____ _____ _____

Sum of 5 folds _____

$\% \text{ FAT} = .29731(X_1) - .00053(X_1)^2 + .03037(X_2) - .63054$

% FAT = _____

QUEEN'S COLLEGE STEP TEST

BPM = _______ X 4 = _______ 65.81 - (0.1847 X _______)

ESTIMATED VO_2 MAX = _______

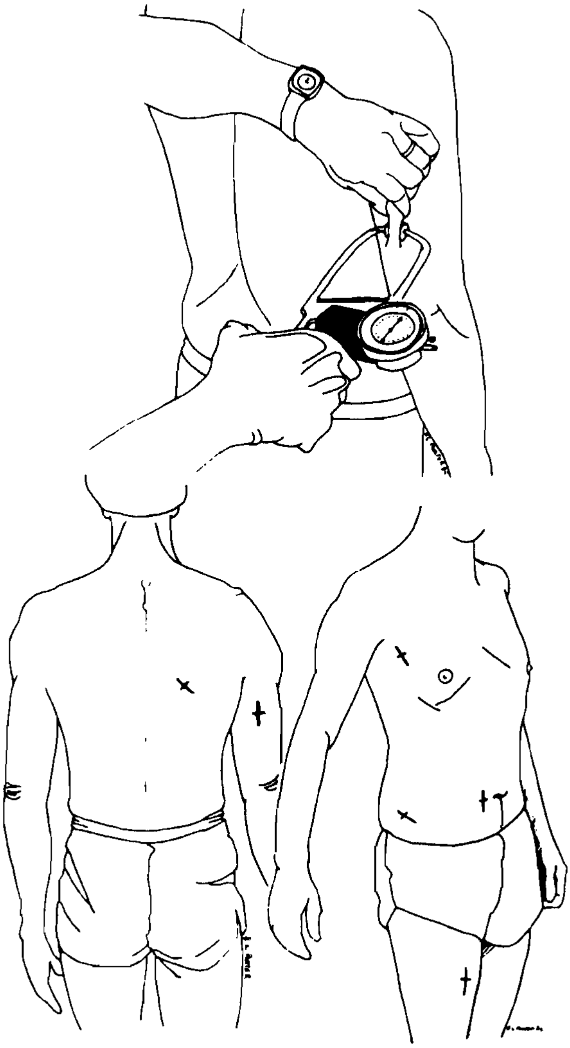
EDI SCORE = _______

CALORIC INTAKE (KCAL) = _______

APPENDIX G

Locations and Descriptions of Skinfold Measurements

SKINFOLD LOCATIONS



Howley, E.T. and Franks, B.D. (1986). Health/Fitness Instructor's Handbook. Champaign, Illinios: Human Kinetics Publishers, Inc.

SKINFOLD LOCATIONS

Definition of measurement: The specific objective of the skinfold measurements is to measure the thickness of a complete double layer of skin and subcutaneous tissue (without including any muscle tissue in the process.)

(1) ABDOMEN

(A) Posture: The subject stood erect with arms at side, but remained relaxed.

(B) Position: A vertical fold one inch to the right of the umbilicus.

(2) ILIUM

(A) Posture: The subject stood erect with right arm lifted laterally and resting on the tester's shoulder, but remained relaxed.

(B) Position: A diagonal fold just above the creast of the ilium on the mid-auxillary line.

(3) TRICEP

(A) Posture: The subject stood erect with arms at side, but remained relaxed.

(B) Position: A vertical fold on the back of the upper arm, midway between the acromion process of the clavicle and the elbow.

(4) SCAPULA

(A) Posture: The subject stood erect with arms at side, but remained relaxed.

(B) Position: A diagonal fold just below the inferior angle of the scapula.

G

(5) THIGH

(A) Posture: The subject with arms at the side shifted her weight to the left leg, keeping the right leg relaxed.

(B) Position: A vertical fold on the quadricep, midway between the groin line and the tip of the platella.

Percentage fat calculation using the sum of five skinfolds:

$\% \text{ FAT} = .29731 (X_1) - .00053(X_1)^2 + .03037(X_2) - .63054$

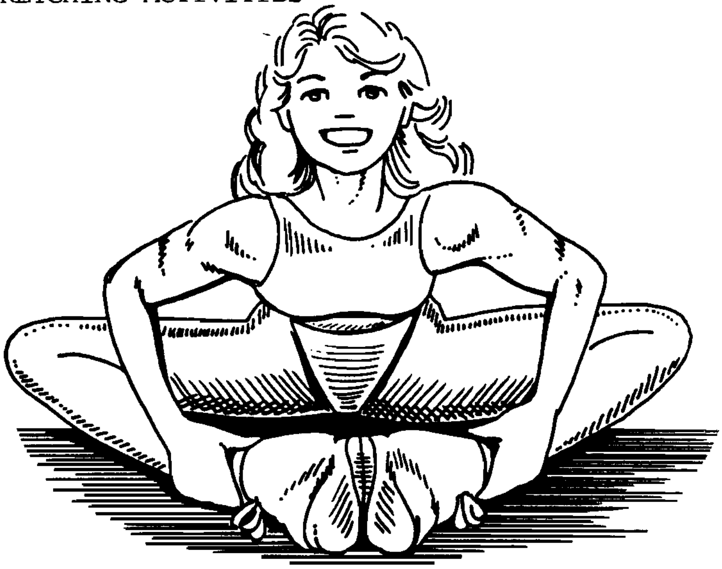
Where X_1 = sum of five skinfolds

Where X_2 = age of subject

APPENDIX H

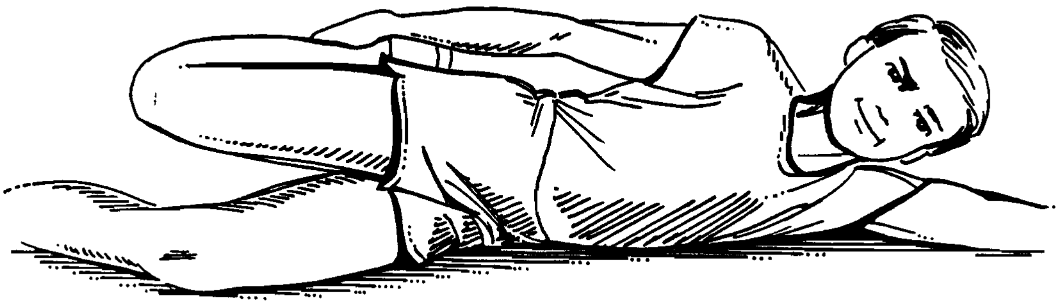
Series of Stretches

STRETCHING ACTIVITIES —



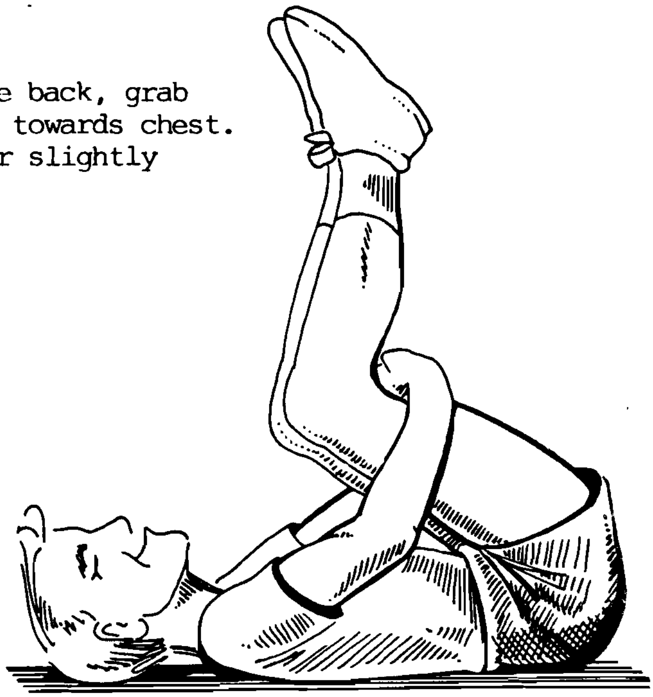
ADDUCTOR STRETCH: With feet pulled into groin with hands, stretch knees down to the floor.

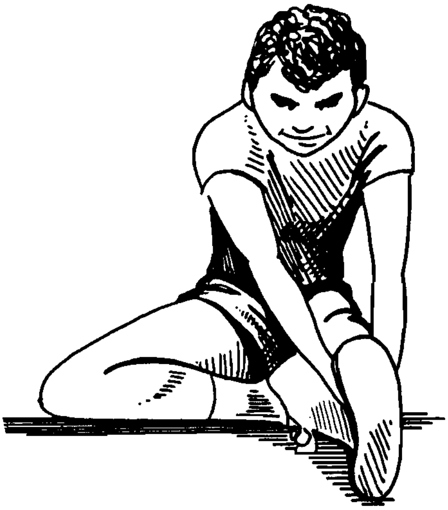
GASTROCNEMIUS/SOLEUS AND ACHILLES STRETCH: Stand in lunge position with toes facing forward. To stretch the calf, bend front leg and keep back leg straight. To stretch achilles tendon (and soleus), bend the back knee keeping the heel on the floor.



QUADRICEPS: While lying on your side, grab below the knee and stretch the back leg.

LOWER BACK: While lying on the back, grab behind the knees and pull legs towards chest. May be done with legs tucked or slightly extended, but not locked.





HAMSTRINGS: In the half-straddle position, reach the chest towards the extended knee.

HIPS, SIDE, AND BACK: While sitting, bring one leg over the other leg. Keep the bottom leg extended. Rotate the torso to both sides by pushing against floor with hands.

Kravitz, L. (1986). Anybody's Guide to Total Fitness. Dubuque, Iowa: Kendal/Hunt Publishing Company.

APPENDIX I

VO_2 Max Conversion Chart and Prediction Equation for the Queen's College Step Test

MAXIMUM OXYGEN UPTAKE CONVERSION CHART FOR THE QUEENS COLLEGE STEP TEST

PERCENTILE RANKING	RECOVERY HR, FEMALE	PREDICTED MAX $\dot{V}O_2$ ($ml \cdot kg^{-1} \cdot min^{-1}$)	RECOVERY HR, MALE	PREDICTED MAX $\dot{V}O_2$ ($ml \cdot kg^{-1} \cdot min^{-1}$)
100	128	42.2	120	60.9
95	140	40.0	124	59.3
90	148	38.5	128	57.6
85	152	37.7	136	54.2
80	156	37.0	140	52.5
75	158	36.6	144	50.9
70	160	36.3	148	49.2
65	162	35.9	149	48.8
60	163	35.7	152	47.5
55	164	35.5	154	46.7
50	166	35.1	156	45.8
45	168	34.8	160	44.1
40	170	34.4	162	43.3
35	171	34.2	164	42.5
30	172	34.0	166	41.6
25	176	33.3	168	40.8
20	180	32.6	172	39.1
15	182	32.2	176	37.4
10	184	31.8	178	36.6
5	196	29.6	184	34.1

McArdle, W.D., Katch, F.I., and Katch, V.L. (1981). Exercise Physiology: Energy, Nutrition, and Human Performance. Philadelphia: Lea & Febiger.

Prediction equation for determining maximum oxygen uptake (ml/kg/min) from raw data obtained from the Queen's College Step Test.

Women: VO_2 MAX = 65.81 - (0.1847 X step test pulse rate)

Where X = step test rate in beats/minute

McArdel, W.D., Katch, F.I., Pechar, G.S., Jacobson, L. and Ruck, S. (1972). Reliability and interelationships between maximal oxygen intake, physical work capacity and step-test scores in college women. Medicine and Science in Sports, 4, (4), 182-186.

ON NOVEMBER 19, 1987, THE COUNCIL OF GRADUATE AND PROFESSIONAL STUDIES UNANIMOUSLY APPROVED THE BELOW LISTED POLICY, EFFECTIVE FALL SEMESTER, 1987

TO: All Graduate Students Who Submit a Thesis or Research Problem/Project as Partial Fulfillment of the Requirements for an Advanced Degree

FROM: Emporia State University Graduate Studies Office

I, DawnElla M. Braley, hereby submit this thesis/report to Emporia State University as partial fulfillment of the requirements for an advanced degree. I agree that the Library of the University may make it available for use in accordance with its regulations governing materials of this type. I further agree that quoting, photocopying, or other reproduction of this document is allowed for private study, scholarship (including teaching) and research purposes of a nonprofit nature. No copying which involves potential financial gain will be allowed without written permission of the author.

DawnElla M. Braley

Signature of Author

April 12, 1989

Date

An Investigation of the Nutritional and Physiological Status and Characteristics of Eating Disorders in Female Ballet Dancers and Distance Runners

Title of Thesis/Research Report

Jackie Tolbert

Signature of Graduate Office Staff Member

April 18, 1989

Date Received

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