MENSTRUAL DYSFUNCTION AND EATING BEHAVIORS IN WEIGHT TRAINING WOMEN

BY

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(Abstract)

To obtain descriptive information concerning female bodybuilders and women who weight train, a questionnaire concerning training regimes, menstrual history and dieting strategies was developed and administered with the EDI included as part of the questionnaire. Factors assessed included: incidence of menstrual irregularity, scores on the Eating Disorder Inventory (EDI), prevalence of behaviors associated with eating disorders, and mean body fat. Subjects were between the ages of 18 and 35 and included individuals from Personal Health Classes at Virginia Tech, the Virginia Tech Weight Lifting Club, and Goad's Gym in Blacksburg, Virginia. Subjects were classified by activity (weight lifters versus controls), involvement (high, moderate and low) and competition (non-competitive and competitive).

Chi-square analysis indicated that there was no difference in incidence rates of menstrual irregularity between weight lifters (WLs) and controls (Cs); however, the rates of both groups were higher than the general population. Although there was no difference in menstrual

function of involvement groups, 50% of the competitors, significantly more than non-competitors, were classified as oligomenorrheic or amenorrheic.

All subject groups had mean scores approaching anorexic patient norms on the EDI Bulimia and Maturity Fears subscales. WLs were significantly higher on Drive for Thinness than Cs and more WLs had subscale scores higher than the mean scores presented for anorexics. Additionally, significantly more WLs reported uncontrollable urges to eat, fear of fat, and history of anorexia. Mean %BF of the WLs was 20.18% with competitors being significantly leaner than non-competitors.

The high degree of menstrual dysfunction in both WLs and Cs is confusing; yet, the 27% incidence of oligomenorrhea and amenorrhea in WLs is much higher than the rates documented for the general population. The high Drive for Thinness and incidence of negative eating behaviors indicate that the prevalence of eating disorders in this population may progress as this relatively new sport evolves and competitive participation increases.

To my father and mother:

for their love and patience

and for literally, paying

for this.

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Chapter 1

INTRODUCTION

In the past 20 years, there has been an increased public awareness of health and fitness. An estimated 73 million Americans participate daily in some form of exercise (Conrad, 1983). Thirty-one million of those are regular joggers, while the rest swim, cycle, lift weights, attend aerobics classes, or participate in recreational sports. Most of these people exercise to develop strong, healthy bodies, while others consider themselves athletes and compete at various levels. Whether they are recreational or competitive athletes, the main goal of many athletes is optimal health. Some athletes pursue more than that; some are striving for the ultimate physique. They are the bodybuilders.

Bodybuilding is rapidly growing in popularity. "Bodybuilding competitions are becoming common sports events in many cities and have been the focus of several major sports and television programs," (Freedson, Mihevic, Loucks and Girondola, 1983). Bodybuilding incorporates weight training to develop muscle size, shape, definition, and proportion. Although there is little scientific information available on bodybuilders training techniques, many of these weightlifters perform multiple sets and repetitions for every muscle group. The routine engorges the specific site with blood to develop a muscle "pump"

(Westcott, 1982). In this sport, muscle size, definition, and a symmetrical whole body immage take precidence over the development of strength (Ryan, 1983).

Contrary to other sports, bodybuilders in competitive condition are not necessarily in peak health. They are often in nutritional states of starvation and dehydration due to extreme dieting in order to obtain minimal body fat, maximum muscle definition and a "cut" appearance. Before a meet, it is common practice for a bodybuilder to drastically decrease water and caloric intake, achieving a level of body fat below the acceptable range for athletes (Freedson, et al., 1983; Heck, 1980).

Dieting is an important aspect of bodybuilding, particularly in competition. However, these athletes extreme hypocaloric diets may not only inhibit training and compromise health, but may also encourage abnormal eating behaviors such as the binge/purge syndrome of bulimia or the forced starvation of anorexia nervosa (Clark, 1984). Like wrestlers and ballet dancers, bodybuilders may employ rapid weight loss to obtain an extremely low percentage of body fat. It has been documented that wrestlers may lose up to 10% of their body weight in several days in order to qualify for a lower weight class (Tipton and Teheng, 1970; Zabraski, Foster and Gross, 1976). Drastically reducing food and water intake while exercising excessively are common practice (Houston, Marrin, Green, and Thompson,

1981; Widerman and Hagan, 1982). Ballet dancers frequently maintain prolonged hypocaloric diets or use techniques such as vomiting and laxative abuse for weight control (Benson, 1985; Petterson, 1982).

In addition to the effects of intensive activity and extreme dietary practices, female bodybuilders may experience another health risk. Female athletes have a higher incidence of menstrual irregularity than the general population (Bonen and Keizer, 1984). Loucks and Horvath (1985) reported the incidence of amenorrhea to be 20 times greater among athletes. The highest rates of amenorrhea appear to be in ballet dancers (Frisch, Wyshak, and Vincent, 1980; Drinkwater, Shangold and Loucks, 1981) and runners (Feicht, Johnson, Martin, Sparkes and Wagner, 1978; Sanborn, Martin, and Wagner, 1982) who like bodybuilders, often maintain low levels of body fat and high levels of exercise.

Statement of the Problem

A search of the literature revealed the research on bodybuilders to be limited (Fahey, Akka and Rolph, 1975; Freedson, 1983: Katch, Katch, Moffa, and Gittleson, 1980; Spitler, Diaz, Howath, and Wright, 1980). Increased participation in female bodybuilding indicated a need for the evolution of available knowledge concerning weight training athletes and the sport of bodybuilding.

The increasing incidence of anorexia nervosa and

bulimia in the general population (Bruch, 1978; Crisp, Palmer and Kalucy, 1976; Schwartz, Thompson and Johnson, 1982), the similarities in dieting goals of bodybuilders compared to wrestlers and ballet dancers, and the emphasis of body composition in bodybuilding competitions indicated that eating disorders may be prevalent in this population of athletes. Additionally, the high incidence rate of athletic menstrual irregularities (AMI) and the relationship of exercise and rapid weight loss with amenorrhea indicated that female bodybuilders may also have a higher risk of developing menstrual dysfunction than the general population; therefore, a survey study of female weightlifters was conducted to determine the incidence of eating disorders and menstrual dysfunction. Mean percent body fat of the subject group was presented because it is an important factor in competitive training, eating behaviors and menstrual irregularity.

Since training and dieting techniques for weight lifters and competitive body builders have not been well researched or documented, weight training and exercise regimes and nutritional composition of diet were presented for several case study subjects as well.

Delimitations

1. All subjects were females, between the ages of 18 and 34, who belonged either to the Virginia Tech Weight Lifting Club or Goad's Gym in Blacksburg, Virginia. Age-

matched control subjects were from Personal Health classes at Virginia Tech.

2. Survey subjects were divided into three groups according to weight training involvement. Those who weight lifted 225-300 minutes per week consituted the high involvement group; those reporting to be lifting 135-240 minutes per week were in the moderate involvement group; and those lifting 15 to 180 minutes a week were in the low involvement group.

3. The competitive group consisted of all subjects who had competed in a bodybuilding meet at least once.

4. The four case study subjects were Virginia Tech students between the ages of 18 and 22 who were members of the Virginia Tech Weight Lifting Club.

Significance of the Study

Women's bodybuilding is a relatively young sport, with competitions beginning in the late 1970's. The unique goals of this sport, muscular mass plus definition, require specific training and dieting techniques. Strategies employed by other athletic populations do not specifically address these goals and scientific inquiry to develop healthy, effective procedures is needed. At present, there is little available information on these athletes. It was hoped that the following survey study would provide baseline data on female weight lifters and indicate possible trends, to

initiate more definitive research on these athletes.

The increase in eating disorders in the general public and specific athletic populations is alarming. Since dieting is an integral part of bodybuilding competition, competitive and noncompetitive bodybuilders may be particularly susceptible. In addition, the relationship of weight loss, exercise and body fat may also predispose these women to athletic menstrual irregularities. Documentation of incidence rates of eating disorders and menstrual dysfunction may not only indicate the susceptibility of bodybuilders, but may also, when compared to incidence rates of other athletic populations, assist in the determination of the mechanisms involved in these problems.

Limitations

The following are limitations that may have affected the results of this study.

1. The survey data relied on subject accuracy in recall and reporting.

2. Weight lifting subjects in the moderate and low involvement groups may not have classified themselves as bodybuilders, but may have considered themselves to be general conditioners. The inclusion of the lower involvement groups was necessary to compare groups according to level of involvement and to assess the population size and training characteristics.

3. Accuracy of the case study data, weight training and exercise records, relied on subjects accuracy in recall, measurement and recording. In addition, the diet assessments depended on their judgement of serving sizes and food content.

4. Percent body fat estimates obtained from hydrostatic weighing may have been affected by subject technique and compliance with pre-weighing protocol, as well as investigator error and calculation..

Basic Assumptions

1. It was assumed that all subjects were accurate in their recall and recording of survey answers. It was also assumed that subjects' interpretation of the questions complied with those of the research committee. The investigator was always present to clarify questions and survey procedures.

2. It was assumed that case study subjects recorded weight lifting, exercise and food and drink accurately on their assigned days and that they were accurate in their estimations of portion sizes and food content.

3. It was assumed that case study subjects followed the preweighing protocol for the hydrostatic weighing.

Definitions and Symbols

1. Amenorrhea - is the condition of lacking menstruation for 12 or more consecutive months. Some studies consider lack of menses for 3 or more months.

2. Anorexia nervosa - is a condition of self-starvation for the purpose of losing or maintaining body weight.

3. Athletic Menstrual Irregularity (AMI)-sports related menstrual dysfunction of oligomenorrhea and amenorrhea.

4. Bodybuilding - is a competitive sport which utilizes weights to develop size, shape, definition, and proportion in various muscle groups.

5. Body Density (BD) - refers to the mass per unit volume of a human body and is used to compute %BF.

6. Bulimia nervosa - refers to the binge/purge syndrome of weight control.

7. Eating Disorder Inventory (EDI) - is a 64 item self report questionnaire designed to assess psychological and behavioral characteristics associated with anorexia nervosa and bulimia.

8. Eumenorrhea - is the condition of normal menstruation, having cycles occurring at consistent intervals of less than 36 days.

9. Hydrodensitometry - is the use of underwater weighing in order to estimate body density and percent body fat.

10. Oligomenorrhea - is the condition of having cycles occurring at inconsistent intervals of less than 36 days, occurring at intervals of 36-89 days, or at varying

intervals, sometimes occurring monthly, sometimes skipping several months.

11. Percent body fat (%BF) - is the percentage of body mass that can be attributed to nonessential lipids.

12. Skinfold measurements - are used to estimate percent body fat from measurements of fatfolds at various sites on the body.

13. Virginia Tech Weight Lifting Club. (VTMC)- is the organization from which most of the weightlifting subjects were recruited.

Research Questions

The overall purpose of this study was to provide descriptive information concerning women who weight train and to encourage further investigation on this population of athletes, specifically at the competitive level. Considering the major topics being presented in the literature concerning female athletes,the following research questions were established to delineate the purpose of the study.

1. What is the incidence of oligomenorrhea and amenorrhea in female weight lifters and does the incidence differ from controls?

2. What are the mean Eating Disorder subscale scores of female weight lifters and do they differ from controls?

3. What are the mean percent body fats of competitive and noncompetitive female weight lifters?

4. Is there a significant difference in percent body fat of female weight lifters estimated using the Jackson, Pollock and Ward equation involving four skinfold sites (tricep, suprailium, abdomen and thigh) versus their equation involving only three sites (tricep, suprailium and thigh)?

5. What are some common training techniques and dieting patterns employed by bodybuilders?

Summary

The main purpose of this study was to provide descriptive information on females who weight train and compete in body building meets. The specific topics to be addressed were incidence of menstrual irregularity, prevalence of eating disorders and mean percent body fat. It is hoped that this study will provide baseline information on the population and initiate future research in this area.

Chapter 2

LITERATURE REVIEW

Review of Related Literature

The following literature review will include available scientific information concerning bodybuilders, athletic amenorrhea, and eating disorders. The review will be divided into the following topics:

1) Psychological and physiological characteristics of bodybuilders.
2) Amenorrhea and oligomenorrhea in athletes.
3) Menstrual History Survey
4) Anorexia and bulimia in athletes.
5) The Eating Disorder Inventory.
6) Body composition assessment in athletes.

The section on amenorrhea and oligomenorrhea in athletes will be further divided into body composition, training intensity, hormonal variations and psychological stress.

Psychological and Physiological Characteristics of Bodybuilders

Most of the literature available on bodybuilders concerns the psychological and personality characteristics of competitive and noncompetitive weight lifters. Early studies have associated bodybuilders with deviant personality characteristics such as feelings of inferiority, latent homosexuality, masculine inadequacy, and introversion (Harlow, 1951; Henry, 1941). Present

studies, however, have characterized bodybuilders as being highly self-motivated and in good mental health (Darden, 1972; Freedson, Mihevic, Loucks and Girandola 1983; Thirer and Greer, 1981).

Investigations of physical characteristics indicate that most bodybuilders have low functional capacities and low percentages of body fat. Fahey, Akka and Rolph (1975) studied 10 high caliber weight lifting athletes, including olympians, world record-holders, and national finalists. Of this group, the bodybuilders had the lowest maximum oxygen consumption (VO_2), with a mean of 3.5L/min, and the lowest percent body fat (%BF), with a mean of 8.4%. Spitler, Diaz, Howath and Wright (1980) found similar characteristics in a group of 10 adult male bodybuilders. The mean VO_2 was 4.04 +/- .8 L/min, and mean %BF was 9.9%. Compared to most athletes, these values of VO_2 max are relatively low, indicating that most bodybuilders do not devote much time to aerobic conditioning.

Katch, Katch, Moffatt and Gittleson (1980) investigated %BF and lean body mass (LBM) in male body builders and weight lifters, while Freedson and his associates, (1983) studied these characteristics in female bodybuilders. The male lifters averaged 9.3 %BF and had 14% greater LBM than Behenke's reference man (Behenke & Wilmore, 1974). Freedson found an average of 13.2 %BF and a 7% higher LBM in 10 competitive female body builders. Compared to

Behenke's reference woman (Behenke & Wilmore, 1974), these women were larger in the upper body (shoulders, chest, biceps, and forearms), and smaller in the lower body (abdomen, buttocks, and thighs). To date, this study by Freedson is the only available data on physique and body composition of female bodybuilders. Other characteristics have not yet been documented.

Amenorrhea and Oligomenorrhea in Athletes

Studies on athletic amenorrhea disagree on whether the incidence in athletes differs from that of the general population. There are also conflicting results on the incidence rates within specific sports. Additionally, the exact mechanisms causing menstrual dysfunction in athletes have not been determined. This section of the literature review will attempt to summarize and compare the incidence rates available on the general population and specific sports, and present the factors that appear to predispose athletes to oligomenorrhea and amenorrhea.

Incidence Rates: In a research review on athletic amenorrhea, Loucks and Hovrath (1985) cited incidence rates of the general population as ranging from 1.8 to 5%, compared to studies on runners which ranged from 1 to 25.7% and dancers which ranged from 19 to 44%. Other studies on dancers showed incidence rates within the presented range. A study by Baker et al. (1981), however, indicated the incidence rate in runners to be 39%, higher than rates

presented by Loucks and Hovrath. In the studies presented by Loucks and Hovrath which showed low incidence rates in runners, 1% (Shangold and Levine, 1981) and 3.4% (Lutter and Cushman, 1982), the mean age of the subjects was 32.6 years. Related literature indicates that athletes over 30 are at less risk for menstrual dysfunction than younger athletes (Baker, 1981). The mean age of the sample populations could have affected the resulting incidence rates.

In addition lower training mileages of the subjects in the studies reviewed by Loucks and Hovrath (1985) may have been a factor since the subjects ran less than 48 Km/wk (Lutter and Cushman, 1982) and less than 32 km/wk (Speroff and Redwine, 1980). Other research has suggested that distance runners training less than 50 miles per week are less susceptible to menstrual irregularity than those running more miles per week (Feicht et al., 1978; Frisch et al. 1981).

Training: Training also appears to be related to oligomenorrhea and amenorrhea. Lutter and Cushman (1982) surveyed 350 female runners in the 1980 Boston Marathon and the Bonnie Bell 10-Km race and found that oligomenorrheic runners ran more miles per week than eumenenorrheic runners, with 58.1% of oligomenorrheic runners averaging more than 30 miles per week, and 14.9 % running 50 or more miles per week. The amenorrheic runners also had greater

weekly mileage with 23.1% averaging 31 to 50 miles a week and 61.5% averaging more than 50 miles a week.

Supporting this indication, Frisch et al. (1981) reported that training increased oligomenorrhea and amenorrhea in college swimmers and runners. In a study by Cohen (1982), professional dancers showed greater menstrual irregularity during the season than when they were not training. Frisch (1980) found that professional dancers had higher incidence rates than university dance students. Contradicting these reports, Baker (1981) found amenorrhea to be higher in subjects running less than 40 miles per week compared to those running more. As of yet, there appears to be no research showing that amenorrheic athletes train at greater percent of their maximal aerobic capacity than cyclic athletes.

Age: Age has been shown to be a predisposing factor. Baker (1981) and Speroff and Redwine (1980) separately found incidence rates of amenorrhea higher in runners under 30 than those over 30. Baker found 66.6% versus 9% and Speroff and Redwine found 8.8% versus 2.2%. Age of menarche and initiation of training have also been associated with sports-related menstrual dysfunction. Several studies show that menarche is delayed in athletes who began training before menarche. In Frisch's study (1981) on college runners and swimmers, the mean menarcheal age of premenarche-trained athletes was 15.1+/-0.5 years,

compared to 12.8+/-0.2 years for the postmenarche-trained athletes. Baker et al. (1981) reported a menarcheal age of 13.8 +/-.5 years in amenorrheic runners versus 12.2+/-0.3 years in cyclic runners. In professional dancers, Cohen (1982) reported a menarcheal age of 14.2 +/-2.8 years versus
12.5+/-1.4 years for a control group.

Body Composition: The association of body fat and weight loss with menstrual irregularity has been widely researched. There are several studies showing amenorrheic athletes to have significantly less body fat and lower body weights than cyclic athletes (Cohen, 1982; Frisch et al., 1980; Lutter and Cushman, 1982; Speroff and Redwine, 1980). Conflicting studies show some low fat athletes to be cyclic (Baker et al., 1981), some high fat or high weight athletes to be amenorrheic (McArthur et al., 1980), and some athletes to regain regular menses without changes in weight (Wakat et al., 1982).

Carlberg, Buchman, Peake and Riedesel (1983) evaluated the body composition of 14 oligo/amenorrheic athletes and 28 eumenorrheic athletes. Seven of the oligo / amenorrheic women had been totally amenorrheic in the previous year and 7 had been oligomenorrheic, with 1-6 menstrual periods during the previous year. Amenorrhea ranged from 3 to 70 months, with a mean duration of 30 months. Both subject groups were similar in age and height.

The oligo/amenorrheic group was significantly lighter than the regularly menstruating athletes on: total body weight, 50.3 kg versus 58.0; ideal body weight, 101.6% versus 92.0%; and Livi Index 23.2 versus 22.4 (Olivier G., 1969). Significant differences were also found for: percent body fat, 13.18% for oligo/amenorrheics compared to 16.3% for eumenorrheics; fat weight, 6.6 compared to 9.5; and lean body weight, 43.7 compared to 48.5.

There was a considerable range of overlap between groups on all variables. There was a 10 kg overlap on weight, 1.5 on the Livi Index, 10% on body fat, 5 kg on fat weight and 12 kg on lean body weight. Therefore, the authors concluded that there was no critical level of body fat or body weight necessary to maintain menstruation as Frisch (1974) hypothesized. Carlberg et al. (1983) and others have hypothesized that "threshold" for menstruation is individual and population norms cannot be developed. However, it is interesting to note that researchers (Shangold & Levine, 1979) have found lower other mean body weights and percent fats for groups with menstrual irregularities compared to those without.

Weight loss: The possible effects of weight loss rather than just fat loss has also been postulated as a contributing factor. Speroff and Redwine (1980) have suggested that weighing less than 115 lb or losing greater than 10 lb after the initiation of running training

increases one's risk of menstrual irregularity. In fact, low body weight and simple weight loss without exercise has been associated with amenorrhea (Vigersky et al. 1977; Wentz, 1980). Baker et al. (1981) studied 23 white female runners and found that the amenorrheic group not only weighed less (50±2 kg versus 53±1 lg) and had less body fat (14.1±1.2% versus 17.7±0.8%), but also had had greater weight loss (2 to 7 kg versus 1 to 4 kg) than the eumenorrheic.

A more recent investigation by Bullen and associates (1985) further exemplifies the compounding effects of weight loss with strenuous exercise. Twenty - eight untrained college women with hormonally documented ovulation and luteal sufficiency were put on an intensive running program. Subjects were expected to run 6.4 km per day progressing to 16.1 km within 5 weeks, and participate in 3 1/2 hrs of moderate activity each day. The subjects were divided into weight - maintenance (N = 12) and weight - loss (N = 16) groups, with age, gynecological age, initial weight, initial body fat, mean total running distance and mean distance on running days being equal. Urinary excretion concentrations of lutenizing hormone, follicle-stimulating hormone, estrial, free progesterone and creatinine were measured using the procedures described by Bullen et al. (1984).

The weight of the weight maintenance group was held

within 2 kg with a mean weight loss of 1 ± 0.2 kg by the end of the training period. The weight loss group was limited to a loss of 0.45 kg per week, with a final mean loss of 4 ± 0.3 kg.

The exercise induced irregularity, with 4 of the 28 subjects having normal cycles during the 8 week training period. Delayed menses and loss of the lutenizing hormone surge occurred more frequently in the weight-loss group ($p < 0.005$) than the weight-maintenance group ($p < 0.05$). In addition, 44% of the weight-loss group was found to proceed from abnormal luteal function during the first 4 training weeks to a loss of luteinizing hormone during the second 4 weeks. The assessment of luteal function presents another element in the study of menstrual irregularity.

Corpus Luteal Sufficiency. Shangold (1985) has presented the following progression of events with increasing severity of menstrual dysfunction: first, luteal phase deficiency with or without prolongation of the follicular phase; second, eueastrogenic anovulation; and third, hypoestrogenic amenorrhea. The author has commented that having regular bleeding intervals does not preclude normal ovulation or luteal function. Ovulation occurs when the wall of the ovary ruptures and the ovum is released. The luteal phase of the menstrual cycle is the period of time during which the corpus luteum is an active endocrine

structure producing progesterone and estrogen (Tepperman, 1984).

Progesterone has a hyperthermic effect. In an average woman this effect usually lasts 12 to 13 days, with phases less than 10 days being connected with infertility (Doung, 1969) and constituting corpus luteal insufficiency. Prior and associates (1982) found that in 48 cycles of apparently eumenorrheic athletes, 33% were anovulatory and 33% had abnormal luteal function.

In the investigation mentioned above by Bullen et al. (1985), normal menstrual function was identified by a biphasic bedtime temperature curve, an ovulatory pattern of gonadotropin and sex-steroid urinary secretion, and a parabolic free progesterone excretion curve lasting for at least nine days between the LH surge and the following menstrual period. Sixty-six percent of the weight-maintenance group and 63 percent of the weight-loss group developed abnormal luteal function. Forty-two percent of the weight-maintenance and 81% of the weight-loss groups developed loss of LH surge indicating anovulation.

Other Factors. Sport specificity and psychological stress have also been proposed as related factors in menstrual irregularity. Incidence rates have been reported higher in runners and ballet dancers than cyclists and swimmers. Like these athletes, bodybuilders tend to either maintain low levels of body fat, or attain them for

competition. Since bodybuilders resemble runners and dancers in body composition characteristics, and possibly in training intensity, the incidence of oligomenorrhea and amenorrhea may similarly be higher than in other athletic populations and the general population.

Stress. Stress has also been associated with menstrual dysfunction. Schwartz et al. (1981) found that amenorrheic runners perceive their exercise as more stressful than do eumenorrheic runners. Using the Hopkins symptom checklist, Galle, Freeman, Galle, Huggins and Sonheimer found that amenorrheic runners scored higher on obsessive-compulsive behavior traits than normally menstruating runners did. On the other hand, Gray and Dale's (1983) results concerning runners was contradictory, with no correlation being found between number of cycles per year and scores on the Schedule of Recent Events. It is possible that the training for bodybulding competition compounded by the necessity of dieting to decrease body fat and body weight is a great physiological stress.

Menstrual History Survey

Limitations. In light of the definitive criteria for menstrual irregularity-anovulation and insufficient luteal function, the limitations of using questionnaires to determine menstrual status must be presented. As Prior (1982) has shown, normal menstrual bleeding patterns do not rule out those two disorders. The hormone profiling

necessary for such evaluations is impractical and expensive to do for large populations.

Classification. The criteria for classifying individuals by menstrual status is inconsistent in the literature. The definition of eumenorrhea appears to be agreed upon as being consistent cycles of less than 36 days, usually denoted as 21-35. The definition of oligomenorrhea varies somewhat depending on the classification of amenorrhea. Researchers agree that cycles of 36 to 89 days and cycles that occur at inconsistent intervals are oligomenorrheic. For example, Lutter and Cushman (1982) used the response to the question, how often do you have a period?: Very difficult to say, sometimes monthly, sometimes skips several months.

Amenorrhea is the most inconsistently defined. Some studies define it by amenses for 3 consistent months (Galle et al. 1983) some say 6 consistent months (Frisch et al., 1981) and some say for 12 or more consistent months (Lutter and Cushman, 1982).

The following presents the criteria used by several authors to classify menstrual status in research investigations. Eumenorrheic has been defined as cycles between 23 and 35 days in length by Carlberg et al. (1983), cycles between 21 and 34 days by Galle et al. (1982), and as menstruation at intervals less than 35 days in length by Lutter and Cushman (1982).

Amenses for 3 to 4 months has been considered oligo/amenorrheic by Carlberg et al. (1983) and oligomenorrheic by Frisch et al. (1981). Frisch et al. (1981) classified amenorrhea as amenses for the previous 6 months. Galle et al. (1983) considered cycles of 35 to 89 days as oligomenorrheic and cycles of greater than 90 days as amenorrheic. Lutter and Cushman (1982) used the following criteria for oligomenorrhea: having cycles of 36 to 120 days, having less than 2 menstrual periods per year and having inconsistent cycles that occur sometimes monthly and sometimes skipping several months. Amenorrhea was defined as amenses for 12 or more months.

Anorexia and Bulimia in Athletes

Evidence of the increasing incidence of anorexia and bulimia in the general population (Bruch, 1978; Crisp, Palmer and Kalucy, 1976; Schwartz, Thompson and Johnson, 1982) has lead to further research on eating disorders among athletes. In a survey study involving 2,977 athletes, Parr et al. (1980) found that the number one nutritional concern among athletes was weight control. Many athletes practice poor nutritional habits and use extreme measures to lose weight and maintain minimal levels of body fat to improve their athletic performance (Benson et al., 1985; Rosen et al., 1986; and Smith, 1980). It has been documented that wrestlers may lose up to 10% of their body weight in several days to qualify for lower weight

classes (Tipton and Teheng, 1970; and Zambraski, Foster and Gross, 1976). Reducing food and water intake drastically and exercising excessively are common practice (Houston et al., 1981; Widerman and Hagan, 1982). Ballet dancers often maintain extreme hypocaloric diets for long periods of time or use techniques such as vomiting and laxative abuse for weight control (Benson, 1985; Peterson, 1982). Being tall and thin enhances the lines and dimensions of the images projected through dance; being soft and curvy distorts them.

To determine whether such behavior is sports-specific, Crago et al. (1985) conducted a 5 year study of collegiate, intramural athletes, but did not find a decline in height-weight ratios of female athletes across time, nor did the sports classified as rigorous, self-competitive, or diet-conscious (cross-country skiing, gymnastics, swimming, and track) attract women with lower height-weight ratios as was expected. In a study of college varsity athletes, however, Rosen et al. (1986) found that 32% of the females practiced at least one pathogenic eating behavior of either self-induced vomiting, binging more than twice a week, or using laxatives, diet pills, and/or diuretics. A follow-up study indicated that the weight concern was for athletic performance, not appearance. The gymnasts (74%) and distance runners (47%) had the highest prevalence of pathogenic eating behavior. Considering the low intensity

of intramural sports compared to varsity sports, it is possible that Crago's subjects more resembled the general population than did Rosen's varsity athletes.

While body fat norms among females in the general population range from 20-28% of body weight (Sloan et al., 1962; Wilmore and Behenke, 1970, Young, 1961), gymnasts, distance runners, cross-country skiers, and ballerinas are often lower than 10% (Smith, 1980). Freedson et al. (1983) found that 60% of competitive female body builders had less than 14% body fat and 50% of those women had less than 11% body fat. Ninety percent of them felt they were above their competitive body weight. Documentation is needed to assess the average body fat levels for bodybuilders for competition and for training periods, and to assess dieting and weight-maintenance techniques. The necessity of achieving low levels of body fat for competition may encourage pathogenic eating habits among bodybuilders.

Eating Disorders. Anorexia nervosa and bulimia are eating disorders which typically affect young women between the ages of 12 and 22. Anorexia has been estimated to affect as many as 1 in every 100 teenagers and young adult women (Bayer and Baher, 1985), and 1 in every 250 girls between 12 and 18. Incidence rates of bulimia have been estimated to be as high as 79% (Hawkins and Clement, 1980). Yager (1984) reports rates of only 5-15% in men. Characteristics of Anorexia and Bulimia. The Diagnostic

and Statistical Manual of Mental Disorders (DSM III) produced by the American Psychiatric Association (1980) is frequently used by researchers to diagnose anorexia nervosa (Herzog, 1984; Mitchell, 1985; Romeo, 1984). DSM III characterizes anorexia as an intense fear of becoming fat, a weight loss of greater than 25% of original body weight, a disturbance in body image, a refusal to maintain a body weight normal to age and height, and no known physical illness that would account for weight loss (Garner and Olmsted, (1984).

Bulimia is characterized by consumption of large quantities of food in a short period of time, obsession with food and eating, and a sense of loss of control concerning eating habits (Garfinkel and Garner, 1982). Obsession with food and weight are prominent in both syndromes; however, self-induced starvation and extreme weight loss below normal weight are indicative of anorexia nervosa, while binge eating and purging behaviors are associated with bulimia. Mitchell, Hatsukami, Eckert, and Pyle (1985) studied eating behaviors of 275 bulimia patients and found that all of them reported episodes of binge eating, 88% self-induced vomiting, 60% either abused laxatives or diuretics, and 65% chewed and spit out food. Over one-third of these subjects reported overeating when feeling anxious and tense or unhappy. Over 50% said they overate when they felt out of control. In anorexia, the

discipline and ability to fast or induce self-starvation provides a sense of self-control and achievement, while bulimics feel a loss of control and self-esteem due to their binging (Levenkron, 1982).

Eating Disorder Inventory (EDI).

The EDI is a 64-item questionnaire developed and validated by Garner, Olmsted and Polivy (1983) for use in clinical research. The instrument measures 8 constructs indicated by research literature and clinicians to be characteristics related to anorexia and bulimia. Although 11 constructs were initially proposed, only 8 dimensions were found to be valid and reliable. The following is a presentation of the eight subscale constructs of the EDI.

Drive for Thinness. The obsessive desire to be thin and fear of being fat is the most prominent symptom of both anorexia and bulimia. Anorexics induce self-starvation and bulimics vomit or purge themselves after binge-eating to lose weight and attain thinness.

Bulimia. This subscale evaluates tendencies toward binge-eating and self-induced vomiting or purging. Levenkron's (1982) description of bulimics as tending toward addictive behaviors has been supported by other researchers who have examined cigarette, alcohol and drug problems. (Herzog, 1984; Kaye, Michael, Ebert, G. Wirtsman and Weiss (1984); Mitchell et al., 1985).

Body Dissatisfaction. A negative body image or

dissatisfaction with adult weight and shape, perceiving oneself or body parts as being too big or fat is characteristic attitudes of individuals with eating disorders. Some investigators have found that such individuals actually over-estimate their body size and distort their body image (Casper, Offer and Ostrov (1981); Slade and Russell, 1973).

Ineffectiveness. This scale assesses feelings of inadequacy or general lack of control. Such low self-esteem has been suggested as being a fundamental component of anorexia nervosa.

Perfectionism. This scale assesses the tendency to have extremely high personal expectations. Many anorexics and bulimics have histories of being exceptional academic achievers and being characterized as perfect children by their parents. Bruch (1973 and 1978) postulates that this is an overconforming adaptation in an attempt to gain acceptability.

Interpersonal Distrust. Another emotional conflict prevalent in eating disorder patients is a fear of or inability to develop close relationships and to express emotions. Anger or negative emotions are often not revealed for fear of rejection and not conforming to the perfect self-image (Bayer and Baker, 1985)

Interoceptive Awareness. Another common personality trait of anorexics is a lack of confidence in identifying

and evaluating internal sensations such as hunger and satiety (Garfinkel and Olmsted, 1985). In inducing self-starvation and extreme overeating, one must deny internal cues to eat and stop eating, perhaps such individuals train themselves not to identify such sensations or to attribute them to other factors.

Maturity Fears. The avoidance of sexual maturity through eating behaviors or weight loss has been considered a factor of anorexia and bulimia since the late 1920's during Freud's psychoanalytic dominance (Bruch, 1973). In view of the facts that anorexia often pivots around puberty, and that two major symptoms of the disorder are amenorrhea and weight loss to pubescent body proportions, Romeo (1984) suggests that sexual conflict is a fundamental issue.

Exercise. Activity is another key topic in eating disorders. Hyperactivity to prevent weight gain is another classic characteristic of anorexia and bulimia (Damlouji and Ferguson, 1985; Jager, 1984). In fact while individuals with eating disorders may take up excessive exercise programs to decrease weight, athletes may develop eating disorders to reduce body fat and improve athletic performance.

Anorexia Nervosa In Athletes. The importance of low body fat and thinness in bodybuilding competition is as dominant as it is in ballet and gymnastic performance.

Obsessive weight consciousness can be addictive and continue to prevale when not in training.

While cases of eating disorders in males are not as common as in females, they usually center around athletics or hyperactivity (Yager, 1984). Researchers are now investigating cases of anorexia athletica and comparing compulsive, obligatory runners to anorexics (Caldwell, 1984; Nutrition and M.D., 1984; Yates Leehey and Shisslah, 1983).

While anorexia tends to affect young females, obligatory running is more prevalent in males 30-60 and is characterized by a complete committement to running, regardless of work, family, illness or physical injury. Yates et al. (1983) interviewed approximately 60 marathon or trail runners to explore the similarities between anorexics and obligatory runners. They concluded that while anorexics have an all-consuming drive for thinness, these runners are consumed by their single-minded commitment to physical effectiveness. As an anorexics life revolves around dieting and she is reluctant to form close relationships with others, the runners become anxious and depressed with physical deterioration and isolate themselves to devote them to their running. While anorexics ignore their visceral cues of hunger and satiety, these runners ignore physical injury and illness. According to Yates et al. (1983), the goals in both cases

become unreasonable obsessions which dominate and possibly destroy the individuals life.

While the connection may and is being questioned (Caldwell, 1984), the environment of athletics, particularly those sports where weight and body fat fundamental issues, could encourage or precipitate weight obsessions and lead to eating disorders.

Body Composition Assessment In Athletes

The three major techniques used in the estimation of body composition are skinfold measurements, hydrostatic weighing and girth measurements. Hydrostatic weighing to estimate body density is considered the "gold standard" for calculation of percent fat (Jackson, 1984; Pollack and Jacobson, 1983; Wilmore, 1982). However, current literature warns that with the underwater weighing technique, equations may tend to underestimate body density of older people and underestimate body density in athletes (Pollack and Jackson, 1984). In a review of body composition assessment methodologies, Wilmore (1983) reiterates that the procedures rely on basic assumptions which may be sources of error.

Siri (1956) and Brozek Grande, Anderson and Keys (1963) developed the two major equations used for calculating body fat. Despite the limitations of this method, improved techniques have not yet been fully developed and validated. Densitometry remaines the gold standard by

which other methods are compared.

Skinfold measurements are often used for field studies since they are less expensive and less complicated techniques. Skinfolds have been found to be more valid predictors of body density than combinations of height and weight (Baumgartner & Jackson, 1982; Lohman, 1982). Intertester reliability of skinfold site measurements has been shown to be quite high. Jackson, Pollock, and Gettman (1978) found that intratester calculations of percent body fat differed by .3%, with a correlation coefficient exceeding r = .97. The recent literature available on bodybuilder's physique and body composition have employed hydrostatic weighing and skinfold measurements to estimate percent body fat.

Anthropometric Measurements. Although it has been suggested that population-specific equations may be needed to accurately assess body composition within specific groups (Sinning, 1980), Jackson, Pollock and Ward (1984) used regression equations to derive generalized equations for predicting body density in women differing in age and body composition. They compared equations using seven, four and three sites and concluded that one of the three-site equations was most feasible for mass testing and had cross-validation statistics similar to the other equations. In a validation study comparing various equations however, Sinning and Wilson (1984) reported that

the mean of the Jackson-Pollock-Ward equation using skinfold sites did not differ significantly from densitometric values.

Sinning and Wilson (1984) conducted a validation study to compare %BF calculated from generalized skinfold equation to hydrodensitometry. Seventy-nine inter-collegiate athletes from Kent State University underwent body composition assessment by hydrostatic weighing and skinfold measurements. Hydrostatic weighing was conducted using the procedure of Sinning (1977). Skinfold measurements were taken on the right side using Harpenden calipers. The site of the tricep site was described as, "the longitudinal fold midway on a line from the acromium process to the olecranon process on the dorsum of the arm." The suprailiac oblique, used in the Jackson, Pollack and Ward (1980) equations, was described as a "horizontally oriented fold following the natural oblique stress lines of the skin, immediately superior to the iliac crest and anterior to the midaxillary axis." The abdominal site was the "vertical fold adjacent to the umbilicus but not including the umbilicus tissue." Site for the thigh was described as "midway between the inquinal fold and patella." The mean of three measurements was considered the criterion. Other skinfold sites used by the other researchers were also described. Both the 4-site and 3-site equations from Jackson, Pollock and Ward (1980) were

generalized equations validated by Sinning and Wilson (1984). Seven other equations were chosen to represent and compare "generalized" and "population specific" equations.

The data analyses from Sinning and Wilson's (1984) validation study involved computation of %BF from Brozek et al. (1963) equations of Fat (kg) = weight (kg) x % Fat/100. The t- test was employed to compare % BF mean for densitometry and skinfold determination. An SPSS subprogram Scattergram was used to compute Pearson Product Moment Correlations, regression lines and standard errors of estimate. Total error (E) was computed by Lohman's (1981) procedure.

All of the assessed equations underestimated body density from 0.12 to .001g/cm^3 except the 4-site Jackson - Pollock - Ward equation. The mean %fat and fat (kg) computed by this equation and the equation by Sloan, Burt and Blyth (1962) were the only ones which did not significantly differ from densitometry. The 3-site Jackson - Pollock - Ward equation was found to overestimate % fat by $\pm$ 1.0% and fat by 0.5kg.

The authors concluded that the 4-site Jackson - Pollock - Ward equation was superior to all other equations, and that the 3-site equation was comparable to the Katch and McArdle (1973) equation for evaluating % fat and fat of female athletes.

Summary

Most of the literature available specifically on bodybuilders concerns psychological and personality characteristics of competitive and non-competitive weight lifters; however, investigations of physical characteristics indicate that most bodybuilders have low functional capacities and low percentages of body fat. In addition, the high degree of menstrual dysfunction in athletes, and the factors associated with sports-related dysfunction suggest that weight training females may be more susceptible than the general population to oligomenorrhea and amenorrhea. Training intensity, age, body composition, weight loss and stress of composition are some related factors that predispose other athletes and possibly weight lifters to irregularity.

The necessity of dieting and achieving low %BFs may also encourage bizarre eating behaviors among bodybuilders. Athletes such as ballet dancers and wrestlers have been shown to develop such habits to achieve desired weight loss to improve athletic performance. The prevalence of menstrual irregularity and of eating disorders in bodybuilding and weight lifting women remains to be investigated.

Chapter 3

JOURNAL MANUSCRIPT

ABSTRACT

To obtain descriptive data concerning female bodybuilders and women who weight train, a questionnaire concerning training regimes, menstrual history and dieting strategies was developed and administered with the EDI included as part of the questionnaire. Factors assessed included: incidence of menstrual irregularity, scores on the Eating Disorder Inventory (EDI), prevalence of behaviors associated with eating disorders, and mean body fat. Subjects were between the ages of 18 and 35 and included individuals from Personal Health Classes at Virginia Tech, the Virginia Tech Weight Lifting Club, and Goad's Gym in Blacksburg, Virginia. Subjects were classified by activity, (weight lifters versus controls) involvement (high, mocerate and low) and competition (competitive versus non-competitive).

Chi-square analyses indicated that there was no difference in incidence rates of menstrual irregularity between weight lifters (WLs) and controls (Cs); however, the rates of both groups were found to be higher than the general population. Although there was no difference in menstrual function of involvement groups, 50% of the competitors, significantly more than non-competitors were classified as oligomenorrheic or amenorrheic.

All subject groups had mean scores approaching anorexic patient norms on the EDI Bulimia and Maturity Fears

subscales. WLs were significantly higher on Drive for Thinness than Cs, and more WLs had subscale scores higher than the mean score presented for anorexics. Additionally, significantly more WLs reported uncontrollable urges to eat, fear of fat, and history of anorexia. Mean %BF of the WLs was 20.18% with competitors being significantly leaner than non-competitors

The high degree of menstrual dysfunction in both WLs and Cs is confusing; yet, the 27% incidence of oligo/amenorrhea in WLs is much higher than the rates documented for the general population. The high Drive for Thinness and incidence of negative eating behaviors indicate that the prevalence of eating disorders in this population may progress as this relatively new sport evolves and competitive participation increases.

Chapter 3

MANUSCRIPT

INTRODUCTION

Bodybuilding is a sport that is rapidly growing in popularity. For competitive training, a combination of dieting and weight lifting is applied to maximize muscle definition and mass and achieve whole body symmetry.

Little scientific information is available on bodybuilding athletes and their dieting and weight training strategies. Considering the importance of dieting for competition, this population may be prone to negative dietary practices similar to some wrestlers and ballet dancers. It has been documented that wrestlers may lose up to 10% of their body weight in several days in order to qualify for a lower weight class (42, 46). Drastically reducing food and water intake while exercising excessively is common practice (24, 43). Ballet dancers frequently maintain prolonged hypocaloric diets or use techniques such as vomiting and laxative abuse for weight control (3,36).

As a consequence to intensive activity and extreme dietary practices, female bodybuilders may experience another health risk. Female athletes have a higher incidence of menstrual irregularity than the general population (4). For example, Loucks and Horvath (27) reported the incidence of amenorrhea to be 20 times greater among athletes. The highest rates of amenorrhea appear to

be in ballet dancers (18,13) and runners (15,34), who like bodybuilders, often maintain low levels of body fat and high levels of exercise. A survey study was conducted to provide descriptive information on female bodybuilders and women who weight train, and to specifically assess the incidence of menstrual irregularity and eating disorders of this athletic population.

METHODS

Subjects. One hundred and three weight female weight lifters (WL), were surveyed at the spring registration of the Virginia Tech Weight Lifting Club and Goad's gym in Blacksburg, Virginia. A control sample (C) of 92 women was obtained from Personal Health classes and the faculty and staff of Virginia Tech. The majority of subjects were 18 to 24 years of age. Since 4 of the weight-training women were 30 to 35 years of age, 4 age-matched controls were recruited from the Virginia Tech faculty.

The survey was developed with questions concerning present training regimes and dieting patterns. The EDI was included as part of the survey.

Group Categorizations. All subjects were categorized by activity group according to whether they were weightlifters (WL) or non-weight lifting controls (C). These groups were denoted as activity groups to distinquish them from all other subject groupings. Using the questions, "How many times a week do you usually weight

train?" and "During an average workout, how long do you actually spend lifting?" WLs were divided into 3 groups according to level of involvement. The high involvement group (HI) consisted of 20 women who weight-trained from 225 to 300 minutes a week. The moderate involvement (MI) subjects (n=50) lifted from 135 to 240 minutes a week while the low involvement (LI) subjects (n=31) lifted 15 to 180 minutes per week.

A third way that WLs were also divided was into a competitive (COMP) group with 12 subjects and a non-competitive (N.COMP) group with 89 subjects. All WLs who had competed in one or more bodybuilding meets were classified as competitors. At the time of the survey distribution, 4 of the competitors were lifting at a high involvement level, 6 at a moderate involvement level and 2 at a low involvement level.

For assessment of menstrual irregularity, WLs plus Cs were divided into menstrual categories of eumenorrheic (EUMEN) or normally menstruating subjects, oligomenorrheic (OLIG) or irregularly menstruating subjects and amenorrheic (AMEN) or non-menstruating subjects. Using cycle length and interval consistency, subjects reporting menstrual cycle lengths of less than 36 days occurring at consistent intervals were classified as eumenorrheic. Oligomenorrheic subjects were those reporting cycle lengths of less than 36 days occurring at inconsistent intervals, those reporting

lengths of 36-89 days whether occurring at consistent or inconsistent lengths and those reporting varying cycles occurring sometimes monthly, sometimes skipping several months. Subjects reporting a lack of menstruation for the previous 12 months or more were classified as amenorrheic. No subjects reported menstrual cycles of 90 or more days in length.

PROCEDURES

Survey. In addition to the formulated weight training and menstrual questions, the Eating Disorder Inventory (EDI), a 64-item self-report questionnaire was used to assess the prevalence of psychological and behavioral characteristics associated with anorexia nervosa and bulimia. Comparisons of mean subscale scores were made between the 2 activity groups (WLs and Cs), the 3 involvement groups (HI, MI and LI), the 2 competition groups (COMP and N-COMP) and the 3 menstrual groups (EUMEN, OLIG and AMEN). Between group comparisons were made for all 8 subscales which include the following:

1)Drive for Thinness, 2)Bulimia, 3) Body Dissatisfaction, 4) Ineffectiveness, 5)Perfectionism
6)Interpersonal Distrust, 7) Interoceptive Awareness and 8) Maturity Fears subscales.

Percent Body Fat Estimations. Skinfold measurements for percent body fat (%BF) estimations of the weight-trained women were either taken at the time of survey

completion or during a later, predetermined meeting. Body fat estimations for the control subjects were not conducted; however, age-group norms were used to compare mean body fat of the weight-training groups to the general population. Seven of the weight-training subjects were not available for skinfold measurements and were therefore not included in the percent body fat estimations.

Skinfold measurements of the tricep, abdomen, suprailium and thigh were taken on the right side using Harpenden skinfold calipers. In a validation study, Sinning and Wilson (40) indicated that Jackson, Pollock and Ward's (25) 4-site skinfold equation for %BF correlated more highly with densitometry. The 3 site equation was considered to over estimate %BF slightly, but was more convenient for assessment of large populations. Therefore, body density (BD) was calculated twice, using 2 equations from Jackson, Pollock and Ward (25), one involving the measurements for all 4 skinfold sites, the other involving only the tricep, suprailium and thigh. The average of three measurements for each site were used as the criterion measurements for percent body fat estimations.

DATA ANALYSIS

A SAS statistical program was used to obtain descriptive statistics. Frequencies for the Combined group of WLs plus Cs were obtained for all items. Chi-square analyses were performed to determine significant

differences between WLs and Cs on all items. In addition, Pearson Product Moment Correlational Analyses were run to indicate relationships among all items, specifically between the dependent measures: Menstrual Status, EDI subscale scores, %BF, and the three subject groupings: activity, involvement, and competition. One-way Analyses of Variance were performed to determine statistical differences between all groups for each subject grouping on EDI subscale scores and %BF estimations. The Tukey Studentized Range (HSD) Test was used to determine the means between which significant differences existed. If the Chi-square indicated no significant difference, ANOVA's were not conducted. Statistical significance for all analyses was set at the .05 level.

RESULTS

Menstrual status. Menstrual status is presented in Table 1 for WLs and Cs, Table 2 for involvement groups, and Table 3 for competition groups. Seventy-three percent of the WLs (n = 75) and 78% of the Cs (n = 72) were classified as eumenorrheic. Additionally, 51% of the eumenorrheic subjects and 59% of the oligomenorrheic subjects were WLs. Only 4 subjects reported being amenorrheic, 2 from the WLs and 2 from the Cs. Twenty-seven percent of all the weight lifters (n = 28) compared to 22% of the Cs (n = 20) had some form of menstrual dysfunction. Two eumenorrheic WLs who responded to the questions concerning menstrual

history did not respond to the questions concerning weight training involvement or hours per week of weight training and are therefore, not included in the involvement groups. Sixty-five percent of the HI group (n = 13) were eumenorrheic , 35% were oligomenorrheic (n = 9) and none were amenorrheic. Twenty-six percent of the MI group (n = 13) had menstrual irregularity. Both of the amenorrheic WLs, were in the MI group, one was a competitor and the other was a non-competitor. Twenty-two percent of the MI group and 26% of the LI group were oligomenorrheic. There was no significant difference among activity or involvement groups.

A significant low positive correlation was found between competition and menstrual irregularity (r = .21). The obtained X^2=5.052 df = 2 for competition by menstrual status and was significant at the .08 level.
Only half of the competitors reported that they regularly menstruated with the remaining 50% being classified within the menstrual irregularity groups.

Related Menstrual Data. When asked at what age they had their first menstrual period, 85% of the subjects reached menarche between 12 and 17 years of age. Fifteen percent of the WLs (n = 15) and 14% of the Cs (n = 13) had menarche before age 12. Only one subject, a control, reported menarche after age 17. There were no correlations of age of menarche with subject groups, involvement groups,

or competition groups.

When questioned about the number of periods they had in the year prior to the survey, significantly more WLs, 43% (n=44) than Cs, 27% (n = 24) reported missing at least one period. The obtained X^2 = 5.671, df = 1 and p < .01. The explanations they offered for the missed periods ranged from pregnancy, dieting, change in exercise, illness and a combination of dieting and illness, with 35% of WLs (n = 16) and 22% of Cs (n = 6) attributing the absence of menses to a change in exercise or a combination of dieting and illness. The response frequencies did not differ between groups.

When questioned about birth control. Frequency of birth control use was no different between activity groups. Forty percent of WLs (n = 41) and 38% of Cs (n = 36) were currently taking them at the time of the survey.

Eating Disorder Inventory Scores. Mean EDI subscale scores for activity groups are presented in Table 4, for involvement groups in Table 5, for competition groups in Table 6, and for menstrual groups in Table 7. Figure 1 compares WLs and Cs to the norms developed for Female College Students (FC) and Anorexic patients (AN). Figure 2 compares the involvement groups while Figure 3 compares the menstrual status groups. WLs and Cs scored statistically different on only one EDI subscale, the Drive for Thinness. The group norms presented in the Manual for

Eating Disorder Inventory (20) presented a mean of 13.8 ± 6.1 for Anorexia patients and a mean of 5.51 ± 5.5 for FC students. On the Drive for Thinness scale, WLs were significantly higher than the Cs, with the WLs scoring in the 15th percentile for AN patients and the 71st percentile for Female College Students (FC), while the Cs were in the 11th percentile for AN patients and the 62nd percentile for FC students.

The range of Drive for Thinness scores for WLs were distributed from 0 to 20, with 26% of the WLs and 16% of Cs scoring greater than the mean score for Anorexia Nervosa Patients (Mean = 11.7) and 16% of WLs and 8% of Cs scoring greater than the mean score for Bulimia Anorexics (Mean = 14.9).

Although there were no differences between activity, involvement or menstrual status groups on the bulimia scale, all subject group means were similar to or greater than the scores for Bulimic Anorexics. The scores for WLs ranged from 0 to 26 and for Cs from 0 to 27, with 82% of WLs and 86% of Cs scoring higher than anorexia patients and 57% of WLs plus 42% of Cs scoring higher than Bulimic Anorexics. Mean score for anorexic patients can be found in the EDI manual.

ANOVAs indicated that the involvement groups were statistically different on 2 subscales, Interpersonal Distrust and Interoceptive Awareness. Further non-

parametric analyses with the Tukey studentized comparison, revealed that the LI group was significantly higher than the MI group on the Interpersonal Distrust scale. However, the HI group was not statisitically different than either the LI or the MI group.

Scores on the Interpersonal Distrust scale ranged from 0 to 14 for WLs and 0 to 12 for Cs. Twelve percent of WLs scored higher than the anorexic and bulimic norms (6.2 and 6.6) while only 7% of Cs had scores higher than 6.

The Tukey Studentized test failed to support the results of the ANOVA on the Interoceptive Awareness scale and indicated no significant differences in mean scores between the involvement groups at the .05 level.

On the Interoceptive awareness subscale, WLs scored between 0 and 13, with 4% scoring higher than the anorexic mean score and 2% scoring higher than the bulimic mean score. Cs ranged from 0 to 9 with 1 individual (1%) having a score of 9, equal to the anorexic mean and no one scoring 12 or greater, equal to the bulimic mean score.

There were no statistical differences between competition groups on any EDI subscale scores.

According to the one-way ANOVAs, statistical differences were found between menstrual status groups on the Body Dissatisfaction and the Ineffectiveness scales. The AMEN group scored highest on Body Dissatisfaction, with a mean score of 4.50, while the EUMEN and OLIG groups had

similar scores of 2.65 and 2.89, respectively. On Ineffectiveness, however, the AMEN group had the lowest score (mean = 0.25), the EUMEN had the next lowest score (mean = 1.15) and the OLIG had the highest score (mean = 2.03).

Again however, the variances between the means on both scales were not great enough to reveal significance on the post-hoc comparison.

On Body Dissatisfaction, both WLs and Cs had scores ranging from 0 to 9, in the range of the mean score presented for Female College Students (Mean = 9.7). The scores for anorexics and bulimics were considerably higher with means of 13.4 and 16.7 respectively.

On Ineffectiveness, WLs ranged 0 to 15, higher than Cs who scored between 0 and 9. Three percent of WLs had scores greater than anorexic patients (Mean = 9.9) and 2% had scores greater than or equal to bulimics (Mean = 13.3). One control (1%) had a mean score of 9, equal to the anorexic mean.

There were no mean differences between any of the subject categorization groups on Perfectionism or Maturity Fears. The frequencies of scores on Perfectionism were distributed between 0 and 12 for WLs and 0 and 9 for Cs. Only 4% of WLs plus 3% of Cs scored higher than 7.7, the Anorexia Nervosa patient mean; additionally, only 2% WLs

plus 1% of Cs scored higher than 9.1, the Bulimia Nervosa mean.

On Maturity Fears, all mean scores of subject groups approached or were greater than Anorexic (5.7) and Bulimic (5.6) mean scores. The score range of WLs was 0 to 18, with 45% scoring greater than anorexics and bulimics. For Cs the range was from 0 to 15, with 40% scoring higher than anorexics and bulimics.

Eating Behaviors. Very low positive correlations were found for activity groups on several eating behavior questions. The correlation coefficients for subject classification, involvement (HI, MI, and LI), competition (COMP and N-COMP) and menstrual status (EM, OM, and AM) on the eating behavior questions (Q36-Q49) are presented in Table 11.

Thirty-seven percent of the WL (n = 38) and 24% of the Cs (n = 22) reported getting uncontrollable urges to eat and eating until physically ill with a significant Chi-square indicating between group differences.

Twenty-seven percent of the WLs (n = 28) and 12% of the Cs (n = 11) reported experiencing the fear of not being able to voluntarily stop eating with frequencies of WLs being significantly higher than Cs.

Sixty-two percent of the WLs (n = 63) and 58% of the Cs (n = 53) reported binge eating, or "episodes of eating enormous amounts of food in a short space of time." The

frequency distributions were no different for WLs than Cs.

Sixty-one percent of the WLs (n = 62) and 57% of the Cs (n = 48) reported feeling miserable after binge eating again with no frequency differences between activity groups.

Eighty-nine percent of (n=92) of the weight lifters and 85% (n=78) of the controls reported never using diet pills, 7% (n=7) of WL and 12% (n=11) of Cs reported usage of less than once a month and the remaining 4% of WLs (n=4) and 2% of Cs (n=2) used them from 1 to 3 times every month to 2 to 6 times a week. One control individual reported using diet pills once every day. The frequency distributions were not different between WLs and Cs.

The majority of WLs, 86% (n=89), and Cs 99% (n=91), reported never using laxatives. The other WLs and Cs reported usage from once a month to 2 to 6 times a week, with the frequency distribution of WLs being significantly higher than Cs.

In regard to the use of diuretics for weight control, 96% (n=99) of WLs and 93% of Cs (n=86) reported never using them. The other subjects reported usage of 1 to 3 times a month to less than once a month, with 1 C reporting using them more than once a day, with no differences between WLs and Cs.

The majority of WLs (95%, n=98) and Cs (96%, n=88) denied vomiting to control weight. The WLs and Cs that did

report vomiting, reported usage between 1 and 3 times a month. No differences were found between activity groups.

In response to the question, "Do you consider yourself to be or to have been bulimic?", 6% of the WLs and 1% of the Cs answered "yes, now"; 6% of WLs and 3% of Cs answered,"yes, used to be"; and 88% of WLs and 96% of Cs answered "no." Chi-square revealed no between group differences.

In response to the question, "Do you consider yourself to be or to have been anorexic," 1% of WLs and 1% of Cs responded "yes, now"; 17% of WLs and 5% of Cs responded that they "used to be" anorexic; and 82% of WLs and 93% of Cs responded "no," they were not and never had been anorexic. Chi-square indicated frequency of history of anorexia to be greater in WLs than Cs.

Thirty-six percent (n=37) of WLs plus 30% (n=28) of Cs reported overactivity/ exercise without enjoyment. Fifty-six percent (n=58) of WLs and 38% (n=35) of Cs reported feeling terrified of fat while 50% (n=35) of WLs and 41% (n=38) of Cs felt that they were fat despite others saying they were too thin. Forty-seven percent of the WLs versus 30% of Cs reported being obsessed or totally preoccupied with food. Although WLs did not have higher frequencies of exercising without enjoyment, or feeling fat despite others saying they were too thin, frequencies of feeling terrified

of fat and being obsessed with food were higher in WLs than Cs.

Body fat Estimations. Percent body fat estimates made from the 4-site equation highly correlated with the estimates from the 3-site equation, (r=.97). Therefore only the mean % BFs obtained from the 4-site equation were used for group comparisons. These means are presented in Table 8.

Dieting Strategies. When questioned about dieting for daily living, 33% of WLs did not usually diet while 12 % of Cs did not usually diet. There was no trend in dieting patterns of Cs with 18% reported dieting for 2 to 3 consecutive weeks and 15% reported dieting for a couple of days at a time then going off for a couple of days. When questioned about dieting for competition, 34 of the WLs responded although there were only 12 competitors. Twelve percent of those who responded said that they did not usually diet for competition. The most common chosen regime (38%) for competitive dieting was, to diet for 2 or more months at a time. The next common response, 29%, was dieting for 2 to 7 consecutive weeks.

Calories eaten per day for daily living ranged from 500-1000 to more than 2500 for Cs and WLs. The most chosen response was 1500-2000. In dieting to lose weight, the majority of WLs and Cs ate between 500 and 1500 Kcals with 51% of Cs and 46% of WLs eating 1000 to 1500 Kcals. The

majority of Cs plus WLs either dieted rarely or dieted several times a year.

DISCUSSION

Menstrual Irregularity. Twenty-seven percent of all weight lifters and 22% of the controls reported some form of menstrual irregularity. The incidence rate presented for the controls is much higher than the 2-5% that is presented in the literature for the general population (2,30,37). Like the subjects represented in the general population studies, the control subjects in this study were college aged women. Peterson, Freis and Nillius (30), presented a 1.8% incidence rate of menstrual dysfunction in the general population, but he also included women up to 45 years of age. As previously stated only 4 of the controls and 4 of the weight lifters were between 30 and 35 years of age. From the data presented, the reasons for the high level of menstrual irregularity in the control group cannot be determined.

Weight loss is a possible factor. Arrington et al. (1) found that 48% of 400 college women surveyed reported following a weight reduction program since enrolling in the university. In the study, 63% of the WLs and 60% of the Cs reported dieting to lose weight between several times a week and several times a year.

With 27% of all the WLs and 50% of the competitors reporting some form of menstrual irregularity, the

incidence rates are similar to those reported for other moderately trained athletic populations. Dale et al. (11) reported that 34% of women who ran more than 30 miles per week, and 23% of women who jogged 5-30 miles per week had menstrual irregularity. Feicht (15) and Sanborn (34) reported irregularity in 24-25.7% of competitive college runners and age-matched marathoners, while ballet dancers have been reported to have higher incidences (7, 10). In a survey study conducted at the Pacific Northwest Body Building Competition, Elliot et al. (14) found that 33% of the competitors not taking oral contraceptives had oligomenorrhea and amenorrhea. Perhaps our competition group had been larger, the incidence of dysfunction would not have been as great but would have been similar to rates found by Elliot and co-workers (14).

The incidence among the competitors is similar to rates of dysfunction presented for long-distance runners and marathoners. Sanborn et al. (34) found that 43% of the women running 70 miles per week had irregularity. Feicht et al. (15) reported a 50% incidence rate in marathoners.

Considering several major factors related to menstrual dysfunction - activity level, body fat and weight loss and stress, it is not surprising that the weight-training group had an incidence rate comparable to other athletes and that the incidence correlated with competition. However the mean % BF for the competitive group was not as low as

competitive long distance runners, suggesting that the dysfunction in this group may be more related to dieting or a combination of activity, weight loss and stress. Elliot et al. (14) found a similar % BF in female participants of the Pacific Northwest Body Building competition.

As Bonen and Keizer (4) and Loucks and Hovrath (27) have pointed out, the validity of the survey approach for assessment of menstrual dysfunction is questionable. First, the results are dependent on subject recall. Second, classification is difficult and the criteria for eumenorrhea, oligomenorrhea and amenorrhea are inconsistent throughout the literature. Researchers agree that menstrual cycles that recur consistently at intervals of 21-34 days are classified as eumenorrheic. Whether cycles between 21 and 34 days in length that occur at inconsistent intervals qualify as oligomenorrheic is not usually discussed. While investigators agree that inconsistent cycles of 35-89 days are consistently classified as oligomenorrheic, classification of consistent cycles of 35-89 days is not clear. Cycles that vary, sometimes occurring monthly and sometimes not occurring for several months, are consistently labeled oligomenorrheic, as absence of menses for 12 months is consistently considered amenorrhea. Ninety days of amenses however, is considered oligomenorrheic by some authors (26) and amenorrheic by others (19). Many researchers have avoided the

discrepancies by grouping oligomenorrhea and amenorrhea into one category of menstrual dysfunction of Athletic Menstrual Irregularity (4,35).

Another possible error associated with using survey questions to determine menstrual status is the inability to determine changes in hormonal status that precede oligomenorrhea. (4). For example, Bullen et al. (6) reported from a longitudinal study that 24 out of 28 women who began a rigorous running program had menstrual abnormalities by the end of the two month investigation. Although all of the women continued menstruating, many stopped ovulating and 18 had shortened luteal phases. These changes appear to be the first step in development of athletic menstrual dysfunction but are difficult to identify without more detailed information. Only a longitudinal study of women before and after initiating a weight training program could determine whether this physical activity would cause the same initial subtle abnormalities as a running program.

EDI Results. While WLs and Cs were no different on the Bulimia and Maturity Fears scales, both groups scored closer to the AN patients than to the FC students on these subscales. Bulimia is characterized by two behaviors, one is the tendency to consume large quantities of food in a single sitting, the other is the impulse to purge the body of unwanted calories through self-induced vomiting or

laxative abuse. The finding that the mean Bulimia scores of both the WL and C groups approached the AN patient norms is not as surprising as one would think. In a study conducted at the same college campus, Hart and Ollendick (18) found that binge-eating was present in 69% of the university women. However, only 5% of those women were found to have the syndrome of bulimia nervosa. In fact, Hart and Ollendick (22) pointed out that in recent investigations which indicate that bulimia is common among females, the incidences are not as high when purging behaviors are considered a pertinent characteristic for diagnosis (21,23).

The Maturity Fears subscale measures one's desire to remain a child and to be sheltered from the stress and problems of adult life. The act of starvation may be a means of achieving a prepubescent figure, and possibly avoiding sexual maturity.

Sexual maturity. Romeo (33) suggests that sexual pressures are associated with the disease since the symptoms of anorexia nervosa often appear with the onset of puperty and the development of secondary sex characteristics. Eating disorders have also been associated with other life events that involve change, such as parental divorce, car accidents and going away to school (5,12). Perhaps the high score of both WLs and Cs on the Maturity Fears scale reflects the sexual pressures of

college and the stress of school and being away from home.

It is interesting that WLs and Cs differed only on the Drive for Thinness scale. Since a result of weight training is muscle toning and development and the major goal of bodybuilding competition is maximal muscle mass plus definition, and a symmetrical whole-body image. It is possible that figure and weight-conscious individuals choose the sport of weight training specifically for its physique conforming effects. Among the subjects of this study, a high Drive for Thinness was not related to level of weight training involvement or competition, merely participation in weight lifting exercise.

Eating Behaviors. More WLs than Cs reported exhibiting several eating behaviors associated with anorexia and bulimia. More WLs said that they had uncontrollable urges to eat, that they sometimes ate until feeling physically ill and that they feared not being able to voluntarily stop eating. Significantly more WLs admitted to using laxatives, to being terrified of fat and to being obsessed with food. Two interesting results were that 17% of WLs, significantly more than Cs, felt that they used to be anorexic; additionally, 12% of WLs compared to 4% of controls felt that they were bulimic at the time of the survey , or that they had been bulimic at some time. Self-consideration of being bulimic was not statistically greater for WLs than Cs; however, the incidence in WLs was

higher than rates presented by Hart and Ollendick (22), Pyle et al. (32) and Stangler and Printz (41), while the Cs rate was similar to these 2 studies. These results suggest that the tendency toward eating disorders, or at least negative eating behaviors, may be greater in weight lifting college women than age-matched controls. Whether weight-conscious women choose weight lifting for its physique conforming effects, or whether the emphasis on body fat and dieting in bodybuilding encourages such behavior cannot be determined.

Percent Body Fat. The mean %BF for the entire group of weight lifters is on the low end of the 20-25% range presented for age group norms, and much lower than the 28% presented for sedentary women (45). Similar results have been for women basketball players, 20.9% (38) and female hurdlers and jumpers, 20.7% (44). A negative relationship was found between body fat and competition. The mean %BF for non-competitive weight lifters was similar to that of all the weight lifters; however, the competitors were significantly lower. Although some researchers have reported competitive distance runners and gymnasts to be as low as 12.5-15.5% BF (29,38,45) Freedson, Mihevic, Loucks, and Girandola (17), found a mean of 13.2 $\pm$ 2.9% BF for competitive female body builders. Our competitors had a higher % BF than Freedson et al's (17) and were comparable to Elliot et al's (14), although few of our subjects could

be considered professional body builders.

A significant difference in mean body fat was also found when the weight lifters were classified by menstrual status. The eumenorrheic group (EUMEN) and oligomenorrheic group (OLIG) had similar mean %BF. The amenorrheic group (AMEN) on the otherhand had a mean % BF similar to other studies of non-menstruating athletes. Such studies with amenorrheic athletes who had %BF less than 15%, have led to the suggestion that a low %BF, although not necessarily the cause of menstrual irregularity, is a common factor in oligomenorrhea and amenorrhea in athletes. Using hydrostatic weighing, Carlberg, KA, Buchman, M.T., Peake, G.T. and Rudesel, M.L. (8) found a mean BF of 16.3% for eumenorrheic athletes and 13.8% for oligomenorrheic plus amenorrheic athletes. Elliot and co-workers (14) found similar %BF, 18%, for competiting female bodybuilders, but found no difference between regular and irregularly menstruating women.

In summary, the results of this study indicate that weight lifting women have a higher incidence of menstrual irregularity than the general population. In addition, eating disorders and eating behaviors associated with anorexia and bulimia were more prevalent in female weight lifters than controls with WLs having a significantly higher Drive for Thinness and more WLs reporting attitudes

and behaviors such as fear of fat, being obsessed with food and abusing laxatives.

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Table 1

Distribution of Menstrual Status by Activity Group

ACTIVITY	EUMEN	OLIG	AMEN	TOTAL
WL	75	26	2	103
C	72	18	2	92
Total	147	44	4	195

Note. Two weight lifters did not respond to the questions concerning weight training involvement. However, they did respond to the questions concerning menstrual status and are therefore included in the weight lifting group but not in any of the involvement groups.

EUMEN, eumenorrheic; OLIG, oligomenorrheic, AMEN, amenorrheic. WL, weight lifters; C, controls.

Table 2

Distribution of Menstrual Status by Involvement

INVOLVEMENT	EUMEN	OLIG	AMEN	TOTAL
HI	13	7	0	20
MI	37	11	2	50
LI	23	8	0	31
Total	73	26	2	101

EUMEN, eumenorrheic; OLIG, oligomenorrheic; AMEN, amenorrheic

HI, high involvement, MI, moderate involvement; LI, low involvement.

Table 3

Distribution of Menstrual Status by Competition

COMPETITON	EUMEN	OLIG	AMEN	TOTAL
N. COMP	67	21	1	89
COMP	6	5	1	12
Total	73	26	2	101

EUMEN. eumenorrhea; OLIG, oligomenorrhea; AMEN, amenorrhea

N. COMP, non-competition; COMP, competition.

Table 4

EDI Subscale Scores by Activity Groups

	1*	2	3	4	5	6	7	8
WL	6.6	10.44	2.75	1.46	1.73	2.36	1.57	5.79
	(5.91)	(7.06)	(1.50)	(2.67)	(2.42)	(3.12)	(2.72)	(4.06)
Max	20	19	9	15	12	14	13	18
C	4.51	10.46	2.75	1.14	1.23	1.91	1.54	5.10
	(4.97)	(7.60)	(1.64)	(1.78)	(1.93)	(2.58)	(2.29)	(3.79)
Max	19	27	9	9	9	12	9	15

Note. Values are means with standard deviations in parentheses and maximum scores (Max) in following row. WL, weight lifters (N = 103); C, control (N = 92)

1 Drive for Thinness

2 Bulimia

3 Body Dissatisfaction

4 Ineffectiveness

5 Perfectionism

6 Interpersonal Distrust

7 Interoceptive Awareness

8 Maturity Fears

Table 5

EDI Subscale Scores by Involvement

	1	2	3	4	5	6	7+	8
HI	7.60	10.85	2.90	0.85	1.35	2.65	0.95[1]	7.05
N=20	(6.20)	(8.06)	(1.91)	(1.69)	(2.66)	(3.26)	(1.36)	(5.79)
Max	9	26	9	7	12	12	4	8
MI	5.44	9.18	2.84	1.34	1.76	1.56[a]	1.18	5.32
N=47	(5.50)	(6.72)	(1.36)	(2.42)	(2.60)	(2.23)	(2.32)	(3.59)
Max	18	24	8	13	12	8	13	14
LI	8.03	12.00	2.58	2.13	1.96	3.58[a]	2.58	5.70
N=27	(6.31)	(6.98)	(1.456)	(3.47)	(2.04)	(3.90)	(3.67)	(3.49)
Max	20	26	9	15	8	14	13	17

Note. Values are means with standard deviation in parentheses and maximum scores (Max) in following row.

[a]Means with same letter are significantly different.

[+] ANOVA revealed a significant difference between involvement groups on Interoceptive Awareness; however, a Tukey Studentized Range (HSD) Test indicated no significant difference between mean scores.

1 Drive for Thinness
2 Bulimia
3 Body Dissatisfaction
4 Ineffectiveness
5 Perfectionism
6 Interpersonal Distrust
7 Interoceptive Awareness
8 Maturity Fears

Table 6

EDI Subscale Scores by Competition

	1	2	3	4	5	6	7	8
N.COMP	6.61	10.43	2.81	1.49	1.82	2.50	1.68	5.60
N=89	(5.95)	(7.07)	(1.53)	(2.68)	(2.53)	(3.16)	(2.87)	(3.96)
Max	20	26	9	15	12	14	13	18
COMP	7.08	10.00	2.50	1.41	1.17	1.58	0.66	7.17
N=12	(6.32)	(7.73)	(1.31)	(2.91)	(1.59)	(2.91)	(1.07)	(4.95)
Max	16	22	5	8	5	9	3	17

Note. Values are means with standard deviations presented in parentheses and maximum scores (Max) in following row.

1 Drive for Thinness

2 Bulimia

3 Body Dissatisfaction

4 Ineffectiveness

5 Perfectionism

6 Interpersonal Distrust

7 Interoceptive Awareness

8 Maturity Fears

Table 7

EDI Subascale Scores by Menstrual Status

	1	2	3+	4+	5	6	7	8
EUMEN	5.29	10.37	2.65	1.12	1.35	1.92	1.42	5.16
	(5.33)	(7.21)	(1.47)	(1.70)	(2.22)	(2.59)	(2.55)	(3.46)
Max	19	26	9	8	12	12	13	14
OLIG	6.55	11.07	2.89	2.03	1.91	2.80	2.02	6.45
	(6.29)	(7.79)	(1.57)	(3.62)	(2.14)	(3.57)	(2.47)	(5.14)
Max	20	27	8	15	9	14	8	18
AMEN	8.25	6.50	4.50	0.25	2.25	3.50	1.50	5.75
	(5.56)	(4.50)	(3.41)	(0.50)	(2.06)	(3.69)	(1.29)	(4.57)
Max	12	12	9	1	5	8	3	11

+ ANOVA indicated a significant difference, but between mean variances were not great enough to be revealed by a Tukey post-hoc comparison.

EUMEN, eumenorrheic; OLIG, oligomenorrhea; AMEN, amenorrheic.

1 Drive for Thinness
2 Bulimia
3 Body Dissatisfaction
4 Ineffectiveness
5 Perfectionism
6 Interpersonal Distrust
7 Interoceptive Awareness
8 Maturity Fears

Table 8

Percent Body Fat of Weight Lifters (WLs) Using Three Grouping Methods

GROUPING	N	MEAN % BODY FAT	SD	MINIMUM-MAXIMUM
INVOLVEMENT				
HI	20	20.52	3.90	13.23 - 28.55
MI	47	19.32	3.74	12.45 - 24.78
LI	27	21.26	3.29	13.11 - 27.62
TOTAL WEIGHT LIFTERS	96	20.18	3.69	12.45 - 28.55
COMPETITION				
N.COMP	89	20.48	3.60	13.11 - 28.55
COMP	12	17.71	3.70	12.45 - 24.85
MENSTRUAL STATUS				
EUMEN	68	20.06	3.65	13.11 - 28.55
OLIG	26	20.91	3.57	13.23 - 27.62
AMEN	2	14.68	3.16	12.45 - 16.92

HI, high involvement; MI, moderate involvement; LI, low involvement; N.COMP, non competition; COMP, competition; EUMEN, eumenorrheic; OLIG, oligomenorrheic, AMEN, amenorrheic.

Table 9

Dieting Frequency

"How often do you diet to lose body weight?"

	CONTROLS	WEIGHTLIFTERS
Never diet	11%	6%
Rarely diet	29%	31%
Several times a year	38%	40%
Several times a month	15%	19%
Several times a week	7%	4%

Table 10

Pearson-Moment Correlations Between Menstrual Data and Subject Groupings

QUESTIONS	ACTIVITY	INVOLVEMENT	COMPETITION
Age of Menarch	r = -.021	r = .015	r = .067
	p = .70	p = .885	p = .504
Average length of	r = .145	r = .029	r = .295
menstrual cycle	p = .044	p = .770	p = .002
Do your periods			
occur at consistent	r = .022	r = .082	r = .177
intervals	p = .758	p = .416	p = .077
Number of periods	r = .066	r = .055	r = .213
within past 3 months	p = .360	p = .587	p = .033
Amenses for 1 or more			
months in previous	r = -.172	r = -.009	r =-.177
years	p = .017	p = .932	p = .079
Use of birth control	r = -.059	r = .010	r = .006
	p = .524	p = .938	p = .965

Table 11

Product-Moment Correlations Between Eating Behaviors and Subject Groupings

QUESTIONS	ACTIVITY	INVOLVEMENT	COMPETITION	MENSTRUAL STATUS
Uncontrollable urges to eat and eat until physically ill	r= .140 p= .050	r=-.171 p= .088	r= .094 p= .341	r= .069 p= .341
Fear of not being able to voluntarily stop eating	r= .190 p= .005	r=-.102 p= .309	r= .134 p= .182	r= .200 p= .005
Having episodes of binge eating	r= .042 p= .557	r=-.171 p= .090	r=-.091 p= .366	r=-.023 p= .744
Feeling miserable and annoyed after binge eating	r= .050 p= .500	r=-.129 p= .203	r= .022 p= .829	r=-.044 p= .547
Diet pill usage	r= .050 p= .732	r= .107 p= .288	r=-.086 p= .395	r= .014 p= .843
Laxative usage	r=-.222 p= .002	r=-.018 p= .862	r= .008 p= .934	r=-.085 p= .239
Vomiting	r= .042 p= .563	r= .018 p= .860	r= .079 p= .431	r=-.069 p= .334

Table 11 Continued

QUESTIONS	ACTIVITY	INVOLVEMENT	COMPETITION	MENSTRUAL STATUS
History of Bulimia	r= .143 p= .046	r=-.028 p= .779	r=-.068 p= .502	r= .072 p= .317
History of Anorexia	r= .149 p= .038	r=-.065 p= .521	r= .200 p= .045	r=-.024 p= .740
Overactivity without enjoyment	r= .062 p= .392	r= .002 p= .978	r= .181 p= .072	r= .135 p= .181
Terrified of fat	r= .182 p= .011	r=-.111 p= .271	r=-.083 p= .410	r= .046 p= .519
Feeling fat despite others saying they are too thin	r= .082 p= .011	r= .041 p= .686	r= .004 p= .971	r=-.027 p= .710
Being obsessed with food	r= .146 p= .041	r=-.088 p= .382	r= .102 p= .311	r= .114 p= .111

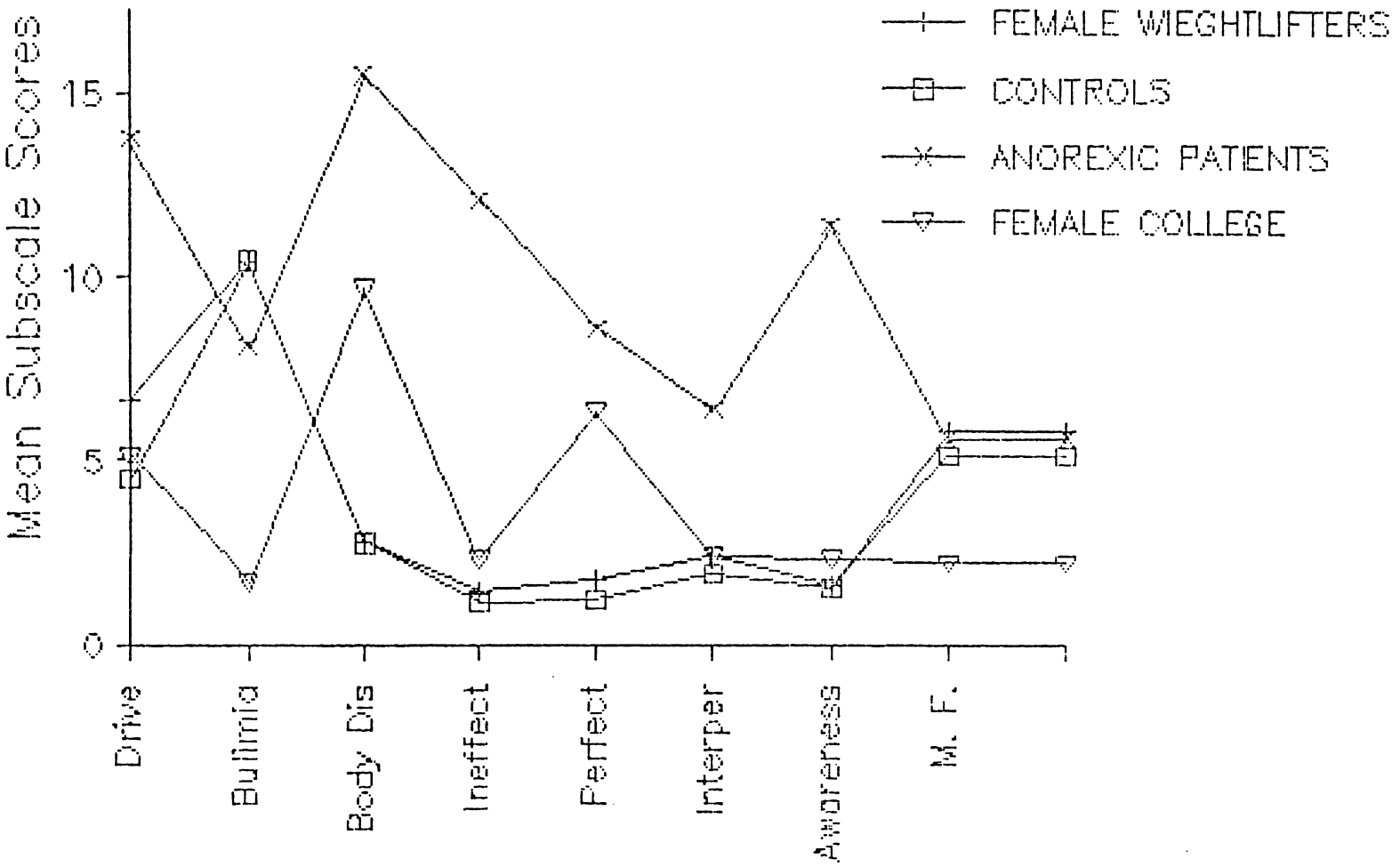

Figure 1
Mean EDI Subscale Scores by Subject Groups

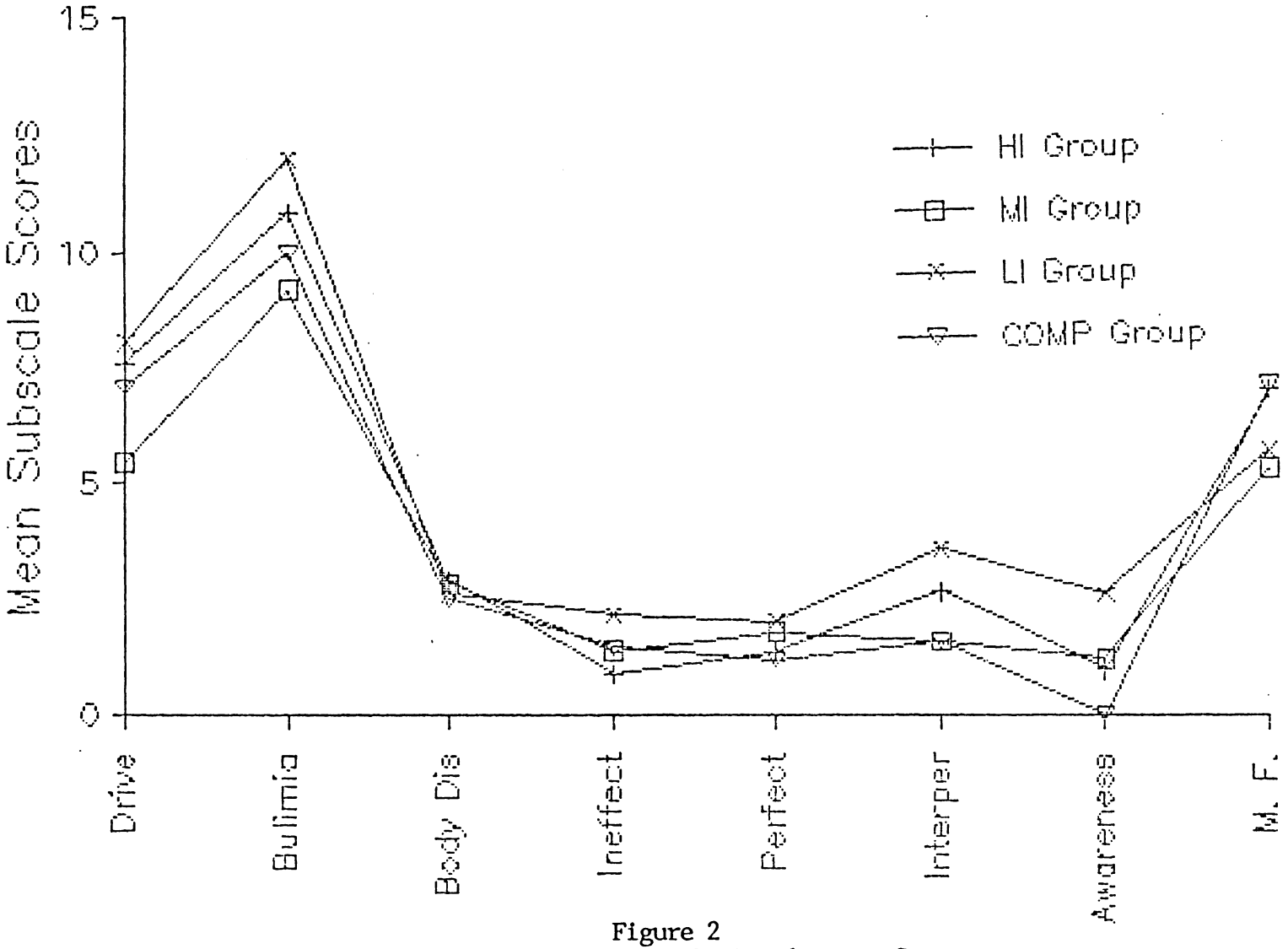

Figure 2
Mean EDI Subscale Scores by Involvement Groups

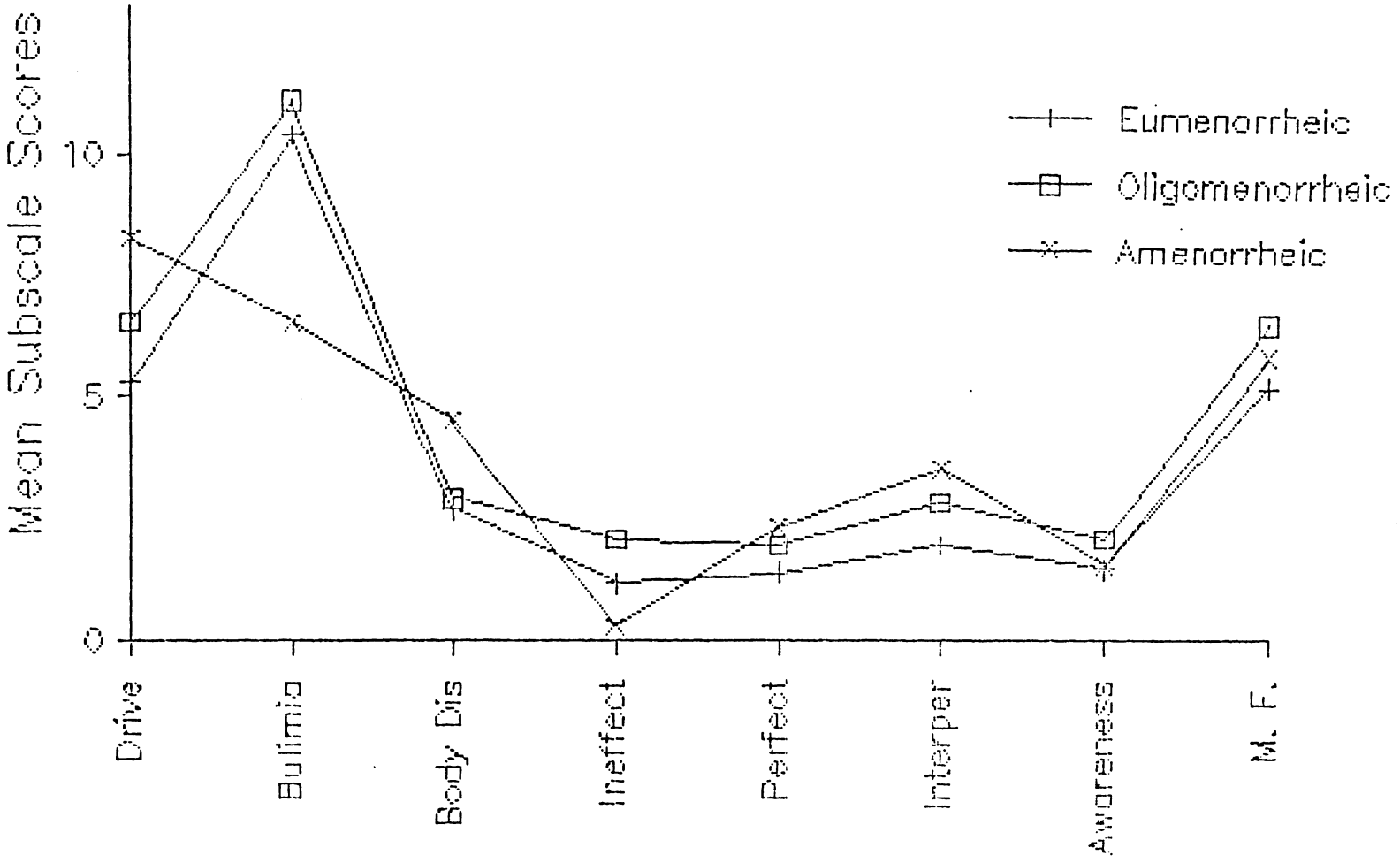

Figure 3
Mean EDI Subscale Scores by Menstrual Status Groups

Chapter 4

Summary

Bodybuilding is a relatively new sport and participation in competitions is increasing. The main goal of the sport is to achieve the ultimate physique and the lowest body fat.

Considering the importance of exercise, dieting and low body fat in bodybuilding, it was thought that the incidence of menstrual dysfunction and eating disorders would be high, similar to incidences found in runners, ballet dancers and wrestlers. To assess the incidences of menstrual irregularity and negative eating behaviors, a questionnaire concerning training regimes, menstrual history and eating patterns was developed and administered to female members of the Virginia Tech Weight Lifting Club and Goad's Gym in Blacksburg, Virginia. Age-matched controls, ages 18-35, were recruited from Personal Health Classes and the staff of Virginia Tech. The Eating Disorder Inventory (EDI) was included as part of the questionnaire.

While the incidence of menstrual irregularity, oligomenorrhea and amenorrhea, was no different for WLs than Cs, significantly more WLs reported having a missed period in the year prior to the survey. In addition, both the WLs and Cs reflected incidence rates greater than those presented for the general population. The high incidence

in WLs was not related to weight training involvement, but was related to competition. In fact, 50% of the competitors had some form of menstrual dysfunction. Although the competitors had significantly lower %BF than non-competitors, the 17.71% was not as low as many competitive long distance runners. This suggest that the dysfunction in competitive bodybuilders may be due to a combination of weight loss, activity and stress of competition rather than low body fat.

The congruent high rate of menstrual irregularity in Cs was not what would have been predicted. Dieting is a possible factor. Arrington, Bonner and Stitt (1985) conducted a study of 400 female college students between the ages of 18 and 46 years, with a mean age of 21.6 years. Forty-eight percent of these women reported participating in a weight loss program since enrolling in the university. The frequency was significantly greater than expected based on age group obesity rates. Seventy-five percent of the dieters were losing weight to improve their figure and only 25% did so for health reasons. In the present study, 60% of the Cs and 63% of the WLs dieted to lose weight either several times a year, several times a month or several times a week. (See Table 9). Dieting and weight loss have been identified as possible factors in menstrual dysfunction in athletes. (Baker et al., 1981; Bullen et al., 1985; and Speroff and Redwine, 1980).

Aerobic activity may have been another factor. Lutter and Cushman (1982) found that of 350 Boston Marathon and Bonnie Bell 10 Km runners, the oligomenorrheic and amenorrheic runners ran more mileage per week than eumenorrheic runners. Supporting these results Frisch et al. (1981) reported that training increased menstrual dysfunction in swimmers as well as runners, and Cohen (1982) found that irregularity was greater in professional dancers during the season than when they were not in training. Although the Cs did not weight train, they may have been involved in other sports such as running, swimming cycling or aerobic dance.

The criteria used for oligomenorrhea and amenorrhea might have been another factor in the abnormally high incidence of menstrual irregularity among the Cs. Furthermore, the 50% incidence rate among the competitors is higher than the rate found by Elliot and Goldberg (1983) in professional bodybuilders (33%). Only 4 of the subjects in our study had competed more than once. Elliot and Goldberg (1983) do not define their criteria for oligomenorrhea and amenorrhea, but they may have considered consistent cycles of less than 21 days as oligomenorrheic and consistent cycles of greater than 35 days as eumenorrheic. Perhaps changing the definitions of dysfunction would alter the results of the present study.

It has been suggested that the emphasis on thinness in

our society has been a catalyzing factor in the development of eating disorders in young women. Considering the importance of low body fat, the necessity of dieting and the stress of competition, bodybuilders may be as susceptible to harmful eating behaviors and dieting patterns as ballet dancers and wrestlers.

When compared to non-weight lifting controls, the weight-lifting women in this study scored significantly higher on the EDI Drive for Thinness scale. Although there was no difference between WLs and Cs on any of the other scales, both groups had mean scores greater than or similar to anorexics and bulimics on the Bulimia and the Maturity Fears scales. Furthermore, the percentage of outliers, individuals scoring higher than anorexics and bulimics, was consistently greater in WLs than Cs on all subscales.

On the Bulimia subscale, where both WLs and Cs scored similarly to anorexics rather than FC students, 82% of WLs and 86% of Cs scored higher than anorexics. Surprisingly, 57% of WLs and 42% of Cs scored higher than bulimic anorexics. Other researchers have found that bulimia is high in college females (Halmi, Falk and Schwartz, 1981; Hawkins and Clements, 1980). Hunt and Ollendeck (1985), however, found that while binge eating was prevalent in 69% of university women, the actual syndrome of bulimia nervosa was only prevalent in 5%. Other factors associated with bulimia and anorexia are purging behaviors such as vomiting

and laxative abuse and attitudes such as fear of fat or of not being able to voluntarily stop eating. As presented in later paragraphs, more WLs than Cs reported having such behaviors and attitudes. The dorm room "pig-outs" and exam-week pizza parties are relatively common social events on university campuses and does not constitute bulimia. Gorging in secrecy followed by severe guilt and purging are more indicative of eating disorders.

The following presents the percentage of WLs and Cs scoring higher than anorexics and bulimics on the EDI subscales not yet discussed. On the Body Dissatisfaction subscale, neither WLs nor Cs scored higher than anorexics or bulimics, with both groups scores ranging from 0 to 9. On Ineffectiveness, WLs ranged higher than Cs, 0 to 15 compared to 0 to 9, with 5% of WLs scoring higher than or equal to anorexics or bulimics, and 1% of C scoring the same as anorexic patients. On the Perfectionism scale, WLs and Cs ranged 0 to 12 and 0 to 9, with 6% of WLs scoring greater than anorexics and bulimics and 4% of Cs scoring greater than or equal to anorexics and bulimics. Only 6% WLs compared to 1% of Cs scored greater on Interoceptive awareness.

On the Maturity Fears scale, WLs and Cs had means similar to AN patients rather than FC students. Scores ranged from 0 to 18 for WLs and 0 to 15 for Cs, with

presented mean scores for ANs and Bulimics being 5.7 and 5.6 respectively. Forty-five percent of WLs and 40% of Cs were outliers, scoring higher than ANs and bulimics.

The development of eating disorders has been correlated with significant life events that involve change, such as puberty, parental divorce, car accidents and going away to camp or college. The majority of the subjects in both the WL and C groups were university students and forced into many of the pressures of adult life. Since the survey was conducted during the last quarter before summer, some may have been concerned about final exams, summer jobs, graduation and the future year. The high scores on the Maturity Fears scale may reflect a fear of such grow-up stressors

As previously stated, significantly more WLs admitted to exhibiting several eating behaviors associated with anorexia and bulimia nervosa. More WLs said that they had uncontrollable urges to eat, that they sometimes ate until they felt physically ill, and that they feared not being able to voluntarily stop eating. Significantly more WLs admitted to using laxcatives, to being terrified of fat plus to being obsessed with food. Two interesting results were that 17% of WLs, significantly more than Cs, felt that they used to be anorexia, while 12% of WLs compared to 4% Cs felt that they were or used to be bulimic. Although self-consideration of being bulimic was not statistically

greater between WLs and Cs, the incidence was higher than reates of bulimia presented for the general population by several investigators, (Hart and Ollendick, 1985; Pyle et al., 1983; and Stangler and Prentz, 1980). Halmi et al. (1981) however, presented a 19% incidence rate which Hart and Ollendick suggest is indicative of the prevalence of binge eating but not the bulimia syndrome.

On the Drive for Thinness, where WLs were higher than Cs scores ranged from 0 to 20 and 0 to 19 for WLs and Cs respectively. Twenty-six percent of the WLs and 16% of Cs scored higher than the anorexic patient mean, while 16% of WLs and 8% of Cs scored higher than the bulimic anorexic score.

Considering the difference in Drive for Thinness scores between WLs and Cs, the higher percentage of outlying WLs on all subscales, plus the higher number of WLs reporting anorexia-and bulimia-associated eating behaviors the tendency toward eating disorders may be greater in WLs than age-matched Cs. It is possible that women who are weight and diet conscious choose to weight train for its physique conforming effects, or that the external motivation of competing in a bodybuilding meet will help them diet or lose unwanted fat.

To lose weight and improve their figure, many women are increasing their activity and participation in sports. While weight loss through aerobic exercise can be a slow

process, the effects of muscular development and toning can be observed within a few weeks. Such results could make weight lifting a popular sport for women who have a strong desire to be thin.

Additionally, the inherent aspect of dieting for bodybuilding competitions could be attractive for women who have a difficult time losing weight. They may feel that by commiting to compete, they will be forced to maintain a weight-reduction diet. Rather than battling with the choices of whether to start dieting today or next Monday, or deciding whether losing ten pounds is really worth not eating brownies and ice cream for a month, they can rely on the pressure of the impending meet to keep them motivated.

The findings that the LI group scored significantly higher on the Interpersonal Distrust subscale than the MI groups and on the Interoceptive Awareness scales than both the MI and HI groups was unexpected. The Interpersonal Distrust scale measures a reluctance to form close relationships or an inability to express emotions towards other people. Such reluctance is thought to be an important factor in the development and persistence of anorexia nervosa (Garner and Olmsted, 1985). The Interoceptive Awareness scale is also thought to reflect a common characteristic of anorexia nervosa patients, which is an inability to accurately detect and identify emotions of internal cues of hunger and satiety (Garner and Olmsted,

1985). Since only the LI showed any significant differences, these results appear to be unrelated to weight lifting.

Although the amenorrheic group scored statistically different than the other groups on Body Dissatisfaction and Ineffectiveness, the importance of these results should be examined with caution since only 4 subjects were amenorrheic and the statistical differences were notsupported by the post-hoc comparisons. Considering that there were no significant differences between WLs and Cs, involvement groups or competition groups, this study indicates that Body Dissatisfaction and Ineffectiveness are unrelated to weight training but possibly related to menstrual irregularity per se. Menstrual irregularity, the incidences of oligomenorrhea or amenorrhea were also unrelated to weight lifting in this study.

Percent body fat for Cs was assumed to be 20 to 28% as indicated in the literature; however, this assumption may be erroneous. Since the literature presents %BFs below 20% for many populations of competitive athletes, the mean of 17.71% for our competitors was not surprising. In a letter to the editor, Elliot and Goldberg (1983) reported a mean of %BF of 18% for females in the Pacific Northwest Body Building Competition. Thirty-three percent of these competitors not taking oral contraceptives were oligomenorrheic or amenorrheic. The mean %BF was no

different for the regularly menstruating women than the irregularly menstruating women.

In the present study, however, the amenorrheic WLs had significantly lower %BF than the other WLs. The body fat of the amenorrheic group (14.68%) agrees with means presented for other athletes with menstrual irregularity. Carlberg et al. (1983) investigated the relationship between body composition and menstrual function by hydrostatically weighing 28 regularly menstruating athletes and 14 oligo / amenorrheic athletes. Mean body fats were 16.3% for the eumenorrheic group and 13.1% for the oligo / amenorrheic group. Again, however, the low number of subjects in the amenorrheic group (n = 2) prohibits making conclusions based on these results.

Implications for Practitioners

As with trainers and coaches of other sports, the prevalence of athletic menstrual dysfunction has some important implication. Shangold (1982) warns that dysfunction cannot immediately be assumed to be sports related, and the possibilities of pituitary tumors, ovarian failure, hypothyroidism and pregnancy must be investigated. Also, athletic amenorrheic women are thought to be at greater risk of developing osteoporosis. Cann, Martin, Genant and Jaffe (1984) found that amenorrheic women participating in strenuous exercise regimes had 20 to 30% decrease in spinal trabecular mass. In addition,

Lloyd, Triantafyllou, Baker, Houts, Whitside, Kalenak and Stumpf (1986) found that 9% of regularly menstruating Collegiate athletes compared to 24% of irregularly menstruating athletes had x-ray documented bone fractures. Hypoestrogenic WLs and other women may need to be treated with exogenous hormones. Elliot and Goldberg (1983) agree that weight-lifting should be associated with oligo/amenorrhea - inducing exercises; therefore, coaches, trainers and weight training athletes should be aware of the risk of menstrual irregularity, and prepared to treat factors not related to exercise and to prevent osteoporosis.

Considering the possibility of developing harmful dieting patterns or even eating disorders, it is important for bodybuilders to have common sense eating and dieting patterns. Individualized diets with appropriate nutritional composition and caloric values may be required to achieve specific amounts of weight loss within time limits. With the element of dieting in bodybuilding, nutritional education should be an inherent aspect of training.

Recommendations for Future Research

The prevalence of menstrual dysfunction in endurance athletes has been widely investigated. However, the relationship between strength training and oligo/amenorrhea has not been experimentally identified. While survey

analysis can be used to classify menstrual status by cycle length and consistency, it cannot be used to determine ovulation and luteal sufficiency. A shorted luteal phase and anovulation have been identified as subtle hormonal abnormalities proceeding oligomenorrhea, specifically in athletes (Bonen and Keizer, 1984).

In a longitudinal study conducted by Bullen and associates (1985), 28 untrained college women were initiated into a vigorous running program. Gonadal and sex hormone excretions were measured to determine ovulation and luteal function and observe changes in hormonal status over 2 menstrual cycles. Although, all of the subjects continued to menstruate, 24 of the subjects became anovulatory and / or developed shortened luteal phases. Such subtle changes are difficult to identify without more detailed information. A longitudinal study measuring hormonal profile of women before and after beginning a weight training program could determine whether strength training would cause the same initial subtle changes as a running program.

The association between bodybuilding or weight training and eating disorder attitudes and behaviors presents several question for future research. One, do weight conscious individuals with tendencies toward eating disorders self-select themselves for weight lifting exercise or does the sport encourage negative eating

behaviors and attitudes? A longitudinal study of naive and experienced competitors, evaluating dieting patterns and feelings before, during and after training for a bodybuilding meet could provide more information. Associated factors such as percent body, amount of weight loss, aerobic activity and diet composition disorders with the progression of menstrual dysfunction as well as eating could also be investigated.

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APPENDIX A

METHODOLOGY

Introduction

Subjects

One hundred weight-trained women were recruited from the spring registration of the Virginia Tech Weight lifting Club and unscheduled meetings at Goad's gym in Blacksburg, Virginia. A control sample of 92 non-weight lifting women were surveyed through Personal Health Classes at Virginia Tech. Three additional subjects from the Personal Health Classes happened to be weight lifters and were added to the WLs for survey analysis. Their status as weight lifters was unexpected and not discovered until preliminary analysis of the questionaire data was conducted; therefore, percent body fat for these subjects was not obtained since arrangements had not been made previously. Additionally, 6 of the other weight-training women were not available for body fat analysis until several months after data collection. Since their % BF may have changed significantly in that time, their %BF estimations were not included. The final analysis included 103 weight-training women and 92 controls. Percent body fats for 96 weight

lifters were used to determine means for involvement, competition, and menstrual groups. The majority of the subjects were ages 18 to 24. Four of the weight-training women were 30 to 35 years of age; therefore, 4 age-matched controls were recruited from the faculty and staff of Virginia Tech.

The original 7 case study subjects consisted of 4 HI subjects and 3 LI subjects. Of the subjects in the H I group, 1 had competed several times, 2 were planning to participate in their 1st competition, and 1 was not going to compete but weight-trained 225 or more minutes per week. However, due to the cancellation of a bodybuilding meet during the first few days of the study, none of the case study subjects were training for competition during record keeping and data collection, as was originally planned. In addition, 3 subjects were dropped from the study because of noncompliance with exercise schedules and sampling procedures. These factors combined resulted in 2 HI and 2 LI case subjects, for case study observations. All subjects were asked to maintain their current weight training schedule for the duration of the 8-week period.

Instrumentation

A questionnaire was developed concerning training regimes, menstrual status and dieting strategies. (See Appendix B). The Eating Disorder Inventory (EDI) was also included as part of the questionnaire. The survey data

were collected on obscan and submitted to the Learning Resource Center for preliminary analysis.
Harpenden skinfold calipers were used to take skinfold measurements for % BF estimation.

Survey development

After reviewing the literature, criteria for involvement, competition menstrual status was determined and incorporated into appropriate questions and responses. The EDI was included as part of the survey. Related menstrual and eating behavior questions were added to further describe the menstrual status and dieting patterns of female weight-lifters. A rough draft was formed and disseminated to the research committee (2 Professors from HPER division and 1 Professor from the Psychology department of VPI and SU), and to the Learning Resource Department to gain feedback on the structure and necessity of specific questions and on the overall design and format of the questionnaire. Based on suggestions by committe members and the statistical consultant, some questions were deleted or reworded. No validity measures were established for the questionnaire.

The Eating Disorder Inventory

The Eating Disorder Inventory (EDI) is a 64-item, self-report questionnaire designed to assess psychological and behavioral characteristics associated with anorexia nervosa and bulimia. The instrument, designed for typological and

clinical research, was validated in 1983 (Garner, Olmsted, and Polivy, 1983). It has been used to compare anorexic patients with weight-preoccupied and non-weight-preoccupied women and used to compare the EDI profiles of obese subjects and female college students (Olmsted and Garner, 1984). The EDI measures 8 subscales: 1) Drive for thinness, 2) Bulimia, 3) Body Dissatisfaction, 4) Ineffectiveness, 5) Perfectionism, 6) Interpersonal Distrust, 7) Interoceptive Awareness and 8) Maturity Fears. It has been used in other scientific research (Hart and Ollendic, 1985).

To pilot the instrument, the questionnaire was administered to 5 non-sedentary women who had weight trained at sometime. Subjects were timed to estimate the amount of time needed for completion and were asked for feedback on the clarity of questions, progression of topics and overall design. As a result, alternative responses were added to several questions.

Procedures

Groups. Both the weight-training women and the controls were initially grouped together to form a combined group (CG). Frequencies on all questionnaire items were obtained for the CG. The CG subjects were then classified by group as weight-lifters (WL) or controls (C).

The WLs were further classified into the following groups by involvement level: high involvement (HI) (n=20)

lifting 225-300 or more minutes per week, moderate involvement (MI) (n=50) lifting 115-240 minutes a week: or low involvement (LI) lifting less than 180 minutes per week (n=31). All WLs were also classified by competition as either competitive (COMP) or non-competitive (N-COMP); all subjects who had completed in 1 or more body building meets were classified as competitive. WLs plus Cs, were also categorized according to menstrual status as either eumenorrheic (EM), oligomenorrheic (OLIG) or amenorrheic (AM).

Menstrual status was defined according to cycle lengths and interval consistency. Women reporting cycles of 0-35 days which usually occured at consistent intervals were classified as eumenorrheic. Those reporting cycles of 0-35 days usually occurring at inconsistent intervals, cycles of 36-89 days usually occurring at consistent or inconsistent intervals, and cycles that were difficult to assess (sometimes occurring monthly, sometimes skipping several months), were considered oligomenorrheic. No one considered their cycle to be 90 or more days long, deleting the need to address the controversy of whether lack of menses for 3 months is considered amenorrhea.. Those reporting lack of menses for the previous 12 months or more were classified as amenorrheic. The resulting categories of subjects discussed in this thesis are: one combined group, CG; 2 subject groups, WL and C; 3 involvement

groups, HI, MI and LI; 2 competition groups, COMP and N-COMP; and 3 menstrual groups, EM, OLIG and AM.

Since Cs did not respond to the weight-training questions, they were easily differentiated from the WLs. The WLs were categoriezed by involvement using their responses to the question, " How many times a week do you usually weight train?" and "During an average workout, how long do you actually spend lifting?"

All possible combinations of responses to the above questions were determined. The resulting ranges of minutes per week were calculated and classified as either high involvement, moderate involvement or low involvement. For example, 3-4 times a week for 15-30 minutes each session results in a range of 45-120 minutes per week. The 3 categories of involvement have overlapping ranges with high involvement being 225 to 300 or more minutes per week, moderate involvement being 135 to 240 minutes per week, and low involvement being less than 180 minutes per week (or 15-180 min per week).

Case Study Instructional Procedures. A general meeting was held prior to the beginning of the study to inform all participants of the exact procedures to be undertaken. Folders containing informed consents, requirements, general instructions, appointment times and dates, and exercise and diet recordkeeping forms were distributed. During the following week, all initial measurements were undertaken

and record keeping began. The initial measurements included weight, skinfold, residual lung volume and body density. Another general meeting was held during this week to educate the subjects on food identification and serving size estimation.

Body Composition. Body composition was assessed during the 1st, 4th, and 8th week of the study. Skinfold measurements were taken as previously described for the survey subjects. Hydrostatic weighing procedures of Brozek et al., (1963) were used. Residual lung volume was measured according to the oxygen dilution technique (Wilmore, 1969). Body weight was measured by the researcher using a Detecto standard medical scale.

Exercise and Diet Records. Subjects were randomly assigned to 2 consecutive days of recordkeeping for Week 1 by drawing a number 1-6 from a bag. Six shifts of consecutive 2-days were rotated each week proceeding in consecutive order from Week 1. The shifts were as follows: 1=Friday and Saturday, 2=Saturday and Sunday, 3=Sunday and Monday, 4=Monday and Tuesday, 5=Tuesday and Wednesday, 6=Wednesday and Thursday. Rotation was intended to allow observation of each day of the week and final profiling of a typical week for each subject without requiring recordkeeping for an entire week. Continuous recordkeeping may have encouraged a change in dietary and training habits. When subjects forgot to keep records for

a day, they were instructed to keep records for the following 2-day period rather than attempt to recall their foods and activities. See Appendix B for an example of the diet records.

Diet Records. Subjects were instructed to record all food and drink and estimate the quantity in number, volume and /or size. Brand names and method of preparation were also included. A Food Intake Analysis program for an IBM PC was used to assess the total number of Calories and percent of RDA of specific nutritients.

Weight Lifting and Other Exercise Records. Weight lifting and exercise were recorded on the same consecutive 2-days as the diet records. On the weight lifting records, subjects were instructed to record the name of the exercise, the number of repetitions performed and the amount of weight in pounds used for each repetition. On the exercise records, subjects were instructed to record the mode of exercise, duration or amount in mileage, time or number of repetitions, and frequency per day. See Appendix B for weight lifting and exercise record sheets.

Human Subjects Forms

The study was reviewed and approved by the Institutional Review Board (IRB) for research involving human subjects. All subjects were required to sign an informed consent explaining the risks involved.

Percent Body Fat Estimations.

Skinfold measurements for percent body fat estimations of the weight-trained women were either taken at the time of survey completion or during a predetermined meeting within 2 weeks of their completion of the survey. Body Fat estimations for the control subjects were not conducted. Age-group norms were used to compare mean body fats of the weight-training groups to the general population. As stated before, fats for 7 of the weight-training subjects were not obtained.

Skinfold measurements of the tricep, abdomen, suprailium and thigh were taken on the right side using Harpenden calipers. Body density (BD) was calculated twice, using 2 equations from Jackson, Pollock and Ward (1980), one involving the criterion measurements for all 4 skinfold sites, the other involving only the tricep, suprailium and thigh. The average of 3 measurements was used as the criterion numbers.

$BD(4\ sites) = 1.0960950 - 0.0006952(X_4)^* + 0.0000011(X_4)^2 - 0.0000714(Age)$

X_4 = Sum of tricep, abdomen, suprailium and thigh.

$BD(2) = 1.0994921 - 0.0009929(X_3)^* + 0.0000023(X_3)^2 - 0.0001392(Age)$

X_3 = Sum of tricep, suprailium and thigh.

The Siri (1956) formula was used to calculate %BF :

$$\%BF = \frac{4.570}{BD} - 4.143$$

(See Appendix B for form.)

Data Analysis

A SAS statistical program was used to obtain descriptive statistics. Frequencies for the Combined group were obtained for all items. Chi-square analysis were performed to determine significant differences between WL and Cs on all items. In addition, Pearson Product Moment Correlational Analysis were run to indicate relationships among all items, specifically between menstrual status, mean EDI subscale scores, and %BF of subject groups, involvement groups, and competition groups. Since the correlational analysis indicated a relationship between several groups and several mean EDI scores, one-way analyses of variance were performed to determine statistical differences between all groups on EDI subscale scores and % BF estimations. Since no relationships were indicated between the groups on menstrual status, Anova's were not conducted. Statistical significance for all analysis was set at the .05 level.

APPENDIX B

ANOVA TABLES

INDIVIDUAL SUBJECT DATA

SURVEY QUESTIONNAIRE

Worksheet for Skinfold Estimations of Body Fat

Worksheet for Hydrostatic Weighing

Worksheet for Residual Lung Volume Determination

Diet, Weight Lifting and Exercise Records

Table 12

Activity Group by Drive for Thinness (Subscale 1)

SOURCE	DF	SS	MS	F-VALUE
Between	1	220.45085	220.45085	7.32**
Within	193	5812.69787	30.11761	
Total	194	6033.14876		

**p<.01

Table 13

Involvement by Mean Score on Interpersonal Distrust (Subscale 6)

SOURCE	DF	SS	MS	F-VALUE
Between	2	79.7400	39.8700	4.32**
Within	98	904.4183	9.2288	
Total	100	984.1584		

**p<.01

Table 14

Involvement by Mean Score on Interoceptive Awareness (Subscale 7)

SOURCE	DF	SS	MS	F-VALUE
Between	2	46.9533	23.4766	3.27*
Within	98	703.8784	7.1824	
Total	100	750.8317		

*p<.04

Table 15

Menstrual Status by Mean Score on Body Dissatisfaction (Subscale 3)

SOURCE	DF	SS	MS	F-VALUE
Between	2	14.2621	7.1310	2.97*
Within	192	460.4250	2.3980	
Total	194	474.6871		

*p<.05

Table 16

Menstrual Status by Mean Score on Ineffectiveness (Subscale 4)

SOURCE	DF	SS	MS	F-VALUE
Between	2	32.0152	16.0076	3.11*
Within	192	989.5231	5.1537	
Total	194	1021.5384		

*p<.04

Table 17

Percent Body Fat by Competition

SOURCE	DF	SS	MS	F-VALUE
Between	1	808459.5849	808459.5849	6.17**
Within	92	12051839.9045	130998.2598	
Total	93	12860299.4894		

**p<.01

Table 18

Individual Subject Data

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
1	WL	HI	EUMEN	12	26	9	0	12	3	3	11	20.29
2	WL	MI	OLIG	10	13	2	5	2	5	2	3	24.46
3	WL	HI	EUMEN	14	20	4	0	0	1	2	2	22.07
4	WL	LI	EUMEN	16	17	3	3	1	2	10	7	19.54
5	WL	MI	EUMEN	17	24	2	5	4	5	1	5	18.53
6	WL	MI	EUMEN	0	2	2	0	1	1	0	7	15.76
7	WL	MI	EUMEN	1	10	4	1	0	2	0	3	15.25
8	WL	LI	EUMEN	11	13	0	0	1	0	0	9	19.33
9	WL	LI	EUMEN	9	23	4	1	5	10	13	9	20.08
10	WL	MI	EUMEN	7	10	5	0	0	1	0	6	20.09
11	WL	LI	EUMEN	3	10	9	0	6	7	6	3	26.34
12	WL	LI	OLIG	6	2	2	0	0	0	0	4	17.31
13	WL	MI	EUMEN	8	17	3	0	0	0	0	2	21.94
14	WL	HI	OLIG	13	16	6	2	2	0	0	18	24.02
15	WL	MI	AMEN	0	1	1	0	2	0	0	3	12.45
16	WL	--	EUMEN	7	13	1	0	0	0	0	8	21.72
17	WL	MI	EUMEN	5	12	1	3	6	2	2	2	14.41
18	WL	MI	EUMEN	1	12	3	0	4	1	1	3	23.01
19	WL	LI	EUMEN	13	13	3	0	0	0	0	11	13.11
20	WL	MI	OLIG	4	18	2	0	3	0	0	9	24.52
21	WL	LI	EUMEN	0	1	3	0	1	0	0	10	18.69
22	WL	MI	EUMEN	2	9	2	1	1	0	0	3	20.58

Table 18 continued

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
23	WL	MI	EUMEN	11	23	3	3	0	2	4	0	24.53
24	WL	LI	EUMEN	1	3	2	3	2	0	2	1	21.58
25	WL	MI	EUMEN	0	8	3	0	0	0	0	5	24.85
26	WL	LI	OLIG	7	5	3	3	3	9	6	3	22.27
27	WL	HI	OLIG	9	22	4	0	0	0	0	4	18.30
28	WL	LI	EUMEN	8	20	3	2	1	2	0	2	21.51
29	WL	LI	EUMEN	1	13	1	1	2	1	0	3	22.97
30	WL	LI	EUMEN	0	2	3	0	0	0	0	3	21.05
31	WL	MI	OLIG	18	15	4	7	0	6	0	7	19.48
32	WL	MI	EUMEN	3	13	3	0	0	0	0	9	22.20
33	WL	MI	EUMEN	0	0	2	0	0	0	0	9	15.32
34	WL	LI	OLIG	3	11	2	0	0	0	0	3	22.68
35	WL	MI	EUMEN	1	4	3	0	4	2	1	0	19.85
36	WL	LI	EUMEN	15	19	3	8	3	6	3	8	21.66
37	WL	MI	EUMEN	6	13	3	0	0	0	0	7	24.74
38	WL	MI	OLIG	14	18	2	0	0	1	2	2	21.45
39	WL	MI	AMEN	12	7	3	0	5	5	1	11	16.92
40	WL	LI	OLIG	6	10	2	4	4	5	4	5	25.24
41	WL	LI	EUMEN	10	11	1	3	3	3	0	10	20.74
42	WL	HI	EUMEN	17	19	4	3	0	5	2	12	28.21
43	WL	HI	OLIG	16	18	2	2	2	0	0	16	15.12
44	WL	HI	EUMEN	7	19	2	1	0	1	0	0	19.28
45	WL	MI	EUMEN	5	1	3	0	1	0	0	1	20.18

Table 18 continued

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
46	WL	MI	OLIG	17	14	0	13	1	7	0	6	22.79
47	WL	MI	EUMEN	0	0	3	6	0	4	0	10	13.76
48	WL	MI	EUMEN	1	1	3	1	1	0	0	14	15.61
49	WL	MI	EUMEN	0	1	2	0	0	1	0	7	16.07
50	WL	MI	EUMEN	18	21	2	0	0	4	1	7	17.75
51	WL	MI	OLIG	2	22	5	2	2	1	4	2	16.72
52	WL	MI	EUMEN	9	22	5	1	6	2	13	2	19.71
53	WL	MI	EUMEN	0	6	3	0	0	0	0	4	14.83
54	WL	MI	EUMEN	7	6	0	0	1	0	0	4	16.07
55	WL	LI	OLIG	20	19	3	11	2	11	4	9	27.62
56	WL	LI	EUMEN	16	1	2	4	0	6	0	7	20.45
57	WL	LI	EUMEN	7	16	2	1	3	3	6	9	17.65
58	WL	HI	EUMEN	1	0	2	0	0	0	0	1	19.08
59	WL	HI	EUMEN	16	10	3	1	2	12	1	12	28.55
60	WL	HI	EUMEN	8	12	2	0	1	4	3	7	18.98
61	WL	MI	EUMEN	0	8	5	3	10	0	8	13	15.33
62	WL	MI	EUMEN	2	7	3	0	1	0	0	3	20.05
63	WL	MI	OLIG	2	0	3	2	0	0	0	10	15.30
64	WL	MI	EUMEN	2	3	4	0	12	0	1	0	18.78
65	WL	MI	EUMEN	4	10	4	0	3	0	0	4	16.92
66	WL	LI	EUMEN	18	19	2	0	8	6	11	4	18.44
67	WL	HI	EUMEN	3	6	2	0	0	1	0	0	21.05
68	WL	MI	OLIG	6	14	8	0	2	7	4	0	21.54

Table 18 continued

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
69	WL	MI	EUMEN	10	10	3	1	3	1	2	5	13.95
70	WL	HI	OLIG	0	9	1	0	2	2	0	3	22.52
71	WL	MI	EUMEN	15	11	3	1	0	4	1	2	15.48
72	WL	LI	OLIG	4	8	3	0	5	2	2	3	16.35
73	WL	HI	EUMEN	12	13	3	0	2	6	4	6	20.50
74	WL	LI	EUMEN	3	21	3	2	0	7	0	3	23.75
75	WL	LI	OLIG	1	13	2	3	1	0	3	5	19.90
76	WL	MI	OLIG	6	11	1	0	4	0	2	3	24.00
77	WL	MI	EUMEN	0	6	3	0	0	0	0	2	14.62
78	WL	LI	EUMEN	6	10	1	0	2	1	1	6	21.98
79	WL	MI	EUMEN	9	6	3	3	1	8	4	11	21.17
80	WL	HI	EUMEN	0	1	2	1	1	2	0	9	14.91
81	WL	LI	EUMEN	8	22	2	0	0	1	0	4	24.76
82	WL	MI	EUMEN	8	0	3	0	0	0	0	5	22.36
83	WL	MI	EUMEN	8	13	1	1	5	3	3	3	25.78
84	WL	MI	OLIG	1	5	4	0	0	0	0	9	19.25
85	WL	--	EUMEN	4	15	2	0	2	1	4	4	23.26
86	WL	HI	OLIG	1	3	2	0	2	4	0	2	21.58
87	WL	MI	OLIG	10	7	3	3	0	3	1	5	22.38
88	WL	HI	EUMEN	0	2	0	0	0	0	0	2	19.51
89	WL	HI	EUMEN	3	9	3	0	0	2	3	8	22.22
90	WL	MI	EUMEN	11	7	2	3	1	0	0	8	22.08
91	WL	LI	OLIG	20	4	3	15	4	14	0	17	22.38

Table 18 continued

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORE 1	2	3	4	5	6	7	8	%BF
92	WL	HI	EUMEN	13	10	3	7	1	9	1	9	17.64
93	WL	HI	OLIG	7	2	2	0	0	1	0	2	23.48
94	WL	HI	OLIG	0	0	2	0	0	0	0	17	13.23
95	WL	LI	EUMEN	12	6	2	0	0	0	0	3	26.72
96	WL	MI	EUMEN	1	3	3	0	0	0	0	3	25.24
97	WL	LI	EUMEN	17	26	3	0	2	5	2	4	
98	WL	MI	EUMEN	3	11	2	2	0	0	1	9	
99	WL	MI	EUMEN	0	4	3	0	0	0	0	7	
100	WL	LI	EUMEN	7	13	2	0	1	0	0	6	
101	WL	LI	EUMEN	6	11	3	2	0	2	0	3	
102	WL	MI	EUMEN	3	0	2	0	2	0	0	11	
103	WL	LI	EUMEN	1	10	3	0	1	8	7	3	
104	C		OLIG	6	15	4	1	9	4	5	9	
105	C		EUMEN	9	17	3	1	0	0	0	3	
106	C		AMEN	11	12	9	0	2	8	3	8	
107	C		EUMEN	3	15	2	2	6	3	9	1	
108	C		EUMEN	0	0	2	0	0	0	0	4	
109	C		EUMEN	3	3	0	0	0	1	0	0	
110	C		EUMEN	9	16	2	3	0	2	4	11	
111	C		EUMEN	4	4	1	0	0	0	0	7	
112	C		EUMEN	0	3	0	0	2	0	0	5	
113	C		EUMEN	0	5	3	0	0	0	0	3	

Table 18 continued

NO.	ACTIVITY	INVOLVE-MENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
114	C		OLIG	0	2	2	0	3	1	2	1	
115	C		EUMEN	3	9	2	1	0	1	1	3	
116	C		EUMEN	1	17	0	2	6	12	7	11	
117	C		OLIG	3	10	3	0	0	0	0	3	
118	C		EUMEN	1	5	4	0	0	0	0	2	
119	C		EUMEN	2	10	3	2	0	0	0	8	
120	C		OLIG	16	20	3	0	1	6	2	2	
121	C		EUMEN	1	12	2	0	0	0	0	3	
122	C		OLIG	6	18	2	1	0	4	0	8	
123	C		EUMEN	1	2	2	0	0	0	0	2	
124	C		EUMEN	5	12	4	2	0	3	0	3	
125	C		EUMEN	4	26	9	6	1	11	5	6	
126	C		EUMEN	3	16	3	0	0	0	0	4	
127	C		OLIG	3	23	2	3	0	1	2	3	
128	C		EUMEN	6	4	1	0	0	1	1	3	
129	C		EUMEN	16	26	2	4	1	2	2	1	
130	C		EUMEN	0	7	1	0	0	1	1	3	
131	C		EUMEN	2	7	3	0	0	0	0	6	
132	C		OLIG	3	7	6	1	7	1	6	0	
133	C		OLIG	2	9	3	0	3	2	8	9	
134	C		EUMEN	6	18	2	3	1	1	7	0	
135	C		EUMEN	3	4	4	0	2	2	2	0	

Table 18 continued

NO.	ACTIVITY	INVOLVEMENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
136	C		OLIG	0	0	2	0	0	2	0	2	
137	C		EUMEN	9	14	2	2	0	1	1	4	
138	C		OLIG	0	0	1	0	1	11	4	15	
139	C		OLIG	0	0	3	0	0	0	0	4	
140	C		AMEN	10	6	5	1	0	1	2	1	
141	C		EUMEN	2	9	2	0	0	0	0	6	
142	C		EUMEN	8	6	2	0	1	3	0	8	
143	C		OLIG	2	7	3	0	2	0	0	7	
144	C		EUMEN	19	12	5	2	0	9	0	9	
145	C		EUMEN	5	14	7	5	0	2	0	11	
146	C		OLIG	16	21	2	9	1	7	8	13	
147	C		EUMEN	12	6	3	2	1	5	1	5	
148	C		OLIG	5	15	2	0	0	0	2	1	
149	C		EUMEN	13	24	3	7	1	3	4	0	
150	C		EUMEN	0	1	1	0	0	0	0	4	
151	C		EUMEN	3	17	3	2	4	1	2	6	
152	C		EUMEN	0	9	4	0	0	0	0	1	
153	C		EUMEN	6	22	3	2	0	1	0	4	
154	C		EUMEN	2	4	3	2	3	3	1	8	
155	C		OLIG	15	27	5	0	6	5	4	15	
156	C		EUMEN	13	22	5	0	1	4	0	6	
157	C		EUMEN	0	4	3	0	2	4	1	11	
158	C		EUMEN	2	12	0	2	0	1	3	4	

Table 18 continued

NO.	ACTIVITY	INVOLVE-MENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
159	C		EUMEN	2	6	2	1	1	0	0	5	
160	C		EUMEN	0	8	2	0	5	1	1	3	
161	C		EUMEN	0	0	2	0	7	3	1	12	
162	C		EUMEN	16	24	3	2	1	1	4	7	
163	C		EUMEN	0	2	2	0	0	0	0	3	
164	C		EUMEN	0	7	2	0	0	0	0	2	
165	C		EUMEN	1	1	5	3	2	5	5	9	
166	C		EUMEN	0	7	0	0	1	1	1	0	
167	C		EUMEN	3	15	4	0	0	0	0	2	
168	C		EUMEN	8	19	2	3	0	1	0	5	
169	C		EUMEN	1	5	2	0	2	0	0	2	
170	C		EUMEN	1	14	2	0	1	0	0	1	
171	C		EUMEN	0	2	2	0	0	0	1	3	
172	C		EUMEN	0	0	2	0	0	0	0	9	
173	C		OLIG	1	2	6	0	1	0	0	8	
174	C		OLIG	1	6	4	2	4	1	4	3	
175	C		EUMEN	8	10	3	3	0	1	0	1	
176	C		EUMEN	14	23	3	0	2	3	1	5	
177	C		EUMEN	0	5	3	0	0	3	0	4	
178	C		EUMEN	6	13	3	2	1	3	0	8	
179	C		EUMEN	0	3	3	2	0	0	0	8	
180	C		EUMEN	12	19	4	6	0	2	0	4	
181	C		EUMEN	11	18	4	1	2	3	3	8	

Table 18 continued

NO.	ACTIVITY	INVOLVE-MENT	MENSTRUAL STATUS	EDI SUBSCALE SCORES 1	2	3	4	5	6	7	8	%BF
182	C		EUMEN	1	9	0	0	0	1	0	1	
183	C		EUMEN	8	24	3	5	0	3	6	4	
184	C		EUMEN	7	6	2	3	0	3	1	6	
185	C		EUMEN	0	3	2	0	0	0	0	12	
186	C		EUMEN	0	4	2	0	0	0	0	6	
187	C		EUMEN	5	4	3	0	3	4	1	12	
188	C		EUMEN	0	6	2	0	1	2	1	3	
189	C		EUMEN	11	15	2	2	1	1	2	2	
190	C		EUMEN	0	8	2	0	4	1	2	0	
191	C		EUMEN	5	21	1	0	1	3	0	6	
192	C		EUMEN	0	3	3	0	1	0	0	9	
193	C		EUMEN	4	13	4	2	0	0	0	1	
194	C		OLIG	12	26	1	0	5	0	8	14	
195	C		EUMEN	3	5	3	0	0	0	0	4	

Questionnaire Instructions

THE FOLLOWING QUESTIONNAIRE IS DESIGNED TO COLLECT INFORMATION ON TRAINING REGIMES, DIETING STRATEGIES, AND MENSTRUAL STATUS OF WOMEN WHO WEIGHT TRAIN. THE INFORMATION WILL BE USED FOR RESEARCH PURPOSES ONLY AND ALL INDIVIDUAL'S ANSWERS WILL BE KEPT CONFIDENTIAL.

PLEASE ANSWER THE QUESTIONS ON THE OPSCAN FORM PROVIDED USING A NUMBER 2 PENCIL. ALL WRONG ANSWERS NEED TO BE ERASED COMPLETELY. THANK YOU FOR YOUR TIME AND HELP WITH THIS STUDY.

I.D.# _____

Please answer the following questions on this sheet. Then begin to fill in the opscan with the questions on page 2.

I. Weight Control

1. What is your height? _____

2. What is your present weight? _____

3. What is the least you've weighed since reaching your present height? _____

4. How long ago was this (lowest weight)?

   days _____ months _____ years _____

5. What is the most you've weighed since reaching your present height? _____

6. How long ago was this (highest weight)?

   days _____ months _____ years _____

7. What do you think is your ideal weight? _____

Begin using the obscan form.

1. For Daily Living (when not in training for competition), I consider myself to be:?
   1. very underweight
   2. underweight
   3. neither underweight nor overweight
   4. overweight
   5. very overweight

2. For weight-lifting Competition, I consider myself to be:? Answer 1 if you do not work-out with weights.
   1. not applicable
   2. very underweight
   3. underweight
   4. average
   5. overweight
   6. very overweight

For questions 10-16. How often do you use the following criteria to determine whether you need to lose weight, gain weight, or maintain your weight for Daily Living?

5 = very frequently use
4 = frequently use
3 = sometimes use
2 = rarely use
1 = never use

3. body weight
4. measured percent body fat
5. visual appearance
6. fit of your clothes
7. advice of family/friends
8. advice of weight lifters
9. advice of athletes other than weight lifters

For questions 10-16. How often do you use the following criteria to determine whether you need to lose weight, gain weight, or maintain your weight for Competition?

6 = not applicable
5 = frequently use
4 = often use
3 = sometimes use
2 = rarely use
1 = never use

10. body weight
11. measured percent body fat
12. visual appearance
13. fit of your clothes
14. advice of family/friends
15. advice of weight lifters
16. advice of athletes other than weight lifters

For questions 17 & 18. Which of the following best describes your dieting pattern when trying to lose body weight?

1.usually diet for 2 or more consecutive months
2. usually diet for 4 to 7 consecutive weeks
3. usually diet for 2 to 3 consecutive weeks
4. usually diet for an entire week
5. usually diet for several consecutive days
6. usually diet for a couple days, go off for a couple days
7. usually diet every other day
8. do not usually diet
9. not applicable

17. When dieting for Daily Living, I?

18. When dieting for Competition, I?

For questions 19 & 20. How many Calories do you usually eat per day?

19. Daily Living:
1. more than 2500
2. 2500-2000
3. 2000-1500
4. 1500-1000
5. 1000-500
6. less than 500

20. Dieting:
1. more than 2500
2. 2500-2000
3. 2000-1500
4. 1500-1000
5. 1000-500
6. less than 500

21. How often do you usually diet to lose body weight?
    1. never diet
    2. rarely diet
    3. several times a year
    4. several times a month
    5. several times a week

For questions 22-27. Have you ever had any of the following negative side effects from dieting? If you do not diet, answer 2.no.

22. dizziness	1. yes	2. no
23. extreme fatique	1. yes	2. no
24. menstrual irregularity	1. yes	2. no
25. headaches	1. yes	2. no
26. heartburn	1. yes	2. no
27. extreme irritability	1. yes	2. no

For questions 28-35. Where do you get information on nutrition and diet? Rate each of the following 1-5 according to frequency of use.

5= very frequently used
4= frequently used
3= sometimes used
2= rarely used
1= never used

28. coaches
29. trainers
30. teachers
31. books
32. magazines
33. weightlifters
34. athletes other than weight lifters
35. family/friends/other

36. Do you get uncontrollable urges to eat and eat until you feel physically ill? 1. yes 2. no

37. Are there times when you are afraid that you cannot voluntarily stop eating? 1. yes 2. no

38. Have you ever had an episode of eating an enormous amount of food in a short space of time (an eating binge)? 1. yes 2. no

39. If you have ever binged, do you feel miserable and annoyed with yourself afterwards? 1. yes 2. no

For questions 40-45. In order to control your weight, how often do you use...

1. never
2. less than once every four weeks
3. 1 to 3 times every four weeks
4. once every week
5. 2 to 6 times every week
6. once every day
7. more than once every day

40. Diet pills

41. Laxatives

42. Diuretics or water pills

43. Vomiting

44. Do you consider yourself to be or to have been bulimic?
1. yes, now
2 yes, used to
3. no

45. Do you consider yourself to be or to have been anorexic?
1. yes, now
2. yes, used to
3. no

For questions 46-49. Have you had any of the following symptoms?

46. Overactivity/exercise without enjoyment 1. yes 2. no
47. Feeling terrified of fat 1. yes 2. no
48. Feeling fat despite others saying you are too thin 1. yes 2. no
49. Being obsessed or totally preoccupied with thoughts of food 1. yes 2. no

II. Menstrual History

50. How old were you when you had your first period?
1. before 12
2. between 12 and 17
3. after 17

51. What is the average length of your menstrual cycle? From the first day of your period (day #1) to the first day of your next period.
1. 0-35 days
2. 36-89 days
3. 90 or more days
4. very difficult to say, sometimes monthly, sometimes skips several months
5. have not had a period in 12 months

52. Do your periods usually occur at consistent intervals?
1. yes
2. no

53. In the past 3 months, how many periods have you had?
1. 4-3
2. 2-1
3. 0

54. Have you missed a period within the last year?
1. yes
2. no

55. If yes, this was probably best explained by:
1. pregnancy
2. dieting
3. change in exercise routine
4. illness
5. none of the above
6. a combination of 2-4

56. How long has it been since you last took birth control pills?
1. not applicable
2. more than 6 months ago
3. 6-3 months ago
4. less than 3 months ago
5. are presently taking them

57. How many times a week do you train aerobically? Aerobic exercise is continuous, rhythmic activity performed at a constant speed. For example, running, cycling, and swimming.
1. 7-5 times
2. 4-3 times
3. 2-1 times
4. never

58. How long do you usually participate in aerobic exercise? Exclude calisthenics, warm-up and cool down.
1. more than 60 min
2. 60-31 min
3. 30-20 min
4. less than 20 min

For questions 59-63. In which aerobic activities, if any, do you usually participate at least once a week?

59. running	1. yes 2. no
60. cycling	1. yes 2. no
61. swimming	1. yes 2. no
62. aerobic dance	1. yes 2. no
63. rowing	1. yes 2. no

If you do not workout with weights, skip to question 82. Please be careful to start on the right opscan number.

64. In weight training, which of the following describes you best?
1. general conditioner
2. bodybuilder
3. olympic lifter
4. powerlifter

65. Have you ever competed in a bodybuilding competition?
1. more than 3 times
2. 3-2 times
3. once
4. never

66. Do you plan to compete within the next 3 months?
1. yes
2. no

67. How many times a week do you usually weight train?
1. 5 or more times
2. 4-3 times
3. 2-1 times

68. During an average workout, how long do you actually spend lifting? (exclude dressing, visiting, warm-up etc.)

1. more than 60min
2. 60-45 min
3. 45-30 min
4. 15-30 min

For questions 69-76. Where do you get information on training? Rate each of the following 1-5 according to frequency of use.

5= very frequently used
4= frequently used
3= sometimes used
2= rarely used
1= never used

69. coaches
70. trainers
71. teachers
72. books
73. magazines
74. weightlifters
75. athletes other than weight lifters
76. family/friends/other

77. What is the most weight you have ever lost for a contest?

1. never been in contest
2. less than 5 pounds
3. 5-10 pounds
4. 10-15 pounds
5. 15-20 pounds
6. more than 20 pounds

For questions 78-81. On which of the following are you interested in obtaining more information.

3= very interested
2= somewhat interested
1= not interested

78. vitamins
79. amino acids or protein supplements
80. potassium
81. steroids

For questions 82-145. 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. Please answer each question very carefully. Thank you.

1 = Always
2 = Usually
3 = Often
4 = Sometimes
5 = Rarely
6 = Never

82. I eat sweets and carbohydrates without feeling nervous.

83. I think that my stomach is too big.

84. I wish that I could return to the security of childhood.

85. I eat when I am upset.

86. I stuff myself with food.

87. I wish that I could be younger

88. I think about dieting.

89. I get frightened when my feelings are too strong.

90. I think that my thighs are too large.

91. I feel ineffective as a person.

92. I feel extremely guilty after overeating.

93. I think that my stomach is just the right size.

94. Only outstanding performance is good enough in my family.

95. The happiest time in life is when you are a child.

96. I am open about my feelings.

1 = Always
2 = Usually
3 = Often
4 = Sometimes
5 = Rarely
6 = Never

97. I am terrified of gaining weight.

98. I trust others.

99. I feel alone in the world.

100. I feel satisfied with the shape of my body.

101. I feel generally in control of things in my life.

102. I get confused about what emotion I am feeling.

103. I would rather be an adult than a child.

104. I can communicate with others easily.

105. I wish I were someone else.

106. I exaggerate or magnify the importance of weight.

107. I can clearly identify what emotion I am feeling.

108. I feel inadequate.

109. I have gone on eating binges where I have felt that I could not stop.

110. As a child, I tried very hard to avoid disappointing my parents and teachers.

111. I have close relationships.

112. I like the shape of my buttocks.

113. I am preoccupied with the desire to be thinner.

114. I don't know what's going on inside me.

115. I have trouble expressing my emotions to others.

116. The demands of adulthood are too great.

1 = Always
2 = Usually
3 = Often
4 = Sometimes
5 = Rarely
6 = Never

117. I hate being less than best at things.

118. I feel secure about myself.

119. I think about bingeing (over-eating).

120. I feel happy that I am not a child anymore.

121. I get confused as to whether or not I am hungry.

122. I have a low opinion of myself.

123. I feel that I can achieve my standards.

124. My parents have expected excellence of me.

125. I worry that my feelings will get out of control.

126. I think that my hips are too big.

127. I eat moderately in front of others and stuff myself when they're gone.

128. I feel bloated after eating a normal meal.

129. I feel that people are happiest when they are children.

130. If I gain a pound, I worry that I will keep gaining.

131. I feel that I am a worthwhile person.

132. When I am upset, I don't know if I am sad, frightened or angry.

133. I feel that I must do things perfectly, or not do them at all.

134. I have the thought of trying to vomit in order to lose weight.

1 = Always
2 = Usually
3 = Often
4 = Sometimes
5 = Rarely
6 = Never

135. I need to keep people at a certain distance (feel uncomfortable if someone tries to ge too close).

136. I think that my thighs are just the right size.

137. I feel empty inside.

138. I can talk about personal thoughts or feelings.

139. The best years of your life are when you become an adult.

140. I think that my buttocks are too large.

141. I have feelings I can't quite identify.

142. I eat or drink in secrecy.

143. I think that my hips are just the right size.

144. I have extremely high goals.

145. When I am upset, I worry that I will start eating.

SKINFOLD MEASUREMENTS FOR SURVEY SUBJECTS

Social security number _____
Phone_____ Name _____

TRICEP	ILIAC-CREST
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
Avg. 3middle _____	Avg. 3 middle _____
ABDOMEN	THIGH
1. _____	1. _____
2. _____	2. _____
3. _____	3. _____
4. _____	4. _____
5. _____	5. _____
Avg. 3middle _____	Avg. 3 middle _____

S_4 = Sum of all 4 sites; S_3 = Sum of tricep, iliac & thigh

A. $BD(7) = 1.0960950 - 0.0006952(S_4) + 0.0000011(S_4)^2 - 0.0000714(AGE)$

$= \frac{1.0960950 - 0.0000011x}{}$

$= \frac{}{}$

$= \frac{}{}$

$BD = \frac{}{}$

B. $BD(13) = 1.0994921 - 0.0009929 (S_3) + 0.0000023 x (S_3)^2 - 0.0001392 (AGE)$

$$\frac{1.0994921 - 0.0000023x}{} = 1.0994921 - \frac{}{} + \frac{}{} - \frac{}{} = BD = \frac{}{}$$

$$\%\text{Body Fat} = 100 \left(\frac{4.570}{BD} - 4.143\right) = A\_\_\_\_\_ \quad B\_\_\_\_\_$$

HYDROSTATIC WEIGHING DATA

Subject _____

Weight (kg) _____

Age _____

Water Temperature (^{o}C) _____

	# boxes on graph	equivalent lbs.
Trial 1	_____	_____
Trial 2	_____	_____
Trial 3	_____	_____
Trial 4	_____	_____
Trial 5	_____	_____
Trial 6	_____	_____
Trial 7	_____	_____
Trial 8	_____	_____

AVERAGE OF 3 HIGHEST TRIALS _____

$$\frac{\text{lbs}}{2.21\ \text{lbs/kg}} = \text{_____ kgs} \qquad BD = \frac{\text{_____ kg}}{\text{_____} - \text{_____}}$$

BD = _____

A. $\%BF = 100 \times \frac{4.570}{BD} - 4.143 =$ _____

B. $\%BF = 100 \times \frac{4.95}{BD} - 4.50 =$ _____

RESIDUAL LUNG VOLUME DATA

Subject _____

VO_2=: _____

a: O% N_2=

b: _____

c: 80% N_2=

d: _____

c-d= _____

RLV= VO_2 X (b-a)/(c-d)

RLV=_____

DIET RECORD

Please write down all food and drink that you have on the two days of your recordkeeping. Indicate the type of food including important adjective such as lowfat cottage cheese the quantity of food such as 2 cups, and the brandnames of foods such as Dannon yogart or Mc Donald's Big Mac.

A. QUANTITY Please include:

1. Number of items eaten, such as 1 apple, 2 slices of bread or 1 large order of french fries.

2. Volume units such as 1/2 cup, 1 quart, 6 oz. Use a measuring cup whenever possible to help you estimate the volume of foods eaten. If you do not have a measuring cup, just ask and one will be provided for you.

3. Size of meat, breads and cake servings are sometimes difficult to estimate. When not indicated on packages or by brands, please try to use the diagrammed models to help you determine serving sizes or estimate ounces of servings.

B. BRAND NAMES: Please indicate brand names when known. For examples Mrs. Paul's fish sticks, Breyer's ice cream, and If you go to a fast food restaurant, please indicate the chain: Hardee's ham and cheese on croisant, Tastee Freeze, McDonald's etc.

C. PREPARATION: if cooked at home, or at restaurant please indicate how it was prepared - fried, broiled, sauteed etc.

D. TIME: Approximate time of day eaten can be also written down. Precise accuracy on this is not important. It is just helpful when keeping records to think in chronological order.

Examples of entries include:

a.	biscuits	2, approx. 2" d.	
	with margarine	1 oz.	oleo
b.	chicken breasts	2	broiled
c.	quarter pounder	1	McDonald's
	with cheese	1 slice	
	tomato, onion, pickels, Mayonaise, ketchup		
d.	cherry bubble gum	3 pieces	Chewels
e.	Lite beer	2 cans	Miller

Again, please try to estimate quantity as accurately as possible. Using the examples given, write down all foods eaten to assure a correct nutritional profile. If you forget details or items, please indicate that on your food record rather than make a haphazard guess. Thanks again for your cooperation. I know it may be difficult at first, but stick with it and it will get easier with practice.

EXERCISE RECORDS

Keep a record of all exercise including weight lifting, aerobic exercise, and recreational sports activities.

Please indicate:

A. Mode or type of exercise

For example, cycling, running, aerobic dance, raquetball etc. Break categories down into warm-up, cool down and calisthenics whenever appropriate.

B. Duration

Total time involved and time of warm-up, aerobics, cool down, and or mileage of cylcing, biking, walking.

C. Frequency

The number of times you participated in that activity that day. For example, you may go 1 aerobics class but ride your bicke twice, once in the morning and once at night.

SS# 223-17-2873 Date: April 7, 1986

EXERCISE RECORD

Mode	Duration	Amount	Frequency
1. Running	30 min.	3 miles	2x
2. Aerobic Dance	60 min		1x
a. warm-up	5 min		
b. calisthenics	15 min		
c. aerobics	30 min		
d. cool down	5 min		
3. Cycling	16 min		2x
a. warm-up	4 min	2 mph	
b. aerobics	10 min	10 mph	
c. cool down	2 min	2 mph	

If you do the same mode more than once but change duration or amount, make a new entry.

WEIGHTLIFTING

Exercise	Repititions	Weight (lbs.)
Front squats	30 x 30 x 30	50 x 60 x 70
Lat pulls	30	75
Leg press	10 x 10 x 10	165

SS# _____ DATE _____

WEIGHTLIFTING

EXERCISE	REPITITIONS	WEIGHT (lbs.)

SS# _____ DATE _____

EXERCISE

MODE	DURATION	AMOUNT	FREQUENCY

APPENDIX C

INFORMED CONSENT

HUMAN PERFORMANCE LABORATORY

Division of HEALTH, Physical Education and Recreation Virginia Polytechnic Institute and State University

INFORMED CONSENT

I,_____, do hereby voluntarily agree and consent to participate in an exploratory study conducted by the personnel of the Human Performance Laboratory of the Division of Health, Physical Education and Recreation of Virginia Polytechnic Institute and State University.

Title of Study: Exploratory Study of Menstrual Status and Eating Patterns of Female Body Builders.

The purposes of this study include: To assess menstrual dysfunction, eating patterns and training regimes of women body builders.

I voluntarily agree to participate in this testing program. It is my understanding that my participation will include completing: a 151-item questionnaire, a hydrostatic weighing procedure to determine percent of body fat, brief

menstrual and diet records every day for ten weeks, and two extensive diet and training records every week for ten weeks.

I understand that participation in this study may produce certain discomforts and risks. These discomforts and risks include: The risks involved in the hydrostatic weighing procedure involve some discomfort in holding breath and lying down underwater. To minimize the risks, the participant will be instructed on the procedure and allowed to practice several times on land and in the hydrostatic tank before conducting the measurements. The procedures will be conducted by a former Water Safety Instructor and competent technician. In addition, there is a possibility of skin-pinching during the skinfold measurement. This procedure will also be performed by experienced technicians.

Certain personal benefits may be expected from participation in this experiment.
These include: an estimation of percent body fat and comparison with norms of the individual's age group, a greater knowledge by participant of menstrual status compared to literature reports on other athletes and the general population, and a weekly nutritional assessment of 2-day diets for ten weeks.

Appropriate alternative procedures that might be advantageous to you include: *The skin-fold measurement and hydrostatic weighing procedures will be terminated if the subject exhibits signs of intolerance such as pallor, redness, shortness of breath, ment confusion or emotional distress, or if the subject terminates the procedures on her own will.

I understand that any data of a personal nature will be held confidential and will be used for research purposes only. I also understand that these data may only be used when no identifiable with me.

I understand that I may abstain from participation in any part of the experiment or withdraw from the experiment should I feel the activities might be injurious to my health. The experimenter may also terminate my participation should she feel the activities might be injurious to my health.

I understand that is is my personal responsibility to advise the researchers of any preexisting medical problem that may affect my participation or of any medical problems that might arise in the course of this experiment and that no medical treatment or compensation is available if injury is suffered as a result of this research. A telephone is

available which would be used to call the local hospital for emergency service.

I have read the above statements and have had the opportunity to ask questions. I understand that the researchers will, at any time, answer my inquiries concerning the procedures used in this experiment.

Scientific inquiry is indispensable to the advancement of knowledge. Your participation in this experiment provides the investigator the opportunity to conduct meaningful scientific observations designed to make a significant educational contribution.

If you would like to receive the results of this investigation, please indicate this choice by marking in the appropriate space provided below. A copy will then be distributed to you as soon as the results are made available by investigator. Thank you for making this important contribution.

_____ I request a copy of the results of this study.

Date _____ Time_____ a.m. p.m.

Participant's Signature_____

Witness _____

HPL personnel

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APPENDIX D

Case Studies

Methods

Subjects. During questionnaire administration, volunteers were recruited to participate in an 8-week observation period. Three subjects who were considered high involvement bodybuilders, 2 subjects who were considered moderate involvement and 2 subjects who were low involvement general conditioners volunteered. Due to lack of compliance and data, 2 subjects were dropped, resulting in a group of 4 case study subjects consisting of 1 high involvement bodybuilder, 2 moderate involvement weight lifters and 1 low involvement general conditioners. The classification procedure for involvement level is described in chapter 3.

The original proposal was organized to observe the bodybuilders as they weight trained and dieted to prepare for a competition. However, cancellation of the bodybuilding meet during the first few weeks of the observation period did not allow such observations. During the case studies, none of the subjects were training for competition and as a result, actual dieting procedures and possible contraindications were not observed.

Procedures

Instructional Procedures. A general meeting was held prior to the beginning of the study to inform all participants of the exact procedures to be undertaken. Folders containing informed consents, requirements, general instructions, appointment times and dates, exercise, and diet recordkeeping forms were distributed. During the following week, all initial measurements were undertaken and recordkeeping began. The initial measurements included weight, skinfold, residual lung volume and body density. Another general meeting was held during this week to educate the subjects on food identification and serving size estimation.

Body Composition. Body composition was assessed during the 1st, 4th and 8th week of the study. Skinfold measurements were taken as previously described for the survey subjects. Hydrostatic weighing procedures of Brozek et al. (1963) were used. Residual lung volume was measured according to the oxygen dilution technique (Wilmore, 1969). Body weight was measured by the researcher using a Detector standard medical scale.

Exercise and Diet Records. Subjects were randomly assigned to 2 consecutive days of recordkeeping for Week 1 by drawing a number between 1 and 6 from a bag. Six shifts of consecutive 2-days were rotated each week proceeding in consecutive order from Week 1. The shifts were as

follows: 1 = Friday and Saturday, 2 = Saturday and Sunday, 3 = Sunday and Monday, 4 = Monday and Tuesday, 5 = Tuesday and Wednesday, 6 = Wednesday and Thursday. Rotation was intended to allow observation of each day of the week and final profiling of a typical week for each subject without requiring recordkeeping for an entire week. Continuous recordkeeping may have encouraged a change in dietary and training habits. When subjects forgot to keep records for a day, they were instructed to keep records for the following 2-day period rather than attempt to recall their foods and activities.

Subjects were instructed to record all food and drink and estimate the quantity in number, volume and/or size. Brand names and method of preparation were also included. A Food Intake Analysis program was used to assess the total number of Calories and %RDA of specific nutrients.

Weight Lifting and Other Exercise Records. Weight lifting and Exercise records were kept on the same consecutive 2-days as the diet records. On the weight lifting records, subjects were instructed to record the name of the exercise, the number of repetitions performed and the amount of weight in pounds used for repetition. On the exercise records, subjects were instructed to record the mode of exercise, duration or amount in mileage, time or number of repetitions, and frequency per day. The following presents survey responses related to the research

questions of this investigation. In addition, exercise histories and regimens plus diet composition analyses are displayed.

Seven day profiles of exercise and diets were developed from individual subject records. The profiles represent patterns observed within each subject's records, but do not represent true weeks. For example, if all of subject C's Wednesday records were similar, that routine was present for day 3. Atypical days, such as periods of inactivity due to illness or examinations, were not included, but assigned rest days were represented.

Case A

Background:

Case Study A was a 22 year old, 5'4" college senior. On the survey, she reported weighing 62.3 kg (137 lbs) and that her adult weight had ranged from 50.9 kg (112 lb) 7 years prior, to 64.5 kg (142 lbs) 2 years prior. She considered her ideal weight to be 55.9 kg (123 lbs). Two weeks after the survey, during Week 1 of the case study, she weighed 60.5 kg (133 lbs) and had 24.0% BF as determined by hydrostatic weighing. Her body weight and percent body fat for weeks 1, 4, and 8 were as follows:

	Week 1	Week 4	Week 8
Body Weight (Kg)	60.5	60.2	60.0
Body Fat (%)	24.0	19.9	21.1

Exercise:

At the initiation of this study, Case A reported running or swimming 4-3x/wk for 20-30 min. She considered herself to be a bodybuilder and had never competed but planned to do so. She reported weight training 5 times or more a week, for more than 60 min per session and therefore, was classified as high involvement. A review of her weight training records presents a combination of straight sets and circuit training. In several workouts she incorporated 10-30 min of jumping rope or running into her weight training work-out.

The following is a 7-day profile of her weekly exercise.

CASE A

Day 1

Exercise	Repetitions/Duration	Weight(lbs.)/Mileage
1. Circuit:		
a. Bench press	10, 8, M[a](6), M(6)	100, 110, 115, 95
b. Lateral dumbbell raises	10, 8, 6, 10	10, 10, 10, 10
2. Circuit:		
a. Incline dumbbell presses	10, 8, 6, M(8)	25, 25, 25, 25
b. Dumbbell flies	10, 8, 6, M(8)	20, 20, 20, 20
JUMP ROPE 10 MIN		
3. Squats	15	95, full depth
4. Lat. pulldowns	12	100
5. Leg extensions	12	100
6. Dumbbell press	12	25
7. Leg curls	12	60
8. Toe raises (on hacksquat)	25	180

[a]M=maximum number of repetitions possible. In this case, the subject could perfore 6 repetitions.

RUNNING	10 minutes	1 mile
9. Circuit:		
a. EZ. bicep curls	10, 8, M(6)	35, 40, 45
b. Tricep dumbbell extensions	10, 8, 6	15, 15, 15
JUMPING ROPE	15 minutes	

Day 2

Exercise	Repetitions/Duration	Weight(lbs.)/Mileage
1. Bench	8, 8, 5, 2	95, 105, 115, 135
2. Incline Flies	8, 8, 8, 8	25, 30, 25, 20
3. Cable crossovers	8, 8, 8	15, 15, 15
4. Lat pulldowns	8, 8, 8, 8	15, 15, 15
5. Bentover rows	8, 8, 8, 8	85, 100, 115, 130
6. T-bar	8, 8, 8	35, 35, 35
7. Russian chair sit-ups	20, 15, 10, 6	25, 25, 25, 25
8. Rocking chair sit-ups	15, 15, 10, 10	0, 0, 0, 0
9. Decline bench sit-ups	8, 8, 8	25, 25, 25, 25
RUNNING:	20 minutes	2 miles

Day 3 NO EXERCISE

Day 4

Exercise	Repetitions/Duration	Weight(lbs.)/Mileage
1. Squats	8, 8, 8	95, 115, 135
2. Leg	10, 10, 10	100, 100, 100

3. Circuit:		
a. Close grip bench	8, 8, 8	65, 65, 65
b. Lateral dumbbell raises	8, 8, 8	15, 15, 15
4. Circuit:		
a. Front dumbbell shoulder raises	8, 8, 8	15, 15, 15
b. Tricep, dumbbell extension	8, 8, 8	15, 15, 15
5. E.Z. bar extensions (supine on bench)	8, 8, 8	40, 40, 40
6. Trapezoid raises	8, 8	40, 40

RUNNING: 1 - 1 + 1/4 mile, 10 min., twice within 1hr.

Day 5

Day off from weight training

RUNNING 10 to 15 minutes 2 miles

Day 6

Exercise	Repetitions/Duration	Weight(lbs.)/Mileage
1. Squats	8, 8, 8, 8	95, 115, 135, 95
2. Leg extensions	10, 10, 10	100, 110, 100
3. Leg curls	10, 8, 8	60, 70, 60
4. Circuit:		
a.Close grip bench	8, 8, 8	65, 65, 65
b.Lateral dumbbell raises	8, 8, 8	15, 15, 15

5. Circuit:		
a. Front dumbbell shoulder raises	8, 8, 8	15, 15, 15
b. Tricep, dumbbell extensions	8, 8, 8	15, 15, 15
6. E.Z. bar tricep extensions	10, 10, 10	40, 40, 40
7. Trapezoid raises	8, 8, 8	40, 40
8. Russian chair sit-ups	20, 20, 20	25, 25, 25
9. Rocking chair sit-ups	15, 15, 10, 10	0, 0, 0
10. Declined sit-ups	8, 8, 8, 8	25, 25, 25

NO AEROBICS OR OTHER EXERCISE

Day 7

Exercise	Repetitions/Duration	Weight(lbs.)/Mileage
1. Circuit:		
a. Bench press	8, 10, 12	45, 45, 45
b. Lat. dumbbell raises	10, 10, 12	20, 15, 10
c. Toe raises	20, 25	35, 35
2. Circuit:		
a. Front military press	10, 10	45
b. Dumbbell press	10, 10	20, 20

c. Pulley rows	10, 10	35, 35
RUNNING:	15 minutes	1 1/2 miles
3. Dumbbell presses	10	20
4. Squat	12	95
5. Dumbbell flies	12	20
6. Leg curls	12	60
7. Lat. pulldowns	12	100
8. Leg extensions	15	100
RUNNING:	15 minutes	1 1/2 miles
9. E.Z. bar extensions	8, 10, 12	35, 35, 35
RUNNING:	7 minutes	3/4 miles
10. Dips	Max., Max.	0, 0
11. Tricep extensions	Max., Max.	10, 10

Dieting History and Patterns

By survey, Case A reported dieting several times a year, for 2 or more consecutive months, on 100-1500 Kcal/d. According to her diet records, she was eating approximately 700-1400 Kcal/d on the days that she reported her intake. The following presents a 7-day profile of her caloric intake and percent of proteins, fat and carbohydrates.

CASE A

Day 1

Total Kcals = 1129

Proteins	25.4%
Fats	21.0%
Carbohydrates	53.5%

Day 2

Total Kcals = 763

Proteins	35.7%
Fats	9.0%
Carbohydrates	55.3%

Day 3

Total Kcals = 977

Proteins	28.3%
Fats	14.3%
Carbohydrates	57.3%

Day 4

Total Kcals = 1079

Proteins	23.5%
Fats	27.3%
Carbohydrates	49.0%

Day 5

Total Kcals = 695

Proteins	29.8%
Fats	9.4%
Carbohydrates	60.8%

Day 6

Total Kcals = 1352

Proteins	23.4%
Fats	24.1%
Carbohydrates	52.4%

Day 7

Total Kcals = 718

Proteins	12.1%
Fats	21.1%
Carbohydrates	66.3%

Eating Patterns:

Case A responded no to all of the eating behavior questions, saying that she did not use diet pills, laxatives, diuretics or vomiting for weight control, nor did she binge-eat or feel terrified of fat or obsessed with food. She did not consider herself to be or to have been anorexic or bulimic.

Her scores on the EDI subscales were as follows:

Drive for Thinness:	0
Bulimia:	2
Body Dissatisfaction:	0
Ineffectiveness:	0
Perfectionism:	0
Interpersonal Distrust:	0
Interoceptive Awareness:	0
Maturity Fears:	2

Menstrual Function:

The subject reported menstrual cycles averaging less than 36 days in length at consistent intervals and was thus classified as eumenorrheic. She did report having missed at least one period and attributed that to a change in diet and exercise or possibly illness. She reported 1 to 2 periods within the past three months. Having reported cycle lengths of less than 36 days at consistent intervals, this subject was classified as eumenorrheic. Subject A also reported menarche between the ages of 12 and 17. During the study, this subject had 2 periods.

CASE B

Background:

Case study B was an 18 year old, 5'3", college freshman. She reported that she weighed 55.5 kg (122 lb) at the time of the survey study, and that her adult weight had ranged from 40.4 kg (89 lb) 3 years prior, to 58.2 kg (128 lb) 2 weeks prior. She considered her ideal weight to be 52.3 kg (115 lb). Two weeks after the survey was completed, during week 1 of the case study, she weighed 54.7 kg and had 24.4% BF as determined by hydrostatic weighing. Her body weight and percent body fat for weeks 1, 4 and 8 were as follows:

	Week 1	Week 4	Week 8
Body Weight (kg)	54.7	55.7	58.5
Body Fat (%)	24.49	21.92	23.77

Exercise:

She was an ex-ballet dancer and had quit dancing because she had been considered by herself and others to have been anorexic 3 years prior to the study.

At the initiation of the study, this subject reported running 5 or more times a week for 31 to 60 minutes, sometimes running twice a day. She reported weight training 5 to 7 times a week for 30 to 45 minutes a session, classifying her in the moderate involvement group. A review of her weight training schedule indicated a 3 day rotation schedule, with back, bicep and abdominal

muscles being exercised on Day 1, chest, triceps, and shoulders on Day 2, and leg and abdominals on Day 3. The following is a one week profile of her weekly exercise regime.

Day 1

EXERCISE	REPETITIONS/DURATION	WEIGHT/MILEAGE
1. Seated Cable Rows	12x12x12x12	70lbs.
2. Back Extensions	20x20x20x20 up & down	10lbs.
3. Bentover Dumbbell	20x20x20x20 twisting	20lbs.
Rows	15x15x15x15	20lbs.
4. Bentover Rows Bar	10x10x10x10	55lbs.
5. Dumbbell Curls	12x12x12x12	15lbs.
6. Seated Crunches	50x50x50x50	0lbs.
7. 10 min. stretch		

Day 2

EXERCISE	REPETITIONS/DURATION	WEIGHT/MILEAGE
1. Jogging	10 minutes	1 mile
2. Cable Rows	12x12x12x12	55x70x70x70
3. Bentover Rows	12x12x12x12	50x60x60x60
4. Dumbbell Rows	15x15x15x15	20x20x20x20
5. Back Extension	20x20x20	0
6. Dumbbell Curls	10x10x15x15	10x10x15x15
7. Sit ups	50x	

Day 3

EXERCISE	REPETITIONS/DURATION	WEIGHT/MILEAGE
1. Bench Press	10x10x10x10	70x70x70x70
2. Cable Flies	12x12x12	20x20x20
3. Seated Military Press	10x10x10	45x45x45
4. Overhead Dumbbell extensions	12x12x12x12	10x10x10x10
5. Tricep Extensions	15x15x15x15	35x35x40x40
6. Jogging	20 minutes	2 mile

Day 4

EXERCISE	REPETITIONS/DURATION	WEIGHT/MILEAGE
1. Bench Press	10x10x6x10x9	75x80x85x80x75
2. Cable Flies	12x12x15	20x20x20
3. Military Press	10x10x10	45x45x45
4. Overhead Dumbbell Extension	12x12x12x12	10x10x10x10
5. Lateral Dumbbell Side Raises	15x15x15x15	5x5x5x5
6. Dumbbell Tricep Extension	12x12x12x12	10x10x5x5
7. Tricep Push-down	15x15x15x15x15	40x40x40x40x40
8. Walking	50 minutes 2 1/2-3miles	2 lbs.

Day 5

EXERCISE	REPETITION/DURATION	WEIGHT/MILEAGE
1. Squats	10x10x10x10x10	65x85x85x85x85

2. Seated Calf Raises	15x15x15x15	55x55x55x55
3. Mute Calf Raises	15x15x15x15x15	175x190x190x190x190
4. Leg Extension	10x10x10x...	80x40x80x40x80x40x80x40
5. Leg Curls	10x10x10x10x10	50x50x50x60x60
6. Roman Chairs	30x30	
7. Abdomen Twist	30x30	
8. Jogging	10 minutes	1 mile

Day 6

EXERCISE	REPETITION/DURATION	WEIGHT/MILEAGE
1. Bench Press	10x10x6x8x10	75x80x85x80x75
2. Dumbbell Flies	12x12x12x12x15	20x20x20x20x20
3. Military Press	10x10x10	45x45x45
4. Dumbbell Extension	15x15x15x15x15	10x10x10x10x10
5. Lateral Dumbbell Raises	15x15x15x15	5x5x5x5 lbs.
6. Overhead Tricep Extensions	12x12x12x12	5x5x10x10
7. Tricep Pushdowns	15x15x15x15x15	40x40x40x40x40

Day 7

Running 20 min

Dieting History and Patterns:

By survey, Case B reported dieting for 2 to 3 weeks at a time, several times a year, on 500 to 1000 Kcals/d. She also reported using diuretics for weight control, and eating more than 2500 Kcals/d when not dieting. According to her diet records, she did eat between 500 and 1000 Kcals and exceed 2500 Kcals on several days. The following is a profile week-diet taken from random 2-day diet records, recorded over a 2 month period.

Day 1

Total Kcals = 930

Proteins	5.9%
Fats	32.3%
Carbohydrates	61.7%

Day 2

Total Kcals = 1340

Proteins	14.2%
Fats	40.3%
Carbohydrates	45.5%

Day 3

Total Kcals = 1883

Proteins	6.7%
Fats	40.3%
Carbohydrates	66.5%

Day 4

Total Kcals = 791

Proteins	13.2%
Fats	31.3%
Carbohydrates	55.4%

Day 5

Total Kcals = 1178

Proteins	15.2%
Fats	35.7%
Carbohydrates	49.1%

Day 6

Total Kcals = 1363

Proteins	21.1%
Fats	54.7%
Carbohydrates	24.1%

Day 7

Total Kcal = 1182

Proteins	12.7%
Fats	59.0%
Carbohydrates	28.3%

Unusual Days:

Day 8

Total Kcal = 2587

Proteins	7.8%
Fats	52.6%
Carbohydrates	39.5%

Day 9

Total Kcals = 3562

Proteins	14.9%
Fats	48.7%
Carbohydrates	36.4%

Comment: Exam week

Eating Patterns:

Although the subject felt that she was no longer anorexic and did not consider herself bulimic, she did think she had poor eating habits. On the survey, she reported episodes of bingeing followed by guilt, preoccupation with food, uncontrollable urges to eat, fear of not being able to stop eating, and fear of being fat. According to the diet records, the subject did increase her caloric intake and fat consumption during exam week when she reported to be "eating - under - stress."

Case B's scores on the Eating Disorder Inventory were as follows:

Drive for Thinness:	10
Bulimia:	7
Body Dissatisfaction:	3
Ineffectiveness:	3
Perfectionism:	0
Interpersonal Distrust:	3
Interoceptive Awareness:	1
Maturity Fears:	5

Menstrual Function:

The subject reported the menstrual cycles averaging between less than 36 days, but at inconsistent intervals. She also reported missing at least 1 menstrual period in the year before the study. Since she reported having 1 to 2 periods within the past 3 months, she was considered oligomenorrheic rather than amenorrheic, and since she had reached menarche before the age of 17, it was considered secondary menstrual dysfunction and therefore, possibly related to diet and exercise. During the study, the subject had 2 menstrual periods.

CASE C

Background:

Case C was a 20 year old college student. At 5'6", she reported weighing 52.3kg (115 lbs.) at the time of the survey study. Her adult weight had fluctuated from 49.1kg (108 lbs.) to 54.5kg (120 lb). She considered herself to be at her ideal weight of 52.3kg (115 lb). During week 1 of the study, she weighed 52.5 kg and was 24.3 %BF by hydrostatic weighing. The following were her measured body weights and percent body fat at weeks 1, 4 and 8.

	Week 1	Week 4	Week 8
Body Weight (kg)	52.3	53.4	53.8
Body Fat (%)	24.3	21.9	21.0

Exercise:

Case C had been a cheerleader in high school but was not active in sports in college. She reported running, cycling and aerobic dancing 4-3x/wk for 20-30 min. a session. She considered herself a general conditioner and used nautilis equipment 15-30 min. 3-4x/wk which classified her as low involvement. A review of her weight training scheduled presented a single regimen of nautilis exercises, performed for 12 repetitions, 3x for 1 set. Fifty repetitions of no weight sit ups were included. The following is a 7-day profile of Case C's weight training and aerobic exercise.

	EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
Day 1			
	Running	15 min	1.25 miles
Day 2	EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
	1. Bench Press	12x12x12	30x30x30
	2. Tricep Press	12x12x12	20x20x20
	3. Front Lat Oulls	12x12x12	40x40x40
	4. Back Lat Pulls	12x12x12	40x40x40
	5. Sit Ups	25x25	0x0
	6. Leg Extension	12x12x12	30x30x30
	7. Leg Curl	12x12x12	20x20x20
Day 3	EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
Running		30 min	2.5 miles
Day 4	EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
	1. Bench Press	12x12x12	35
	2. Leg Extensions	12x12x12	30
	3. Leg Curl	12x12x12	20
	4. Tricep Press	12x12x12	20
	5. Front Lat Pulls	12x12x12	20x20x20
	6. Back Lat Pulls	12x12x12	40x40x40
	7. Butterflies	12x12x12	40x40x40
	8. Sit Ups	50x	0
	1. Hop Lifts	5 minutes	25x
	2. Firehydrants (doggies)		25x
Day 5	EXERCISE	REPETITION/DURATION	WEIGHT/MILEAGE
	Bike riding	45 min	4 miles

Day 6 EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
1. Bench Press	12x12x12	35x35x35
2. Front Lat Pulls	12x12x12	40x40x40
3. Back Lat Pulls	12x12x12	40x40x40
4. Tricep Press	12x12x12	20x20x20
5. Sit Ups	50x50	0 x 0
6. Leg Curls	12x12x12	20x20x20
7. Leg Extensions	12x12	40x30
1. Running	30 minutes	3 miles

Day 7 REST

Dieting History and Patterns:

By survey, Case C reported dieting to lose body weight several times a week, by eating 500-1,000 Kcal/d for a couple of days and then going off the diet for a couple of days and eating 1,000-1500 Kcal/d. She reported fatigue, headaches and menstrual irregularity as side effects she had experienced from dieting. A review of her dieting profile indicated that she usually ate 12-1700 Kcal.

Day 1

Total Kcals = 1616

Proteins	7.9
Fats	36.8
Carbohydrates	55.2

Day 2

Total Kcals = 1276

Proteins	19.0%
Fats	33.9%
Carbohydrates	47.0%

Day 3

Total Kcals = 1386

Proteins	9.5%
Fats	36.6%
Carbohydrates	53.8%

Day 4

Total Kcals = 1865

Proteins	15.4%
Fats	43.2%
Carbohydrates	41.3%

Day 5

Total Kcals = 1237

Proteins	36.2
Fats	14.0%
Carbohydrates	49.8%

Day 6

Total Kcals = 777

Proteins	8.9%
Fats	33.6%
Carbohydrates	57.6%

Day 7

Total Kcals = 1724

Proteins	27.8%
Fats	42.8%
Carbohydrates	29.4%

Unusual Day Total Kcals = 2719

Proteins	21.1%
Fats	34.4%
Carbohydrates	44.5%

Comment: Last day of school

EATING PATTERNS:

Case Subject C answered yes to the eating behavior questions 36-39 and 46-49. She responded no to the use of diet pills, laxatives, diuretics, & vomiting for weight control. She considered herself to have had anorexia nervosa but not bulimia. She admitted to being overactive and exercising without enjoyment, being terrified of fat, feeling fat despite others saying she was too thin, and being obcessed with food.

The following presents her individual scores on the EDI:

Drive for Thinness:	11
Bulimia:	7
Body Dissatisfaction:	2
Ineffectiveness:	3
Perfectionism:	1

Interpersonal Distrust: 0

Interoceptive Awareness: 0

Maturity Fears: 8

Menstrual Function:

Subject C reported having inconsistent menstrual cycles that sometimes occurred monthly and sometimes skipped several months. On the survey, she reported having 1-2 periods within the previous 3 months; during the case observation time, C had 1 menstrual period. She reported having missed a period during the previous year. Due to her inconsistency and th presence of sporadic menstrual periods, the subject was classified as oligomenorrheic. Since she reported menarche at less than 17 years of age, subject C's menstrual dysfunction was considered to possibly be related to diet, exercise, stress or a combination.

CASE D

Background:

Case D was a 23 year old, 5'7" college senior. On the survey, she reported weight 60kg (132 lb) and that her adult weight had fluctuated from 52.3 kg (115 lb) five years prior to the study to 65.9 kg (145 lb) 18 months prior to the survey. She felt her ideal weight was (115 lb). During Week 1 of the case study, she weighed and had 22.7 %BF as calculated through hydrodensitometry. Her body weight and percent body fat during weeks 1, 4 and 8 of the study follow.

	Week 1	Week 4	Week 8
Body Weight (kg)	58.7	59.1	60.5
Body Fat (%)	22.7%	29.8%*	24.6

Exercise:

At the initiation of this study, Case D reported running or doing aerobic dance 3-4x/wk for at least 20-30 minutes. She reported weight training with nautilis 3x/week for 45 to 60 minutes, categorizing her in the moderate involvement group. A review of her weight training records revealed a standard nautilus circuit regimes. The following present Case D's 7-day exercise profile.

Day 1

EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
Circuit:		
1. Hip Flexion/Extension (Hip/Back Machine)	60 each leg	30
2. Military Press	12x12x15	25x25x35
3. Bench Press	12x12x15	35x35x50
4. Tricep Pressdown	12x12x15	20x20x20
5. Lateral Pulldown	12x12x15	50x50x50
6. Leg Curls	12x12x15	10x10x10
7. Leg Extension	12x12x15	20x20x20
Exercise:		
8. Arm Curls	12x12x15	10x10x10
1. Sit Ups	200	
2. Pelvic Thrust	200	
3. Leg Lifts in hydrant position	50 each leg	

Day 2

EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
Circuit:		
1. Hip Flexion/Extension	60 each leg	30
2. Military Press	12x12x15	25x25x35
3. Bench Press	12x12x15	35x35x50
4. Tricep Pressdown	12x12x15	20x20x20
5. Lateral Pulldown	12x12x15	50x50x50
6. Leg Curls	12x12x15	10x10x10

7. Leg Extensions	12x12x15	20x20x20
8. Arm Curls	12x12x15	10x10x10

Exercise:

1. Sit Ups	200	
10.Pelvic Thrust	200	
11.Side Leg Lifts in hydrant position	50 each leg	

Day 3

EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
No Weight Lifting		
1. Running	20 minutes	2 miles
2. Sit Ups	200	
3. Pelvic Thrusts	200	

Day 4

EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
1. Military Press	10x10x15	25x25x35
2. Bench Press	10x10x15	35x35x50
3. Tricep Pressdown	10x10x15	20x20x20
4. Lateral Pulldown	10x10x15	50x50x50
5. Leg Curls	10x10x15	10x10x10
6. Leg Extensions	10x10x15	20x20x20
7. Hip Flexions/Extensions	60 each leg	20x20x20
8. Bicep Curls	10x10x15	10x10x10

Exercises:

1. Sit Ups	200
2. Pelvic Thrusts	200

3. Side Leg Lifts in

hydrant Position 50 each leg

EXERCISE	REPITITION/DURATION	WEIGHT/MILEAGE
Day 5		
Running	20 min	
Day 6		
1. No Exercise		
Day 7		
1. No Aerobic Exercise		

Dieting History and Pattern:

On the questionnaire, Case D reported dieting several times a month, by restricting calories for a few days and going off restrictions for a few days. She claimed that she normally ate 2000-2500 Kcal/d when not dieting and 1000-1500 Kcal/d when dieting. Her diet records below confirm this. One diet record showed a consumption of over 3000 Kcal/d. For information on diet, nutrition and exercise, she reported consulting books and magazines frequently and friends and family sometimes.

Day 1

Total Kcal = 2263

Proteins	10.9%
Fats	41.4%
Carbohydrates	47.5%

Day 2

Total Kcal = 1461

Proteins	12.5%
Fats	30.0%
Carbohydrates	57.4%

Day 3

Total Kcal = 2599

Proteins	16.2%
Fats	37.2%
Carbohydrates	46.3%

Day 4

Total Kcal = 1129

Proteins	21.8%
Fats	41.7%
Carbohydrates	36.5%

Day 5

Total Kcal = 2143

Proteins	17.3%
Fats	23.4%
Carbohydrates	59.3%

Day 6

Total Kcal = 3111

Proteins	14.8%
Fats	32.6%
Carbohydrates	52.7%

Day 7

Total Kcal = 1746

Proteins	13.8%
Fats	26.8%
Carbohydrates	59.4%

Eating Patterns:

Case D reported episodes of binge eating followed by feeling miserable and annoyed. She also reported feeling terrified of getting fat and feeling fat despite others saying she was too thin. She also felt preoccupied with food. Her EDI subscale scores were as follows:

Drive for Thinness:	20
Bulimia:	4
Body Dissatisfaction:	3
Ineffectiveness:	15
Perfectionism:	4
Interpersonal Distrust:	14
Interoceptive Awareness:	0
Maturity Fears:	17

Menstrual Function:

This subject reported menarche between 12 and 17 years of age. She had consistent menstrual cycles of less than 36 days intervals. She reported a missed period during the previous year but did not think it was due to pregnancy, dieting, change in exercise, illness or any combination.

At the time of the survey and case study Case D was on birth control pills.

Summary of Case Studies

Although none of the subjects were actually in training for a bodybuilding meet, several did show decreases in body fat. Case A had a 4.1% decrease in %BF with a slight decrease in body weight from week 1 to week 4. She had been dieting to lose weight, and had incorporated 10 to 20 minutes of running or jumping rope into her weight lifting work-out. Her %BF increased slightly by week 8, but subject A claimed that she had not been lifting as consistently as she had at the beginning of the quarter subject C continued to decrease. Subject D showed a dramatic increase of 7.5 %BF from week 1 to week 4 with a negligible increase in body weight. The subject was not feeling well, and therefore, may have had difficulty completely expelling air from her lungs or may have retained gas in her gastro-intestinal region. She gained more weight by week 8, and her body fat dropped from 29.8% to 24.6%, which was 2% greater than at the beginning of the study.

The dieting patterns of the subjects are interesting, with large fluctuations in total calories per day by subjects B and D. The percent of fat was high, approximately 30 to 50%, for subjects B, C and D but only 9 to 20% for subject A. Since subject A was the highest involved weight lifter, it seems likely that her diet would be low in fat. Her protein consumption was higher than the

other subjects; she ate 25 to 30% of her calories in protein, while the other subjects' diets were usually 15% protein. Many bodybuilders and other athletes feel they need more protein while in training, and the steak and potato dinner has been a pre-football game tradition for years.

Although it was expected that more involved weight lifters would be more likely to have eating disorders, it was the moderate and low involved case subjects who showed a history of anorexia and or negative eating behaviors. Cases B, C and D all scored above 10 on the Drive for Thinness, with D scoring 20. On Bulimia, Case B and C scored 7 which is closer to bulimic norms (10.9) than female college students (1.7). Since the Cs scored high on this subscale, it is difficult to attribute this to weight training. However, it is interesting that while case D claimed to binge-eat, she only scored 4 on the Bulimia scale. Since she did not admit to purging behaviors, perhaps this supports Hart and Ollendicks (1985) findings that binge-eating is prevalent in college women but the bulimia syndrome is not.

The variations in training regimes is interesting. Case A used a combination of circuits, pyramiding sets, and consistent-weight sets with 10-20 minutes of jumping rope or running included. Case B worked separate body parts on a 3-day rotation system, using four straight sets of

repetitions. Cases C and D both combined nautilus work-outs with calisthenic exercises, doing e sets of 10 to 12 repetitions.

The parameters observed in the four case subjects, body fat and weight, diet composition, eating patterns, menstrual status and weight training, are distinct variables, yet they are inter-related. The unique goals of bodybuilding, maximizing muscle mass and minimizing body fat, would logically enhance the interaction of these variables. Since these subjects were not in training for a meet, and one subject was lifting at a low involvement level, the effects of dieting and competitive stress were not observed. However, it is interesting to note the individual variations in training and compare the survey responses to actual records.

As a suggestion for future research of this kind, daily exercise logs and diet records may provide more accurate information and allow for documentation of the progression training. Although the best three-out-of-ten trials was used for body fat criterion scores, conducting the procedure several times during week 1 may have protected against a possible learning effect. It is hoped that this research inspi9res and encourages further investigation on female bodybuilders. The sport is young and has the potential to provide insight into many unanswered questions in women's athletics.

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