University of Bahrain
College of Education
Department of Physical Education



The female athlete triad among female Students of the Physical Education Department at the University of Bahrain

Dissertation submitted in partial fulfillment of the requirement for Master of Physical Education in Sport Medicine

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DECLARATION

I declare that this work is the result of my own investigation and that it has not already been accepted in substance for any degree, nor is it being currently submitted for any degree.

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Dedication

This dissertation is dedicated with gratefulness and heartfelt to my family for instilling in me confidence and drive for pursuing my master degree.

Layla Ahmed Al-madany

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Abstract

A prospective, cross – sectional prevalence study was carried out between November 2003 and March 2004 on active Physical Education Department (PED) female students and non Physical Education Department female students at the University of Bahrain (UOB). The purposes of this study were to define the prevalence of female athlete triad (FAT) among PED female students at UOB, and also to study the factors that are related to FAT among PED female students at the UOB.

A sample of 276 (78.86%) out of 350 the total number of PED female students, and 244 of non PED female students as a control group were volunteered for the study. The researcher conducted questionnaire for the purpose of assessing the main factors related to FAT. It consisted of several parts: physical exertion, dietary intake, nutrition habits, and reproductive system health. And also the bone mineral density (BMD) was evaluated by using Achilles Express Bone Densitometer.

The results revealed that the prevalence BMD reduction among PED female students at the UOB was a 25.36%. With a the mean of (- 0.14) and standard deviation (1.14), the BMD of PED female students was significantly less than non PED female students (BMD mean and ± standard deviation were (0.16 ±1.15). Pearson correlation revealed that FAT factors were significantly related, whereas linear multiple regression revealed, that there is a reciprocal effect between these factors and that these factors explined BMD by 30.6% .

It was concluded that FAT could be present between some PED female students at the UOB. And that the equation prediction for BMD scores is BMD score = -1.7399 - 0.102 (physical exertion score) + 0.005035 (nutrition score) + 0.120 (reproductive system health score).

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Chapter 1

Introduction

Sport and exercise are healthy activities for girls and women of all ages. Exercise helps to prevent from disease, improves psychological well-being and promotes overall health. However, appropriate conditioning and training are essential to prevent injury. While male and female athletes face many similar problems, some conditions occur more often or only in women. Girls and women who are actively involved in sports run the risk of acquiring the female athlete triad. The female athlete triad is a syndrome composed of eating disorders, amenorrhea, and osteoporosis.

The American College of Sports Medicine (Otis et al., 1997) published their position stand on the female athlete triad; the triad consists of disordered eating, amenorrhea, and osteoporosis, that occurs not only in elite athletes but also in physically active girls and women. The components of the triad are interrelated in cause, progression, and outcome. Alone or in combination, triad disorders can reduce physical

performance and have serious medical and psychological consequences(Otis et al., 1997).

Any physically active woman can be at risk of developing this condition (Howe, 2001). Physical education students are physically active. They are participating in practical courses, and these courses are requirements of Physical Education Bachelor Program. They must be fit and healthy to pass these practical courses. Accordingly the researcher had done a pilot study among female students in the Department of Physical Education at University of Bahrain. The result of the study showed warning signs and risks of the female athlete triad.

Physically active girls and women, female athletes, and also physical education female students are under intense pressure to be thin for performance, which may result in a disordered eating, development of amenorrhea, and then suffering the consequences of osteoporosis or bone mineral density reduction. The consequence of female athlete triad can be tragic and lead not only to an increased risk of fracture and irreversible bone loss but to a permanent damage to the kidneys, heart and skeleton (Clairmont, 2000). It can be life threatening and lead to possible death (Smith, 1996).

Disordered eating is the first step in the triad. The prevalence of disordered eating behavior is between 15-62% of female college athletes whereas it has been found to range from 5 to 10% in the general population (Smith, 1996). Women and girls are subject to inner and societal pressures to reach and maintain unrealistically low levels of body weight and body fat. Other factors that are specific to athletes include sport-related emphasis on body weight and body fat, perfectionism, lack of nutrition knowledge, drive to excel at any cost, impact of injury, and pressure to lose weight from parents, coaches, and others (Howe, 2001). These forces contribute to the development of disordered eating behaviors which help to initiate the triad.

Disordered eating may cause amenorrhea and in the long run, osteoporosis (Otis et al., 1997). Amenorrhea is a menstrual abnormality that may be caused by low caloric intake, strenuous training, low body fat, low weight and eating disorder. Skolnick (1993) reported that 2-5% of women in the general population in the U.S. have amenorrhea, while 3.4%-66% of female athletes have amenorrhea (Hobart & Smucke, 2000).

Amenorrhea, when it is due to lack of estrogen, can impair reproductive health, and can lead to the third point of the female athlete

triad, osteoporosis. Osteoporosis is a disease characterized by low bone mass (Hobart & Smucke, 2000). Although this disease is commonly thought of as a disease striking postmenopausal women, it has been in young amenorrheic women. However, women with menopause develop a ten-fold increase in the rate of bone loss due to estrogen deficiency (Miller & Klibanski, 1999). Low bone density can be caused by disordered eating, amenhorrea, or both. This is the single most dangerous point of the triad, because once you lose bone mass, after a certain age, it is very difficult to regain.

It is well established that female athlete triad refers to a series of three illnesses that can strike physically active women and athletes who push their physical capabilities to the limits, and can cause long-term damage to their health or even death.

Statement of the Problem

The three compounds of female athlete triad, eating disorders, amenorrhea, and osteoporosis can reduce physical performance and have serious medical and psychological consequences and even death. A Physical Education Bachelor Program is an intensive course work that

places huge physical involvement upon students. Intensity of the practical courses, disturbances in dietary intake, menstruation, bone density and other factors that may be related to the female athlete triad can lead to health problems.

Results of a pilot study, which was conducted on female students in the Department of Physical Education at University of Bahrain showed warning signs that can develop risk of female athlete triad. Therefore, determination of the prevalence of this condition and factors that are related to the female athlete triad among female students in the Department of Physical Education at University of Bahrain should be established and addressed.

Significance of the Study

The researcher had conducted a pilot study among female students in Department of Physical Education at the University of Bahrain, and the result, showed warning signs of risks for the female athlete triad. Owing to these results, this study is important to define the prevalence female athlete triad among the female students.

This study may prevent female students in Department of Physical Education at the University of Bahrain from female athlete triad and health problems. The female athlete triad can decrease their physical performance and cause morbidity or mortality, thus can interfere with their performance in practical courses which are requirements of Bachelor of Physical Education Program.

Early diagnosis and education related to nutrition, dietary needs and bone health should help to prevent Physical Education Department female students from running the risk of the female athlete triad. This study may help instructors, physicians and athlete trainers and teachers to take action early in order to prevent the likelihood of other serious medical complications of female athlete triad components.

More specifically, the findings of this study may lead to suggestions regarding physical examinations and physiological laboratory testing as requirements to enter a Bachelor of Physical Education Program, and an education course in female athlete triad may prevent Physical Education Department female students from this syndrome.

This study may contribute in a broader research context by exposing female athletes in sport clubs and federations as well as other researches for school female students and Physical Education Department female students to the triad problems.

Purpose of the Study

1. To define whether the female athlete triad among female students in the Department of Physical Education at the University of Bahrain dose exist or not.
2. To identify order of participation of the factors that relate to the female athlete triad among female students in the Department of Physical Education at the University of Bahrain.

Research Questions

1. What is the percentage of Bahrain University female students in the Department of Physical Education who are having reduced bone mineral density relatively to an international standard.
2. Is the bone mineral density of the Physical Education Department female students significantly less than the bone mineral density of

non Physical Education Department female students at the Bahrain University.

3. Is there a significant relationship between nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Department female students at the Bahrain University.
4. Are there reciprocal effects between female athlete triad factors which are nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Department female students at the Bahrain University.
5. What is the prediction equation of nutrition disturbance, menstrual irregularity and physical exertion by which bone mineral density of the Physical Education Department female students at the Bahrain University can be predicted.

Limitation

This study is limited to female students who are not or have previously not been pregnant female students, whether they are from the Department of Physical Education or from non-Department of Physical Education at the University of Bahrain.

Definitions of Terms

1. Female athlete triad:

a. Hobart & Smucke (2000) defined the female athlete triad as a combination of three interrelated conditions that are associated with athlete training : disordered eating, amenorrhea and osteoporosis.

b. Drinkwater, et al. (1990) defined the female athlete triad as a syndrome occurring in physically active girls and women. Its interrelated components are disordered eating, amenorrhea, and osteoporosis.

2. Disordered eating:

Craig, et al. (1997) defined disordered eating as continuum of severity from occasional fasting, to eating fewer calories than expended ,to using diet pills and finally to the full-blown eating disorders of anorexia nervosa and bulimia.

3. Amenorrhea:

Craig, et al. (1997) defined amenorrhea as the lack of menstruation.

4. Osteoporosis:

a. Hobart & Smucke (2000) defined osteoporosis as "the loss of bone mineral and inadequate formation of bone which can lead to increased bone fragility and risk of fracture".

b. Craig, et al. (1997) defined Osteoporosis as "the premature loss of bone density to degree that skeleton is fragile and susceptible to fracture".

5. Physical Exertion: As for this study is concerned, physical exertion is defined as practical physical education courses and physical activities.

Pilot Study

The researcher conducted a pilot study. Female students in the Department of Physical Education at the University of Bahrain were used as subjects. The purpose of the pilot study was to find out if there were specific signs or symptoms that were related to the female athlete triad. One hundred and five female students in the Department of Physical

Education at University of Bahrain participated in the pilot study. They were given a questionnaire.

The findings revealed that there was a 36.19% of the female students were experiencing irregular cycles or loss of menstrual cycles, 31.42 % of female students were experiencing abnormal fatigues, and 68.57% of female students were experiencing some of reduction in their ability to concentrate; moreover 1.9% of the female students had fractures, while the 7.62% of the female students had anemia based on self- reporting.

These results of the pilot study showed that female students in the Department of Physical Education at the University of Bahrain had some signs and symptoms of being at risk of having female athlete triad.

Chapter 2

Review of the Literature

The female athlete triad refers to three distinct but interrelated disorders: disordered eating, menstrual dysfunction and osteoporosis (Otis et al., 1997). An athlete may initially develop disordered eating that leads to menstrual dysfunction and subsequent loss of bone mineral density (Nattiv et al., 1994). While each disorder of the triad is a significant medical concern, when all three disorders occur together, the potential health consequences worsen substantially (Warren & Perloth, 2000; Nattiv et al., 1994). For this reason, both legislative and educational efforts have attempted to stem the growing prevalence of the triad among young women.

Disordered eating and lack of nutrition leads to the postponement or cessation of the menstrual cycle, which in turn results in the decreased production of ovarian hormone and estrogen; the primary cause of premenopausal osteoporosis is the decreased production of ovarian hormone and estrogen (Otis et al., 1997). Clearly, the female athlete triad is a dangerous and harmful cycle. Not only does it decrease athlete performance in terms of lack of endurance and muscle response, but it also increases the risk of injury due to decreased bone density.

Disordered Eating

Disordered eating can be defined as "a wide spectrum of harmful and often ineffective eating behaviors used in attempts to lose weight or achieve a lean appearance" (Otis et al., 1997). Any eating behavior that is harmful occurs on a spectrum. This ranges from calorie, protein and fat restriction and pathogenic weight control measures (e.g., diet pills, laxatives, excessive exercise, self-induced vomiting) to classic Eating Disorders (ED), such as anorexia nervosa and bulimia nervosa (Yeager et al., 1993).

Prevalence Rates of Eating Disorders

Disordered eating is the first step in the triad. The prevalence of disorder eating behavior had been found in studies to range between 15-62% of female college athletes whereas it has been found to range from 5 to 10% in the general population (Smith, 1996).There is much variance in reported prevalence rates of diagnosed eating disorders such as anorexia nervosa and bulimia nervosa, but the reported range is from 4% to 39% of female athletes studied (Nattiv et al., 1994). In general a population, the prevalence of anorexia nervosa is 1% and bulimia nervosa is 1% to 3%.

the prevalence rate for pathogenic eating behaviors is as high as 62% in athletes (Sanborn et al., 2000 & West, 1998).

Sport-specific Risk Factors and Disorders

Sundgot-Borgen (1994) developed an inclusive model of variables that influence the development of disordered eating. General risk factors are grouped into four main categories, genetic influence, biological factors, psychological mechanisms, and social factors, and are listed as "predisposing factors." Sport-specific risk factors are grouped into two categories, High Risk and Low Risk. High Risk factors are as follows:

1. Recommendation to lose weight, or dieting, without guidance.
2. Start of sport specific training at an early age.
3. Start of dieting at an early age.
4. low acceptance of puberty, from a performance perspective.
5. Sudden increase in training volume.
6. Injury.
7. Loss of coach.

Accordingly, the Low Risk factors are as follows:

1. Recommendation to lose weight, or dieting, with guidance.
2. Start of sport specific training at a later age.

3. Start of dieting at a later age.
4. High acceptance of puberty, from a performance perspective.

This model indicates that eating disordered behavior will develop only when general, predisposing factors, such that the athlete is considered vulnerable, are coupled with high risk sport-specific factors. Interestingly, this model includes body image in the general category of psychological mechanisms and not as a separate mediating variable.

Classifications of Eating Disorders

Athletes can have a variety of harmful behaviors that characterize disordered eating that include restricting food intake, taking diet pills, diuretics, or laxatives, having periods of binge eating and purging, or excessive exercise (Sanborn et al.,2000). The American Psychiatric Association, APA (2000) created specific guidelines that represent diagnostic criteria for anorexia nervosa, bulimia nervosa, and eating disorder not otherwise specified, outlined in Tables 1,2, & 3.

Table 1: Components of Anorexia Nervosa	
A	Refusal to maintain body weight at or above a minimally normal weight for age and height (e.g., weight loss leading to maintenance of body weight less than 85% of that expected; or failure to make expected weight gain during period of growth, leading to body weight less than 85% of that expected).
B	Intense fear of gaining weight or becoming fat, even though underweight.
C	Disturbance in the way in which one's body weight or shape is experienced, undue influence of body weight or shape on self-evaluation, or denial of the seriousness of the current low body weight.
D	In postmenarcheal females, amenorrhea, i.e., the absence of at least three consecutive menstrual cycles.
Specify Type:	1. Restricting type – During the current episode of anorexia nervosa, the person has not regularly engaged in binge eating or purging behavior (i.e., self induced vomiting or the misuse of laxatives, diuretics, or enemas) 2. Binge eating / purging type – During the current episode of anorexia nervosa, the person has regularly engaged in binge eating or purging behavior (i.e., self-induced vomiting or the misuse of laxatives, diuretics, or enemas)

Note: Adapted from American Psychiatric Association (2000).

Table 2: Components of Bulimia Nervosa

A	Recurrent episodes of binge eating. This is characterized by both of the following: 1. Eating, in a discrete period of time (e.g., within any 2 hour period), an amount of food that is definitely larger than most people would eat in a similar period of time under the same circumstances. 2. A sense of lack of control over eating during the episode (e.g., a feeling that one cannot stop eating or control what or how much one is eating).
B	Recurrent inappropriate compensatory behavior in order to prevent weight gain, such as self-induced vomiting; misuse of laxatives, diuretics, enemas, or other medications; fasting; or excessive exercise.
C	The binge eating and inappropriate compensatory behaviors occur, on average, at least twice a week for three months.
D	Self-evaluation is unduly influenced by body shape and weight.
E	The disturbance does not occur exclusively during episodes of anorexia nervosa.
Specify Type:	1. Purging type – During the current episode of bulimia nervosa, the person has regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas. 2. Non purging type – During the current episode of bulimia nervosa, the person has used other inappropriate compensatory behaviors, such as fasting or excessive exercise, but has not regularly engaged in self-induced vomiting or the misuse of laxatives, diuretics, or enemas.

Note: Adapted from American Psychiatric Association (2000).

Table 3: Components of Eating Disorder Not Otherwise Specified

A	For females, all the criteria for anorexia nervosa are met except the individual has regular menses.
B	B. All the criteria for anorexia nervosa are met except that, despite significant weight loss, the individual's current weight is the normal range.
C	C. All the criteria for bulimia nervosa are met except binge eating and inappropriate compensatory behaviors occur at a frequency less than twice a week for a duration of three months.
D	D. The regular use of inappropriate compensatory behaviors by an individual of normal body weight after eating small amounts of food (e.g., self-induced vomiting after the consumption of two cookies).
E	E. Repeatedly chewing and spitting out, but not swallowing, large amounts of food.
F	F. Binge eating disorder: recurrent episodes of binge eating in the absence of regular use of inappropriate compensatory behaviors characteristic of bulimia nervosa.

Note: Adapted from American Psychiatric Association (2000).

Physical Problems Associated with Eating Disorders

American Psychiatric Association (2000) reported different physical problems and biological manifestations, which can be due to eating disorders, include decreased vasopressin secretion which leads to difficulty concentrating urine, abnormal temperature regulation which can result in hypothermia, hypercarotenemia which results in a yellow coloring of the skin, and deficiencies in zinc and magnesium which contributes to weight loss, gastric distention, depression, and amenorrhea. Cardiovascular changes that occur include shrinkage of the left ventricle, decreased cardiac output, bradycardia, hypotension, and arrythmias. The presence of edema and renal calculi are the result of metabolic problems and dehydration that increase the blood urea nitrogen and decrease the glomerular filtration rate. Other biological changes that can occur within the body include increased hepatic enzyme levels, anemia, leukopenia, and thrombocytopenia. Prolonged starvation results in stomach shrinkage and delayed gastric emptying. As a result of this, patients who begin refeeding will feel satiety far earlier than normal. The long term effects of this disorder can be deadly. It is estimated that the mortality rate for this disease is 10-15% of all diagnosed patients (Skolnick,1993).

Psychological Problems Associated with Eating Disorders

American Psychiatric Association (2000) reported different psychological aspects of the eating disorders. Anorexia patients struggle with feeling powerless and striving for perfectionism, very low self-esteem and are overcompensating by being perfectionistic. The individuals use caloric restriction as a sense of power in their life (Skolnick, 1993). Furthermore, it is commonly believed that if they can achieve the perfect body, they will also attain the perfect life. Other risk factors of individuals with disordered eating behaviors include a poor sense of identity, low self-esteem, perfectionism, role conflicts with parental figures or within themselves, pressure to win from coaches or parents.

Diagnosis of Eating Disorders

The most important aspect of working with young female athletes is being able to recognize the signs and symptoms of disordered eating. The list is long and variable, but recognition of one or multiple of the following is enough of an indicator to make sure the athlete receives a medical examination (Putukian, 1998; Beals & Manore, 1999). Table 4

outlines behavioral signs and symptoms; while Table 5 lists physical signs and symptoms of eating disorders.

Table 4: Behavioral Signs and Symptoms of Eating Disorders

1. Repeatedly expressed concerns about being fat even when weight is average or below average.
2. Refusal to maintain a minimal normal weight consistent with their age, height, body type, and sport.
3. Preoccupation with food, calories, and weight
4. Increased criticism of one's body
5. Consumption of huge amounts of food that is inconsistent with the athlete's weight
6. Secretly eating or stealing food
7. Disappearing or making trips to the restroom after eating meals
8. Vomits or odor of vomits in the toilet, sink, shower, etc.
9. Excessive use of laxatives or diet pills
10. Periods of severe caloric restriction or repeated fasting
11. Relentless physical activity that is not related to the training regimen
12. Depressed mood following eating
13. Avoiding situations in which the athlete will be viewed while eating
14. Appearing preoccupied with eating behaviors of others
15. Mood swings, irritability, poor concentration, or sleep disturbances
16. Wearing baggy or layered clothing
17. Complaints of bloating or lightheadedness that is not attributed to other medical causes.
18. Moving food around the plate without eating it.

The physical signs and symptom observed in female athletes with restrictive eating habits related to weight loss and fluid and electrolyte. (Skolnick, 1993).

Table 5: Physical Signs and Symptoms of Eating Disorders

1. Dry hair and skin, cold hands and feet, and fine hair on the face and body
2. Bloodshot eyes, swollen parotid glands, and a chipmunk-like appearance in the face
3. Foul breath, poor dental hygiene, or frequent sore throats
4. Wide fluctuations in weight in short periods of time
5. Chronic fatigue
6. Anemia
7. Frequent gastrointestinal problems
8. Cold intolerance
9. Callused fingers
10. Irregular or absent menstrual cycles
11. Frequent musculoskeletal injuries, including stress fractures
12. Delayed or prolonged wound and injury healing

Evaluation of Eating Disorders

A medical examination is important in the instance of an athlete that presents with disordered eating patterns. Vital signs such as heart rate, respirations, blood pressure, and body temperature should be assessed. Parotid, submaxillary, and submandibular glands should all be palpated for tenderness. A cardiac evaluation including an electrocardiograph EKG, especially in cases where the heart rate is resting below 50 beats per minute, is routine (Sanborn et al., 2000). Other laboratory tests should be ordered including urine tests to check PH levels, a complete blood count to rule out anemia or infection, and a blood chemistry profile to analyze electrolyte levels and thyroid, kidney, and liver function (Sanborn et al., 2000). In cases of prepubertal females who present with menstrual irregularities or amenorrhea, a pelvic examination may be necessary.

Treatment of Eating Disorders

Coaches, athlete trainers, and supervising physicians must be watchful for student athletes who may be prone to eating disorders, particularly in sports in which appearance or body weight is a factor in

performance. Decisions regarding weight loss should be based on the following recommendations to reduce the potential of an eating disorder: Weight loss should be agreed upon by both the coach and the student-athlete with consultation with appropriate medical and nutritional personnel; A responsible and realistic plan should be developed by all individuals involved; and weight-loss plans should be developed on an individual basis. If a problem develops, thorough medical evaluation of the student-athlete suspected of an eating disorder is imperative. Once confirmed, behavior modification should emanate from professional guidance through nutritional, psychological, and psychiatric counseling. Because eating disorders are a growing problem with serious health consequences, the establishment of professionally guided support groups, access to personal counseling (APA, 2000).

The individuals with disordered eating behaviors are to structure food intake. Often these individuals do not have a clear sense of hunger so it is important to organize three meals per day. Ideal body weight needs to be calculated, and then daily caloric intake is set by multiplying 15 kilocalories per pound of ideal body weight. The 75% to 90% rule is often used to ease patients who are refeeding. It is recommended to these patients that they eat 75% of all food items on their plate every day and

not eat at least 10% of all food items on their plate every day. This allows the patient to still have some control over his or her caloric intake, but also ensures adequate nutrition (APA, 2000). Patients will also undergo psychotherapeutic treatment such as cognitive therapy that allows distortions and automatic negative thoughts regarding themselves, others, the future, and associations between their body and food to be identified, challenged, and corrected. One other step in the treatment process is the use of pharmacological agents to address the biochemical component of the disease as well as any associated affective disorders. Overlooking the psychological counseling component of the treatment process can have enormous repercussions when dealing with disordered eating. Psychotherapy can be needed for a minimum of 4 years following diagnosis (Sanborn et al., 2000). It has been documented that 5-10 years following diagnosis of the disorder, 50% of women with bulimia nervosa have fully recovered, 20% still meet full criteria for the disorder, and 30% experienced a relapse of symptoms; however, the risk of relapse was shown to decline after 4 year of intervention (APA, 2000).

Prevention of Eating Disorders

Prevention of eating disorders, and the female athlete triad, in general, is appropriately managed through educational programs that can

dispel body fat myths with regard to performance, provide nutritional information, and deal with issues of personal wellness. First, athletes, as well as parents and coaches, need to understand that there is no ideal body composition for a given sport. Body composition is an individualized factor in sport performance. Just as it is possible for an athlete's weight to exceed what is necessary for optimal performance and increase the risk of injury, there is also the same effect when an athlete's weight or percent body fat becomes too low (Sanborn et al., 2000). An athlete needs to be healthy to produce sufficient strength, power, and energy for her best performance. And, if weight loss is necessary, nutritional information is crucial in allowing for a healthy change in body composition. The recommended weight loss or gain is not to exceed 5% of total body weight or 1-2 pounds per week (Sanborn et al., 2000). According to Sanborn et al. (2000) nutritional programs should focus on:

1. Educating all involved individuals on nutrient-dense food choices in the context of training and retiring from training.
2. Promotion of dietary habits consistent with long-term health and prevention of diseases such as cardiovascular disease and osteoporosis.
3. Providing hands-on practice of food selection, shopping preparation.
4. Dispelling nutritional myths and replacing them with facts.

Specific details on caloric requirements, based on individual needs, are important, especially in the cases of disordered eaters. If a female athlete exercises 10-20 hours per week, she requires at least 2200-2500 kilocalories per day to maintain her weight (Manore, 1999). If the athlete is involved in high endurance activities, then the energy requirements can be as high as 4000 kilocalories per day (Manore, 1999). Female athletes also have a higher protein requirement then the recommended 0.8 grams per kilogram of body weight. Athletes females need between 1.2-1.4 grams of protein per kilogram of body weight (Manore, 1999).Carbohydrate intake needs to be at least 5 grams per kilogram of body weight to be sufficient enough to restore glycogen levels. If an athlete restricts their caloric intake to 1800 kilocalories it will be virtually impossible for their energy output to be adequate enough to suffice their training regimine (Manore, 1999). Athletes who need to gain weight or increase their energy level should increase total daily caloric intake as the initial step. Personal wellness issues also need to be addressed when educating athletes on disordered eating. Athletes need to be given information and strategies on preventing or handling life stressors. Demonstrating proper coping techniques is a valuable asset to an athlete susceptible to or experiencing disordered eating behaviors.

Amenorrhea

Amenorrhea is usually defined as the absence of three or more consecutive menstrual cycles (Otis et al., 1997)

Prevalence of Amenorrhea

The prevalence of amenorrhea is higher in athletes than in the general population. Studies have reported a rang of 3.4% to 66% of female athletes suffer from secondary amenorrhea, while only 2% to 5% of the general population is diagnosed with this condition (Van & Johnson., 1995; West, 1998).

Classification of Amenorrhea

Amenorrhea is indicative of menstrual changes in the athlete's body as a result of this tri-part medical condition. There are two primary categories of amenorrhea Primary amenorrhea or delayed menarche is the absence of menstruation by age 16 in a girl with secondary sex characteristics (Otis et al., 1997; Otis, 1992).

Secondary amenorrhea is the absence of three or more consecutive menstrual cycles after menarche (Otis et al., 1997; Otis, 1992). Another

type of menstrual dysfunction that can be present in athletes and individuals with disordered eating behaviors, while not a factor of amenorrhea, is oligomenorrhea. This condition refers to menstrual periods that occur at intervals longer than 35 days (APA, 2000).

Once considered a relatively benign and "normal" response to physical training, professionals now recognize menstrual dysfunction as a serious medical condition (Otis et al., 1997; Otis, 1992). The primary medical concern from menstrual dysfunction includes decreased bone density and premature osteoporosis (Nattiv et al., 1997).

Normal Menstruation

A normal menstrual cycle occurs regularly every 25 to 38 days. Oligomenorrhea refers to a menstrual cycle that occurs inconsistently, resulting in fewer than nine cycles per year. Amenorrhea is the cessation of the reproductive cycle with ovulation occurring infrequently or not at all (Warren, 1999)). A central issue involving menstrual irregularities is a lower level of circulating estrogen (hypoestrogenemia), and its potential health consequences. With normal menstrual function, the hypothalamus secretes gonadotropin releasing hormone (GnRH) in a normal pulsatile

normal pulsatile rate. This hormone is then carried on portal vessels to the anterior pituitary gland where it effects leutinizing hormone (LH) and follicle-stimulating hormone (FSH) producing cells and results in the secretion of these two hormones (Post et al., 1998). Both LH and FSH are necessary for initiating maturation of the egg, stimulating ovulation, and supporting the corpus luteum after ovulation (Post et al., 1998). These two hormones are also responsible for triggering the ovaries to produce both estrogen and progesterone at the appropriate times during the menstrualcycle (Post et al., 1998).The menstrual cycle is broken into two phases, the follicular phase, and the luteal phase. Initially, FSH production is high during the follicular phase and estrogen is produced. This results in growth of the follicle and eventually results in a decrease in FSH production (Putukian, 1998).

At this point, the follicle continues to grow independent of FSH release and LH secretion increases. Just prior to ovulation, progesterone levels increase and when joined by the already high estrogen levels, they produce an increased secretion of both FSH and LH (Manore, 1999). Ovulation occurs 34-36 hours following these surges (Putukian,1998). Following ovulation is the luteal phase, where progesterone levels continue to increase and act on granulose cells to produce the corpus

luteum, whose life span is only 14 days (Putukian,1998). Also, the uterus is prepared for implantation. If this does not occur, estrogen and progesterone levels are ceased and the proliferated endometrium is sloughed off producing menstrual blood flow (Post et al., 1998).Normal menstrual cycles can last anywhere from 23-35 days and occur between 10-13 times per year (Putukian,1998). Individuals who have normal menstrual cycles aretermed "eumenorrheic" (Putukian, 1998).

Exercise Related Menstrual Irregularity

Numerous theories have been developed to explain the relationship between exercises and amenorrhea, (see table 6) many factors can affect the normal menstrual function such as diet, body composition, level of stress, and reproductive maturity.

Table 6 : Suggested Causes of Exercise Induced Amenorrhea	
Psychological stress	Training
	Competition
	Personal
	Society
Body composition	Changes in lean /fat ratio
	Weight loss
Nutrition	Poor dietary intake
Acute or chronic effects of repeated exertion	
Energy drain	Sport specific
	Physical stress
Reproductive immaturity	
Endocrinologic causes	Hypothalamic orgin
	Endocrgenous opioids
	Acute changes caused by repetitive exercise
	Chronic changes by exercise
	Pregnancy
	Hyperrolactinaemia
	Ovarian failure

Note : Adapted from Ruffin, Hunter, and Arendt (1999).

The Relationship between Estrogen and Bone Mineral Density

The decreased bone mineral density (BMD) can result from menstrual irregularities (Putukian, 1998). A linear relationship exists in athletes with no history of amenorrhea having the highest BMD and athletes with a history of amenorrhea having the lowest BMD (Putukian, 1998). This lowered BMD is attributed to the low estrogen levels associated with amenorrhea. There is also evidence of lowered androgen levels in amenorrheic athletes (De Cree, 1998). It is suspected that testosterone plays some part in bone management but the exact role is still unknown. Even cortisol, which is elevated in amenorrheic athletes, is thought to take a part in bone maintenance, although this relationship is also just hypothesized. Furthermore, delayed menarche and amenorrhea during adolescence are associated with a decreased peak bone mass, suggesting there is a window of opportunity during puberty when adequate gonadal steroids are essential in reaching peak bone mass (De Cree, 1998).

This lowered BMD is seen throughout the body including in the spine, intertrochanteric regions, femoral neck, femoral shaft, tibias, tarsals, and metatarsals (Putukian, 1998; Warren, 1999). These sites of

low BMD manifest into stress fractures, especially in weight bearing areas. A study by Barrow & Saha (1998) showed that most stress fractures manifested in the tibia with 63% of 140 total stress fractures in the tibia. Another bone related change that results from amenorrhea is a failure to mineralize bone with mechanical stress. Typically, a physiochemical signal stimulates bone to mineralize; however, this mechanism is not present and the reason is unclear (Miller & Klibanski, 1999). Resumption of menses has been shown to reverse the effects on lowered BMD; however, how much of the damage can be reversed is unknown. Some bone loss may be irreversible (Putukian, 1998; Barrow & Saha, 1998).

Diagnosis of Amenorrhea

The diagnosis of exercise-induced amenorrhea is one of exclusion because no physical examination or laboratory test is available that will determine if the amenorrhea is caused only by excessive exercise (Skolnick, 1993).Therefore, underlying medical conditions need to be ruled out (Nattiv et al., 1994).All student-athletes with menstrual irregularities should be seen by a physician. General guidelines should include: Full medical evaluation, including an endocrine work-up, if

necessary; Nutritional counseling with specific emphasis on: Eating disorders; Total caloric intake vs. energy expenditure, looking at the quality of the diet consumed (percentage of protein, fats, and carbohydrates); and Calcium intake of 1,200 to 1,500 milligrams a day. At least two thirds of this should be ingested as daily dietary intake and not solely in the form of a supplement (National Institutes of Health ,NIH, 2001). Review of training program/exercise habits with decrease in exercise intensity if over training is a concern; Routine monitoring of diet, menstrual function, weight-training schedule, and exercise habits; and Counseling with emphasis on possible stress factors in the student-athlete's environment. If the treatment scheme does not result in regular menstrual cycles, a physician's reevaluation is recommended (NIH, 2001).

There are a multitude of other elements that could result in amenorrhea so it is important to get a thorough examination to determine the root of the problem. A thorough medical examination, pelvic examination, and laboratory tests can rule out any pathological condition. Other potential causes of amenorrhea are listed in table 7. Recently published review articles discuss the differential diagnosis and evaluation of amenorrhea in further detail (Kiningham et al., 1996).

Table 7: Differential Diagnosis of Amenorrhea

Pregnancy	
Hypothalamic Dysfunction:	Absence of GnRH
	Psychological or physical stress
	Anorexia nervosa
	Kallmann's syndrome
	Idiopathic
	Drugs
Pituitary Dysfunction:	Prolactinoma or other pituitary neoplasm
	Sheehan's syndrome
	Granulomotous disease(sarcoidosis)
	Emprty-sella syndrome.
Ovarian Dysfunction	Menopause
	Premature ovarian failure
	Polycystic ovary syndrome
	Gonadal dysgenesis
	Autoimmune disease
	Ovarian neoplasm
Uterine Dysfunction	Asherman's syndrome
	Absence of a uterus
Endocrine Disease	Hypothyroidism
	Cushing's syndrome

Note: Adapted from Yeager, Agostini, Nattiv, & Drinkwater (1993).

Treatment of Amenorrhea

All student-athletes with menstrual irregularities should be seen by a physician. General guidelines should include: Full medical evaluation, including an endocrine work-up, if necessary; Nutritional counseling with specific emphasis on: Eating disorders; Total caloric intake vs. energy expenditure, looking at the quality of the diet consumed (percentage of protein, fats, and carbohydrates); and Calcium intake of 1,200 to 1,500 milligrams a day. At least two thirds of this should be ingested as daily dietary intake and not solely in the form of a supplement. Review of training program and exercise habits with decrease in exercise intensity if over training is a concern; Routine monitoring of diet, menstrual function, weight-training schedule, and exercise habits; and Counseling with emphasis on possible stress factors in the student-athlete's environment. If the treatment scheme does not result in regular menstrual cycles, a physician's reevaluation is recommended.

For all student-athletes with menstrual irregularities the National Collegiate Athlete Association (NCAA, 2002) recommentded:

1. full medical evaluation, including an endocrine work-up and bone mineral density test.

2. nutritional counseling with specific emphasis on total caloric intake versus, energy expenditure, calcium intake of 1,200 to 1,500 milligrams a day.
3. routine monitoring of the diet, menstrual function, weight-training, schedule and exercise habits.

Other recommendation for American Academy of Pediatrics Committee on Sport Medicine (2000) for amenorrheic athlete were evaluation of amenorrhea includes a complete physical examination including endocrine examination, nutritional counseling, review of training program and exercise habits and decrease in exercise intensity if overtraining is concern, and counseling with emphasis on possible stress factors in the athlete's environment. If this treatment scheme does not result in regular menstrual cycles, low estrogen dosages should be considered, with appropriate counseling on hormone replacement and review of family history. Hormone-replacement therapy is thought to be important for amenorrheic women and oligomenorrheic women whose hormonal profile reveals an estrogen deficiency (Fagan, 1998).The need for hormone replacement therapy (HRT) and vitamin supplementation are varied. Criteria for initiating HRT have not been set, but the result is usually resumption of menses (AAP, 2000). The controversy surrounding

the use of hormones and supplements lies more in the relationship that amenorrhea has with bone mineral density BMD. Doses for HRT have been set for postmenopausal women and have varying effects on replacing bone mass in amenorrheic athletes. However, HRT may prevent any further bone loss (Miller & Klibanski, 1999). Another discrepancy lies in the dosage levels because young females in their reproductive years have higher levels of estrogen than is present in HRT, suggesting higher doses of estrogen are necessary (Miller & Klibanski, 1999). The minimum daily estrogen dose that has been shown to prevent additional bone loss in postmenopausal women is 0.625 mg of conjugated estrogens (AAP, 2000; Drinkwater et al.,1990). Further support of this oral contraceptive as a deterrent of additional bone loss versus the use of progesterone came from Hergenroeder et al. (1997) when they found higher total body and spine BMD levels after 12 months of treatment in the oral contraceptive group. This dose has not been proven to increase BMD though (AAP, 2000).

Increasing supplementation, also to help sustain bone health, to reach 1500 mg per day of Calcium and 600-800 units per day of Vitamin D is also recommended, although supplementation has been shown to have varying results on the effects on BMD also (Hergenroeder et

al.,1997). The female athlete needs to be advised to consume sufficient calories to match her energy expenditure to avoid menstrual dysfunction (Otis et al., 1997). Also, many female athletes follow vegetarian diet or diets which are high in carbohydrates (Anderson, 1999). Since an inadequate intake of protein may cause an athlete to be susceptible to hypothalamic amenorrhea, she should be advised to consume an adequate amount of dietary protein(Anderson, 1999).

Osteoporosis

The final component of the female athlete triad is osteoporosis. In past decades, this illness was seen in the elderly and postmenopausal women. Now this condition is even seen in young female athletes, because the prevalence rates of disordered eating and amenorrhea have increased in female athletes. Osteoporosis is a decline in bone mass and tensile strength that leads to microarchitectural deterioration, which results in an increased risk of fragility and fracture (Putukian, 1998). Peak bone mass is thought to occur between the ages of 18 and 25 (Skolnick, 1993. In adolescents, peak bone mass has been found to be related closely to the cessation of rapid height and weight gain, within 1 to 2 years (Nattiv et al., 1997). By the end of adolescence, 90% of bone mineral content has been deposited (Hergenroeder et al.,1997). Following this peak, bone mass is lost at a rate of 0.3% to 0.5% per year. According to Skolnick (1993) at menopause, women experience a bone loss of 3% per year for an average of 10 years. The rate returns to 0.3% loss per year after this time period until death The reason for this bone loss is the estrogen deficiency which is also a resultant of menopause (Post et al., 1998; Skolnick, 1993). In terms of bone loss in athletes with amenorrhea, the rate can be from 2% to 6% per year with up to 25% of total bone mass

lost (Post et al., 1998). Athletes with amenorrhea have a significantly lower BMD in the spine, femoral neck, intertrochanteric regions, Ward triangle, greater trochanter, femoral shaft, tibia, and metatarsals as compared with eumenorrheic athletes.(Post et al.,1998). The two most important factors in osteoporosis are the amount of peak bone mass attained and the rate of bone loss (Nattiv et al., 1997).

Definition of Osteoporosis

Osteopenia is a condition of low bone mass that, if not detected and treated, may lead to osteoporosis. Osteoporosis is a progressive disease resulting in low bone mass and bone deterioration of the micro architecture of bone tissue. According to National Institutes of Health (NIH, 2001) this systemic skeletal disease results in increased bone fragility and susceptibility to bone fractures Individuals with osteoporosis have weak bones due to the depletion of BMD and bone structure. The combination of low BMD and alteration in bone composition results in weak bones, and numerous persons with osteoporosis will experience bone fractures. The definition of osteoporosis as set by the World Health Organization (WHO) is a BMD of $\geq$ 2.5 standard deviations below the young-adult, gender-matched mean (WHO, 1994). Four general diagnostic categories for bone mass have been established for adult

women (Lane, 1999). These categories include: normal (T score ≥ 1 SD below young-adult average); osteopenia (T score< 1 but > 2.5 SD below young-adult average); and severe osteoporosis (T score ≥ 2.5 SD below young-adult average plus the presence of one or more osteoporotic fractures). The link between low BMD, skeletal fragility, and bone fracture risk is strong; thus, BMD testing provides the best method for detecting osteoporosis (Ross et al., 1991). Fractures most commonly arise in the tibia, hip, pelvis, rib, spine, and wrist (Cummings et al., 1993). Nearly every bone fracture that occurs in an older individual is an osteoporotic fracture as the bone has become demineralized (Nevitt et al., 1994).

Bone Health

Bone health is a continuous process called bone remodeling that includes bone resorption and bone formation. There are two types of bone cells, osteoblasts and osteoclasts. The osteoblasts are responsible for bone formation and the osteoclasts are responsible for bone resorption (Hergenroeder et al., 1997). Until peak bone mass is reached, osteoblastic activity is higher than osteoclastic activity; however once the peak is attained bone formation equals bone resorption (Hergenroeder et al.,

1997; Nattiv et al., 1997). During bone formation, mature osteoblasts synthesize the major proteins of the bone matrix, type I collagen and osteocalcin, via the production of growth hormones (Hergenroeder et al., 1997). Systemic hormones, 1-25 dihydroxyvitamin D, control the mineralization of this matrix into new bone(Hergenroeder et al., 1997). Bone resorption occurs through osteoclastic proton production and release, which demineralizes bone, followed by proteolytic enzymes that degrade the remaining matrix (Hergenroeder et al., 1997). It takes 7 to 10 days to complete the osteoclastic resorption phase and 3 months to complete bone formation (Hergenroeder et al., 1997). In osteoporosis, osteoclasts are more active than osteoblasts and resulting in bone loss. Recent research has identified the link between amenorrhea and osteoporosis through estrogen and androgen receptors on bone cells. There is a ten fold lower amount of estrogen and androgen receptors in osteoblasts and osteoclasts than found in reproductive tissues, and the distribution of these receptors in bone cells does not vary by gender (Nichols et al., 2000). In mice, it was concluded that estrogen receptors were instrumental in preventing a decrease in BMD after ovariectomy as compared to mice that were lacking these receptor (Nichols et al., 2000). More specifically, the estrogen receptor-alpha was more effective on BMD while the estrogen receptor-beta had minimal effect. Androgen

receptors also play a part in BMD maintenance, but are probably more effective in males (Nichols et al., 2000).Mechanical stresses also play a role in bone remodeling. Compressive forces are resisted by the mineral part of the bone whereas tensile forces are resisted by the collagen component (Hergenroeder et al., 1997). Wolff's law explains this complex system of bone adaption as a function of the number of loading cycles, cycle frequency, amount of strain, strain rate, and strain duration per cycle (Hergenroeder et al., 1997). Whether or not the bone responds to strain by strengthening or weakening depends on metabolic state, level of fitness, biochemical changes, menstrual pattern, age, sex, and ethnicity of the individual (Hergenroeder et al., 1997). There are varying theories as to the dynamics behind this adaption, but a commonly believed theory, termed the mechanostat theory, suggests there are "set points" for both bone resorption and bone formation and a "controller" of bone biology. Bone strain is sensed by the "controller" by mechanical usage and compared to both "set points" to determine which cellular response is to be activated (Hergenroeder et al., 1997). Another theory incorporates a piezoelectric phenomenon. Tension forces create an electropositivity that result in bone resorption. Susceptibility to injury results due to the weakened bone created via this process (Hergenroeder et al., 1997). On the other hand, compression forces create an electronegative field, which

stimulates osteoblastic activity and the deposit of healthy bone (Hergenroeder et al., 1997). This theory further supports itself by stating that most stressors are of a tension force and resultant microfractures result in the weakened bone (Hergenroeder et al., 1997).

Contributing Factors to Osteoporosis

There are many factors that contribute to the development of osteoporosis. This illness has a strong hereditary link that can be controlled with exercise, diet, and hormonal influences. For example, the amount of weight bearing activity, consumption of calcium and Vitamin D, levels of estrogen and progesterone, race, and body weight are all factors that affect BMD (Putukian, 1998). Specific risk factors for osteoporosis include female gender, Asian or Caucasian race, age, sedentary lifestyle, thinness, tobacco use, decreased BMD, prolonged corticosteroid use, decreased calcium intake, and estrogen deficiencies (Putukian , 1998) . The largest risk factor for osteoporosis is gender, as females have a 30% lower peak bone mass than males(Skolnick, 1993). Females who have a lower exposure to estrogen, such as those with delayed menarche, amenorrhea, or oligomenorrhea, are at higher risk of osteoporosis (Skolnick, 1993). Genetic factors can account for 60% to

80% of peak bone mass (Hergenroeder et al., 1997). Weight bearing physical activity has been shown to be correlated with increased BMD at multiple skeletal sites. For example, runners have been shown to have lower BMD at the femoral neck, lumbar spine, and whole body than gymnasts. This suggests that loading from muscular contractions during training have powerful osteogenic effects that counteract the increased bone resorption that results from oligomenorrhea or amenorrhea (Post et al., 1998). Furthermore, progressive resistive exercise such as weight training has been shown to be the optimal form of exercise to promote BMD via bone remodeling.

Evaluation of Osteoporosis

Once osteoporosis has been diagnosed, BMD should be assessed. This can help confirm the diagnosis, predict future fractures, monitor the progress of the disease, and monitor the effectiveness of any treatments (Tanji, 2000). BMD is measured in terms of bone mineral per unit of area because most available technology cannot assess volume of bone (Putukian, 1998). There are many laboratory tools that measure BMD including a Quantitative CT (QCT), which does actually measure bone volume, single and dual photon absorptiometry (SPA, DPA), single and

dual energy x-ray absorptiometry (SEXA,DEXA), and quantitative ultrasound (QUS), which measures the speed of sound and structural properties of bone (Putukian, 1998; Nattiv et al., 1997). A new method can be used in the forearm and heel-bone (calcaneus) Computed tomography (QCT) and ultrasound (QUS), such as Achilles Express Bone Ultrasound to evaluate the bone mineral density. It have also been used, but large prospective studies on the diagnostic ability of these methods have just recently started to emerge (Genant et al., 1996).

A working group of the World Health Organization developed the operational definition of osteoporosis (BMD of $\geq$ 2.5 standard deviation below the referenced mean (Kanis et al., 1994). This definition was adopted, in part, because fracture risk is strongly associated with BMD score; each 10% decrease in a spinal BMD measurement has been linked to a doubling of the vertebral fracture risk (Melton et al., 1993). Each 15% decrease in a hip BMD score has been associated with a 2.4-fold increase in hip fracture (Melton et al., 1993). Although low BMD scores best predict risk of fractures at the site of measurement, BMD scores, in general, reasonably predict the risk of osteoporotic fractures at any site of the skeleton (Melton et al., 1993).

Treatment of Osteoporosis

There are many treatment options available for osteoporosis; however, the effectiveness and use with the female athlete triad is somewhat disagreed upon. Some examples include calcium and Vitamin D supplementation, HRT, bisphosphonates, calcitonin, and selective estrogen receptor modulators (SERM). All of the current drugs approved by the Food and Drug Administration for osteoporosis are considered antiresorptive drugs because they halt the loss of bone resorption while bone formation remains the same (Nattiv et al., 1999). These FDA approved drugs are only approved for administration to post-menopausal women. There have not been any drugs approved specifically for treating osteoporosis related to the female athlete triad. Calcium supplementation may be beneficial but alone does not increase BMD. This supplement may, however, slow bone loss in late postmenopausal women. When Vitamin D is supplemented in conjunction with calcium, increases in BMD have been shown (Nichols et al., 2000). Calcium levels are recommended to be 1500 mg per day and 600-800 units of Vitamin D per day is recommended in individuals with low BMD (Tanji, 2000). Estrogen replacement therapy (ERT) has been shown to halt the loss of and even increase bone mass in postmenopausal women (Nichols et al.,

2000). There are too few studies to confirm ERT is effective in treating osteoporosis and amenorrhea in young female athletes; however, most studies are indicating that BMD is improved (Nichols et al., 2000). For instance, one study showed an 8% BMD increase in vertebrae and a 4% increase in the femoral neck following 2-30 months of treatment with ERT of amenorrheic athletes as compared to a 2.5% decrease in BMD at each bone site in the non physical education female students group who did not receive ERT (Callahan, 2000). Bisphosphonates are the most powerful form of antiresorptive drugs currently being used in the treatment of osteoporosis by targeting osteoclasts specifically (Nichols et al., 2000). The only drug currently approved by the FDA is alendronate. There are many gastrointestinal and esophageal problems associated with this drug as well as a poor absorbency rate when the drug is not taken in the recommended mode (Nichols et al., 2000). Also, since it is deposited in the bone itself, there is some concern about long-term effects, but currently there is no available information (Tanji, 2000). Calcitonin is a hormone the body uses in calcium regulation. It is typically prescribed to females greater than 5 years post menopause that have contraindications for ERT (Callahan, 2000). There is an injectable and nasal spray form of this hormone that has been shown to increase BMD (Nichols et al., 2000). SERM are under investigation in terms of their prevention of

osteoporosis. Studies are not widespread enough to declare their complete effectiveness, but preliminary studies show an increase in BMD. A benefit of these drugs is there is no risk of cancer as seen with ERT (Callahan, 2000). The downfall of these drugs is that the increase in BMD is not as high as seen with ERT (Nichols et al., 2000).

Effect of Osteoporosis on Athletes

In fact it is estimated that less than 25% of individuals suffering from this disorder have been diagnosed (Tanji, 2000). Typically osteoporosis becomes apparent to both physician and patient in the form of a fracture. This is also the most serious complication of the disease (Tanji, 2000). Hip fractures have the highest prevalence with 25% of patients losing their ability to ambulate and 20% to 30% of patients dying within one year of injury (Tanji, 2000). For those who escape death and can still perform their activities of daily life, persistent pain will most likely be the consequence. Other fracture sites that are common with osteoporosis are the femur, vertebrae, and distal forearm (Tanji, 2000). In terms of the female athlete triad and young athletes who develop osteoporosis, it manifests through the development of stress fractures. A stress fracture is defined as a partial or complete fracture of bone

resulting from its inability to withstand nonviolent stress that is applied in a rhythmic, repeated, sub threshold manner (Hergenroeder et al., 1997). Some contributing external causes of stress fractures include acute changes in the training routine, poor initial level of fitness, poor shock absorbing quality in athlete footwear, shoe age, and poor running surfaces such as uneven terrain or hard surfaces (Hergenroeder et al., 1997). Intrinsic mechanical factors that can contribute to the development of stress fractures include delayed menarche, amenorrhea, ovulatory disturbances, poor calcium and vitamin D intake, disordered eating behaviors, smoking, excessive alcohol consumption, the use of medications such as glucocorticoids, thyroid medication, anticonvulsants, antipsychotics, and chemotherapy, and any other risk factor of osteoporosis (Hergenroeder et al., 1997).

Review of Related Studies

All female athletes are at risk for developing the triad however the actual magnitude of the problem is unknown (Sanborn et al., 2000). Although the exact prevalence is unknown, data showed the prevalence of eating behavior disorder was between 15-62% of female college athletes (Smith, 1996). While studies of women experiencing amenorrhea are reported from 2% to 5% (Vinci, 1999), amenorrhea in female athlete has been reported to occur between 3.4% to 66 %(Hobart & Smucke, 2000). The prevalence of osteoporosis among female athlete triad is generally unknown (Smith, 1996), but the severity of menstrual dysfunction based on the menstrual history appears to be linear with decreased bone mineral density (Ruch et al., 1997).

Any physically active woman can be at risk of developing this condition (Howe, 2001). The study of Lauder, et al. (1999) was " The female athlete triad: prevalence in military women." The objective of this study was to define the prevalence of the female athlete triad, the simultaneous occurrence of disordered eating, amenorrhea, and osteoporosis, in military women. A total of 423 active duty female soldiers participated in a three-part prospective, cross-sectional study.

Part 1 entailed completing the eating disorder Inventory and a clinical interview. Part 2 consisted of a clinical evaluation and laboratory studies. Part 3 evaluated the bone mineral density. The results suggested that the female athlete triad was not a clinically significant problem for the active duty female soldiers.

Studies that indicate that female athletes struggle more with eating disorders than women in the non-athlete population .In a study done by Beals & Manore (2002), it was discovered that athlete women were eating significantly less than non-athlete women. That study examined the prevalence of and relationship between the disorders of the female athlete triad in collegiate athletes participating in aesthetic, endurance, or team/anaerobic sports. Participants were 425 female collegiate athletes from 7 universities across the United States. Disordered eating, menstrual dysfunction, and musculoskeletal injuries were assessed by a health/medical, dieting and menstrual history questionnaire, the eating attitudes test (EAT-26), and the eating disorder inventory body dissatisfaction subscale (EDI-BD). The data showed that prevalence of clinical eating disorders was low in female collegiate athletes; many were at risk for eating disorder, which places them at increased risk for menstrual irregularity and bone injuries. That significant research might

explain why women have 75% more sports injuries than do their male counterparts

Eating disorders are complex disorders that have social, cultural, psychological, behavioral and physiological components. A study by Rush, et al. (1997) concluded that poor eating habits and characteristics of the female athlete triad are common among dancers. In their study, a survey to identify risk factors for the triad was administered to experienced ballet dancers between the ages of 15 and 19. The study found that 4% of the ballet dancers had been diagnosed with disordered eating, 21% reported four or more characteristics of disordered eating (skipping meals, weighing oneself more frequently than biweekly, use of over the counter diet pills or laxatives or diuretics, fasting, vomiting, and excessive exercise). Only one of the women had adequate dietary intake of calcium and 53% reported avoiding meat, a sign of inadequate protein and iron consumption. The researchers concluded that these female athletes were by far not meeting the nutritional needs for their age and activity level.

Women with eating disorders, when attempting to keep low weight and body fat, restrict their dietary intake which is necessary to remain

healthy. Low calorie intake can lead to decreased metabolic rates and further suppress health. The poor nutrition is a primary cause of amenorrhea because a healthy level of nutrients is needed to sustain estrogen levels. McComb, et al. (1999) did a study entitled " Energy deficit and oligo/ amenorrhea: Implications of female athlete triad. " The primary purpose of that study was to explore the energy deficit hypothesis. The difference in caloric intake relative to energy expenditure between eumenorrheic (n=20) and oligo amenorrheic (n=14) female athletes was analyzed using independent t-tests. There was a significant difference in the ratio between the two groups. Further investigation also revealed significant differences in variables that might contribute to the athlete triad of eating disorders, osteoporosis, and amenorrhea.

Moreover, a study by Williams et al. (1995) "Strenuous exercise with caloric restriction: effect on luteinizing hormone secretion." The study tested whether strenuous exercise with and without caloric restriction alters LH secretion, and whether these changes are apparent in the immediate post-exercise period; LH pulse parameters were studied in four moderately trained eumenorrheic women over three successive menstrual cycles. Blood samples were obtained five hours before and five hours after 90 min of running at 74% VO2max. Each test was preceded

by a seven days treatment of controlled diet and exercise (74% VO2max). During control, subjects were eucaloric for 1-7 days, and performed no exercise on days 5-7. Results of this study suggested that high-volume training combined with caloric restriction might predispose one to exercise-induced changes in LH pulse frequency, while adequate caloric intake might prevent these changes.

High-intensity training can alter the normal pattern of pubertal development in elite gymnasts. In study of " Gender-related differences in elite gymnasts: the female athlete triad" Weimann (2002) investigated sex hormones, the ob gene product leptin, body composition, nutrition, and eating habits in female and male elite gymnasts from national cadres to elucidate gender-related differences. Serum leptin levels were decreased, particularly in pubertal girls, and did not show the normal developmental pattern. After leptin levels were transformed into standard deviation scores, mainly pubertal female gymnasts had significantly lower values than normal controls of the same gender, pubertal stage, and body mass index. The percentage of body fat was reduced compared with a normal age-matched population in both genders but to a higher degree in female gymnasts. Pubertal development is influenced to a different degree in female and male elite gymnasts. In contrast to their male counterparts,

high-intensity training takes place during the sensitive phase of pubertal maturation in female gymnasts. Whereas the girls displayed low estrogen levels, hypoleptinemia, reduced body fat mass, insufficient caloric intake, and retarded menarche, the pubertal development of male gymnasts remained almost unaltered.

Disordered eating, amenorrhea, and excessive exercise can contribute to osteoporosis. Germion, et al. (2001) completed a study entitled " Oligo-amenorrheic long-distance runners may lose more bone in spine than in femur." The purpose of this study was assessing influence of strenuous training upon amenorrhea leading to amenorrhea-related accelerated bone loss. Insufficient calorie energy, calcium, and protein intakes can also be frequently encountered in women with intense training, possibly contributing to bone loss. Long-distance runners with or without regular menses (age range 19-37 yr) were prospectively studied. Changes in a real bone mineral density (BMD) were measured at one year interval. The researchers found that oligo-amenorrhea in long-distance runners, with adequate dietary intakes, was associated who had a decrease in BMD which affected the lumbar spine more than the proximal and midshaft femur during one year follow-up.

Drinkwater, et al (1990) studied the relationship of prior menstrual irregularities and current menstrual status to the bone density of 97 young athletes was determined at seven sites using single- and dual-photon absorptiometry. Menstrual patterns were ranked on a scale of 1 to 9 in terms of their potential adverse affect on bone. The combination of menstrual pattern and body weight predicted 43% of the total variation in lumbar density. These data suggested that extended periods of oligomenorrhea/amenorrhea might have a residual effect on lumbar bone density

Many studies showed that weight bearing exercise increases bone density. Valentino, et al. (2001) found result of BMD for young dancers by evaluating the effects of intense weight-bearing exercise and dietary restriction, started during puberty, on bone mineral density (BMD), menarche age, menstrual function, and gonadotropin structure. Twenty current dancers (group 1) and 9 exdancers (group 2) were compared with a non physical education female students group of 30 age-matched, regularly cycling women. Body weight, body mass index, total daily caloric intake, and nutritional markers BMD were evaluated, The date showed that ballet training performed by dancers during puberty, dietary restriction, and low body mass index could all be associated with

reduction in BMD and altered gonadotropin isoforms, with subsequent delay of menarche, menstrual dysfunctions, and insufficient peak bone mass. A longitudinal study must be conducted to confirm the persistence of low lumbar spine bone density in adult age.

The female athlete triad affects many female athletes; however, female athletes have little knowledge of the female athlete triad. Howe (2001) performed a study entitled "A study regarding the knowledge of female athletes about the female athlete triad." The purpose of this study was to survey female intercollegiate varsity athletes who compete in the Northern Sun Intercollegiate Conference (NSIC) regarding their knowledge about the female athlete triad, menstrual function, and understanding of unhealthy eating behaviors and the association of these with future health problems, such as osteoporosis. A notification email was sent to 144 female athletes that either competed in volleyball or cross country at one of the six universities within the NSIC. Qualitative and quantitative analysis were performed to interpret the results. Of the 144 subjects, only eight had ever heard or read about the female athlete triad. However, the athletes were more aware of the individual components. Twenty-two athletes were aware of the term disordered eating and 34 were aware of consequences that accompany disordered eating. While 39

athletes were aware of the term osteoporosis and 38 were aware of consequences that accompany osteoporosis. The least known component was amenorrhea, with only eleven athletes being aware of the term and 21 being aware of any consequences. The female athlete triad affects many female athletes; however, female athletes have little knowledge of the female athlete triad. Researchers have suggested that there is a need for education about the triad and its individual components, and especially amenorrhea, as it is the least known but easiest to diagnose component. Through education, athletes, coaches, parents, and peers may learn how to prevent and control the three components of the triad, as well as how to identify and assists fellow athletes.

Moreover, Simpson, et al. (1998) studied the relationship between disordered eating, amenorrhea and osteoporosis. The knowledge of athletes was investigated at three Midwestern Universities regarding the female athlete triad. A total of 189 athletes from two division III institutions and one division I institution participated. Overall the subjects had normal height, weight, and body mass index. Most athletes knew they were at risk for osteoporosis at their age; however they did not understand the association it had with amenorrhea. Unlike the division II schools, subjects reported: (a) more stress fractures, (b) no history of eating

disorders and (c) the highest percentage of athletes that had been told losing weight will increase performance. Getting the message out about the triad is imperative especially to the athletes so they will be in a better position not to become complacent and begin poor health

Chapter 3

Methodology

A prospective, cross – sectional prevalence study was carried out between November 2003 and March 2004 on female students in the Department of Physical Education at the University of Bahrain.

Study Population and Samples

The study population consisted of all female students in the Department of Physical Education at the University of Bahrain, academic year 2003/2004. Of the 350, total number of Physical Education Department female students who were enrolling at the time, a sample of 276 was taken. The percentage was 78.86%.

Also, a sample of a control group was also taken from the non Physical Education Department female students who were studying at the Bahrain University during the same period. The number of this control sample was 244 female students, percentage representing this sample could not be known due to university policy.

Experimental Design

The study designed to define the prevalence female athlete triad and to find the relationship between female athlete triad factors, which are nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Department female students at the Bahrain University.

In this study the nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Department female students were evaluated by four parts as the follow:

Part1: Physical Exertion:

Physical exertion was assessed by a questionnaire related to practical physical education courses and physical activities (Appendix1). The total number of questions was six. Each question was quantified from 1 to 4. The highest physical exertion was given 4, whereas the lowest was given 1.

Part2: Eating Disorders

Eating disorders were assessed by a questionnaire related to dietary intake and eating behaviors (Appendix1). The total number of questions

related to dietary was nine questions. Each question was quantified from 1 to 7. The highest was given 7, whereas the lowest was given 1. And the total number of questions that related to eating behaviors was five. Each question was quantified from 1 to 3. The highest was given 1, whereas the lowest was given 3.

Part 3: Menstrual State

Menstrual irregularities were assessed by a questionnaire related to menstrual history (Appendix1). The total number of questions was five. They were yes or no questions. Each question was quantified from 0 to 1. The question which was answered by no was given 1, whereas the question which was answered by yes was given 0. Except question number two which was rated in the opposite way; the question which was answered by no was given 0, whereas the question which was answered by yes was given 1.

Part 4: Bone Mineral Density

The bone mineral density was evaluated by using Achilles Express Bone Densitometry (GE LUNAR, USA).

Measurement Instruments

1. A stadiometer was used to measure the height.
2. A scales was used to measure the body mass in kilograms.
3. A Lange skin fold was used to measure selected skin fold areas (Cambridge Scintific, MD, USA).
4. An Achilles Express Bone Densitometer was used to evaluate the bone mineral density (GE LUNAR, USA).
5. A questionnaire was used to evaluate physical exertion, eating disordered and menstrual history.

Anthropometric Measurements

Anthropometric methods of body composition measurement were used in this study in order to find the correlation between body mass, body mass index BMI and bone mineral density. BMI was calculated by the following equation:

BMI = weight (kg) / height^2 (m) .(Hazaa, 1992)

Skin fold thickness technique was chosen to measure the fat percentage using Lange caliper.

Skin fold thickness was measured at the following sites:

1. Abdomen: a vertical fold about 1-2 cm one inch to the right of the umbilicus.
2. Triceps: a vertical fold halfway between the olecranon process and acromion process with arm must be straight.
3. Suprailiac: a diagonal fold just above the iliac crest. (Hazaa, 1992)

The sum of the three sites skin fold thickness, weight, and Age were used to calculate the body density, body mass, fat percentage, lean mass, by the following equations;

1. Jackson & Pollock equation of body density for women age between (18-61 years old):

Body density = 1.089733 - 0.0009245 × A + 0.0000025 × (A×A) - 0.0000979 ×B.

A = Abdomen skin fold thickness + triceps skin fold thickness + suprailiac skin fold thickness in millimeter.

B = age in years. (Hazaa, 1992).

2. Siri equation of body fat percentage

Body fat percentage = [4.95/ (Body Density – 4.5)] ×100. (Hazaa, 1992)

3. Fat mass = current body weight × body fat percentage. (Hazaa, 1992)

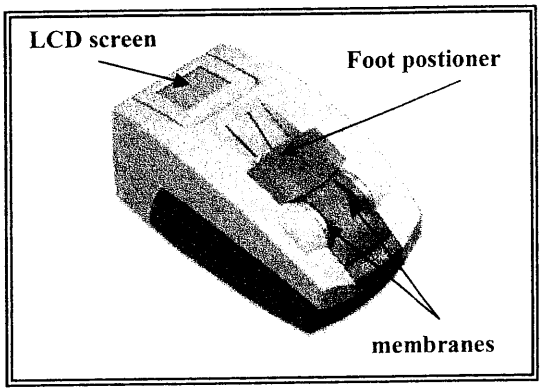
4. Fat free mass (FFM) = current body weight - fat mass. (Hazaa, 1992)

Bone Mineral Density Measurement

Measurement Procedures:

1. Patient's personal information should be inserted in the main menu on the LCD screen of Achilles Express Bone Densitometer, which include the age, sex, and foot.
2. Foot postioner and membranes of Achilles Express Bone Densitometer should be cleaned and disinfected.
3. Three important things should be fixed. First the patient should seated in a stable chair; second, Achilles Express Bone Densitometer should face the patient; third, the position of the leg the foot, the calf and the thigh should be aliened with the center of the foot postioner.
4. A water soluble gel should be applied on Achilles Express Bone Densitometer membranes and patient's heel.
5. The one-minute ultrasound test is simple to perform: a touch of the built-in LCD screen of Achilles Express Bone Densitometer is all it takes. Achilles Express automatically calculates the patient's Stiffness Index which is compared to young adult and age-matched references to provide both a T-score and Z-score. These, together with other risk factors, assist physicians in the diagnosis of osteoporosis (GE LUNAR, 1999).

Figure 1: Achilles Express Bone Densitometer



Achilles Express Bone Densitometer was used to evaluate the bone mineral density. The measurement takes one-minute. Four general diagnostic categories for bone mass have been established by world health organization (WHO) for adult women. These categories include:

1. normal (BMD score < -1 but > 1 SD.
2. osteopenia (BMD score < -1 but > - 2.5.
3. osteoporosis (BMD score ≤ - 2.5 SD.

It should pointed out the internal SD according to WHO is < -1 but > 1 SD of z score. The bone mineral density (BMD) scores age-matched were used in this study to test the significant difference between Physical Education Department female students and non Physical Education Department female students at Bahrain University.

Also the normal bone mineral density scores age matched is ≥ 1 SD below average, and bone mineral density reduction, the BMD score< 1 SD below average. The bone mineral density reduction can be exist of female athlete triad factors which are nutrition disturbance, menstrual irregularity and physical exertion. bone mineral density was in this study depended variable, the prevalence of BMD reduction, and the relationship between BMD scores matched with age and the other factors for female athlete triad factors, which are nutrition disturbance, menstrual irregularity and physical exertion were calculated in order to define this the female athlete triad among Physical Education Department female students at Bahrain University. Also the prediction equation of nutrition disturbance, menstrual irregularity and physical exertion by which bone mineral density can be predicted.

Questionnaire

The questionnaire was conducted by the researcher for the purpose of assessing the factors related to the female athlete triad. Hence, the questionnaire consisted of three parts. In the first part, students were asked some questions about their physical exertion, the second part included questions about their dietary intake and eating behaviors, and the last part included some questions about their menstrual history.

Development of Questionnaire

In order to develop the questionnaire, the researcher has followed the following steps:

1. A systematic overview to many previously utilized questionnaire (Simpson et al.,1993; Beals & Manore, 2000)
2. Taking into consideration the purposes of the study, several questions were chosen and discussed with the advisor in order to be adapted in this study.
3. After the decision upon questions being applied, the researcher wrote a letter of purpose and attached to this letter two things:

a. The proposed questionnaire.

b. A sheet related to instrument of content validity with which the researcher tried to assess the content validity of the questionnaire.

4. The package (Appendix 3), then was delivered* to several specialists in the field of the sport medicine, sport physiology, sport coaching & conditioning, nutrition and health.
5. After about two weeks, the assessments were back and the researcher in collaboration with the advisor reviewed the responses.

6. Questions that had a mean rated of 7 and below were cancelled**, whereas questions that had a mean rated of 8 and above were chosen.
7. A new questionnaire was constructed according to the specialists' responses.
8. The new questionnaire was used in this study.

Instrument Validity

The most important characteristic of an instrument is its validity. As instrument content validity of the questionnaire was established by using a panel of experts in the field of sport medicine, sport physiology, sport coaching & conditioning, nutrition and health. They were asked to examine the questionnaire items. Kendall's W Test was used to test the validity of the questionnaire.

Instrument Reliability Test

A test - retest study was conducted in order to establish the instrument reliability of the female students. A convenient sample of 30 female students was used to test - retest the questionnaire. This sample

* Delivery was achieved by either fax or given in person
** According to instrument of content validity.

was randomly selected. The technique used to establish instrument reliability was test- retest procedure. After two weeks of the interim period the same questionnaire was administered to those female students to check stability of their responses. The results were analyzed using the Pearson product- moment correlation for part one and two of the questionnaire and Phi correlation for the last part.

Data Analysis

The researcher used the Statistical Package for Social Sciences (SPSS) computer program, version 11.01 for statistical treatment and chose the suitable techniques for the research design of the study to test the research questions as the following:

1. Descriptive statistics was used to report the age, body mass index, body mass, fat mass and lean mass.
2. Pearson product- moment correlation was used to test the reliability part one and two (physical exertion and nutrition) of the questionnaire in order to find out the relationship between trials 1 and 2 of test – retest procedure. Also, it was used to evaluate the relationship between the physical exertion, nutrition, reproductive system health variables, and BMD scores matched with age.

3. Phi correlation was used to test part three (reproductive system health, yes or no questions) of questionnaire reliability by calculating the relationship between trials 1 and 2 of the test – retest procedure.
4. Kendall's W test (Nonparametric Paired test) was used to calculate the validity of the questionnaire
5. An independent two tail -test: BMD scores variable were tested at the 0.50 level between Physical Education Department female students and non Physical Education Department female students from general population of the female students at the Bahrain University.
6. Linear multiple regressions was conducted to test the correlation between the physical exertion, nutrition reproductive system health variables, and BMD scores matched with age.

Chapter 4

Results and Discussion

There were two main purposes of the study. The first one was related to define whether the female athlete triad among female students in the Department of Physical Education at the University of Bahrain dose exists or not. The second one was to identify order of participation of the factors that relate to the female athlete triad among female students in the Department of Physical Education at the University of Bahrain.

Description of Sample Groups

Group 1: Physical Education Department female students Sample

By using the appropriate measuring technique, the description of Physical Education Department female students sample was obtained. The mean ± standard deviation of age, height and weight were 20.29 ± 1.51 old years, 1.59 ± 0.05 meters, 56.00 ± 13.76 Kilogram respectively.

The body composition measurement showed that the mean ± standard deviation of lean mass, fat mass, fat percentage, and body mass index BMI were 40.72 ±7.77 kilogram, 15.33 ± 6.68 kilogram, 26.47± 5.26%, and 22.19 ± 5.11 Kg/m^2 respectively. The mean and ± standard deviation of Physical Education Department female students BMD scores matched with age were -0.14 ±1.14. No significant correlation was found between the bone mineral density and either body mass, fat mass, lean mass, or BMI ($P > 0.50$). Table 8 shows these measurements.

Table 8: Descriptive Statistics of Physical Education Department Female Students at the University of Bahrain

	Minimum	Maximum	Mean	Std. Deviation
Age (years old)	18.00	23.00	20.29	1.51
Height (meter)	1.46	1.75	1.59	0.05
Wight (Kg)	38.00	125.00	56.00	13.76
BMD* (z scores)	-3.40	2.60	-0.14	1.14
BMI** (Kg/m^2)	14.13	44.82	22.19	5.11
Fat %	16.03	43.07	26.47	5.26
Fat mass (Kg)	6.09	53.84	15.33	6.68
Lean mass (Kg)	24.20	71.16	40.72	7.77

*BMD: bone mineral density
**BMI: body mass index

Group 2: Non Physical Education Department female students Sample

By using the appropriate measuring technique, the description of non Physical Education Department female students sample was obtained. The mean ± standard deviation of age, height and weight were 20.21 ± 1.37 years old; height 1.58 ± 0.06 meters, weight 57.58 ± 13.91 Kilogram respectively.

The body composition measurement showed that the mean ± standard deviation of lean mass, fat mass, fat percentage and BMI were 41.53±8.49 kilogram, 16.05± 6.29 kilogram, 27.24± 4.71%, and 22.77 ± 5.16 Kg/m^2 respectively. Table 9 shows these measurements.

The mean and ± standard deviation of non Physical Education Department female students BMD scores matched with age were 0.16 ±1.15. No significant correlation was found between the bone mineral density and either body mass, fat mass, lean mass, or BMI ($\underline{P} > 0.50$).

Table 9: Descriptive Statistics of Non- Physical Education Department Female Students at the University of Bahrain

	Minimum	Maximum	Mean	Std. Deviation
Age (years old)	18.00	23.00	20.21	1.37
Height (meter)	1.43	1.76	1.58	0.06
Wight (Kg)	39.00	130.00	57.58	13.91
BMD* (z scores)	-3.40	2.90	0.16	1.15
BMI** (Kg/m^2)	14.13	44.82	22.77	5.16
Fat %	15.03	42.07	27.24	4.71
Fat mass (Kg)	6.07	53.66	16.05	6.29
Lean mass (Kg)	24.15	71.16	41.53	8.49

*BMD: bone mineral density
**BMI: body mass index

Result of Instrument Reliability Test

A test- retest study was conducted in order to establish instrument reliability for the questionnaire. Upon final tabulation of the data in the Trails 1 and 2 of the test – retest procedure, and the correlation was used to test the three parts of the questionnaire.

As shown in table (10), results of the correlation were the following:

1. The Pearson correlation (r) was 0.966 which indicated that part one of the questionnaire was reliable ($\underline{P} < 0.50$).
2. The Pearson correlation (r) was 0.939 which indicated that part two of the questionnaire was reliable ($\underline{P} < 0.50$).
3. The Phi correlation (ϕ) was 0.987 which indicated that part two of the questionnaire was reliable ($\underline{P} < 0.50$).

Table 10: Reliability Test for the Questionnaire

Part	Total Items	Product Correlation	Correlation	Sig.
Physical Exertion	6	Pearson correlation	0.966	0.000
Nutrition (Dietary Intake, Habits)	14 (9+5)	Pearson correlation	0.939	0.000
Reproductive System Health	5	Phi correlation	0.987	0.000

The test- retest study also provided the following important information: all the items in the questionnaire were clear and easy to answer; and the procedures for administering the questionnaire were adequate.

Instrument Validity

Kendall's W Test used to test validity of the questionnaire test at the 0.50 level. Kendall's W Test result was 0.707 which indicated that all parts of the questionnaire were adequally valid ($\underline{P} < 0.50$).

Statistical Results of the Research Questions.

Research question 1: What is the percentage of Bahrain University female students in the Department of Physical Education who are having reduced bone mineral density relative to an international standard.

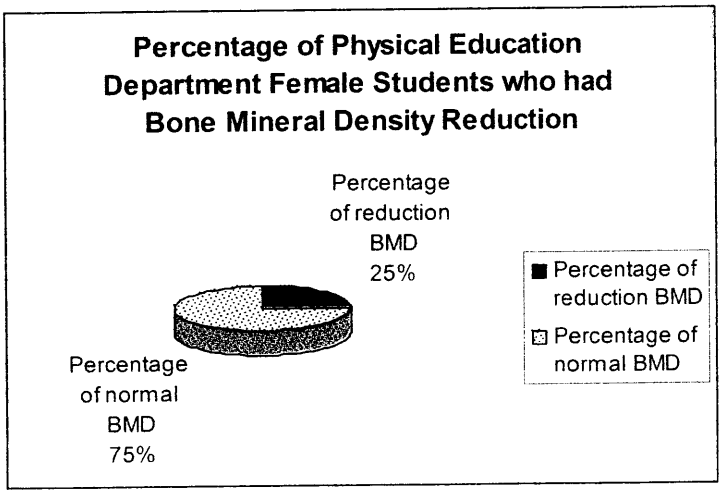
In order to answer this research question, bone mineral density was measured using Achilles Express Bone Densitometer for the female students in the Department of Physical Education at Bahrain University. The results of the bone mineral density were computed in percentage.

Table 11: Percentage of Physical Education Department Female Students who had Bone Mineral Density Reduction.

Group	Total number of students sample size	number of students with BMD reduction	Percentage of reduction BMD
physical education female students	276	70	25.36%

As shown in table (11), figure (2). The findings revealed that there were 25.36% of female students in the Department of Physical Education at the Bahrain University suffering from a reduction in bone mineral density.

Figure (2): Percentage of Physical Education Department Female Students Bone Mineral Density:



Research question 2: Is the bone mineral density of the Physical Education Department female students significantly less than the bone mineral density of non Physical Education Department female students at the Bahrain University.

In order to answer this research question, bone mineral density (BMD) measured for the Physical Education Department female students and the non Physical Education Department female students. An independent two tail t-tests was conducted, and the BMD scores matched with age for each group compared for significant difference at the 0.50 level.

Table (12) Independent Two Tail T-Test of Physical Education Department Female Students and non Physical Education Department Students in Bone Mineral Density.

Groups	M	SD	df	t- value	Sig. (2-tail)	MD
Physical Education Department female students	-0.1400	1.1404	518	-3.015	0.003	-.3037
Non Physical Education Department female students	0.1637	1.1527				

As shown in table (12) a t-test analysis revealed that there was a significant difference in BMD scores matched with age mean between the Physical Education Department female students and non physical education female students (t- value = -3.015, df = 518, P < 0.50).

Mean Difference (MD = -0.3037) showed that the Physical Education Department female students BMD scores matched with age mean (M = -0.14, SD = 1.1404) was lower than that of the non Physical Education Department female students (M = 0.1637, SD = 1.1527).

Research question 3: Is there a significant relationship between nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Departments female students at the Bahrain University.

In order to answer this research question, Physical Education Department female students responses to the questionnaire were reported by parts, including the BMD measurement. Linear multiple regression was conducted to test the correlation between the factors of physical exertion, nutrition (frequency of daily intake and habits), reproductive system health variables, and BMD scores matched with age.

As shown in table (13), the results of the Pearson correlations showed that:

1. There was a significant, negative, medium correlation between BMD scores matched with age and the level of the physical exertion ($\underline{r} = -0.469$, $\underline{P} < 0.05$) among Physical Education Department female students .
2. There was a significant, positive, medium correlation between BMD scores matched with age and nutrition ($\underline{r} = 0.456$, $\underline{P} < 0.05$) among Physical Education Department female students.
3. There was a significant, positive, weak correlation between BMD scores matched with age and reproductive system health ($\underline{r} = 0.352$, $\underline{P} < 0.05$) among Physical Education Department female students.
4. There was a significant, negative, weak correlation between physical exertion and nutrition ($\underline{r} = -0.444$, $\underline{P} < 0.05$) among Physical Education Department female students.
5. There was s a significant, negative, medium correlation between physical exertion and reproductive system health ($\underline{r} = -0.485$, $\underline{P} < 0.05$) among Physical Education Department female students.

6. There was a significant positive weak correlation between nutrition and reproductive system health ($\underline{r} = 0.354$, $\underline{P} < 0.05$) among Physical Education Department female students.

Table (13) Pearson Correlation of the Female Athlete Triad Factors among the Physical Education Department Female Students. (n = 276).

		BMD scores (age matched)	physical exertion	nutrition	reproductive system health
Pearson correlation	BMD scores (age matched)				
	physical exertion	-0.469			
	nutrition	0.456	-0.444		
	reproductive system health	0.352	-0.482	0.354	
Sig. (1-tailed)	BMD scores (age matched)				
	physical exertion	0.000			
	nutrition	0.000	0.000		
	reproductive system health	0.000	0.000	0.000	

Research question 4: Are there reciprocal effects between female athlete triad factors which are nutrition disturbance, menstrual irregularity and physical exertion and the reduced bone mineral density of the Physical Education Department female students at the Bahrain University.

The following results can drawn from table (14) the multiple regression, figure (3), and table (15), one way analysis of variance (ANOVA) of factors that are related to the female athlete triad among Physical Education Department female students:

1. The correlation R was (0.553), thus there was a positive, medium correlation between the BMD scores matched with age (dependent variable) and the physical exertion, nutrition, and reproductive system (independent variables) among Physical Education Department female students.
2. It is specified that 30.6% of BMD scores matched with age between BMD scores matched with age (dependent variable) can be explained by physical exertion, nutrition, and reproductive system (independent variables).
3. Results of the ANOVA showed that, there was a significant linear multiple regression for the factors that are related to the female athlete triad among Physical Education Department female students ($P < .05$, F value = 39.990).

Table (14) Linear Multiple Regression of the Female Athlete Triad Factors among the Physical Education Department Female Students.

R	R Square	Adjusted R Square	Std. Error of Estimation
0.533	0.306	0.298	0.95527

Note:

Predictors: (Constant) physical exertion, nutrition, reproductive system.

Dependent variable: BMD scores (age matched).

Figure (3): Linear Multiple Regression of the Female Athlete Triad Factors among the Physical Education Department Female Students.

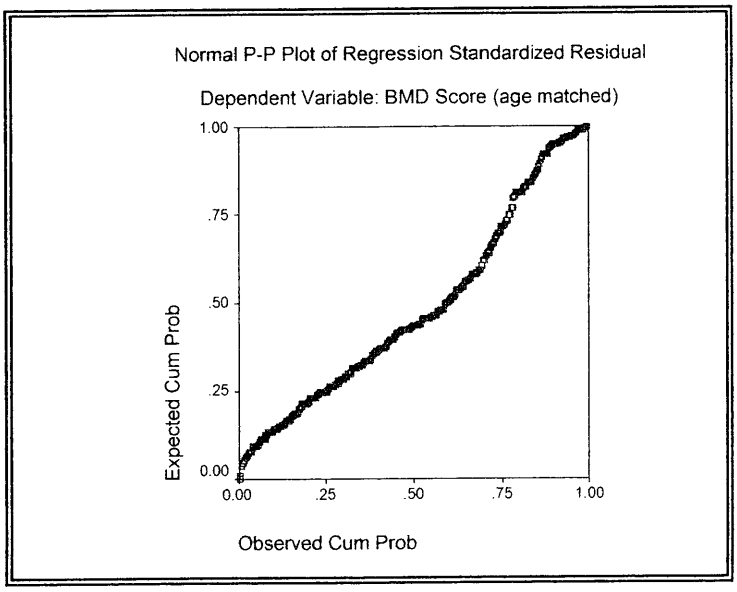


Table (15) ANOVA of the Female Athlete Triad Factors among the Physical Education Department Female Students.

	Sum Squares	df	Mean Square	F	Sig.
Regression	109.478	3	36.493	39.990	0.000
Residual	248.212	272	0.913		
Total	357.690	275			

Note:
Predictors: (Constant) physical exertion, nutrition, reproductive system.
Dependent variable: BMD scores (age matched).

The prevalence bone mineral density reduction among the students in the Department of Physical Education at the Bahrain University was a 25.36% of the total number of Physical Education Department female students, and the mean ± standard deviation for Physical Education Department female students were 0.14 ± 1.14 respectively.. Also the findings of the linear multiple regression revealed, that 30.6% of BMD scores matched with age (dependent variable) could be attributed to physical exertion, nutrition, and reproductive system (independent variables), therefore there was a significant linear multiple regression for

the factors, that are related to the female athlete triad among Physical Education Department female students.

Research question 5: What is the prediction equation of nutrition disturbance, menstrual irregularity and physical exertion by which bone mineral density of the Physical Education Departments female students at the Bahrain University can be predicted.

The coefficients results of linear multiple regressions of the factors which are related to the female athlete triad among the Physical Education Department female students were used to answer this research question.

As shown in table (16) that linear multiple regressions was significant for all the factors, and the contribution of physical exertion, nutrition, reproductive system on BMD score were 0.102 , 0.005035 , 0.120 respectively, so they were not equal in contribution. The regressions equation was the following:

BMD score = -1.7399 - 0.102 (physical exertion score) + 0.005035 (nutrition score) + 0.120 (reproductive system health score).

Also the contribution of physical exertion, nutrition, reproductive system on BMD score were 0.102 , 0.005035 , 0.120 respectively.

Table (16) : Coefficients of Linear Multiple Regression of the Female Athlete Triad Factors among the Physical Education Department Female Students.

	Unstandardized Coefficients		Standardized Coefficients		
	B	Std. Error	Beta	t	Sig.
Constant*	-1.7399	0.681		-2.554	0.011
Regression**	-0.102	0.022	-0.288	-4.704	0.000
Nutrition	0.005035	0.010	0.289	5.054	0.000
Reproductive system	0.120	0.54	0.111	1.887	0.050

Note:
*Predictors: (Constant) physical exertion, nutrition, reproductive system.
**Dependent variable: BMD scores (age matched).

The finding of this study revealed that the prevalence bone mineral density reduction among Physical Education Department female students at Bahrain University were 25.36% . It was higher than the prevalence bone mineral density reduction among the sample of non Physical

Education Department female students at Bahrain University, which was 15.16%. Also the t-test analysis revealed that there was a significant difference in BMD scores matched with age mean between Physical Education Department female students group and non Physical Education Department female students (t- value = -3.015, df = 518, P < 0.05), and the Mean Difference (MD = -0.3037) showed a negative charage, because the mean ± standard deviation of the Physical Education Department female students BMD scores matched with age -0.14 ±1.14 was lower than the non Physical Education Department female students 0.1637±1.5279.

The prevalence bone mineral density reduction among some female students in the Department of Physical Education showed evidence of risk for the female athlete triad. However, the triad consists of disordered eating, amenorrhea, and osteoporosis which occurs not only in elite athletes but also among physically active girls and women. The components of the triad are interrelated in cause, progression, and outcome. (Otis et al., 1997)The Physical Education Department female students are physically active. They are participating in practical courses, which are requirements of the Physical Education Bachelor Program. Because of the Prevalence bone mineral density reduction among some

female students in the Department of Physical Education at the University of Bahrain, they were at the risk of the female athlete triad, This significance because the consequence of the female athlete triad is irreversible bone loss and permanent damage to the skeleton (Clairmont, 2000).

The female athlete triad refers to three distinct but interrelated disorders: disordered eating, menstrual dysfunction, and osteoporosis (Otis et al., 1997). In order to study the correlation between the components of the female athlete triad among Physical Education Department female students, they were given a questionnaire. Their responses to the questionnaire were reported by parts (the physical exertion, nutrition, and reproductive system health), beside the BMD measurement. Then the Pearson correlation was used to calculate the correlation of the factors that are related to the female athlete triad among the Physical Education Department female students at the 0.05 level of significance.

The BMD scores matched with age was a positive, medium correlation with nutrition and a lower correlation with reproductive system health among the female students in the Department of Physical

Education at University of Bahrain. These results were proved by Drinkwater, et al. (1990) in a study of the relationship between the prior menstrual irregularities and the current menstrual status to the bone density among 97 young athletes; the finding revealed that extended periods of oligomenorrhea/amenorrhea might have a residual effect on the lumbar bone density.

The level of the physical exertion was showed a negative, medium correlation between the reproductive system health and the BMD scores matched with age, and also it showed a lower but ,a significant correlation with the nutrition among the female students in the Department of Physical Education at the University of Bahrain. However many studies proved that lower calcium and protein intakes, and also be frequently encountered among women who participated in intense training, possibly contributing to bone loss (Germion, et al; 2001, Weimann, 2002)

The nutrition which included frequency of daily intake and habits was negatively weak correlated with the reproductive system health among the Physical Education Department female students at the University of Bahrain.

Linear multiple regression was conducted to test the correlation between the physical exertion, nutrition (frequency of daily intake and habits), reproductive system health variables, and the BMD scores matched with age. The findings of the linear multiple regression revealed that 30.6% of the BMD scores matched with age (dependent variable) could be attributed to physical exertion, nutrition, and reproductive system (independent variables); therefore, a significant linear multiple regression for the factors that are related to the female athlete triad among the Physical Education Department female students. These results proved that there is prevalence of the female athlete triad phenomenon among some female students in the Department of Physical Education.

The factors which are related to the female athlete triads among the students in the Department of Physical Education at the University of Bahrain are not equal in contribution, as the coefficients of linear multiple regressions showed. The linear multiple regressions were a significant for all the factors, even though they were not equivalent in contribution. The regressions equation was as the follows: BMD score = -1.7399 - 0.102 (physical exertion score) + 0.005035 (nutrition score) + 0.120 (reproductive system health score).

Chapter 5

Conclusions and Recommendations

Conclusions

The following conclusions were drawn based on the results of this study:

1. There was a significant difference between the bone mineral density of Physical Education Department female students and non Physical Education Department female students at the University of Bahrain.
2. The prevalence bone mineral density reduction among the sample of non Physical Education Department female students at Bahrain University was 15.16%., while the prevalence bone mineral density reduction 25.36% which was higher among Physical Education Department female students at the University of Bahrain.
3. There was a prevalence of some female athlete triad among Physical Education Department female students at the University of Bahrain.
4. The factors are related to the female athlete triads among Physical Education Department female students at the University of Bahrain are not equals in contribution

Recommendations

1. The medical examinations that are required to enter the Bachelor of Physical Education at Bahrain University should include the bone density measurement and for female students.
2. The Bachelor of Physical Education curriculum at Bahrain University should include specific theoretical course of sport nutrition.
3. Physical Education Department female students should be educated about the female athlete triad syndrome components: eating disorders, amenorrhea, and osteoporosis.
4. Physical activity, including type, duration, intensity and frequency of activity should be recommended for Physical Education Department female students.
5. Colleges Programs at the Bahrain University should require physical activity coursers for all female students, each semester.
6. The Deanship of student Affairs at Bahrain University should work with others health committees to prevent the female student with BMD reduction from the risk of osteoporosis.

7. Health programs should be provided by the Deanship of Student Affairs at Bahrain University to educate the female student who has BMD reduction, irregular menopause or eating disorders.
8. The Ministry of Health should actively support health authorities in taking action in planning, implementing, and evaluating bone health and disease prevention strategies.
9. The Ministry of Health should be encouraged to implement and facilitate a policy for child and youth health initiatives that promote healthy lifestyle practices, such as physical activity, and good nutrition. This will target the age group at a critical period in bone development, and could potentially reduce future osteoporosis-related health care costs. Corollary benefits to other important areas of health can also be a result of such a strategy.
10. Bahrain osteoporosis society should take an action in order prevent strategies for youth bone health.
11. Bahrain osteoporosis society should study the prevalence of BMD reduction, and osteoporosis among females for all ages.
12. Sport medicine physicians and sport dieticians, and a group of leaders from sports in which the female athlete triad seems to occur most frequently, should meet to discuss the problems and potential answers, and appoint a task force to address the triad issues.

13. Dieticians, psychologists and physicians familiar should evaluate female pre-participation physical eating habits, weight changes, methods of weight control, excessive exercise and, , and evaluation should include menstrual function.
14. Weight-bearing exercises such as walking, jogging, and weight lifting can stimulate bone growth and make bones healthier. Regular exercise will also help maintain good balance, and stimulating bone growth and preventing bone loss through exercise should be part of female student's lifestyle.
15. When low bone density is identified in a healthy, active woman, a thorough evaluation to determine the cause or causes should include the following: menstrual history; family history of osteoporosis; nutrition status (calcium and vitamin D intake); history of eating disorders medication use, especially thyroid hormone replacement, corticosteroids, and Phenytoin sodium; Low lean-body mass or muscle mass; and training intensity.
16. In premenopausal active woman whose menstrual dysfunction is related to calorie deficit, therapy may include reducing exercise levels or increasing calorie intake; improving nutrition status, particularly calcium intake; increasing body weight.

17. Adequate calcium consumption and weight bearing physical activity builds strong bones, optimizes bone mass, and may reduce the risk of osteoporosis later in life.

Recommendations for Future Studies

Based on the findings of this study, the following recommendations for future study are made:

1. Future research related to this study should be done on among female athlete on national teams and in sport clubs, in order to define the prevalence of female athlete triad.
2. Future research is recommended to study the main factors that lead to bone mineral density reduction among the female student at the Bahrain University.
3. Future research is recommended to evaluate the effectiveness of weight bearing exercise program among the female student at Bahrain University.
4. Other research should be done to compare the effect of different sports on bone mineral density among the Bahraini female athletes.
5. Future research is recommended to define the prevalence of bone mineral density reduction, eating disorders, and irregular menopausal among the Bahraini female school students.
6. Future research is recommended to evaluate the effectiveness of physical education classes and bone health education among the Bahraini female school students.

7. Future research is recommended for a longitudinal study on the bone development and health for the Bahraini females.
8. Future research is recommended to define the prevalence of osteoporosis among pre menopausal Bahraini women.
9. Future research is recommended to study lifestyle and bone mineral density characteristics among Bahrain girls and women.
10. Future research is recommended to evaluate the optional type and level of physical activity with regard to prevention of specific medical conditions, particularly the role of low-intensity activity.
11. Future research is recommended to study the role of physical activity during childhood on childhood bone health status as well as subsequent disease prevention and bone health status during adulthood, and osteoporosis in the elderly women.

Appendix 1

Please answer the following questions as best as you can. Circle or fill your response in the space provided. If you have any questions, please do not hesitate to ask:

ID : ---------- Major Study :---------- Age:----------Date of Birth:----------

How many practical courses credit hour in physical education have you passed?----------(PE students only)

Do you suffer from any disease?

☐ No ☐ Yes specify:----------

Physical Exertion

1. How many courses credit hours have you registered in the first semester?

☐less than 12 credit hours ☐ 12-14 credit hours ☐ 15-17 credit hours ☐ More than 18 credit hours

2. How many numbers of physical education practical courses have you registered in this semester?

☐No courses ☐ One course ☐ 2-3 courses ☐ More than 10 courses

3. Do you practice sport or exercise at the university during activity period (UT: 11Am -1 PM)?

☐Never ☐ Sometime ☐ Most of the time ☐ Always

4. Can you describe your level of physical exertion while you are at the university?

☐low ☐ Medium ☐ Hard ☐ Very Hard

5. How many hours do you practice sport or exercise when you are outside the university?

☐ not practicing ☐ less than 3 hours ☐ 3-7 hours ☐ More than 7 hours

6. Can you describe your level of physical exertion while you are outside the university?

☐low ☐ Medium ☐ Hard ☐ Very Hard

Dietary Intake

1. How many serving units of milk and milk products group are you taking (cheese, ...etc.)?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

2. How many serving units of meat, chicken or eggs group are you taking?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

3. How many serving units of logumen are you taking?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

4. How many serving units of fruits group are you taking?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

5. How many serving units of vegetables group are you taking?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

6. How often do you drink water or soft drinks?

☐ Never ☐ 1-2 cups a day ☐ 3-4 cups a day ☐ 5-6 cups a day ☐ 7-8 cups a day ☐ 9-10 cups a day ☐ More than 10 cups a day

7. How often do you take vitamins supplement?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

8. How often do you take iron supplement?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

9. How often do you take calcium supplement?

☐ Never ☐ Seldom ☐ Once a week ☐ 2-4 times a week ☐ 5-6 times a week ☐ Once a day ☐ more than once a day

Nutrition Habits

1. Do You skip meals?

☐ Always ☐ Sometime ☐ Never

2. Do you feel extremely guilty after eating and worried of gaining weight?

☐ Always ☐ Sometime ☐ Never

3. Being a sensitive female toward gaining weight, have you had the desire to vomit to have you had self – induced vomiting?

☐ Always ☐ Sometime ☐ Never

4. Have you ever used diet pills ,chemicals or laxatives to lose weight?

☐ Always ☐ Sometime ☐ Never

5.Have you currently been screened for eating disorders?

☐ Always ☐ Sometime ☐ Never

Reproductive System Health

1. Have ever had a period of more than fourteen days?

☐ Yes ☐ No

2. For the last six months, was your menstruation regular?

☐ Yes ☐ No

3. Have you ever had menstruation irregularity?

☐ Yes ☐ No

4. Have you missed your period for more than three months?

☐ Yes ☐ No

5. Do you take birth control pills?

☐ Yes ☐ No

Body measurements

1. weight: ----------(Kilogram).
2. Height:---------- (meter).

3. Skin fold thickness:

   Abdomen Skin fold Thickness ----------(mm)

   Triceps Skin fold Thickness ---------- (mm)

   Suprailiac Skin fold Thickness ----------(mm)

4. Bone mineral density:

BMD scores matched with age ----------

Appendix 2

من فضلك أجيبي عن الأسئلة التالية بوضع دائرة حول الإجابة المناسبة . من فضلك لا تترددي في السؤال والاستفسار.

الرقم الجامعي : ---------- التخصص :---------- العمر : ---------- تاريخ الميلاد :----------

عدد الساعات العملية في التربية الرياضة المجتازة (لطالبات التربية الرياضية فقط) :----------
هل تعانين من مرض معين ؟

☐ نعم ☐ لا

حدد المرض : ----------

الجهد المبذول

1. ما عدد الساعات المسجلة لهذا الفصل الدراسي الأول ؟

☐ أقل من 12 ساعة معتمدة ☐ 12- لأقل من 15 ساعة معتمدة ☐ 15- لأقل من 18 ساعة معتمدة ☐18 ساعة معتمدة أو أكثر

2. ما عدد المقررات العملية في التربية الرياضية المسجلة لهذا الفصل الدراسي؟

☐ لا يوجد ☐مقرر واحد ☐ مقررين أو ثلاث مقررات ☐ أكثر من ثلاث مقررات

3. هل تمارسين النشاط البدني في الجامعة في فترة النشاط الطلابي (يومي الأحد والثلاثاء الساعة 11 – 1)؟

☐ لا أمارس النشاط ☐ نادراً ما أمارسه ☐ أمارسه في أغلب الأحيان ☐ أمارسه دائماً

4. كيف تصفين الجهد البدني الذي تبذلينه في الجامعة ؟

☐ خفيف ☐ معتدل ☐ شاق ☐ شاق جداً

5. ما هو عدد ساعات ممارسة النشاط الحركي والرياضة خارج الجامعة (اسبوعياً)؟

☐ لا أمارس ☐ أقل من 3 ساعات ☐ 3-7 ساعات ☐ أكثر من 7 ساعات

6. ما هو مستوى النشاط الحركي والجهد البدني المبذول خارج الجامعة؟

☐ خفيف ☐ معتدل ☐ شاق ☐ شاق جداً

التغذية

1. كم حصة تتناولين من مجموعة الحليب ومشتقاته (الجبن، الزبادي ...)؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

2. كم حصة تتناولين من مجموعة اللحوم الحمراء والبيضاء أو البيض؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

3. كم حصة تتناولين من البقوليات؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

4. كم حصة تتناولين من مجموعة الفاكهة؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

5. كم حصة تتناولين من مجموعة الخضراوات؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

6. كم مرة تشربين الماء أو السوائل؟

☐ أبدًا ☐ 1-2 كوب يومياً ☐ 3-4 أكواب يومياً ☐ 5-6 أكواب يومياً ☐ 7-8 أكواب يومياً ☐ 9-10أكواب يومياً ☐ أكثر من 10 أكواب

7. هل تتعاطين الفيتامينات كمكملات غذائية (أقراص أو شراب..الخ) ؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

8. هل تتعاطين الحديد كمكمل غذائي (أقراص أو شراب..الخ)؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

9. هل تتعاطين الكالسيوم كمكمل غذائي (أقراص أو شراب..الخ)؟

☐ أبدًا ☐ نادرًا ☐ مرة كل أسبوع ☐ 3- 4مرات في أسبوع ☐ 5 - 6 مرات في أسبوع ☐ يومياً ولمرة واحدة ☐ يومياً ولأكثر من مرة

العادات الغذائية

1. هل تهملين تناول أحد الوجبات؟

☐ دائما ☐ أحيانا ☐ أبدا

2. هل تشعرين بالذنب بعد تناول الطعام لأنك حساسة جدا بشأن زيادة الوزن؟

☐ دائما ☐ أحيانا ☐ أبدا

3. هل تتقايين أراديا أو لديك الرغبة للتقيؤ بعد تناول الوجبات لأنك حساسة جدا بشأن زيادة الوزن ؟

☐ دائما ☐ أحيانا ☐ أبدا

4. هل استخدمت في وقت ما أدوية لتخيف الوزن (أدوية كيمائية، أو عشبية أو أدوية خفض سوائل الجسم)؟

☐ دائما ☐ أحيانا ☐ أبدا

5. هل تم تقويم غذاؤك وأخبرت أنك تعانين من اضطراب في التغذية بسبب العادات الغذائية الخاطئة ؟

☐ دائما ☐ أحيانا ☐ أبدا

صحة الجهاز التناسلي

1. هل تعرضت لنزيف بما فيها زيادة مدة الطمث عن 14 يوم؟

☐ نعم ☐ لا

2. خلال الأشهر الـ6 الماضية، هل كان الدورة منتظمة لديك ؟

☐ نعم ☐ لا

3. هل عانيت لفترة ما من اضطرابات في الدورة الشهرية؟

☐ نعم ☐ لا

4. هل عانيت من انقطاع في الطمث لأكثر من 3 أشهر ؟

☐ نعم ☐ لا

5. هل تتناولين أقراص لتنظيم الدورة الشهرية ؟

☐ نعم ☐ لا

قياسات جسمية

1. الوزن (كيلوجرام) :_____

2. الطول (متر) :_____

3. سمك طية الجلد :
منطقة العضلة ذات الثلاثة رؤوس (ملّيمتر) _____ منطقة فوق العظم الحرقفي (ملّيمتر)_____ منطقة البطن (ملّيمتر)_____

4. كثافة العظم :_____

Appendix 3

Dear Sir,

The researcher, Layla Ahmed Al Madany is doing the present study as a requirement for a master degree. The title of this study is "The female athlete triad among female students of the Physical Education Department at the University of Bahrain" supervised by Dr. Sami Mohammed A.Fatah.

The enclosed questionnaire is one of the research instruments which is going to be used in this study. In light of your specialized experiences, the researcher would like to draw on those experiences in assessing this questionnaire as to assess content validity instrument. Please view this questionnaire and give your useful opinions and suggestions.

I appreciate your cooperation with me and I feel indebt to you. I look forward to hearing from you soon.

Yours faithfully,

Layla Ahmed Al Madany

Content Validity Instrument

parts	No.	Questions	Please circle or fill your response to questions.										Notes
Physical Exertion	1	Attendance days at the university.	1	2	3	4	5	6	7	8	9	10	
	2	Number of credit hours of the registered courses in the first semester	1	2	3	4	5	6	7	8	9	10	
	3	Numbers of registered courses in SMW	1	2	3	4	5	6	7	8	9	10	
	4	Numbers of registered courses in UT	1	2	3	4	5	6	7	8	9	10	
	5	Sport or exercise at the university during activity period.	1	2	3	4	5	6	7	8	9	10	
	6	Level of physical exertion at the university	1	2	3	4	5	6	7	8	9	10	
	7	Transportation to university	1	2	3	4	5	6	7	8	9	10	
	8	Type of sport or exercise	1	2	3	4	5	6	7	8	9	10	
	9	Practicing sport or exercise outside the university	1	2	3	4	5	6	7	8	9	10	
	10	Level of physical exertion outside the university	1	2	3	4	5	6	7	8	9	10	
	11	Daily activity at home.											
Other questions		----------											
Dietary Intake	1	Number of meals	1	2	3	4	5	6	7	8	9	10	
	2	Skipping meals	1	2	3	4	5	6	7	8	9	10	
	3	snakes consumption	1	2	3	4	5	6	7	8	9	10	
	4	Milk consumption	1	2	3	4	5	6	7	8	9	10	
	5	Milk products consumption	1	2	3	4	5	6	7	8	9	10	
	6	Fish consumption	1	2	3	4	5	6	7	8	9	10	
	7	Meat consumption	1	2	3	4	5	6	7	8	9	10	
	8	Chicken consumption	1	2	3	4	5	6	7	8	9	10	
	9	Eggs consumption	1	2	3	4	5	6	7	8	9	10	
	10	Fruits consumption	1	2	3	4	5	6	7	8	9	10	
	11	Vegetables consumption	1	2	3	4	5	6	7	8	9	10	
	12	Drinking water	1	2	3	4	5	6	7	8	9	10	
	13	Vitamins supplement consumption	1	2	3	4	5	6	7	8	9	10	
	14	Iron supplement consumption	1	2	3	4	5	6	7	8	9	10	
	15	Calcium supplement consumption	1	2	3	4	5	6	7	8	9	10	
Other questions		----------											
Nutrition Habits	1	Being vegetarian	1	2	3	4	5	6	7	8	9	10	
	2	Feeling extremely guilty after eating	1	2	3	4	5	6	7	8	9	10	
	3	Vomiting or endorsed vomiting	1	2	3	4	5	6	7	8	9	10	
	4	Using diet pills ,chemicals or laxatives	1	2	3	4	5	6	7	8	9	10	
	5	Being screened for eating disorders	1	2	3	4	5	6	7	8	9	10	
	6	Eating disorders that lead to amenorrhea.	1	2	3	4	5	6	7	8	9	10	
	7	Low body weight can increase performance.	1	2	3	4	5	6	7	8	9	10	
Other questions		----------											

Content Validity Instrument

parts	No.	Questions	Please circle or fill your response to questions.										Notes
Reproductive System Health	1	Age of menarche	1	2	3	4	5	6	7	8	9	10	
	2	Number of menstrual cycles per year.	1	2	3	4	5	6	7	8	9	10	
	3	Number of menstrual period days.	1	2	3	4	5	6	7	8	9	10	
	4	Had had a period for more than fourteen days	1	2	3	4	5	6	7	8	9	10	
	5	Had had regular mensturation for the last 12 months	1	2	3	4	5	6	7	8	9	10	
	6	Irregular menstruation	1	2	3	4	5	6	7	8	9	10	
	7	Missing menstrual period for more than three months.	1	2	3	4	5	6	7	8	9	10	
	8	Feeling healthy whine miss period for a long time	1	2	3	4	5	6	7	8	9	10	
	9	Taking birth control pills	1	2	3	4	5	6	7	8	9	10	
Other questions		----------											
Suggestions for other parts of questionnaire		----------											

Appendix 4

الى حضرة الفاضل الدكتور ---------- المحترم

تحية طيبة وبعد ،

تقوم الباحثة ليلى أحمد المدني طالبة ماجستير التربية الرياضية في الطب الرياضي بدراسة انتشار ظاهرة "female athlete triad " على طالبات التربية الرياضية بجامعة البحرين بإشراف الدكتور الفاضل سامي محمد عبد الفتاح ، تحت عنوان بحث :

"The female athlete triad among students of the Physical Education Department at the University of Bahrain"

والأستبانه المرفقة هي أحد أدوات البحث التي ستستخدم في الدراسة ، وترغب الباحثة بإطلاعكم على الاستبانة والأخذ بآرائكم السديدة في ارتباط أسئلة الاستبانه بالبعد لما لكم من خبرة مشهودة في مجال علوم الرياضة والبحث العلمي. فالرجاء الاطلاع عليها وتعديل ما يلزم.

وتفضلوا جزيل الشكر والاحترام

الباحثة
ليلى أحمد المدني

استمارة آراء المحكمين في الاستبانة

البعد	رقم السؤال	السؤال	الرجاء وضع دائرة حول الدرجة التي تراها ملائمة (الدرجة من صفر حتى عشرة) حسب ارتباطها بالبعد المحدد										الملاحظات
الجهد المبذول	1	أيام الحضور للجامعة	صفر	1	2	3	5	6	7	8	9	10	
	2	عدد الساعات المسجلة في الفصل	صفر	1	2	3	5	6	7	8	9	10	
	3	عدد المقررات العملية SMW	صفر	1	2	3	5	6	7	8	9	10	
	4	عدد المقررات العملية UT	صفر	1	2	3	5	6	7	8	9	10	
	5	النشاط البدني في فترة النشاط الطلابي	صفر	1	2	3	5	6	7	8	9	10	
	6	الجهد البدني المبذول في الجامعة	صفر	1	2	3	5	6	7	8	9	10	
	7	الانتقال للوصول إلى الجامعة	صفر	1	2	3	5	6	7	8	9	10	
	8	ممارسة الرياضة خارج الجامعة	صفر	1	2	3	5	6	7	8	9	10	
	9	ساعات ممارسة الرياضة خارج الجامعة	صفر	1	2	3	5	6	7	8	9	10	
	10	تصنيف النشاط الممارس خارج الجامعة	صفر	1	2	3	5	6	7	8	9	10	
	11	مزاولة أعمال المنزل	صفر	1	2	3	5	6	7	8	9	10	
	أسئلة مقترحة	----------											
التغذية	1	عدد الوجبات	صفر	1	2	3	5	6	7	8	9	10	
	2	اهمال تناول أحد الوجبات	صفر	1	2	3	5	6	7	8	9	10	
	3	تناول الطعام بين الوجبات (Snacks)	صفر	1	2	3	5	6	7	8	9	10	
	4	شرب الحليب	صفر	1	2	3	5	6	7	8	9	10	
	5	تناول مشتقات الحليب	صفر	1	2	3	5	6	7	8	9	10	
	6	تناول السمك	صفر	1	2	3	5	6	7	8	9	10	
	7	تناول اللحوم الحمراء	صفر	1	2	3	5	6	7	8	9	10	
	8	تناول اللحوم البيضاء	صفر	1	2	3	5	6	7	8	9	10	
	9	تناول البيض	صفر	1	2	3	5	6	7	8	9	10	
	10	تناول الفاكهة	صفر	1	2	3	5	6	7	8	9	10	
	11	تناول الخضراوات	صفر	1	2	3	5	6	7	8	9	10	
	12	شرب الماء	صفر	1	2	3	5	6	7	8	9	10	
	13	تعاطي الفيتامينات كمكملات غذائية	صفر	1	2	3	5	6	7	8	9	10	
	14	تعاطي الحديد كمكمل غذائي	صفر	1	2	3	5	6	7	8	9	10	
	15	تعاطي الكالسيوم كمكمل غذائي	صفر	1	2	3	5	6	7	8	9	10	
	أسئلة مقترحة	----------											
العادات الغذائية	1	أنها نباتية	صفر	1	2	3	5	6	7	8	9	10	
	2	الشعور بالذنب بعد تناول الطعام	صفر	1	2	3	5	6	7	8	9	10	
	3	التقيؤ أراديا أو الرغبة للتقيؤ بعد الوجبات	صفر	1	2	3	5	6	7	8	9	10	
	4	تعاطي مدرات لتخفيف الوزن	صفر	1	2	3	5	6	7	8	9	10	
	5	الاضطراب في التغذية	صفر	1	2	3	5	6	7	8	9	10	
	6	ممارسة العادات الغذائية الخاطئة قد تؤدي لاضطراب الطمث	صفر	1	2	3	5	6	7	8	9	10	
	7	نقص الوزن قد يحسن من الأداء الرياضي	صفر	1	2	3	5	6	7	8	9	10	
	أسئلة مقترحة	----------											

تابع استمارة آراء المحكمين في الاستبانة

البعد	رقم السؤال	السؤال	الرجاء وضع دائرة حول الدرجة التي تراها ملائمة (الدرجة من صفر حتى عشرة) حسب ارتباطها بالبعد المحدد										الملاحظات
صحة الجهاز التناسلي	1	سن بدأ الحيض	صفر	1	2	3	5	6	7	8	9	10	
	2	عدد الدورات الشهرية في السنة الواحدة	صفر	1	2	3	5	6	7	8	9	10	
	3	عدد أيام الطمث	صفر	1	2	3	5	6	7	8	9	10	
	4	التعرض لنزيف (مدة الطمث أكثر من 14 يوم)	صفر	1	2	3	5	6	7	8	9	10	
	5	انتظام الطمث خلال الأشهر الـ12 الماضية	صفر	1	2	3	5	6	7	8	9	10	
	6	التعرض لاضطرابات الطمث	صفر	1	2	3	5	6	7	8	9	10	
	7	التعرض لانقطاع في الطمث لأكثر من 3 أشهر	صفر	1	2	3	5	6	7	8	9	10	
	8	السلامة والصحة عند اضطرب الطمث لمدة طويلة	صفر	1	2	3	5	6	7	8	9	10	
	9	تناول حبوب لتنظيم الدورة الشهرية	صفر	1	2	3	5	6	7	8	9	10	
أبعاد أخرى		----------											
أسئلة مقترحة		----------											

الرجاء إعادة إرسال الاستمارة على فاكس مشرف البحث الدكتور الفاضل سامي عبد الفتاح (0097317)

وتفضلوا جزيل الشكر والامتنان

الباحثة
ليلى أحمد المدني

Appendix 5

Questionnaire for Physical Education Female Students

Academic year:

☐ First ☐Second ☐ Third ☐ Fourth ☐ Fifth

Age: ---------- years old
Wight: ---------- Kilogram Height: -------- meters.

How many numbers of physical education practical courses have you registered in this semester? ----------

How many course credit hours have you registered in SMW? ----------
How many course credit hours have you registered in UT? ----------

Do you practice sport or exercises when you are outside the university?

☐ Yes ☐ No

How do you describe your level of physical exertion?

☐low ☐ Medium ☐Hard ☐Very Hard

Have you ever had menstruation irregularity?

☐ Yes ☐ No

Have you suffered from stress fracture while you are studying in Physical Education Department?

☐ Yes ☐ No

Have you suffered from a general physical fatigues and/or loss of mental ability to concentrate while you are studying in Physical Education Department?

☐ Yes ☐ No

Have you suffered from physical abnormal stress while you are studying in Physical Education Department?

☐ Yes ☐ No

Have you been diagnosed as an anemic while you are studying in Physical Education Department?

☐ Yes ☐ No

Appendix 6

استبيانة لطلبة التربية الرياضية

السنة الدراسية :

☐ أولى ☐ ثانية ☐ ثالثة ☐ رابعة ☐ خامسة

العمر: ---------- سنة

الوزن ---------- كيلوجرام الطول:---------- متر

كم عدد الساعات العملية التي تدرسيها في هذا الفصل الدراسي ؟ ----------

كيفية توزيع المواد العملية ؟
(يوم السبت والاثنين والأربعاء) عدد الساعات : ----------(يوم الأحد والثلاثاء):----------

هل تمارسين الرياضة خارج الجامعة ؟

☐ نعم ☐ لا

كيف تصنفين الجهد البدني الذي تبذلينه ؟

☐ خفيف ☐ متوسط ☐ عالي ☐ عالي جداً

هل سبق وان عانيت من انقطاع أو عدم انتظام الدورة الشهرية؟

☐ نعم ☐ لا

هل سبق وان تعرضت لكسر خلال فترة دراستك ؟

☐ نعم ☐ لا

هل سبق وأن عانيت من ضعف عام وعدم القدرة على التركيز خلال فترة دراستك؟

☐ نعم ☐ لا

هل سبق وتعرضت لإجهاد بدني خلال فترة دراستك؟

☐ نعم ☐ لا

هل أصبت بأنيميا خلال فترة دراستك؟

☐ نعم ☐ لا

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ملخص البحث

أجرت الباحثة دراسة وصفية بعنوان " ظاهرة بين طالبات female athlete triad بين طالبات التربية الرياضية لجامعة البحرين ، هدفت الدراسة للتعرف على انتشار ظاهرة و العوامل المتعلقة بظاهرة بها بين طالبات قسم التربية الرياضية بجامعة البحرين.

استخدمت الباحثة المنهج الوصفي لملاءمته لموضوع الدراسة، وقد تم تطبيق البحث في الفترة من نوفمبر 2003 حتى ديسمبر 2004 على عينة من طالبات التربية الرياضة بلغ عددهن 276 (78.86%) مع استبعاد من سبق لهن الحمل، وعينة أخرى ضابطة من طالبات خارج قسم التربية الرياضية ممن يدرسن في جامعة البحرين وقد بلغ عددهن 244 طالبة. تراوحت أعمارهن بين 17- 24 عام. جميع الطالبات أجرين اختبار كثافة الأملاح المعدنية بالإضافة لملء الاستبانة المصممة للتعرف على الجهد البدني ومقدار التغذية والعادات الغذائية وصحة الجهاز التناسلي المبذول والنشاط البدني اليومي.

أسفرت نتائج الدراسة على أن هناك نسبة انخفاض في كثافة الأملاح المعدنية بين طالبات قسم التربية الرياضية (25.36 %). وأن هناك اختلاف دال معنويا بين كثافة الأملاح المعدنية لطالبات قسم التربية الرياضية و كثافة الأملاح المعدنية للمجموعة الضابطة من غير طالبات قسم التربية الرياضية ولصالح المجموعة الضابطة. كذلك دلت النتائج على وجود علاقة ارتباط عكسية بين كثافة الأملاح المعدنية والجهد البدني المبذول وعلاقة طردية بين كثافة الأملاح المعدنية وكلا من التغذية وصحة الجهاز التناسلي. وأن كلاً من اضطرابات التغذية و الجهاز التناسلي والجهد البدني المبذول تؤثر بنسبة 30.6% على كثافة الأملاح المعدنية. كما أسفرت النتائج عن وجود علاقة انحدار خطي متعدد بين انخفاض كثافة الأملاح المعدنية وكلا من الجهد المبذول واضطرابات التغذية و الجهاز التناسلي. وقد استنتجت الباحثة انتشار الظاهرة بين بعض طالبات التربية الرياضية بجامعة البحرين وتباين تأثير العوامل المتعلقة بها.وان معادلة التنبؤ بالانخفاض الحاصل في كثافة الأملاح المعدنية هي:

كثافة الأملاح المعدنية = - 1.7399 - 0.102 (درجة الجهد البدني المبذول) + 0.005035 (درجة التغذية) + 0.120 (درجة صحة الجهاز التناسلي).