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FEMALE HEALTH AND PHYSICAL FITNESS AT THE NAVAL ACADEMY

by

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August 1998

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FEMALE HEALTH AND PHYSICAL FITNESS AT THE NAVAL ACADEMY

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ABSTRACT

Stress related health disorders may be an indication that some female midshipmen at the Naval Academy are making exceptional efforts to meet specified physical performance standards. The stress at the service academies is much higher than in many civilian occupations and may increase the risk of females developing gender related health problems such as amenorrhea, bone loss, and eating disorders. The purpose of this research is to shed some light on ways in which gender related health problems can be decreased while improving the overall quality of midshipmen at the Naval Academy. First, a comparison of male versus female exercise patterns and performance is provided. In order to identify risk factors, hypotheses testing procedures are used to examine the relationship between female health disorders and selected explanatory variables. Recognizing risk factors early can also reduce the risk of gender related problems long after midshipmen have graduated. Lessening the amount of injuries now can prevent health problems that develop by middle age, and will also help reduce the cost of medical compensation later in an officer's life.

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I. INTRODUCTION

The first vessels of the United States Navy were launched in 1797; among them were the USS UNITED STATES, USS CONSTELLATION, and the USS CONSTITUTION. Thirty years later, President John Quincy Adams asked Congress to establish a Naval Academy that would educate officers in science and leadership. President Adams's proposal, however, was not acted upon until nearly 20 years later by Secretary of the Navy George Bancroft. Secretary Bancroft established the Naval School without congressional funding at a 10-acre Army post named Fort Severn in Annapolis, Maryland, on October 10, 1845. It was reported that Bancroft decided to move the Naval School to this "healthy and secluded" location in order to rescue the midshipmen from the temptations and distractions of the city. At the time, midshipmen were trained at the Philadelphia Naval Asylum and similar facilities located in New York City, Boston, and Norfolk. The first class at Annapolis consisted of 50 midshipmen and seven professors. The curriculum included mathematics, navigation, gunnery, steam, chemistry, English, natural philosophy, and French.

In 1850, the school became the United States Naval Academy. A new curriculum went into effect requiring midshipmen to study at the Naval Academy for four years and to train aboard ships during the summers. This format remains much the same today as midshipmen continue training to lead the future Navy (Naval Academy home page, 1998).

The development of the Naval Academy has always reflected the history and political climate of the country. In 1949, Wesley A. Brown became the first African-American to receive a degree and commission from the Naval Academy. The first women were accepted as midshipmen in 1976 when Congress authorized the admission of women into all of the service academies. Currently, women comprise approximately 14% of the entering Plebe (Freshmen) class. These women receive the same professional and academic training as men (Naval Academy Home Page, 1998).

The transition of women into a predominantly and traditionally male institution has not been easy. With the introduction of women into the brigade of midshipmen, differences between men and women have created controversy. Arguments have been made that women are not capable of meeting the physical standards required by service members (Barrett, 1997, 1995; Webb, 1979; Roush, 1997; and USGAO, 1993). Some see physical fitness tests not as a measure of women's health but rather a measure of how closely they can emulate men's strengths (Barrett 1997, 1995; Webb, 1979).

Regardless of gender, the physical fitness standards of the physical readiness test (PRT) at the Naval Academy are well above fleet standards (Commandant Midshipmen Instruction 5210.5A, 1994 and OPNAVISNST 6110.1D, 1994). For example, the minimum run times for midshipmen qualify as outstanding when compared to fleet standards. The PRT standards are higher for midshipmen in order to ensure that all members of the Navy's premier officer accession program set the example, thus epitomizing the image that all officers pursue excellence in mind, body, and spirit.

The belief that females should bear arms in defense of their country alongside men has always been a controversial issue (Webb, 1979 and Roush, 1997). Plato suggested nearly two and a half centuries ago that women have as much responsibility and potential to serve their nation as men (Plato, translated by Cornford in 1968). In *Republic,* concerning the equality of women, he wrote that women should shoulder the same civic responsibilities as men. All should share equally in public affairs and should receive identical educations. He further stated that women with the right natural gifts should serve in the military. "Women must have the same two branches of training for mind and body and also be taught the art of war, and they must receive the same treatment as men. If the country goes to battle men and women should take the field together" (Plato, translated by Cornford in 1968).

Today, men and women do compete side by side in the battlefield arena despite their physical differences. However, the average man is taller, heavier, and stronger than the average female (Eitelberg, 1990). Eitelberg, calls this measurable difference the "delta factor"(1990). The "delta factor" includes measurable differences between men and women, such as strength, height, weight, and bone thickness, which can be measured.

When determining the standards of a physical fitness program, Eitelberg asserts that these factors must be taken into account to make physical fitness programs relatively equal for both men and women (1990). He states that professional organizations such as fire and police departments have long acknowledged these differences and have adjusted fitness events in order to make them more competitive, or they have set equal minimum standards that both sexes must meet. In Olympic competition, for example, there is a marked difference in time, distance, and strength requirements between women's and men's events. The same holds true for military physical fitness standards. In both examples, the women are not required to run the same times or perform as many strength exercises as men in order to pass minimum standards. The standards are not designed to accentuate men's and women's differences but serve to set minimum health standards that are dependent upon age and gender (U.S. Olympic home-page, 1998 and OPNAVINST 6110.1D, 1994).

However, physical fitness standards for females have become more difficult over the years, as well as more competitive with men's fitness programs in and out of the military (U.S. Olympic home-page, 1998; OPNAVINST 6110.1D, 1994; Commandant Midshipmen Instruction 5210.5A, 1994). Women are achieving physical fitness standards that were not previously thought possible.

The Marine Corps offers a clear example of this phenomenon. Before a recruit can call himself or herself a marine, he or she must complete a rigorous and extensive combat exercise designed to test both the physical stamina and mental prowess of the recruit. This acceptance program has been dubbed the "Crucible." Regardless of gender, failure to complete the Crucible results in a discharge from the Corps or, in cases of injury, possible repetition of the cycle (NBC News *Dateline*, 1997). Women's and men's standards are remarkably similar, and both women and men have performed admirably.

What then are the physical limits of females and how close in structure will male and female physical fitness programs become before women reach the peak of their physical performance? Olympic competition has seen a remarkable gain in strength and agility during the last century (U.S. Olympic Association home-page, 1998). The differences in men's and women's world record track and field times and distances are also quickly closing (U.S. Olympic Association home-page, 1998). For example, Florence Griffith-Joyner's Olympic record 100-meter dash is only three-tenths of a second slower than Jesse Owens's world record time of the 1940s (U.S. Olympic Association home-page, 1998 and Jesse Ownes home-page, 1998). Much of this improvement can be attributed to improved training aids, knowledge, and sometimes even medications. Such innovations tend to decrease the difference in performance between the sexes.

What are the physical and psychological consequences for women in current fitness programs that require rigorous physical training? When does the pursuit for excellence in fitness become hazardous to a woman's health? Research suggests that there may be definite side effects such as eating disorders, bone loss, and increased risk of injury in female athletes (Loucks & Horvath, 1985; Winfield, 1997; and Sundgot-Borgen, 1994). Walter et al. showed that among 1,680 runners enrolled in a cohort study, excessive risk of injury was associated with those runners who ran more than 40 miles per week (1989). Studies on women within the military have also indicated that there is a higher risk of stress fractures among women than men (Winfield et al., 1997). Other researchers (Sundot-Borgen, 1994; Drinkwater et al., 1990; and Bijur et al., 1997) have presented evidence suggesting there is an increased risk of amenorrhea (the complete cessation of menstrual periods), bone loss, and eating disorders among female athletes.

There has been little research at the Naval Academy to determine if female midshipmen are at a high risk of injury or illness. Evidence does suggest an increased risk of health-related problems among women who participate in sports requiring weight limitations or those who run excessively. Health problems include eating disorders, menstrual irregularities, bone loss, and increased risk of injuries (White & Hergenroeder, 1990; Warren et al., 1990; and Schotte & Stunkard, 1987). Female midshipmen may be at risk because of their participation in varsity sports and training for the PRT.

The Naval Academy has proactively addressed women's health issues. In a report to the Superintendent of the Naval Academy on the status of women in the brigade of midshipmen, the Women Midshipmen Study Group (WMSG) reported that 80% of the women midshipmen indicated they had firsthand knowledge of a classmate having some degree of disordered eating (WSMG, 1995). Other research is currently being conducted to determine the extent of bone mineral density loss in female midshipmen, and further research in this area has been approved.

In the next Chapter, I will present evidence showing the physiological effects that high-intensity workouts and rigorous training programs have on female athletes. Several of the articles use the word "elite" to describe their athlete subjects without defining elite. Whether the women and men at the academy are elite athletes is not clear. However, the rigorous acceptance requirements to the Academy, the physical fitness program, and the number of midshipmen participating in varsity athletics indicate that female midshipmen are above average compared to civilian college students.

The literature review Chapter comprises three sections. The first section discusses common injuries experienced by females in athletics and the military. The second section discusses eating disorders, and the third presents material concerning menstrual irregularities and their associated maladies.

The literature on female health issues and the effects that high intensity training programs have on women's bodies is extensive (Baldi, 1991; Bijur et al., 1997; Drinkwater et al., 1990; Inger, F. & Sundgot-Borgen, J., 1991; Putikan,1994;

Sundgot-Borgen, 1994). However, research data on women at the service academies is scarce. Although there has always been concern for the health of service members, the Naval Academy has traditionally been an all-male institution. Since women were not introduced into the service academies until the mid-1970's, research concerning midshipmen over the last 150 years has focused primarily on the needs of men. However, studies such as those performed by the Women's Study Group and the Naval Academy Midshipmen Health Studies Group indicate that attitudes and concerns toward women in the military are changing drastically from those of 20 years ago.

II. LITERATURE REVIEW

A. INJURIES

Those midshipmen who participate in athletics generally perform better at the Naval Academy than those who do not. In a report submitted to the Naval Academy Superintendent in 1987, it was noted that the attrition rate for female athletes was 13%; the attrition rate for all females (athlete and non-athlete) was 35%. The dropout rate for those women who had never participated in a varsity sport was 50% (Baldi, 1991). The report also showed that women athletes were performing nearly as well as men, whose overall dropout rate at the time of the report was 23%.

The author of the report (unknown, 1987) hypothesized there were a number of factors affecting the lack of attrition among female athletes, including a higher degree of fitness among female athletes and psychological factors such as an increased recognition and greater acceptance of women athletes by male midshipmen. This improved relationship with male midshipmen was thought to act as a support system for those women involved in team sports. Baldi stated that such reports indicate that women are capable of a much higher level of physical performance than previously thought possible (1991). At the very least, the report suggested that it is advantageous for females to participate in varsity sports if they want to improve their chances of receiving a commission.

Regardless of a midshipman's participation in varsity athletics, physical fitness requirements dictate that he or she maintain a healthy lifestyle in order to meet the rigorous standards of the Naval Academy. Among the various methods of improving cardiovascular fitness, running is the most common form of exercise for both males and females. Krammer and Wells (1996) suggested that there are some definite advantages to healthy, active lifestyles for women, such as possible reduction in breast, endometrial, and ovarian cancer. In addition, it is well documented that aerobic fitness benefits both men and women by reducing the risk of cardiovascular disease (Shepard, 1994).

But, is too much of any good thing bad? Many believe so and have presented evidence supporting their claims. Hoffman (1997) stated that in contrast to other studies, his study suggested that there is a point in which an athlete, male or female, may overexercise, thus limiting recovery from high-intensity exercise after a certain point of aerobic fitness. However, he was not the first to recognize this fact.

Nearly ten years earlier, Macera et al. reported that although running is perceived to be beneficial to the cardiovascular system, it may be potentially harmful to the musculoskeletal system (1989). Among habitual runners, they found that injuries to the lower extremities appeared to be the most common. They also reported that annual rates of injuries for runners ranged from 24% to 65%.

That same year, Walter et al. showed that there was an increased risk of injury to the lower extremity associated with those who ran more than 40 miles per week and those athletes who ran year-round (1989). According to Broody (1980), this increased rate of injuries should not be surprising. In fact, nearly 20 years ago, he reported that a runner's gait involves 50 to 70 strokes per minute. Each foot strike carries a force of three to eight times the runner's body weight, depending on the terrain. The data presented by Broody lends support to the reports of Macera et al. (1989), Walter et al. (1989), and Hoffman(1997).

Although Walter et al. (1989) suggested that injury rates among male and female runners were similar, several other studies suggest there is a definite difference between male and female athletes. Sherman and Davis (1997) reported a unique problem among women. They found that approximately one third of physically active female soldiers surveyed experienced urinary incontinence. Alarmingly, many of those females seriously restricted their fluid intake in order to prevent leakage. Restriction of fluids during high-intensity workouts can further aggravate other injuries.

Winfield and Moore (1997) also studied risk factors associated with stress fractures in female marines. They found that women had a higher incidence of stress reactions (11.5%) than men (7.9%) when participating in the same training programs. The same year that Broody (1980) published the physics of gait, Kowel suggested a female's larger pelvic width or Q-angle may be a participating factor in stress fractures to the lower extremity (1980). The increased width of the female pelvis was thought to increase the biomechanical stresses on the female, thus increasing the prevalence of injury. Bijur et al. (1997) also supported Kowel's findings. They suggested that the increased Q-angle may be a factor as well.

Surprisingly, that same year, Winfield and Moore's study suggested just the opposite. Their study found that there was a trend toward an association between smaller pelvic width and stress reactions (1997). They hypothesized that a larger pelvic width is an indication for increased bone density or that increased width improves the biomechanics of the female.

Kowel acknowledged that Q-angle is not the only cause of injury among females. He also suggested that weight, percent of body fat, and limited leg strength are related to an increased incidence of injuries among female athletes and that injuries may often be attributed to lack of prior fitness or conditioning (1980). He further reported that through assessment techniques it may be possible to identify women who are at risk for orthopaedic injury prior to training.

Of special interest are those women who are members of the armed forces. Studies by Bijur et al. showed a significant increase in injury episodes among women at the U.S. Military Academy (Table 1.1). The percentage of injuries to female cadets was 2.5 times greater than the male's percentage (1997). Sixty-one percent of females at the academy had one or more injuries resulting in medical treatment and at least one day absent due to those injuries. The corresponding figure for males was 28%. The types of injuries (Table 1.2) experienced by both men and women were, for the most part, similar with two exceptions: women had a significantly higher incidence of stress fractures or stress reactions; whereas, men were much more likely to have ingrown toenails. Fifteen percent of the female cadets had one or more stress fractures compared to only 2.3% of the male cadets (Bijur et al., 1997).

Bijur et al. stated that two possible reasons for the difference in the rate of injuries were height and pretraining conditioning (1997). They affirmed:

> The measure of pre-training conditioning on the initial 2 mile run, was strongly associated with

the rate of injuries for both men and women. As the average run time increased, the rate of injuries increased (Table 1.3). The fastest women, whose average 2-mile run time was 7.2 minutes (time per mile), had rates of injuries similar to that of the slowest men, whose average runtime was 7.8 minutes. Multiple injury episodes were significantly associated with 2-mile run performance in women.

Another possible reason for the increase in injuries could be military drill. The prescribed length of the step in military drill is 30 inches. Women, who tend to be shorter, need to push off with their toe with greater force. The force of the push-off results in a greater heel strike, thus increasing the amount of stress on the lower extremities of the female cadet (Bijur et al., 1997).

TABLE 1.1 Distribution of Injury Episodes per 100 Cadets by Gender During Cadet Basic Training

	% of Women (N = 85)	% of Men (N= 473)
All injuries		
0	38.8	71.7
1	44.7	25.2
≥2	16.5	3.2
Injuries resulting in hospitalization		
0	83.5	95.1
≥1	16.5	4.9

Source: adapted from Bijur et al., 1997 *Comparison of Injury During Cadet Basic Training by Gender.* Archives of Pediatric and Adolescent Medicine 151: 456-461.

TABLE 1.2 Distribution of Diagnoses of Injuries During Cadet Basic Training by Gender.

Diagnoses	Women (N=87)	Men (N=184)	All (N=271)
Blister	17.2	17.9	17.7
Tendonitis or synovitis	17.2	15.2	15.9
Sprain	10.3	14.7	13.3
Stress fracture reaction	19.5	7.1	11.7
Contusion	11.5	8.7	9.6
Ingrown toenail	1.1	12.5	8.9
Strain	11.5	5.4	7.4
Subluxation/dislocation	2.3	3.3	3.0
Other	9.1	15.2	13.3

Source: adapted from Bijur et al., 1997 *Comparison of Injury During Cadet Basic Training by Gender.* Archives of Pediatric and Adolescent Medicine 151: 456-461.

TABLE 1.3 Mean Time per Mile of Injuries per 100 Cadets by Run Time in Quartiles by Gender

Run time quartile	Mean run time, min	Rate of injuries per 100 cadets
	Men	
1	6.0	22.4
2	6.6	25.0
3	7.0	35.4
4	7.8	42.6
	Women	
1	7.2	42.1
2	8.1	66.7
3	8.7	76.2
4	9.8	126.3

Source: adapted from Bijur et al., 1997 *Comparison of Injury During Cadet Basic Training by Gender.* Archives of Pediatric and Adolescent Medicine 151: 456-461.

B. EATING DISORDERS

The two most common types of eating disorders are anorexia nervosa (AN) and bulimia nervosa (BN). Anorexia nervosa is defined as a refusal to maintain body weight over a minimal level considered normal for age and height, a distorted body image, an intense fear of fatness or weight gain while being underweight, and amenorrhea (American Psychiatric Association, 1987). Bulimia nervosa is defined as binge eating followed by manual purging. This typically involves consumption of calorie-dense food, usually eaten inconspicuously or secretly. By relieving abdominal discomfort through vomiting, binge eating can continue (American Psychiatric Association, 1987).

Experts disagree on the prevalence of eating disorders. Estimates of the percentage of disorders among women range from less than 1% to as high as 39.2%, depending greatly on whether the queries were self-reported or diagnosed in a clinic (Burckes-Miller & Black, 1988; Warren et al., 1990). In a study of Navy nurses, McNulty (1997) found the prevalence of bulimia and anorexia to be 12.5% and 1.1% respectively. McNulty further stated that estimates of eating disorders among military personnel are probably conservative due to a person's fear of not being selected for promotion or being selected for involuntary separation.

Some evidence even suggests that eating disorders may not be as prevalent as once thought. For instance, Schotte & Stunkard (1987) reported that the prevalence of eating disorders (specifically bulimia) depends on the researcher's definition of the term. If bulimia is defined as self-reported overeating associated with occasional purging, then there is definitely an epidemic of eating disorders among athletes and college females. If the term bulimia is referred to as a serious clinical problem, then there is probably not such an epidemic.

There is still much debate over whether eating disorders have become an epidemic among females. However, in 1989, Drewnowski et al. reported that a study conducted in the mid-1980's showed that at least 50% of college women who met the criteria for eating disorders at the beginning of their freshman year no longer met them when reassessed nine months later.

Despite the range in percentages or the plausibility of an epidemic, Sundgot-Borgen (1994) argues that there is a definite increase in the frequency of eating disorders among athletes, and it is more prevalent among athletes engaging in sports that possess stringent weight standards. Puglise et al. (1983) found that many athletes suffered from many of the same symptoms as nonathletic sufferers despite the effects of malnutrition on their training regime; therefore, he further defined the term anorexia nervosa to include anorexia athletica because of the prevalence of eating disorders among these elite athletes. General features of anorexia athletica are the fear of gaining weight or becoming obese regardless of actual size or weight. An athlete's weight is reduced through excessive exercise and by the reduction of food intake. In 1993, Sundgot-Borgen & Larsen discovered that athletes suffering from anorexia athletica usually have a caloric intake that is less than the amount required by the athlete's training regime. In addition, they found that binge eating is also associated with anorexia athletica and is planned and scheduled by the athletes as part of training and study requirements (Sundgot-Borgen & Larsen, 1993).

It is important for coaches and administrators to be able to recognize which athletes are at risk for developing eating disorders. Brownell et al. reported that comparing an individual's body type with the sport in which they participate in order to help identify athletes who are at high risk (1987). For example, a large-framed female participating in gymnastics may be steered toward eating disorders because of the desire and pressure to reduce her weight and size to more competitive levels. The greater the difference between a person's body type and that required by the sport, the greater the likelihood of developing eating disorders (Brownell et al., 1992). According to Sundgot-Borgen, those athletes who start sport-specific training prior to the development of their adult physique increase their chances of developing eating disorder, especially if their adult bodies do not match the sport they have chosen (1994). He also suggested that athletes should start sport-specific training at the postpubescent stage.

Regardless of the athlete's build, Powers (1996) stated that females who participate in gymnastics, figure skating, distance running, or swimming are at a special risk for developing eating disorders. Athletes in sports that require weight standards must often lose weight quickly in order to maintain standards, and the quickest way to reduce weight is to lose body water.

Unfortunately, the desire to maintain competitive weight standards through weight loss only further degrades an athlete's performance. Webster et al. (1990) showed that dehydration resulting from eating disorders can cause a loss of coordination and endurance and therefore a reduction in athletic performance. Inger and Sundgot-Borgen (1991) also concluded that stringent weight standards may reduce output. They reported that elite female endurance athletes with a significant reduction of body weight over two months showed a significant decrease in maximum oxygen uptake (VO_{2max}) and running speed during the weight-reduction period relative to athletes who did not lose weight.

Athletic performance is not the only risk associated with anorexia athletica. Myocardial impairment, a much more serious malady, is also a risk factor associated with eating disorders. Kreipe & Harris (1992) reported that athletes suffering from eating disorders may predispose themselves to cardiac arrest or impairment. They found that a reduction in myocardial mass occurred in those athletes with anorexia nervosa.

One way to check athletes for possible myocardial impairment is by checking for changes in an athlete's pulse. In the same study, Kreipe and Harris found that physically fit adolescents who have a pulse of less than 50 beats per minute typically have an increase in heart rate of less than 10 bpm when moving from the supine position to standing. Those patients with anorexia frequently had a pulse differential of greater than 20 bpm, as well as standing systolic pressure of less than 80 mm Hg, and a greater than 30 mm Hg change when moving from supine to standing.

In 1994, Putukian reported there were a plethora of negative effects of anorexia athletica. Long-term effects of the eating disorders include decreased bone density with its complications, infertility, malnutrition, decreased functioning of the immune system, electrolyte disturbances, gastrointestinal problems, and psychiatric problems. She further stated that 6% of individuals with anorexia die from starvation, cardiac abnormalities, sepsis, or suicide. Suicide accounts for the majority of deaths.

The Naval Academy, despite its close observation of midshipmen, has not been immune to females with eating disorders. Although exact numbers have not yet been published, the need for research and increased awareness of eating disorders within the Naval Academy has been recognized as evidenced by a report to the Superintendent on the status of women in the brigade of midshipmen (1995). Several midshipmen within the study admitted they had firsthand knowledge of classmates who had some degree of an eating disorder. The report recommended that a female psychologist be included on the staff in order to monitor and assess the problem of eating disorders as well as other items associated with gender. The report further recommended that the eating disorder group suggest changes in the Commandant's Standard Organization Manual (CSORM) based on the analysis of research conducted in the brigade, and that one staff member should be an expert in eating disorders.

C. MENSTRUAL IRREGULARITIES AND ASSOCIATED MALADIES

It is important for coaches and administrators to understand the menstrual cycle of the female because the interruption of flow may effect much more than just the reproductive system. Pitukian (1994) defines the normal menstrual cycle(eumenorrhea)for females as 23 to 35 days, with 10 to 13 cycles per year. Oligomenorrhea, which is often associated with excessive stress or exercise, is a reduction to three to six cycles annually. Amenorrhea, a more advanced and serious case of oligomenorrhea, is defined as the absence or decline of menstrual flow and is often the clinical manifestation of a variety of other disorders (Doody, 1990). An amenorrheic female has less than two cycles per year and none within the past three to six months. Those females who have not experienced menarche by age 16 are referred to as having primary amenorrhea, and loss of flow after menarche is classified as secondary amenorrhea (Pitukian, 1994).

Frisch et al. (1981) and Warren (1986) hypothesized that females who start sport-specific training prior to menarche may delay their menarche and may have an increased risk for secondary amenorrhea. Marcus et al. (1985) further suggested that runners who are amenorrheic tend to initiate training within one year of their menarche, whereas those runners with normal cycles tend to begin training nearly five years later. Barrow and Saha (1988) narrowed the times down even further. They reported that women with regular cycles began training an average of six months prior to menarche; whereas, the amenorrheic runners began training on the average of 16 months prior to menarche.

Increased physical training causes many changes in a female's body, including weight, body composition, energy utilization, and cardiovascular adaptations (Pitukian, 1994). Pitukian divides the effects of excessive training into three areas: luteal phase deficiency, anovulation, and exercise-associated amenorrhea (EAA). Each deficiency has its own side effects and associated dangers.

Luteal phase deficiency results in decreased levels of progesterone production and an overall shortening of the luteal phase that often goes unnoticed (Pitukian, 1994). It is associated with decreased bone density (Prior, 1990) and infertility(Shanghold et al., 1979). Swimmers and runners have been reported to have increased frequencies of luteal phase deficiency (Pitukian, 1990). Those females experiencing anovulation do not have normal progesterone levels and often experience oligomenorrhea; however, normal amounts of estrogen are produced. Anovulation has been associated with endometrial hyperplasia and adenocarcenoma (Pitukian, 1994).

Pitukian (1994)and Loucks & Horvath (1985) reported that EAA is the most common ailment experienced by female athletes. The most common side effects of this ailment include anorexia nervosa, premature menopause, and hyperprolactinemea. Loucks and Horvath reported that in the general population 2% to 5% of women experience amenorrhea (1985). However, depending on the study, the prevalence in athletes has ranged from 3.4% (Bonnen & Keizer, 1984) to 66% (Luther & Suchman, 1982).

Understanding who is most at risk for developing menstrual disorders is crucial to preventing unnecessary injury or harm to an athlete. Arendt's (1993) study showed that females participating in college varsity athletics had a 28% higher prevalence of amenorrhea. Of this 28%, 57% were cross-country runners and 13% varsity basketball players. Beim and Stone's (1994) research supports Arendt's research. They too found that long-distance runners are more likely to become amenorrheic than are other athletes.

Athletes, regardless of gender, have always had to concern themselves with fatigue stress fractures. A fatigue stress fracture is a partial or complete fracture of the bone due to its inability to sustain nonacute macrotraumatic stress that is implemented in a repeated, rhythmic submaximal manner (Devas, 1975 & McBryde, 1985). However, an insufficiency stress fracture, most often associated with decreased bone mineral density, is due to normal stress on bone that is less resistant to fractures (Goergen et al., 1981). Barrow and Saha (1988) stated that insufficiency fractures are one of the risks associated with those women who exhibit signs of EAA.

In normal athletes, exercise tends to increase bone formation and bone density, especially exercises that are weight-bearing rather than nonweight-bearing (White and Hergenroeder, 1990). Lindberg et al. (1984) found that amenorrheic runners experienced a much higher incidence of stress fractures than did runners who were eumenorrheic, oligomenorrheic, or postmenopausal. In their one-year study, 49% of the amenorrheic runners experienced stress fractures; there were no stress fractures in the eumenorrheic runners or control athletes. That same year, Cann et al. (1984) found that exercise-associated amenorrhea actually decreased bone density and that any increase in bone density due to exercise was negated. A 22% to 29% decrease in bone mineral density occurred, which indicated that the longer an athlete experienced amenorrhea the greater the loss. Lloyd et al. reported that women who have reached age 20 and have missed 50% of their menstrual periods are even more likely to have reduced bone density, and thus an increased risk of deficiency stress fractures (1988).

Evidence has continued to support Lindberg's et al. and Cann's et al. original findings. In 1995, Beim and Stone reported the majority of fractures experienced in their study were due to insufficiency stress fractures. The fractures also occurred more often in the cortical weight-bearing bones and not in trabecular bone, as would be expected if the athletes were experiencing premature osteoporosis.

Among females, evidence also suggests that Caucasian athletes may be at a higher risk for injury than African Americans. Brudvig et al. (1983), who studied 295 military trainees, reported that there was a much higher incidence of stress fractures among Caucasian than African American females. Interestingly, African American women are less susceptible to osteoporosis as well (Brudvig et al., 1983). Barrow and Saha (1988) show similar results and reported a twofold difference in stress fractures between Caucasian and African American females. White et al. (1990) revealed in their study that the difference in lumbar bone mass density (BMD) of Caucasian females with normal cycles could be explained by the difference in weight and size of Caucasians and African Americans. Their evidence suggested that the relationship between BMD and menstrual status depends upon body weight. They also showed that the femoral and lumbar BMD peaked in late puberty and further suggested that the optimal time for capitalizing on lumbar and femoral neck BMD is during midadolescence. Cahn et al. (1997) also agreed that the difference may be a result of increased BMD in African Americans.

Concerning the relationship between BMD, low estrogen levels, and amenorrhea, Pitukian (1994) assorted that past studies indicated that menstrual dysfunction, especially amenorrhea, is associated with low estrogen levels and low BMD. Because peak bone mass is reached by the mid-twenties, the decrease in bone density as seen in amenorrheic individuals may present an increased risk for stress fracture and osteoporosis. When these individuals become older and menopausal, the additional decrease in bone density increases this risk. Unfortunately, little is known of the natural history of athletic amenorrhea.

Initially, it was thought that once an amenorrheic or anorexic athlete's weight was returned to ideal levels, BMD would increase accordingly. Drinkwater et al. reported in 1986 that six of seven amenorrheic athletes who resumed menses showed marked increased in vertebral bone mass density. They stated that although it would be premature to assume that athletes bone mass would eventually return to normal levels, a 6.2% increase in 14.4 months was an encouraging finding.

Their earlier cautious claims, however, proved correct. In a later study (Drinkwater et al., 1990), they reported the gain they had recorded earlier may actually be limited and that it is possible that extended periods of amenorrhea or oligomenorrhea may result in long-term effects on BMD. They found that the 6.3% increase in BMD reported in 1988 slowed to 3% in 1989 and a complete cessation of growth the following year. At the time of the second study, lumbar bone density still remained well below the average for their age group four years after the resumption of menses. Drinkwater and company concluded their data suggested extended periods of menstrual irregularities may very well lead to an irreversible loss of lumbar BMD.

Rigotti et al. (1991) concurred with Drinkwater's findings. They reported insignificant BMD increases in postanorectic and amenorrheic females over a 25-month period. They also found that no marked difference occurred in those females who eventually recovered to within 15% and 20% of their ideal body weight. Research is currently underway at the Naval Academy to determine if new methods of treatment might improve upon the results found by Drinkwater et al. and Rigotti et al.

III. RESEARCH HYPOTHESES

A. STATEMENT OF THE PROBLEM AND RESEARCH

Grades are one of the most important measures of success at any institution of higher learning. They are also a great source of stress. However, women and men at the Naval Academy may endure more stress than the average college student due to the large number of other requirements, such as physical fitness, physical appearance (body fat, uniform, etc.), and professional development. These added demands may deplete a midshipman's valuable study time. If a midshipman is spending excess time exercising in preparation for physical fitness tests, varsity sports, or weight/body fat standards, then his or her overall GPA may be lower compared to midshipmen not spending as much time exercising.

Evidence has shown that there is a strong correlation between menstrual and eating disorders, and the amount of exercise among women (Arendt, 1993; Baldi, 1991; Barrow & Subrata, 1995; Bones & Keizer, 1984; Broody, 1980; Burckes-Miller & Black, 1988; Drinkwater et al., 1990; Georgen et al., 1981; Lloyd et al., 1988; Marcus et al., 1985; McNulty, 1997; Norwood & Ursano, 1997; Puglise et al., 1983; Rigotti et al., 1991; Sundgot-Borgen & Larson, 1993; Webster & Weltman, 1990.) Females experiencing eating disorders may be expected exercise more compared to those without these disorders. Consequently, women at the Naval Academy experiencing disordered eating or menstrual cycles may show a lower GPA. Lower grades, eating disorders, menstrual irregularities, and the added requirements of the Naval Academy may add to the stress of these midshipmen.

The purpose of this study is to determine if the amount of exercise, involvement in activities, such as varsity sports and sports requiring weight standards, and PRT scores are credible predictors for GPA, disordered eating, and menstrual irregularities. If so, these predictors may pinpoint which midshipmen are at a high risk of poor performance at the Naval Academy and/or health-related conditions related to stress and excess exercise.

Table 3.1 summarizes the hypotheses as well as predicts how the independent variables will effect the dependent variables. It is read by matching the sign with the arrow. For example, as the miles per week increases(↑) the chance of amenorrhea increases (+). Body mass index (BMI) is used instead of weight and height in some cases depending on the predicted significance level of each of the values.

3.1 Table of Hypothesized Predictions

	Technical major	Miles per week	Minutes per week	Varsity athlete	PRT run	PRT sit-ups	PRT push-ups	Sport with weight con.	Body weight	Height	Validate PRT
Amenorrhea	*↔	+↑	+↑	+↑	+↑	↔*	↔*	+↑	−↑	*↔	+↑
Oligomenorrhea	*↔	+↑	+↑	+↑	+↑	*↔	*↔	+↑	−↑	*↔	+↑
QPR (GPA)	+↓	+↓	+↓	+↓	+↓	*↔	*↔	*↔	*↔	*↔	+↓
Eating dis.	*↔	+↑	+↑	+↑	+↑	*↔	*↔	+↑	−↑	*↔	+↑
Eumenorrhea	*↔	+↓	+↓	+↓	+↓	*↔	*↔	+↓	−↓	*↔	−↓

(*) Indicates that the value is expected to be minimal or insignificant

B. HYPOTHESES

From Table 3.1 a number of hypothesis can be developed:

1. The risk of menstrual disorders increases with hours of exercise performed or miles run per week.

2. The risk of eating disorders increases with hours of exercise performed or miles run per week.

3. The risk of menstrual disorders increases as 1.5 mile run time decreases but is not related to increases in the number of sit-ups and pushups performed in two minutes.

4. Women participating in varsity sports requiring weight standards experience an increased risk for menstrual disorders.

5. Women participating in varsity sports requiring weight standards experience an increased risk for eating disorders.

6. As the miles run and minutes of other exercise increases per week, the more likely GPA will decrease.

C. QUESTIONS TO BE ANSWERED DURING ANALYSIS

The following are questions this study hopes to answer:

1. What are the average miles ran per week for those midshipmen experiencing menstrual disorders?

2 What are the average miles ran per week for those midshipmen experiencing eating disorders?

3. What are the average minutes of exercise per week of those midshipmen experiencing menstrual disorders?

4. What are the average minutes of exercise per week of those midshipmen experiencing eating disorders?

5. Do those female midshipmen with low or high BMIs tend to participate in sports requiring weight standards?

6. Do varsity athletes have a higher occurrence of eating disorders?

7. Do varsity athletes have a higher occurrence of menstrual disorders?

8. Does a midshipman's weight correlate with menstrual disorders?

IV. ANALYTICAL METHODOLOGY

A. PROTOCOL

The Women Midshipmen Study Group (WMSG) was tasked by the Superintendent of the Naval Academy to conduct research concerning the prevalence of eating disorders among female midshipmen at the Naval Academy. The study consisted of 801 midshipmen from the class of 1999 and 1,206 midshipmen from the class of 2000. Initial surveys were taken by both classes during their plebe indoctrination. For the class of 1999, a follow-up was conducted at the end of their freshman year prior to the completion of the Spring term. Midshipmen from this class were not required to place their names on the survey forms. For the class of 2000, however, midshipmen were required to place their names on the surveys to allow researchers to inquire further into individual cases. Those midshipmen who attrited between the first and second interviews or during their plebe year have been removed from the data base. Funding was provided by the Naval Academy with funds from the Morale, Welfare, and Recreation (MWR) department. Consent and privacy statements were signed by all participants (Appendix A).

Midshipmen completed the Eating Disorder II Survey developed by David Garner (Appendix B). The demographics section of the survey the was primarily utilized for this research. Incidences of eating disorders were self-reported, and reports were collected from those midshipmen who knew someone thought to be exhibiting disordered eating.

B. EXERCISE AND PHYSICAL TRAINING

The Interval Exercise Questionnaire (Appendix C) was administered during the midshipmen's initial interviews and during their Spring interviews. Time spent exercising was recorded as numbers of hours per week in weight-bearing exercises, such as running and stair climbing. For those midshipmen participating in varsity sports, extracurricular activities, and club sports, the time spent training for these events was added to their time exercising outside of the sport.

Times and scores for the Fall and Spring PRTs were provided by the Physical Education Department. Scores were then calculated in accordance with the Commandant Midshipmen Instruction 5210.1D dated 1994 (Appendix D). Validation of the PRT requires that a midshipmen score in the 90% or better for the run, sit-ups, and push-ups (Appendix E). For the purpose of this study, the variable "Validate" was calculated based on the run time only and did not include the number of calisthenic exercises conducted. The calculation was performed this way because low run times require much more preparation in the form of cardiovascular exercise. Validation of the run requires that females finish the mile and a half run in 10 minutes and 5 seconds or less and men in 8 minutes and 45 seconds or less. Percent body fat was measured in accordance with Navy standards. BMI (the ratio of weight to height) was obtained by using the formula:

[BMI=Mass(KG)/Height^2(m)].

Since members of varsity sports can be expected to run or lift weights more than the average student, the respondents indicated whether they were part of a varsity team or participated in extracurricular activities on their initial and follow-up questionnaires.

C. MENSTRUAL CYCLE

Reports of oligomenorrhea and amenorrhea were self-reported. Subjects were queried as to whether they had experienced menstrual disorders during high school or while at the Naval Academy and their number of cycles per year. Eumenorrheic women, or women considered to have normal menstrual cycles, were then considered to have nine or more cycles per year. These survey forms are provided in Appendices B and C.

D. EATING DISORDERS

Eating disorders were only reported for the class of 1999 and were self-reported. Two variables were created from the survey forms: those who know someone they suspect has an eating disorder and those who self-report having an eating disorder. Neither question asked what type of eating disorder they had experienced, that is, bulimia or anorexia nervosa.

E. ACADEMIC GRADES

Grades for the midshipmen were provided by the Institutional Research Department at the Naval Academy. Academic grades were collected during the first two semesters of the two classes' plebe year. Files were then merged with attrition data provided by Dr. David Armstrong of the Women's Midshipmen Study Group (WMSG) to exclude those midshipmen who had attrited during their plebe year. Data on individual majors is provided and, since technical majors are possibly more demanding, majors were divided into technical and nontechnical.

F. ATTRITION DATA

Attrition, provided by Dr. Armstrong was merged with the data bases of both files and is current through the year 1997. For the purpose of this research, midshipmen who attrited after their plebe year remained in the data base with one exception. There is no attrition data for females for the class of 2000; however, there were 298 missing or unanswered cases for this calculation, leading the researcher to believe that several of these cases were females who had left during their plebe year.

G. DATA ANALYSIS

A 95% confidence level was utilized to determine whether the classes of 1999 and 2000 could be combined into separate databases for males and females. Means and standard deviations were calculated using weight, age, and height for the Fall and Spring semesters for both female and male classes of 1999 and 2000 (See Tables 4.1 through 4.4).[1] Plots of the statistical test revealed there was enough overlap between the two year groups to combine women from the classes of 1999 and 2000 and men from the class of 1999 and 2000.

[1] Note: The symbol "E" represents the number 10 raised to the power that follows. For example, 5.8E-02 equals 5.8 X 10^{-2} or 0.058.

Table 4.1 Statistics: Class of 1999 females

	N		Mean		Median	Std. Deviation
	Valid	Missing				
	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Fall Age (Yrs)	119	73	18.4041	5.758E-02	18.2878	.6281
Fall Weight (Lbs)	124	68	136.5516	1.4291	137.8125	15.9133
Spring Weight (Lbs)	122	70	138.9366	2.0246	140.3182	22.3628
Spring Height (Ft)	125	67	5.5136	1.950E-02	5.5003	.2180

Table 4.2 Statistics: Class of 2000 females

	N		Mean		Median	Std. Deviation
	Valid	Missing				
	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Fall Age(Yrs)	116	0	18.4682	6.8E-02	18.2930	.7296
Fall Weight (Lbs)	115	1	136.461	1.5579	135.000	16.7066
Spring Height (Ft)	114	2	5.4885	2.2E-02	5.5000	.2375
Spring Weight(Lbs)	116	0	137.595	1.5885	134.100	17.1086

Table 4.3 Statistics: Class of 1999 Males

	N	Mean		Median	Std. Deviation
	Missing				
	Statistic	Statistic	Std. Error	Statistic	Statistic
Fall Height (Ft)	403	5.8824	1.0E-02	5.9170	.2380
Fall Weight (Lbs)	405	167.3210	1.0218	165.3750	23.9207
Fall Age (Yrs)	367	18.6262	6.2E-02	18.4990	1.5049
Spring Weight (Lbs)	360	172.0800	1.0411	170.3864	25.3535

Table 4.4 Statistics: Class of 2000 Males

	N		Mean		Median	Std. Deviation
	Valid	Missing				
	Statistic	Statistic	Statistic	Std. Error	Statistic	Statistic
Fall Height (Ft)	793	23	5.8803	8.5E-03	5.8750	.2405
Fall Weight (Lbs)	793	23	171.6417	.9011	169.0000	25.3764
Fall Age (Yrs)	795	21	18.7766	3.3E-02	18.5620	.9228
Spring Weight (Lbs)	795	21	171.5508	.9012	169.0000	25.4091

We now turn to the independent variables of this analysis. The independent variables for the regressions, cross tabulations, and frequencies are presented in Table 4.5.

Table 4.5

Independent Variables

Description	**Variable Label**
Minutes of exercise per week	Minutes
Miles of exercise per week	Miles
Sports requiring weight standards	Wtcon
Varsity sports participation	Varsity
Body mass index	BMI
PRT results (for run/pushups/sit-ups)	PRTrun/PRTpu/PRTsu
Weight (lbs)	WTlbs
Height (ft)	HTft
Validation of the PRT run	Valid

Note: S# and F# indicates whether data was taken in the Spring or Fall of Plebe Year

Dependent variables are presented in Table 4.6.

Table 4.6
Dependent Variables

Description	**Variable Label**
Self reported eating disorders	Pared
Knowledge of someone with an eating disorder	Knowed
Self reported oligomenorrhea	Oligo
Self reported amenorrhea	Amenno
Self reported eumenorrhea	Eumen
1^{st} and 2^{nd} semester QPR	QPR1/QPR2

Note: S# and F# indicates whether data was taken in the Spring or Fall of Plebe Year

Cross tabulations were conducted to determine the characteristics of the data such as averages of miles ran and exercise per week among and between genders. Regression analysis was then performed on the females sub-sample to determine if the independent variables significantly affected the dependent variables. After analyzing the initial regression, those independent variables with a t-value of 1.0 or greater were included in the final model. In the regression analysis, independent variables were transformed by taking the natural log or square of the of the variable to approximate a nonlinear relationship between the dependent and independent variables. LOGIT analysis was conducted when the dependent variable was dichotomous, that is, when only two outcomes were possible. This technique provided a more accurate assessment of the relationship between the dependent variables of amenorrhea, oligomenorrhea, eumenorrhea, attrite, and eating disorder and the relevant independent variables.

V. ANALYSIS OF DATA AND HYPOTHESES

A. INTRODUCTION

This Chapter presents and analyzes the data employed in this study. In an effort to characterize the data, the first section examines observed frequencies and cross tabulations. Graphs and Tables are provided to assist the reader in understanding the relationship between exercise and its effects on females. Comparisons are made among genders to ascertain if there are particular groups of females or males that spend significantly more time exercising than others. There is also an examination of whether certain females have a higher percentage of health disorders and menstrual irregularities.

The second section of this Chapter formally evaluates the hypotheses specified in Chapter three by predicting the risk factors associated with increased exercise. The primary risk factors examined are grades, attrition, menstrual irregularities, and eating disorders. Logistic and linear regression analysis are utilized to develop models relating these variables to relevant independent variables.

B. CHARACTERIZING DATA (FREQUENCIES AND CROSS TABULATIONS)

1. Physiological Data

A characterization of the data is presented in Tables 5.1

and 5.2. As expected, mean age for men and women was not significantly different. The women's average age in the Fall of plebe year was 18.62 years, and the men's average age was 18.54 years.[2]

Body Mass Index (BMI) was calculated for both males and females in the Fall and Spring terms. Nearly all of the women participated in the Spring study; however, the number of men who were still participating had decreased by over half. Both men and women showed a increase in overall BMI; however, women tended to increase their body mass slightly more (0.4 kilograms per meter squared).

[2]The term "system missing" in the Tables refers to those cases that did not have data in a specific category. The letter "N" indicates the number of cases for the Table.

Table 5.1 Data Characterization for Men

	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Fall BMI	1341	428	23.9678	23.6770	24.42	2.8660
Spring BMI	591	1178	24.0127	23.7245	23.01	2.6173
Spring Height (Ft)	1343	426	5.8812	5.8750	6.00	.2394
Spring Weight (Lbs)	1388	381	171.7769	169.0000	165.38	25.3776
Fall Age (Yrs)	793	976	18.7762	18.5620	18.73	.9234

Table 5.2 Data Characterization for Women

	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Fall BMI	239	69	22.1148	22.0933	21.97	2.0556
Spring BMI	234	74	22.4866	22.3606	21.33	1.8848
Spring Weight (Lbs)	239	69	136.5079	135.3068	140.32	16.2655
Spring Height (Ft)	239	69	5.5016	5.5003	5.58[a]	.2274
Fall Age (Yrs)	230	78	18.3860	18.2395	18.54[a]	.6819

a. Multiple modes exist. The smallest value is shown

2. Exercise Data

Exercise data is presented in Tables 5.3 through 5.5. Exercise data for Fall requested self-reported miles and minutes of exercise per week during the midshipmen's senior year of high school. Although both genders averaged nearly identical miles of exercise per week, there was a significant difference in the minutes of exercise per week where this variable excluded the time spent running. On the average, men exercised 10.4 minutes per week longer than women, possibly indicating that men typically spent more time lifting weights or conducting strengthening exercises.

Spring Naval Academy data for the women showed that they tended to run 1.2 miles per week more than their male counterparts. However, the difference of minutes of exercise per week between men and women increased to 19.9 minutes. Both high school and Spring Academy data show that, on average, women tended to run more miles per week, but men spent more time exercising.

It might be noted that no significant difference (at the 0.05 level of statistical significance) in miles run per week in high school or during the Spring term at the Naval Academy was identified between males and females. There was, however, a significant difference between males and females in the minutes of exercise per week. For males there was a significant reduction in miles ran and minutes of exercise per week between high school and the Spring term at the Naval Academy. For females, minutes of exercise were significantly lower at the 0.05 level between high school and the Naval Academy. There was not, however, a significant difference in miles run per week. For a more detailed explanation of the comparison of means, see Appendix F.

Table 5.3 Male vs Female Exercise Statistics

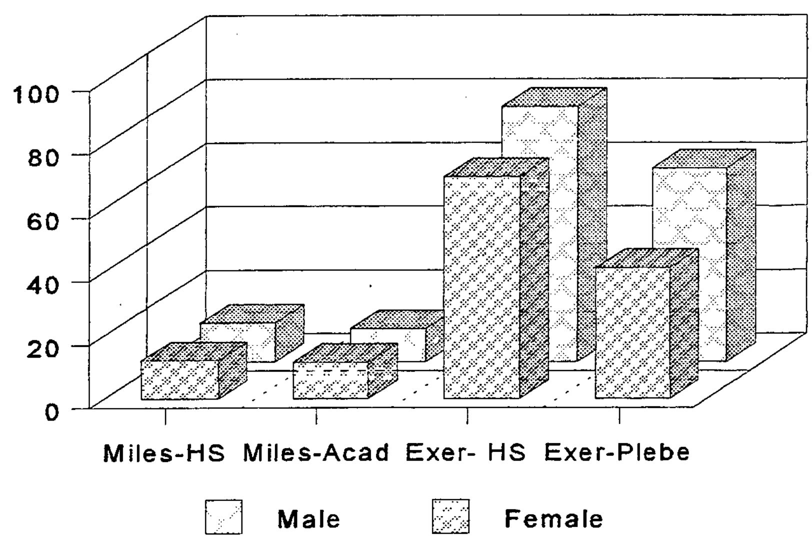


Table 5.4 Exercise Statistics for Females

	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Miles ran in HS	237	71	12.1308	10.0000	10.00	8.4490
Minutes of exercise per week in HS	238	70	69.7269	60.0000	30.00	58.2663
Spring miles per week	236	72	11.5085	10.0000	10.00	9.2793
Spring minutes of exercise per week	237	71	41.0802	30.0000	30.00	35.2089

Table 5.5 Exercise Statistics for Men

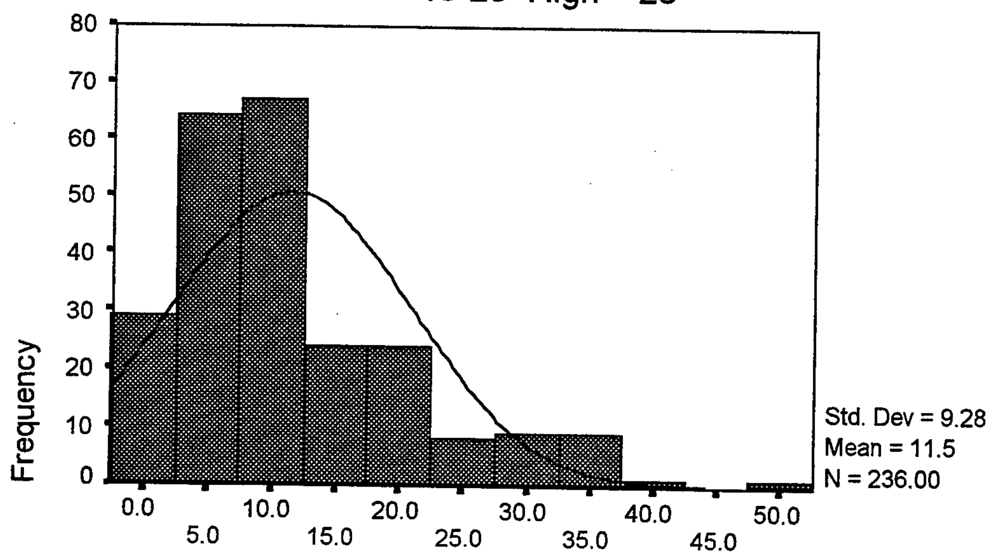
	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Miles ran in HS	540	1229	12.2389	10.0000	10.00	10.6665
Minutes of exercise per week in HS	546	1223	80.1410	60.0000	60.00	68.4775
Spring miles per week	1404	365	10.3344	8.0000	10.00	9.4701
Spring minutes of exercise per week	1394	375	60.7626	60.0000	60.00	46.0553

Histograms for both men and women show that there are natural breaks or categories within the data in miles and minutes of exercise per week. Data for all four sets were separated into three categories: low, medium, and high. Regressions, frequencies, and cross tabulations have been tabulated to indicate how the individuals in these categories compare within and across their gender lines. For miles of exercise per week in the Spring, low mileage equals 0 to 15 miles, medium 15 to 25 miles, and high 25 miles or greater. For minutes of exercise per week in the Spring of their plebe year, low time equals 0 to 80 minutes, medium 80 to 140 minutes, and high 140 minutes or greater per week. Particular attention is given to women to determine if those females in the higher categories had an increased risk of menstrual disorders, eating disorders, lower grades, or attrition. In the following charts (Tables 5.6 through 5.9) a normal curve is also provided to evaluate whether the histogram data is skewed.[3] It is also important to keep in mind that exercise per week is over and above the time spent running.

[3]In the histograms, the term "Med" means medium and is not to be confused with median or mean.

Table 5.6

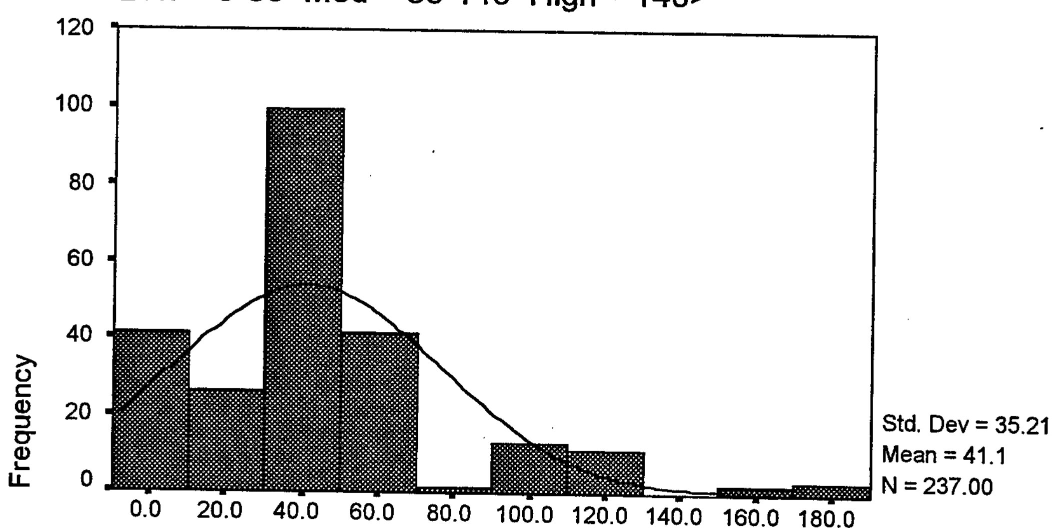
Low = 0-15 Med = 15-25 High = 25>



Female: Spring miles per week

Table 5.7

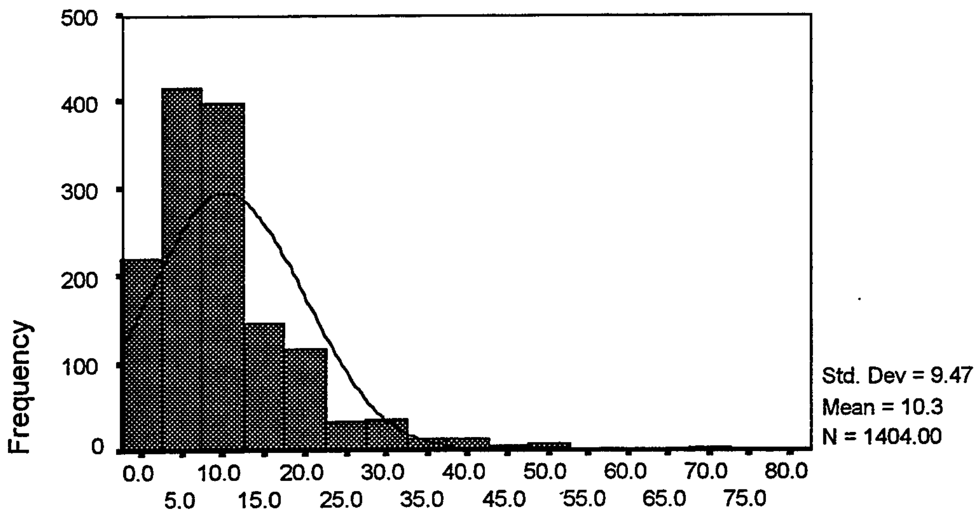
Low = 0-80 Med = 80-140 High = 140>



Female: Spring minutes of exercise per week

Table 5.8

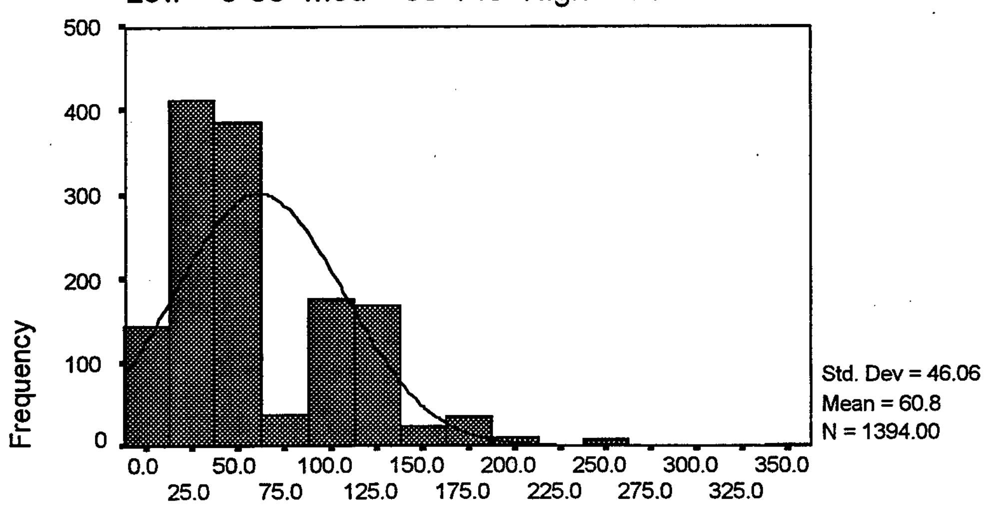
Low = 0-15 Med = 15-25 High = 25>



Male: Spring miles per week

Table 5.9

Low = 0-80 Med = 80-140 High = 140>



Male: Spring minutes per week

Frequencies show that men ran slightly more than women while in high school, but once at the Naval Academy they concentrated on minutes of exercise rather than time running. Both men and women exercised approximately 20 minutes less per week in the Spring than they did in the in the Fall; however, by Spring, women tended to run more than men. These data may indicate that men tend to exercise more than women, possibly to gain more upper body strength and a better physique; whereas, women tend to run more at the Naval Academy, possibly for both weight loss and improved physique.

Women on average tend to participate in varsity sports more than men while at the Naval Academy. Data indicates that 24.6% of the men were active in varsity sports their plebe year while 44.2% of the women were active at the time.

Table 5.10 Female: Varsity or Nonvarsity Player in Spring of Plebe Year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	100	32.5	42.4	42.4
	Yes	136	44.2	57.6	100.0
	Total	236	76.6	100.0	
Missing	System missing	72	23.4		
	Total	72	23.4		
Total		308	100.0		

Table 5.11 Class 1999 Male: Varsity or Nonvarsity Player in Spring of Plebe Year

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Missing	358	37.6	37.6	37.6
	No	361	37.9	37.9	75.4
	Yes	234	24.6	24.6	100.0
	Total	953	100.0	100.0	
Total		953	100.0		

There is little difference between the number of men and women participating in sports requiring weight standards. The data show that 8.1% of men participated in sports with weight requirements, while women show 12.3%. Charts 5.10 and 5.11 show that a higher percentage of women participate in varsity sports, therefore it should come as no surprise to find that women in general participate more often in sports requiring weight standards than do men.

3. PRT Data

PRT data for both men and women are relatively equal. Average scores for the Fall semester PRT were 79.6% for males and 75.6% for females. Spring PRT data demonstrated that the women's average (82.8%) was slightly higher than the men's (82.2%). The greatest improvement on score was in those components of the test measuring the women's upper body strength. The average number of push-ups increased from 69% (50 push-ups) to 90.6% (69 push-ups). Men and women use the same straightened body off the ground method when executing pushups.

Females who exercised more than 140 minutes per week had the lowest average number of sit-ups and pushups and thus subsequently had the lowest average Spring PRT score (75.2%), despite the fact that they spent significantly more time exercising. Females who exercised between 80 and 140 minutes per week had the highest average PRT scores (83.4 %). Men who exercised between 80 and 140 minutes per week also had the highest average Spring PRT score among men (85.7 %). This score, however, is only slightly higher than those men who exercised more than 140 minutes per week.

Women who ran less than 15 miles per week averaged 81.4% on the Spring PRT; women who ran 15 to 25 miles per week averaged 86.7 %; and women who ran more than 25 miles per week averaged 93.1 %. The data indicate that more miles run per week yielded higher average PRT scores for both men and women. Appendix F provides the results of the paired sample t-tests for the components of the PRT for the female midshipmen. A significant improvement is shown in the number of pushups and the run time. There was not a statistically significant improvement in the number of situps.

Despite the evidence that women run more than men and experience a lower drop in the number of miles ran per week between the Fall and Spring semesters, the data show that women's BMI and weight still increased between the two semesters. Although men's BMI and weight increased as well, they did spend considerably more time in nonaerobic exercises where weight gain can be expected.

Table 5.12 Average PRT Data for Women

	N		Mean	Median	Mode	Std. Deviation
	Valid	Missing				
Pushups in Fall PRT	104	204	49.9135	50.0000	50.00	15.8194
PRT run in Fall (Min)	113	195	11.9860	12.0000	11.47[a]	1.2970
Pushups in Spring PRT	222	86	68.9324	71.0000	101.00	23.1409
Sit-ups in Spring PRT	216	92	81.7639	80.0000	65.00	15.4632
PRT Time in Spring (Min)	212	96	10.9702	11.0000	11.50	.9321

a. Multiple modes exist. The smallest value is shown.

4. Grades and Attrition Data

Cross tabulation shows that approximately the same percentage of men and women left the class of 1999 and 2000 during plebe year, but a higher percentage of women left after plebe year. Attrition data is accurate through the Fall of the first-class year for the class of 1999 and through the second- class year for the class of 2000.

Attrition data was examined to learn whether women and men who run or exercise more per week than others had a higher rate of attrition. Data show that mileage per week had little effect on attrition percentages. In fact, women who exercised more minutes per week than others actually experienced lower attrition rates.

Table 5.13 Females Attrition during Plebe Year

			Those who attrited plebe year			
			Left during plebe year	Stayed through plebe year	system missing	Total
Gender	Female	Count	31	276	1	308
		% of gender	10.1%	89.6%	.3%	100.0%

Table 5.14 Females Attrition during Plebe Year or After

			Those who attrited plebe year or after		
			Left	Stayed	Total
Gender	Female	Count	67	241	308
		% of gender	21.8%	78.2%	100.0%

Table 5.15 Male Attrition during Plebe Year

			Those who attrited plebe year			
			Left during plebe year	Stayed through plebe year	System missing	Total
Gender	MALE	Count	142	1606	21	1769
		% of gender	8.0%	90.8%	1.2%	100.0%

Table 5.16 Male Attrition during Plebe Year or After

			Those who left plebe year or after		
			Left	Stayed	Total
Gender	MALE	Count	282	1487	1769
		% of gender	15.9%	84.1%	100.0%

Women's QPRs were slightly lower than men's even though 10.8% more men were enrolled in technical majors. QPR in the category of minutes of exercise per week are approximately the same as the overall averages. The only exception was women who report exercising 140 minutes a week or more[4]. These women had the highest average grades among all midshipmen in any category with an average Fall QPR of 298.20 and Spring QPR of 296.20. However, there are only five valid cases for women who exercise more than 140 minutes a week. The lowest cumulative QPRs are those obtained by females who run 25 or more miles per week. Their average QPR for the Fall was 254.20 and 243.15 for the Spring.

[4] QPR is measured as GPA X 100

Table 5.17 Average QPR for Males and Females

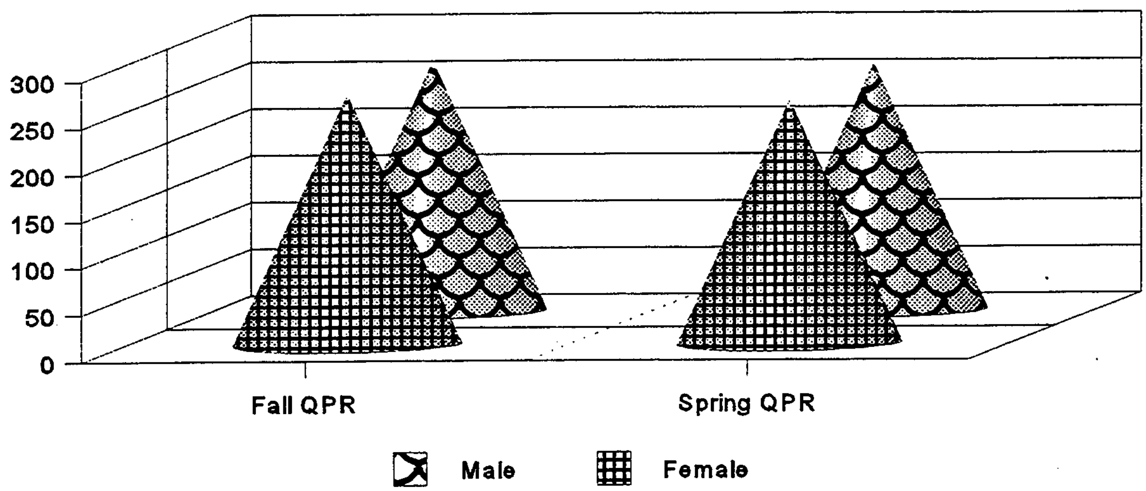


Table 5.18 Male and Female QPR vs Minutes of Exercise

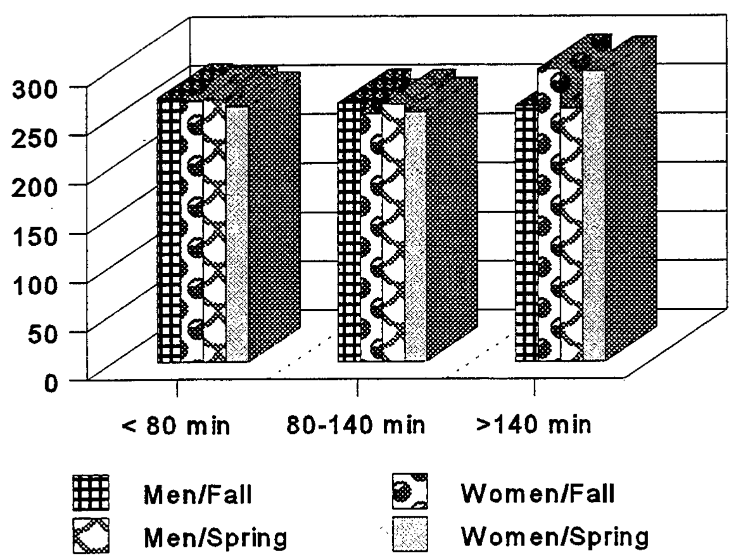
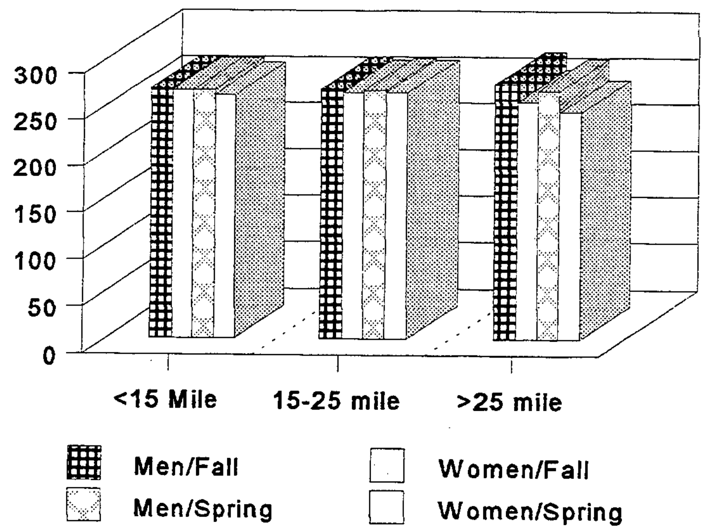


Table 5.19 Male and Female QPR vs Miles Ran



5. Menstrual Irregularities and Eating Disorders

Self-reported data for menstrual cycles in high school showed that 69.8% of females exhibited normal cycles (nine or more per year) within the previous year. However, there was a 10.1% decrease in the number of women who had normal cycles by the end of plebe year, and a subsequent rise in the number of cases of amenorrhea and oligomenorrhea. For the women of both classes, oligomenorrhea increased by 4.5% and amenorrhea increased by 6.8%.

Data for these classes were also categorized into miles and minutes of exercise per week. Cross tabulation of this data, provided in Table 5.20, show that those women who run more miles per week have more incidence of amenorrhea and oligomenorrhea than those who exercise more. There were no cases of oligomenorrhea or amenorrhea for females who reported exercising 140 minutes or more per week during high school. Only four women reported to have exercised more than 140 minutes per week in the Spring of plebe year. One female from that group reported having decreased menstrual flow, and one reported complete cessation of flow.

The highest incidence of menstrual irregularities occurred among women who ran 15 miles or more per week. Twenty-five percent of the women who ran more than 25 miles per week indicated that they had a decreased number of cycles per year (less than nine); whereas, the percentages for women who ran less than 15 miles per week or who ran 15 to 25 miles were 17.3% and 17.1%, respectively. Women who reported experiencing amenorrhea in the Spring of plebe year was highest for those women who ran 15 to 25 miles (17.1%), followed by those who ran more than 25 miles per week (15.8%).

Four women for the class of 1999 and 2000 reported having an eating disorder. All four had normal menstrual cycles in high school, and all but one reported having normal menstrual cycles their plebe year. The one midshipman who did not have normal cycles reported a decrease in flow but not a complete cessation. All four of these women exercised 80 minutes or less per week; two of them ran 15 to 25 miles per week; and only one ran more than 25 miles per week.

Table 5.20 Miles Run vs Eating Disorders in Spring

			Eating disorders in Spring		
			no	yes	Total
Miles divided into segments	missing	Count	1 100.0%		1 100.0%
	0-15 miles	Count	86 98.9%	1 1.1%	87 100.0%
	15.1-25 miles	Count	12 85.7%	2 14.3%	14 100.0%
	25.1 or greater miles	Count	11 91.7%	1 8.3%	12 100.0%
Total		Count	110 96.5%	4 3.5%	114 100.0%

C. REGRESSION ANALYSIS FOR FEMALE MIDSHIPMEN

Logit analysis was conducted to determine the effect of specified explanatory variables on the likelihood of amenorrhea, oligomenorrhea, eumenorrhea, eating disorders, and attrition. Standard linear regression was used to determine QPR because the variable is continuous. Although some significant variables were identified, frequently the variables were not significant, and the models were revised to deal with issues of multicollinearity and statistical insignificance. While variables might be employed to predict the health and academic performance of female midshipmen, it is quite difficult to explain the full complexity of women's health. Therefore, statistical significance values were adjusted in order to increase the number of relevant variables. The Wald value[5] of those variables retained in the model was lowered to 1.0. The following rules were used to assess the significance:

.01 - Highly significant

.05 - Significant

.10 - Marginally significant

<.15 - Less than marginally significant

The variables used in this Chapter are the same discussed in the methods Chapter and are considered as possible explanatory

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[5] A Wald value can be viewed as a t^2 in large samples.

variables in all of the regressions estimated. The symbol (S#) in the result Tables indicates that the data were taken in the Spring of the women's plebe year.

Body mass index, height, and weight were examined in every regression to determine which combination provided the best explanatory power. The relationship between body mass and height and weight is complicated, and, in some cases, BMI was more significant; in others weight and height were more significant. When height was even slightly statistically significant, the variables weight and height were found to be more accurate than BMI. When height was very insignificant, BMI became a better predictor of the dependent variable. All initial models were developed by using Table 3.1 in Chapter III. This Table included the expected signs of the coefficients of the explanatory variables.

1. Amenorrhea

The initial specification of the likelihood of having amenorrhea is as follows:

$$\mathbf{LN}\left(\frac{\mathbf{P\ ameno}}{\mathbf{1-\ P\ \ ameno}}\right) = \beta_0 + \beta_1\ \mathbf{Major} + \beta_2\ \mathbf{Miles}$$

$$+ \beta_3\ \mathbf{Minutes} + \beta_4\ \mathbf{Varsity} + \beta_5\ \mathbf{PRTrun} + \beta_6\ \mathbf{PRTsu} + \beta_7\ \mathbf{PRTpu}$$

$$+ \beta_8\ \mathbf{Wtcon} + \beta_9\ \mathbf{BMI} + \beta_{10}\ \mathbf{Validate},$$

where $LN\left(\frac{P_{ameno}}{1-P_{ameno}}\right)$ = log of the odds of having Amenorrhea.[6]

There were 185 cases used in this analysis. The results of the initial specification are shown in Table 5.2. Values retained in the alternate model are Minutes, Varsity, Wtcon, and BMI. The results are shown in Table 5.22. Wtcon was marginally significant with a significance value of ..0710. Minutes was the next significant variable, with a significance value of .0887. BMI had less than marginal significance levels but was retained in the model.

Further discussion of the variable Varsity is appropriate. Analysis of this variable was significant in the initial model but insignificant in the final model. Therefore it was excluded from the alternate model. Further analysis revealed that there was multicolliniarity between varsity and two of the retained variables: Minutes and Wtcon (sports requiring weight conditions). The coefficients of these variables, therefore, may represent both their own direct effect on amenorrhea and also the indirect effect of these variables through their effect on varsity participation.

The most reliable predictor of amenorrhea among women is

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[6] Note that the coefficients of the model do not measure the effect of a change in an independent variable on the predicted probability of the relevant condition. They are the effect of the change in an independent variable on the log of the odds.

BMI with a significance level of .0394. This level indicates that the lower a female's BMI, the more likely she will become amenorrheic. Minutes and wtcon were both marginally significant and were retained in the alternate model. Although its significance value was marginal, Wtcon also exhibited an opposite sign than was predicted, indicating that sports with weight condition requirements were negatively related to the likelihood of amenorrhea.

Table 5.21 Initial model: Likelihood of Amenorrhea

Variable	B	Wald	Significance
MAJOR2(1)	-.1786	.6048	.4367
S#MILES	.0205	.6004	.4384
S#MINUTE	.0092	2.8802	.0897
S#VARSTY(1)	-.3354	1.5803	.2087
S#PRTRUN	.3012	.6675	.4139
S#PRTPU	9.01E-05	.0001	.9936
S#PRTSU	.0068	.2042	.6514
S#WTCON(1)	-.4742	3.2593	.0710
S#BMI	-.1406	1.2810	.2577
S#VALID(1)	-.3347	.7040	.4014
Constant	-2.8312	.3677	.5443

N = 233
Chi-Square = 13.121, Significance = .1572

See footnote[7]

Table 5.22 Atlernate model: Likelihood of Amenorrhea

Variable	B	Wald	Significance
S#BMI	-.2204	4.2436	.0394
S#MINUTE	.0084	2.9032	.0884
S#WTCON(1)	-.3947	3.0135	.0826
Constant	2.9168	1.5613	.2115

N = 233
Chi-Square = 10.273, Significance = .0164

[7] Chi-Square tests the overall significance of the model. For example, if the significance level is less than 0.05, then the hypothesis that all regression coefficients equal zero is rejected at the five percent significance level. The "1" indicated by the variable indicates that the categorical outcome 1, is the reference level.

2. Oligomenorrhea

The initial model of the likelihood of oligomenorrhea is:

$$\mathbf{LN}\left(\frac{\mathbf{P\ oligo}}{\mathbf{1-\ P\ \ oligo}}\right) = \beta_0 + \beta_1\ \mathbf{Major} + \beta_2\ \mathbf{Miles} + \beta_3\ \mathbf{Minutes}$$

$$+ \beta_4\ \mathbf{Varsity} + \beta_5\ \mathbf{PRTrun} + \beta_6\ \mathbf{PRTsu} + \beta_7\ \mathbf{PRTpu}$$

$$+ \beta_8\ \mathbf{Wtcon} - \beta_9\ \mathbf{WTlbs} + \beta_{10}\ \mathbf{HtFt} + \beta_{11}\ \mathbf{Validate},$$

where $LN\left(\frac{P\ oligo}{1-\ P\ \ oligo}\right)$ = log of the odds of having Oligomenorrhea.

The variables for oligomeorrhea are the same with the exception of height and weight which replaced BMI. Preliminary analysis showed that HTft and WTlbs should be utilized because these variables had higher significance than BMI. The initial results are contained in Table 5.23. The remaining variables retained in the alternate model were HTft, WTlbs, and PRTpu. The variable PRTsu was removed from the model because it was statistically insignificant. Further analysis revealed that PRTsu was a function of varsity participation, miles, height, and eumenorrhea, but none of these variables had any explanatory power for oligomenorrhea. The results of the alternative model are contained in Table 5.24. HTft was the only variable with statistical significance. WTlbs and PRTpu were both marginally significant but were retained in the model to discern whether significance values would improve once a more detailed analysis was conducted.

WTlbs was the most statistically significant variable in the alternate model, indicating that as weight decreases, the chance of oligomenorrhea increases. The significance value for the variable HTft was less than marginal but was retained in the alternate model.

Table 5.23 Initial model: Likelihood of oligomenorrhea

Variable	B	Wald	Significance
MAJOR2(1)	.1904	.7478	.3872
S#MILES	-.0135	.2244	.6357
S#MINUTE	.0044	.5615	.4537
S#VARSTY(1)	-.1604	.4226	.5156
S#PRTRUN	.1056	.0900	.7641
S#PRTPU	.0180	2.2543	.1332
S#PRTSU	-.0109	.4742	.4910
S#WTCON(1)	-.2055	.5031	.4781
S#VALID(1)	.1779	.1822	.6694
S#HT.FT	2.4060	4.1677	.0412
S#WTLBS	-.0315	2.4950	.1142
Constant	-11.9936	2.9255	.0872

N = 156
Chi-Square = 10.899, Significance = .5376

Table 5.24 Alternative model: Likelihood of Oligomenorrhea

Variable	B	Wald	Significance
S#HTFT	1.1826	1.4466	.2291
S#WTLBS	-.0265	2.8840	.0895
Constant	-4.3098	.9550	.3284

N = 192
Chi-Square = 3.015, Significance = .2215

3. **Eumenorrhea**

The initial model for the likelihood of Eumenorrhea is:

$$\mathbf{LN}\left(\frac{\mathbf{P\ eumen}}{\mathbf{1-P\ \ eumen}}\right) = \beta_0 + \beta_1\ \mathbf{Major} + \beta_2\ \mathbf{Miles} + \beta_3\ \mathbf{Minutes}$$

$$+ \beta_4\ \mathbf{Varsity} + \beta_5\ \mathbf{PRTrun} + \beta_6\ \mathbf{PRTsu} + \beta_7\ \mathbf{PRTpu} + \beta_8\ \mathbf{Wtcon}$$

$$+ \beta_9\ \mathbf{BMI} + \beta_{10}\ \mathbf{Validate},$$

where $\mathrm{LN}\left(\frac{\mathrm{P\ Eumen}}{1-\ \mathrm{P\ \ Eumen}}\right)$ = log of the odds of having Eumenorrhea.

BMI replaced HTft and WTlbs in this model because it was more significant. The results from the initial specifications are contained in Table 5.25. The variables Varsity and PRTsu had the highest explanatory power. Minutes, miles, and BMI were all less than marginally significant but were retained in the model.

Table 5.26 contained the alternate model for eumenorrhea. PRTpu had the most explanatory power within the model. Miles was marginally significant but was retained within the model. Both variables were negatively correlated with eumenorrhea. This was predicted for miles but not for PRTpu. Further analysis found that PRTpu in the Spring was highly correlated PRTrun and Wtlbs in the Spring. The variables Minute, Valid, and BMI were removed from the alternative model because they proved to be very insignificant when included in that model.

Table 5. 25 Initial Model: Likelihood of Eumenorrhea

Variable	B	Wald	Significance
MAJOR2(1)	.0486	.0583	.8093
S#MILES	-.0334	1.7420	.1869
S#MINUTE	.0083	1.7141	.1904
S#VARSTY(1)	.4834	4.1553	.0415
S#PRTRUN	-.0691	.0432	.8354
S#PRTPU	-.0267	5.1600	.0231
S#PRTSU	.0084	.2736	.6010
S#WTCON(1)	-.0992	.1178	.7314
S#VALID(1)	.0391	.0115	.9144
S#BMI	-.1618	2.0551	.1517
Constant	7.3874	2.8119	.0936

N = 185

Chi-Square = 21.04, Significance = .0333

Table 5.26 Alternative model: Likelihood of Eumenorrhea

Variable	B	Wald	Significance
S#MILES	-.0303	2.9536	.0857
S#PRTPU	-.0242	8.5625	.0034
Constant	3.4508	27.6017	.0000

N = 214

Chi-Square = 14.987, Significance = .2215

4. Participation in Eating Disorders

The initial model for eating disorders is:

$$\mathbf{LN}\left(\frac{\mathbf{P\ Edi}}{\mathbf{1\text{-}P\ \ Edi}}\right) = \beta_0 + \beta_1\ \mathbf{Major} + \beta_2\ \mathbf{Miles} + \beta_3\ \mathbf{Minutes}$$

$$+\ \beta_4\ \mathbf{Varsity} + \beta_5\ \mathbf{PRTrun} + \beta_6\ \mathbf{PRTsu} + \beta_7\ \mathbf{PRTpu} + \beta_8\ \mathbf{Wtcon}$$

$$+\ \beta_9\ \mathbf{WTlbs} + \beta_{10}\ \mathbf{HTft} + \beta_{11}\ \mathbf{Validate},$$

where $LN\left(\frac{P\ Edi}{1-\ P\ \ Edi}\right)$ = log of the odds of having an eating disorder.

Eighty-four cases were selected for the initial regression. As shown in Table 5.27 there were no significant variables, but those that met minimum criteria were retained. The retained variables included: Major, Miles, Minutes, Varsity, PRTpu, PRTsu, Wtcon, and HTft.

The results obtained in the alternate model are shown in Table 5.28. For the alternate model, Miles was the most statistically significant of the variables. Minutes, Varsity, Wtcon, and HTft were all less than marginally significant but were retained in the model because when they were removed, the significance value of miles dropped considerably, indicating that there is some association between these variables.

Table 5.27 Initial model: Likelihood of Eating Disorders

Variable	B	Wald	Significance
MAJOR2(1)	2.2691	1.7375	.1875
S#MILES	.1188	1.5305	.2160
S#MINUTE	-.0761	1.3396	.2471
S#VARSTY(1)	2.5975	1.9613	.1614
S#PRTRUN	-.6211	.2054	.6504
S#PRTPU	-.2400	2.3764	.1232
S#PRTSU	.1338	1.3162	.2513
S#WTCON(1)	-1.8684	1.6732	.1958
S#VALID(1)	-1.2717	.3497	.5543
S#HT.FT	5.4429	1.0793	.2988
S#WTLBS	.0907	.6655	.4146
Constant	-31.1424	.8346	.3609

N = 85
Chi-Square = 13.414, Significance = .3397

Table 5.28 Alternative Model: Likelihood of Eating Disorders

Variable	B	Wald	Significance
MAJOR2(1)	1.0763	2.1439	.1431
S#MILES	.1087	3.2739	.0704
S#MINUTE	-.0435	1.9449	.1631
S#VARSTY(1)	.7174	1.2805	.2578
S#WTCON(1)	-.9370	1.5558	.2123
S#HT.FT	2.6085	1.3955	.2375
Constant	-17.9268	2.0152	.1557

N = 113
Chi-Square = 8.799, Significance = .2674

5. QPR

The initial models for QPR at the end of the first year are:

$$QPR = \beta_0 + \beta_1 \text{ eumono} + \beta_2 \text{ oligo} + \beta_3 \text{ Ameno} + \beta_4 \text{ EDI}$$

and

$$QPR = \beta_0 + \beta_1 \text{ Major} + \beta_2 \text{ Miles} + \beta_3 \text{ Minutes}$$

$$+ \beta_4 \text{ Varsity} + \beta_5 \text{ PRTrun} + \beta_6 \text{ PRTsu} + \beta_7 \text{ PRTpu}$$

$$+ \beta_8 \text{ Wtcon} + \beta_9 \text{ WTlbs} + \beta_{10} \text{ HTft} + \beta_{11} \text{ Validate}$$

Regressions were run on both models to distinguish which model had the better explanatory power for QPR. The first model regressed QPR against eating disorders and menstrual irregularities. The second model regressed QPR against those factors that affect eating disorders and menstrual irregularities. Table 5.29 contains the initial model for QPR as a function of menstrual and eating disorders and Table 5.30 contains the initial model for QPR as a function of those variables effecting menstrual and eating disorders. PRTsu, Valid, Wtcon, and WTlbs in Spring were statistically significant. Miles was less than marginally significant but had a t value of 1.218; therefore, it was retained in the model. Women who reported having eating disorders had the greatest explanatory power for QPR. Women with amenorrhea was less than marginally significant but the variable was retained in the alternate model.

Amenorrhea and eating disorders were the most statistically significant variables in the first model (Table 5.32). Women with amenorrhea has a low significance value, but was retained. The low significance values of the remaining variables may indicate that this model is unreliable, requires a larger database, or requires more independent variables to explain QPR effectively.

As shown in Table 5.31, WTlbs, Validate, and PRTsu are highly significant in the second model. Validate and WTlbs are negatively related to GPA while PRTsu and Miles are positively related with QPR.

Table 5.29 Initial model: QPR vs Eating/Menstrual Disorders (Spring) [a]

	Unstandardized coefficients B	Sig.
(Constant)	249.997	.000
Amenorrhea	18.352	.369
Normal cycles	1.747	.894
Oligomenorrhea	-4.832	.711
Eating disorders	59.401	.037

a. Dependent Variable: QPR 2nd semester:
N = 113; R Squared = .047

Table 5.30 Alternate Model: QPR vs Eating/Menstrual Disorders (Spring) [a]

	Unstandardized Coefficients B	Sig.
(Constant)	250.316	.000
Amenorrhea	17.593	.32
Eating disorders	59.184	.037

a. Dependent Variable: QPR 2nd semester
N=113; R-Squared = .046

Table 5.31 Initial Model: QPR vs Variables (Spring)[a]

	Unstandardized Coefficients B	Sig.
(Constant)	423.194	.017
Major (technical or nontechnical	-2.620	.594
Miles	.875	.163
Minutes	-8.359E-02	.579
Varsity	.622	.958
PRTpu	1.534E-02	.957
PRTrun	-1.736	.840
PRTsu	.585	.139
Wtcon	1.093	.941
Validate	-51.993	.007
HTft	-18.775	.512
WTlbs	-.615	.170

a. Dependent Variable: QPR 2nd semester
N = 155; R Squared = .113

Table 5.32 Alternativel Model: QPR vs Variables (Spring)[a]

		Unstandardized coefficients B	Sig.
1	(Constant)	300.151	.000
	PRTsu	.805	.007
	Validate	-42.372	.001
	WTlbs	-.746	.008
	Miles	.630	.225

a. Dependent Variable: QPR 2nd semester:
N = 192; R Squared = .101

6. Attrition

An attempt was made to discover whether attrition could be predicted with the variables. The initial regression showed that the only significant value that predicted attrition was QPR. All other variables were well below a reasonable significance threshold and were therefore rejected. No further analysis was performed on attrition.

VI. CONCLUSIONS AND RECOMMENDATIONS

A. INTRODUCTION

This Chapter discusses the results of the hypotheses and questions presented in Chapter III. The hypotheses will be summarized and the questions will be answered by reviewing the cross tabulations, frequencies, and regressions. This summary will be followed by the conclusions. The final section of this Chapter will present questions that may lead to further research and analysis.

B. HYPOTHESES RESULTS

1. Hypothesis 1:

The risk of menstrual disorders increases with the amount of exercise performed per week and the miles of running per week.

Cross tabulations on women with oligomenorrhea and amenorrhea indicate that women with these disorders are exercising more than the average female. Frequencies and cross tabulations further show that the highest incidents of menstrual disorders are among those women who run more than 15 miles per week. In addition, twenty-five percent of those women experiencing oligomenorrhea run more than 25 miles per week. Logit regressions reveal that the risk of amenorrhea does increase as a female midshipman increases the minutes of exercise per week. Although the regressions were not as significant as expected, there is a relationship for women between running or exercising excessively and eating disorders that merits further investigation. Cross tabulations, frequencies, and the regression model present sufficient evidence to support hypothesis one; that there is a relationship between menstrual disorders and the female midshipmen's running and exercise patterns.

2. Hypothesis 2:

The risk of eating disorders increases with the amount of exercise performed per week and the miles of exercise per week.

Frequencies show that three out of the four women who self-reported an eating disorder also reported that they averaged more than 15 miles of running per week. It should be noted however, the percentage of women with eating disorders within the Naval Academy is consistent with national averages. The regression model for predicting eating disorders indicates that the number of miles per week does have some influence on the dependent variable. There is enough evidence in this model to accept hypothesis two. However, there is not ample evidence to show minutes of exercise, outside of running, increases the likelihood of eating disorders.

3. Hypothesis 3:

The risk of menstrual disorders increases as the run time ran the PRT decreases but not as the number of sit-ups and pushups increases.

There is no evidence to show that the run time for the PRT is a precursor of an eating disorder. Cross tabulations and frequencies indicate that the highest PRT scores were obtained by those women who exercised and ran the most during their plebe year. Those women who exercise between 80 and 140 minutes had the highest improvement on scores during the spring PRT. Females who exercised more than 140 minutes per week were the only exception. Their average scores were the lowest for all of the female groups.

The regression model for eumenorrhea indicates that miles per week and minutes of exercise per week do decrease the likelihood of normal menstruations and, as noted earlier, minutes of exercise increase the probability of amenorrhea. For this model we do not accept hypothesis three because of the lack of supporting evidence from the regressions and the contradictory evidence from cross tabulations and frequencies.

4. Hypothesis 4:

Women participating in varsity sports requiring weight standards have a higher risk of menstrual disorders.

Only 24% of the women who were either amenorrheic or oligomenorrheic actually participated in sports requiring weight conditions. The regression model for amenorrhea actually showed that participating in these sports reduced the likelihood of such disorders. It is possible that women are self-selecting out of these programs. Those who anticipate possible physical complications or already have menstrual irregularities may choose not to participate in these sports. The fact that the women with the lowest body weight and BMI are either amenorrheic or have an eating disorder may support this view. For hypothesis four, the null that there is no relationship cannot be rejected due to the lack of evidence from cross tabulations, frequencies, and regressions.

5. Hypothesis 5:

Women participating in varsity sports requiring weight standards have a high risk of eating disorders.

Frequency analysis revealed that only one of the four women who reported having an eating disorder was involved in sports with weight conditions. The regression model indicates that those sports with weight conditions actually decrease the risk of eating disorders. Whether the implications of the regression analysis is correct remains to be seen, but as with the previous hypothesis regarding eating disorders, the low number of respondents precludes any final conclusions. Again, women may be self-selecting out of these sports if they foresee a problem, in participating in them. Hypothesis five cannot be accepted due to the lack of evidence from cross tabulations, frequency analysis, and regression analysis.

6. Hypothesis 6:

As the miles ran per week and minutes of exercise per week increases, the more likely GPAs will decrease.

Frequencies and cross tabulations show that women's QPRs are slightly lower than men's, despite the fact that men select technical majors more often than women. Analysis shows that women with the poorest grades are those who exercise 25 miles or more per week. The highest QPR, however, is among those women who exercise more than 140 minutes per week.

Two regression models were run to determine if QPR could be better predicted by using eating and menstrual disorders as independent variables or by using the same independent variables as before. As previously stated, the low significance values of the first regression prohibit an accurate assessment of QPR. For the second model, miles of running per week increased the probability of better grades but the significance level was very low (.225). It is certain that the scope of this paper is not nearly comprehensive enough to accurately predict QPR using this analysis and variables. For these reasons hypothesis six cannot be accepted.

C. QUESTIONS ANSWERED IN THIS THESIS

Q: What are the average miles run per week for midshipmen experiencing menstrual disorders?

A: The average miles run per week for women experiencing amenorrhea was 13.65 miles, and the average miles run per week for those with oligomeorrhea was 11.11 miles. Women with normal menstrual cycles ran 10.42 miles peer week.

Q: What are the average miles run per week for midshipmen experiencing eating disorders?

A: Women experiencing eating disorders averaged 18.25 miles per week.

Q: What are the average minutes of exercise per week for midshipmen experiencing menstrual disorders?

A: Women experiencing amenorrhea averaged 50 minutes of exercise per week. Women experiencing oligomenorrhea averaged 42.7 minutes of exercise per week, and eumenorrheic women exercised 40.96 minutes per week.

Q: What are the average minutes of exercise per week for midshipmen experiencing eating disorders?

A: The average minutes of exercise per week for women with eating disorders was 20.00 minutes.

Q: Do female midshipmen with low or high BMIs tend to participate in sports requiring weight standards?

A: The BMI for women in sports with weight conditions was 22.00; the average BMI for women not involved in these events was 22.58. The average BMI for all women was 22.46. There is a slight propensity for small-built women to participate in these activities; however, the averages for women with eating disorders or menstrual irregularities is higher than 22.00, averaging 21.5 or higher for all cases. Women may be self-selecting out of such sports or women with small builds may be able to remain in these sports with little or no effort to maintain body weight.

Q: Do varsity athletes have a higher occurrence of eating disorders than nonvarsity athletes?

A: The alternate regression model for eating disorders revealed that participating in varsity sports does increase the probability of eating disorders, but the significance values are very small. Overall, 50% (2 out of 4) of those who reported having an eating disorder participated in varsity sports. Hence, there is no propensity for women with eating disorder to participate in varsity athletics.

Q: Do varsity athletes have a higher occurrence of menstrual disorders than nonvarsity athletes?

A: There is not enough evidence to determine if varsity sport participation and menstrual disorders are positively related. The alternate regression models of oligomenorrhea and amenorrhea do not show varsity sports as a significant predictor of menstrual disorders. Cross tabulations reveal that the majority of women with normal menstruations (77%) are varsity athletes, while only 68% of the women who are amenorrheic are varsity athletes. Only one female midshipman with oligomenorrhea participated in a varsity sport. Consequently, there is no propensity for women with menstrual disorders to participate in varsity sports.

Q: Does a midshipman's weight positively correlate with menstrual disorders?

A: The alternate regression model for oligomenorrhea does show that the less a midshipman weighs, the higher the chance of missed menstrual cycles, but the significance value of this variable is very poor. Frequency analysis, however, does indicate that women with menstrual disorders tend to weigh less than women with normal menstruations. The average weights for the amenorrheic and oligomenorrheic women were 133.4 and 135.5 pounds, respectively. In contrast, women with normal cycles averaged 138.8 pounds. Granted, women with menstrual disorders do tend to weigh less, but the difference in the mean weight is only five pounds. As a result, there is not a high degree of confidence in this answer.

D. DISCUSSION

Do women attending the Naval Academy have problems with eating and menstrual disorders? A cursory examination of the data indicates that they probably fall within the norms of women of the same age group at any campus across America. In fact they may even be doing better. However, some important differences between a military academy and a typical college must not be overlooked. Although the pressures of maturing and becoming a responsible adult are similar for any 18 year old, military schools such as the Naval Academy require students to prepare for stressful jobs and responsibilities at a much younger age than most recent college graduates. The Naval Academy is also in the business of hiring its own people, thereby increasing the pressure to do well and become a part of the organization. Answers to questionnaires or interviews that are perceived to be wrong, whether it is so or not, may in fact help preclude midshipmen from answering "honestly",[8] especially when those questions regard one's health. This should not be surprising however, since the medical and mental requirements for acceptance to flight school, nuclear power school, and other specialties require people who are physically and psychologically sound. In any case the stress upon the midshipmen is significant, or at least it is perceived by them to be so.

The data presented in this thesis are too limited to predict such variables as attrition, QPR, and eating disorders for individuals. The data do show, however, that there are women with eating and menstrual disorders at the Naval Academy. In addition, some variables such as miles of exercise per week, sports with weight conditions, and varsity athletics do have limited effects on the dependent variables, and mildly accurate predictions can be made for the group as a whole.

The task of the Naval Academy is to teach young men and women the essence of leadership prior to entering the fleet. Data in this thesis should not be used to emphasize the weaknesses, failures, or shortcomings of any midshipmen, but rather, it should be used as a tool to help faculty and staff monitor and guide midshipmen toward healthier lifestyles and

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[8] The author realizes that there could be some cognitive dissonance which would make it difficult to define an honest answer.

better careers as naval officers.

E. RECOMMENDATIONS FOR FURTHER RESEARCH

1. With the exception of empirical data (PRT scores, height, weight, etc...), all of the midshipmen's questionnaires were self-reported results. One should at least consider the possibility that perceived weaknesses may not be revealed because of fear of retribution or in an effort to fit in. It would be applicable to consider a follow-up test that would be given to the midshipmen of the classes of 1999 and 2000 during their senior year and after graduation. In this manner, one could examine whether the results are as currently reported or if it is possible that incidences of eating disorders and menstrual irregularities are more prevalent than we currently believe.

2. Most of the women who self-reported eating disorders and menstrual irregularities will eventually graduate and leave the Naval Academy. Should programs be established to monitor women with amenorrhea and eating disorders once they have left Annapolis? Is there a propensity for women to regain normal cycles and eating habits once they have graduated, or do many of them continue such behavioral and health patterns throughout their career?

3. The literature review shows that many women who suffer eating disorders or interruption of menstrual cycles

have long-term health effects. The first women to be accepted to the Naval Academy are close to retirement age. Assuming that those women endured the same, if not more stressor than today's midshipmen, should they be interviewed and studied to discover what long-term effects eating disorders or menstrual irregularities may have had?

APPENDIX A: CONSENT FORM

NATIONAL NAVAL MEDICAL CENTER, BETHESDA, MARYLAND
Consent Form for Males

I consent for voluntary participation in a clinical investigation study.

1. I, ___________________________________ , have been asked to voluntarily participate in a research project entitled, the Association of Bone Mineral Density and Menstrual Dysfunction with stress fractures in USNA midshipmen being conducted at the Naval Branch Clinic, Bancroft Hall, U.S. Naval Academy, Annapolis, Maryland, and the National Naval Medical Center, Bethesda, Maryland.

2. The purpose of this research project has been explained to me. stress fractures and related orthopedic injuries are a common problem in Midshipmen during training. Risk for stress fractures may be related to variations in bone mineral density (BMD)i.e. the amount of calcified bone material present in a given volume of bone) among individuals. This study will seek to determine if the risk for stress fractures in USNA midshipmen is related to decreased BMD.

3. I understand my participation in this research project will be for a period of four (4) years or for the duration of my enrollment at the USNA.

4. The procedures have been explained to me as follows: Upon entering this study, after providing written informed consent, I will be medically evaluated by a physician participating in the study. I will have a complete medical history and a basic physical examination, as well as yearly interval medical history within two to three months of entry into the study, and then each year thereafter for four years, a bone mineral density and body composition measurement (percent body fat and percent body water) will be performed utilizing a dual energy x-ray bone densitometer, which is a machine that measures bone mineral density and body composition with a painless scan technique requiring only a few minutes to perform while I am lying down on the scan table.

Patient initials ____________

I understand that the procedure is painless, requires approximately 30-45 minutes or less of total time, and involves a minimal exposure to ionizing radiation - less than that of a routine standard chest x-ray. My percent body fat measurement will also be validated by caliper measurements of my skinfold thickness each year.

Upon entry into the study and yearly thereafter for four years, I will have blood drawn and will collect urine samples as described below for routine laboratory testing and for examination of biochemical markers of bone metabolic activity and endocrine (hormonal) function. I will have approximately three (3)tablespoons (45 cc) of blood drawn initially for the baseline laboratory tests and up to 4 times per year follow-up blood draws of approximately two (2) tablespoons (30 cc). The urine samples will consist of giving a first morning fasting urine sample. up to 4 times per year, collected by urinating into a urine sample container just after awakening in the morning before eating breakfast, and after fasting (no food or drink except water) after 2000 hours the night before.

Other procedures that I perform will include a 24 hour diet recall interview. I will be asked to remember everything I have eaten or drunk in the previous 24 hours 4 times per year. I understand that this 24 hour diet recall will be analyzed to determine my caloric and nutrient intake with a copy of the analysis provided to me as well as to the study investigators.

In addition, I will be evaluated in the Orthopedic Department in the Bancroft Hall Branch clinic for any orthopedic complaints or injuries. After evaluation by an orthopedic physician further studies such as routine x-rays or bone scanning will be performed as medically indicated.

periodically, about 4 times per year I nay be asked to maintain a 3 day activity log and wear an instrument, about the size of a wrist-watch, on my wrist to record my activity patterns.

In the event of any unusual test results I may be referred for further testing, evaluation, and treatment.

5. Specifically, I am aware that the <u>experimental</u> <u>part</u> of this study is the measurement of my bone density and percent

Patients Initials ________

body composition yearly for four years, the analysis of information (to test for statistical relationships) concerning any orthopedic injuries I may experience while at the USNA, and the analysis of information from my medical history, mood, diet history, activity patterns, blood tests, and urine tests.

6. A total of 430 subjects are expected to participate in this project.

7. The risks or <u>discomforts</u> which are possible are as follows:

A. For blood drawing: Pain and inconvenience, as well as possible 'black and blue bruise marks, infection and/or fainting spells.

B. For bone mineral density and bone composition measurement: Inconvenience and minimal exposure to ionizing radiation (the skin doses of 2-5 mrem or less per scan are a little above background solar radiation and are significantly less than the 10-40 rem exposure of a typical routine chest x-ray).

C. For urine collection: Inconvenience.

D. For orthopedic evaluation of injuries: Possible discomfort at routine orthopedic examination.

E. For giving of a complete medical history: Inconvenience.

F. 24 hour diet recall interview: Inconvenience

G. Skinfold thickness measurement: Possible mild discomfort

H. Activity log and monitor: Inconvenience.

I understand and accept these risks. Patient Initials__________

8. I understand that the research may or may not help me personally but that the results may help the investigator learn about risk factors for stress fractures and decreased bone mineral density or aid in the prevention or treatment of these conditions in other patients.

9. The alternate treatment, should I decline enrollment into this study, has been explained as follows: My nonparticipation in this study will not affect the care and evaluation I receive in the orthopedics clinic at the USNA for any orthopedic injuries or complaints I may have while at the USNA. This study does not otherwise involve a medical treatment. Therefore, there is no alternative treatment that would be advantageous to me.

Patients Initials ____________

10. I am aware that this study may involve risks to me which are currently unforeseeable.

11. The investigator may terminate my participation in this project for the following reasons: If I am discharged from the USNA.

12. I understand that I may withdraw from this study at any time without prejudice to my future care. I understand that my withdrawal from this project may result in decreased information being available concerning possible further changes in my bone density; however, I will not lose any benefits to which I am otherwise entitled.

13. Any new significant findings developed during the course of the research which may affect my willingness to participate further will be explained to me.

14. In all publications and presentations resulting from this research project, my anonymity will be protected to the maximum extent possible; although, I realize that authorized Navy Medical Department personnel may have access to my research file in order to verify that my rights have been safeguarded. Otherwise my research *file* will be maintained in a secure location accessible only to the study investigators.

15. It I suffer any physical injury as a result of my participation in this study, immediate medical treatment is available at the National Naval Medical Center, Bethesda, Maryland and/or the Bancroft hall Branch Medical Clinic. I understand that although no compensation is available, any injury as a result of my participation will be evaluated and treated in keeping with the benefits or care to which I am entitled under applicable regulations.

16. I have been informed that there will not be additional cost to me if I choose to participate in this research project. However, should I require hospitalization at the National Naval Medical Center arising from participating in this research project. I will be required to pay the customary fees for hospital meals to National Naval Medical Center based on my Department of Defense beneficiary status.

17. If I have any questions regarding this research project, I may contact Dr. A. J. Drake, III MC. USN at (301) 295-5165. If I have any questions regarding my rights as an individual while participating in a research project at the Naval Branch Clinic, Bancroft Hall, USNA and the National Naval Medical Center, Bethesda, I can contact one of the research Administrators, Clinical Investigation Department, at (301) 295-2275. He/she will answer my questions or refer me to a member of the committee for the protection of human subjects for further information. If I believe I have been injured as a result of this project I may call the Legal office at (301) 295-2215.

Patient Initials________

18. I understand that my participation in this project is voluntary and that my refusal to participate will involve no penalty or loss of benefits to which I am entitled under applicable regulations. If I choose to participate, I am free to ask questions or to withdraw from the project at any time.

If I should decide to withdraw from the research project, I will notify Dr. A. J. Drake, III, MC, USN at (301) 295-2215, to ensure an orderly termination process. My withdrawal will involve no loss of benefits to which I am entitled.

Patient Initials________

I certify that I have received a copy of this consent term.

Patient Initials ________________

Date signed_______

____
Volunteer Signature

____
Volunteer Printed Name-Rank-USN

____
Witness' Signature and Date

____
Investigator Signature and Date

____
Witness' Printed Name/Rank/USN

____
Investigator Printed Name-Rank-USN

I have reviewed the above documents and hereby authorize my son:

__________________________ to participate in this research project.

____
Signature

____
Date

PRIVACY ACT STATEMENT

1. Authority. 5 USC 201

2. **Purpose.** Medical research information will be collected to enhance basic medical knowledge, or to develop tests, procedures, and equipment to improve the diagnosis, treatment, or prevention of illness, injury or performance impairment.

3. Use. Medical research authorization will be used for statistical analysis and reports by the Departments of the Navy and Defense, and other U.S. Government agencies, provided this use is compatible with the purpose to which the information was collected. Use of the information may be granted to non-Government agencies or individuals by the Chief, Bureau of Medicine and Surgery in accordance with the provisions of the Freedom of Information Act.

4. Disclosure. I understand that all information contained in this consent statement or derived from the experiment described herein will be retained permanently at National Naval Medical Center, Bethesda, Maryland and salient portions thereof may be entered into my health record. I voluntarily agree to its disclosure to agencies or individuals identified in the preceding paragraph and I have been informed that failure to agree to such disclosure may negate the purposes for which the experiment was conducted.

______________________ Subject/Guardian Signature

______________________ Signature of Witness

______________________ Printed Name, Grade or Rank

____________ Date of Birth

Date ____________________

National Naval Medical Center
Bethesda Maryland

Consent Form for Females

Consent for voluntary Participation in a clinical Investigation

1. I ________________________________ have *been* asked to voluntarily participate in a research project entitled "The Association of Bone Mineral Density and Menstrual Dysfunction with Stress Fractures in USNA Midshipmen" being conducted at the Naval Branch clinic, Bancroft Hall U.S. Naval Academy, Annapolis, Maryland, and the National Naval Medical center, Bethesda, Maryland

2. The purpose of this research project has been explained to me. Stress fractures and related orthopedic injuries are a common problem in Midshipmen during training. Risk for stress fractures may be related to variations in bone mineral density (BMD) (i.e., the amount of calcified bone material present in a given volume of bone) among individuals. In addition, in females, menstrual irregularities are frequent in the setting of increased physical and mental stress such as that at the USNA. There is evidence in the medical literature that persistent menstrual abnormalities can result in decreased bone mineral density in females, and subsequent increased risk for stress fracture. This study will seek to determine if the risk for stress fractures in USNA midshipmen is related to decreased BMD and if the risk in female Midshipmen in particular is related to subtle abnormalities in menstrual function and bone density.

3. I understand my participation in this research project will be for a period of four (4) years or for the duration of my enrollment at USNA.

4. The procedures have been explained to me as follows: Upon entering this study, after providing written informed

Patients Initials ____________

consent, I will be medically evaluated by a physician participating in the study. I will have a complete medical history and a basic physical examination, as well as yearly interval medical history within two to three months of entry into the study, and then each year thereafter for four years, a bone mineral density and body composition measurement (percent body fat and percent body water) will be performed utilizing a dual energy x-ray bone densitometer, which is a machine that measures bone mineral density and body composition with a painless scan technique requiring only a few minutes to perform while I am lying down on the scan table. I understand that the procedure is painless, requires approximately 30-45 minutes or less of total time, and involves a minimal exposure to ionizing radiation - less than that of a routine standard chest x-ray.

My percent body fat measurement will also be validated by caliper measurements of my skinfold thickness each year.

Upon entry into the study and yearly thereafter for four years, I will have blood drawn and will collect urine samples as described below for routine laboratory testing and for examination of biochemical markers of bone metabolic activity and endocrine (hormonal) function. I will have approximately three (3)tablespoons (45 cc) of blood drawn initially for the baseline laboratory tests and up to 4 times per year follow-up blood draws of approximately two (2) tablespoons (30 cc). The urine samples will consist of giving a first morning fasting urine sample. up to 4 times per year, collected by urinating into a urine sample container just after awakening in the morning before eating breakfast, and after fasting (no food or drink except water) after 2000 hours the night before.

Other procedures that I perform will include a 24 hour diet recall interview. I will be asked to remember everything I have eaten or drunk in the previous 24 hours 4 times per year. I understand that this 24 hour diet recall will be analyzed to determine my caloric and nutrient intake with a copy of the analysis provided to me as well as to the study investigators.

In addition, I will be evaluated in the Orthopedic Department in the Bancroft Hall Branch clinic for any orthopedic complaints or injuries. After evaluation by an orthopedic physician further studies such as routine x-rays or bone scanning will be performed as medically indicated.

Patients Initials ____________

Periodically, about 4 times per year I may be asked to maintain a 3 day activity log and wear an instrument, about the size of a wrist-watch, on my wrist to record my activity patterns. In the event of any unusual test results I may be referred for further testing, evaluation, and treatment.

5. Specifically, I am aware that the <u>experimental part</u> of this study is the measurement of my bone density and percent body composition yearly for four years, the analysis of information (to test for statistical relationships) concerning any orthopedic injuries I may experience while at the USNA, and the analysis of information from my medical history, mood, diet history, activity patterns, blood tests, and urine tests.

6. A total of 480 subjects are expected to participate in this project.

7. The risks or <u>discomforts</u> which are possible are as follows:

A. For blood drawing: Pain and inconvenience, as well as possible 'black and blue bruise marks, infection and/or fainting spells.

B. For bone mineral density and bone composition measurement: Inconvenience and minimal exposure to ionizing radiation (the skin doses of 2-5 mrem or less per scan are a little above background solar radiation and are significantly less than the 10-40 rem exposure of a typical routine chest x-ray).

C. For urine collection: Inconvenience.

D. For orthopedic evaluation of injuries: Possible discomfort at routine orthopedic examination.

E. For giving of a complete medical history: Inconvenience.

F. 24 hour diet recall interview: Inconvenience

G. Skinfold thickness measurement: Possible mild discomfort

H. Activity log and monitor: Inconvenience.

I understand and accept these risks.

Patients Initials ____________

8. I understand that the research may or may not help me personally but that the results may help the investigator learn about risk factors for stress fractures and decreased bone mineral density or aid in the prevention or treatment of these conditions in other patients.

9. The alternate treatment, should I decline enrollment into this study, has been explained as follows: My nonparticipation in this study will not affect the care and evaluation I receive in the orthopedics clinic at the USNA for any orthopedic injuries or complaints I may have while at the USNA. This study does not otherwise involve a medical treatment. Therefore, there is no alternative treatment that would be advantageous to me.

10. I am aware that this study may involve risks to me which are currently unforeseeable.

11. The investigator may terminate my participation in this project for the following reasons: If I am discharged from the USNA.

12. I understand that I may withdraw from this study at any time without prejudice to my future care. I understand that my withdrawal from this project may result in decreased information being available concerning possible further changes in my bone density; however, I will not lose any benefits to which I am otherwise entitled.

13. Any new significant findings developed during the course of the research which may affect my willingness to participate further will be explained to me.

14. In all publications and presentations resulting from this research project, my anonymity will be protected to the maximum extent possible; although, I realize that authorized Navy Medical Department personnel may have access to my research file in order to verify that my rights have been safeguarded. Otherwise my research *file* will be maintained in a secure location accessible only to the study investigators.

15. It I suffer any physical injury as a result of my participation in this study, immediate medical treatment is available at the National Naval Medical Center, Bethesda, Maryland and/or the Bancroft hall Branch Medical Clinic. I understand that although no compensation is available, any injury as a result of my participation will be evaluated and treated in keeping with the benefits or care to which I am entitled under applicable regulations.

16. I have been informed that there will not be additional cost to me if I choose to participate in this research project. However, should I require hospitalization at the National Naval Medical Center arising from participating in this research project. I will be required to pay the customary fees for hospital meals to National Naval Medical Center based on my Department of Defense beneficiary status.

Patient Initials________

17. If I have any questions regarding this research project, I may contact Dr. A. J. Drake, III MC. USN at (301) 295-5165. If I have any questions regarding my rights as an individual while participating in a research project at the Naval Branch Clinic, Bancroft Hall, USNA and the National Naval Medical Center, Bethesda, I can contact one of the research Administrators, Clinical Investigation Department, at (301) 295-2275. He/she will answer my questions or refer me to a member of the committee for the protection of human subjects for further information. If I believe I have been injured as a result of this project I may call the Legal office at (301) 295-2215.

18. I understand that my participation in this project is voluntary and that my refusal to participate will involve no penalty or loss of benefits to which I am entitled under applicable regulations. If I choose to participate, I am free to ask questions or to withdraw from the project at any time. If I should decide to withdraw from the research project, I will notify Dr. A. J. Drake, III, MC, USN at (301) 295-2215, to ensure an orderly termination process. My withdrawal will involve no loss of benefits to which I am entitled.

I certify that I have received a copy of this consent term.

Patient Initials ________________

Date signed_______

____
Volunteer Signature

____
Volunteer Printed Name-Rank-USN

____
Witness' Signature and Date

____
Investigator Signature and Date

____
Witness' Printed Name/Rank/USN

____
Investigator Printed Name-Rank-USN

I have received the above documents and hereby authorize my son:

______________________________ to participate in this research project.

____
Signature

____
Date

PRIVACY ACT STATEMENT

1. Authority. 5 USC 201

2. **Purpose.** Medical research information will be collected to enhance basic medical knowledge, or to develop tests, procedures, and equipment to improve the diagnosis, treatment, or prevention of illness, injury or performance impairment.

3. Use. Medical research authorization will be used for statistical analysis and reports by the Departments of the Navy and Defense, and other U.S. Government agencies, provided this use is compatible with the purpose to which the information was collected. Use of the information may be granted to non-Government agencies or individuals by the Chief, Bureau of Medicine and Surgery in accordance with the provisions of the Freedom of Information Act.

4. Disclosure. I understand that all information contained in this consent statement or derived from the experiment described herein will be retained permanently at National Naval Medical Center, Bethesda, Maryland and salient portions thereof may be entered into my health record. I voluntarily agree to its disclosure to agencies or individuals identified in the preceding paragraph and I have been informed that failure to agree to such disclosure may negate the purposes for which the experiment was conducted.

______________________ Subject/Guardian Signature

______________________ Signature of Witness

______________________ Printed Name, Grade or Rank

APPENDIX B: EXERCISE QUESTIONNAIRE

Alpha: __________ Name _____________ SSN _________________

Since your arrival at USNA in July 1996:

Office use only

1. Did you compete as a member of a VARSITY sports team? Yes No ___________
2. Were you a member of a team with body weight requirements? Yes No ___________
3. How many miles per week, on average, do you jog or run? _______________ miles.
4. How many minutes of exercise do you perform each day? _________ mm/day (DO NOT INCLUDE time spent at TEAM PRACTICE or RUNNING/JOGGING)

5. PRT: 1.5 mile run: Mm _______________ Sec _____________
PU_________________ SU ___________________

6. How tall are you? feet ____________ inches ___________

7. How much do you presently weigh? _____________ lbs

8. Do you know anyone who has experienced an eating disorder at the Naval Academy? Yes No ___________

9. Do you have an eating disorder? Yes No __________

10. Has anyone ever touched your body in a sexual way that made you feel uncomfortable during your time at the Naval Academy?(i.e. date rape, inappropriate touching) Yes No ____________

11. Have you experienced sexual harassment from any officer or midshipman during your time at the Naval Academy? Yes No ___________

12. How many menstrual periods have you had since July 1996? ___________________

13. Do you use oral contraceptive pills? Yes No _________________

14. Since July 1996, have you stopped menstruating for 6 months or longer? Yes No __________

YOUR RESPONSES TO THIS SURVEY ARE ABSOLUTELY CONFIDENTIAL

Please complete the other side

Please LIST by NUMBER ALL (3 max) Extra Curricular Activities in which you ACTIVELY participated while at the Naval Academy (alphabetical listing) from MOST important to LEAST important:

1. ____________
2. ____________
3. ____________

1 Aerobics
2 Airborne Training Unit
3 Amateur Radio Club
4 Archery Club
5 Astronomy Club
6 Baseball
7 Basketball
8 Bicycle Racing
9 Big Brother/Sister Club
10 Black Studies Club
12 Brigade Activities Com
13 Cannoneers
14 Cheerleading
15 Chemistry Club
16 Choir/Glee Club
17 Computer Club
18 Crew
19 Crew: Light Weight
20 Cross Country
21 Dolphin Club
22 Drum and Bugle Corps
23 Fellowship of Christian Ath
24 Field Hockey
25 Football
26 Football: Light Weight
27 Foreign Affairs Conf.
28 Forensic Society
29 Frisbee
30 Gymnastics
31 History Club
32 Honor Society
33 Ice Hockey
34 International Club
35 Judo
36 Karate
37 Lacrosse
38 Language Club
39 Log Magazine
40 Lucky Bag
41 Masqueraders
42 Math Club
43 Midn. Action Org.
44 Midn Aviation Club
45 National Eagle Scout
46 Navigators
47 Navy Tactical Wargaming
48 officers Christian Fellowship
49 Photography Club
50 Pistol and Rifle
51 Powerlifting
52 Public relations
53 Reef Points
54 Religious Club
55 Ring and Crest Com.
56 Rugby
57 Scuba Club
58 Semper Fidelis
59 Silent Drill Team
60 Ski Club
61 Small Arms Club
62 Soccer
63 Social Affairs Comm.
64 Softball Team
65 Sportsman Club
66 Surface Action Grp.
67 Swim Team
68 Tennis
69 Track and Field: Run
70 Track and Field: Field
71 Trident Calendar
72 Volleyball
73 Women's Prof. Assoc.
74 Wrestling
75 WRNV Radio
76 Yard Patrol Squadron
77 Other ____________

YOUR RESPONSES TO THIS SURVEY ARE ABSOLUTELY CONFIDENTIAL

APPENDIX C: EXERCISE AND HEALTH QUESTIONNAIRE

Alpha: ________ Name ______________ SS# _____-____-________

Please respond as accurately as possible to the questions listed below.
YOUR RESPONSES TO THIS SURVEY ARE ABSOLUTELY CONFIDENTIAL

Office use only

1. In what year did you graduate from High school? _______ ______

2. Did you compete as a member of a sports team in High School?
   VARSITY? Yes No INTRAMURAL? Yes No ______

3. Were you a member of a team with body weight requirements? Yes No ______
   (for example wrestling, cheerleading, light wgt crew, 150lb football, etc.)

4. What sport were you recruited to participate in at the Naval Academy? ______

   I was not recruited ________.

5. How many miles per week, on average, do you jog or run? ______miles ______

6. How many minutes of exercise do you perform each day? ________ min/day ______
   (DO NOT INCLUDE time spent at team PRACTICE or RUNNING/JOGGING)

7. What is your BIRTH DATE? ____/____/____ ______

8. What is your SEX?: Male Female ______

9. What is your ethnic extraction (circle)?
   Asian Black Caucasian Hispanic American Indian Other ______ ______

10. How tall are you? ____feet _____inches ______

11. How much do you presently weigh? ________ lbs _____

<u>WOMEN ONLY</u>:

12. How old were you when you had your 1st menstrual period? _____years old. ______

13. How many menstrual periods do you have per year? ______ per year. ______

14. Do you use oral contraceptive pills? Yes No ______

15. In the past year have you stopped menstruating for 6 months or longer?
Yes No ______

Please LIST by NUMBER ALL (3 max) Extra Curricular Activities in which you ACTIVELY participated while at the Naval Academy (alphabetical listing) from MOST important to LEAST important:

1. ______.
2. ______
3. ______

1 Aerobics
2 Airborne Training Unit
3 Amateur Radio Club
4 Archery Club
5 Astronomy Club
6 Baseball
7 Basketball
8 Bicycle Racing
9 Big Brother/Sister Club
10 Black Studies Club
12 Brigade Activities Com
13 Cannoneers
14 Cheerleading
15 Chemistry Club
16 Choir/Glee Club
17 Computer Club
18 Crew
19 Crew: Light Weight
20 Cross Country
21 Dolphin Club
22 Drum and Bugle Corps
34 International Club
35 Judo
36 Karate
37 Lacrosse
38 Language Club
39 Log Magazine
40 Lucky Bag
41 Masqueraders
42 Math Club
43 Midn. Action Org.
44 Midn Aviation Club
45 National Eagle Scout
46 Navigators
47 Navy Tactical Wargaming
48 officers Christian Fellowship
49 Photography Club
50 Pistol and Rifle
51 Powerlifting
52 Public relations
64 Softball Team
65 Sportsman Club
66 Surface Action Grp.
67 Swim Team
68 Tennis
69 Track and Field: Run
70 Track and Field: Field
71 Trident Calendar
72 Volleyball
73 Women's Prof. Assoc.
74 Wrestling
75 WRNV Radio
76 Yard Patrol Squadron
77 Other ________

23 Fellowship of Christian Athletes	53 Reef Points
24 Field Hockey	54 Religious Club
25 Football	55 Ring and Crest Com.
26 Football: Light Weight	56 Rugby
27 Foreign Affairs Conf.	57 Scuba Club
28 Forensic Society	58 Semper Fidelis
29 Frisbee	59 Silent Drill Team
30 Gymnastics	60 Ski Club
31 History Club	61 Small Arms Club
32 Honor Society	62 Soccer
33 Ice Hockey	63 Social Affairs Comm.

YOUR RESPONSES TO THIS SURVEY ARE ABSOLUTELY CONFIDENTIAL

Do you know anyone who has experienced an eating disorder? Yes No ______

Has anyone ever touched your body in a sexual way that made you feel uncomfortable? (i.e. fondled as a child, date rape) Yes No ______

Do you want to meet with a counselor regarding any personal issues you may have? (i.e. adjusting to USNA, discussing this survey, sexual abuse, suicide, alcoholism, family issues, etc.) Yes No ______

APPENDIX D: PRT SCORING SHEET

%	#Curlups	%	#Pushups/Men	%	#Pushups/Women
99.9	101+	99.9	101+	99.9	85+
98.5	100	99.1	100	99.6	84
97.4	99	98.4	99	99.0	83
96.3	98	97.8	98	93.4	82
95.2	97	97.1	97	97.8	81
94.1	96	96.5	96	97.2	80
93.0	95	95.8	95	96.6	79
91.9	94	95.2	94	96.0	78
90.8	93	94.5	93	95.4	77
89.7	92	93.3	92	94.8	76
88.6	91	93.2	91	94.2	75
87.5	90	92.5	90	93.6	74
86.4	89	91.9	89	93.0	73
85.3	88	91.2	88	92.4	72
84.2	87	90.6	87	91.8	71
83.1	86	89.9	86	91.2	70
82.0	85	89.3	85	90.6	69
80.9	84	88.6	84	90.0	68
79.8	83	87.9	83	89.4	67
78.7	82	87.3	82	88.8	66
77.6	81	86.6	81	88.2	65
76.5	80	86.0	80	87.6	64
75.4	79	85.4	79	87.0	63
74.3	78	84.7	78	86.4	62
73.2	77	84.1	77	85.8	61
72.1	76	83.4	76	85.2	60
71.0	75	82.8	75	84.6	59
69.9	74	82.1	74	84.0	58
68.8	73	81.5	73	83.4	57
67.7	72	80.8	72	82.8	56
66.6	71	80.2	71	82.2	55
65.5	70	79.5	70	81.6	54
64.4	69	78.9	69	81.0	53
63.3	68	78.2	68	80.4	52
62.2	67	77.6	67	79.8	51
61.1	66	76.9	66	79.2	50
60.0	65	76.3	65	78.6	49
		75.6	64	78.0	48
		75.0	63	77.4	47
		74.3	62	76.8	46
		73.1	61	76.2	45
		73.0	60	75.6	44
		72.4	59	75.0	43
		71.7	58	74.4	42
		71.1	57	73.8	41
		70.4	56	73.2	40
		69.8	55	72.6	39

%	#Pushups/Men
69.1	54
68.5	53
67.8	52
67.2	51
66.5	50
65.9	49
65.2	48
64.6	47
64.0	46
63.3	45
62.6	44
62.0	43
61.3	42
60.7	41
60.0	40

%	#Pushups/Women
72.0	38
71.4	37
70.8	36
70.2	35
69.6	34
69.0	33
68.4	32
67.8	31
67.2	30
66.6	29
66.0	28
65.4	27
64.8	26
64.2	25
63.6	24
63.0	23
62.0	22
61.8	21
61.2	20
60.6	19
60.0	18

1.5 MILE RUN

Men's Run Time	%	Women's Run Time	%
8:15	**99.9**	**9:35**	**99.9**
8:20	98.3	9:40	960
8:25	96.7	9:45	95.0
8:30	95.1	9:50	94.0
8:35	93.5	9:55	930
8:40	91.9	10:00	92.0
8:45	90.3	10:05	90.0
8:46	**90.0**	**10:10**	**90.0**
8:50	88.7	10:15	89.0
8:55	87.1	10:20	88.0
9:00	85.5	10:25	87.0
9:05	83.9	10:30	86.0
9:10	82.4	10:35	85.0
9:15	81.0	10:40	84.0
9:19	**80.0**	10:45	83.0
9:20	79.6	10:50	82.0
9:25	78.2	10:55	81.0
9:30	76.8	**11:00**	**80.0**
9:35	75.4	11:05	79.0
9:40	74.0	11:10	78.0
9:45	72.6	11:15	77.0
9:50	71.2	11:20	76.0
9:54	**70.0**	11:25	75.0
9:55	69.8	11:30	74.0
10:00	68.4	11:35	73.0
10:05	67.0	11:40	72.0
10:10	65.6	11:45	71.0
10:15	64.2	11:50	70.0
10:20	62.8	11:55	69.0
10:25	61.4	12:00	68.0
10:30	**60.0**	12:05	67.0
		12:10	66.0
		12:15	65.0
		12:20	64.0
		12:25	63.0
		12:30	62.0
		12:35	61.0
		12:40	60.0

APPENDIX E: PRT VALIDATION SHEET

PHYSICAL READINESS TEST
GRADING CRITERIA ACADEMIC YEAR 1994

<u>1.5 MILE RUN/500 YARD SWIM:</u>*

<u>RUN:</u> Fail - Men: Time exceeding 10 minutes and 30 seconds
Women: Time exceeding 12 minutes and 40 seconds
Validate - Men: Time of 8 minutes and 45 seconds or less
Women: Time of 10 minutes and 5 seconds or less
Incomplete - Men/Women: No time entered

<u>SWIM</u>: Fail - Men/Women: Time exceeding 11 minutes and 20 seconds
Validate - Men/Women: Time of 7 minutes and 50 seconds or less
Incomplete - No time entered

* <u>NOTE: Midshipmen may only exercise the swim option with an approved medical chit and with express permission of the Deputy Physical Education Officer.</u>

<u>PRT STRENGTH</u>: Fail - Men: Fail sit & reach, missing any scores, or less than 65 curlups or less than 40 pushups

Women: Fail sit & reach, missing any scores, or less than 65 curlups or less than 18 pushups

Validate - Men/Women: Pass sit & reach, average of pushups and curlups is 90% or more (Per PE supplied tables)**

**<u>NOTE: In order to make a "clean break" from the old format in transitioning to the new format, there will be no validations carried over from the Spring '94 semester to the Fall '95 semester.</u>

Incomplete - No scores entered

<u>SEMESTER SCORE:</u> PRT STRENGTH - average of pushups & curlups per supplied tables
RUN - percentage per supplied tables

FINAL PRT GRADE: Average of PRT STRENGTH and RUN scores with RUN counting 1/3 and PRT STRENGTH counting 2/3

APPENDIX F: COMPARISON OF MEANS

This appendix contains the results of the t-tests discussed in Chapter five. All statistical tests are performed the 0.05 level of statistical significance. Table F-1 is presented first and provides group statistics for males and females for miles run and minutes of exercise per week.

Table F-1 Group Statistics: Male vs Female in High School

	gender	N	Mean	Std. Deviation
Miles in High School	FEMALE	237	12.1308	8.4490
	MALE	540	12.2389	10.6665
Minutes in High School	FEMALE	238	69.7269	58.2663
	MALE	546	80.1410	68.4775

Table F-2 Independent Samples Test: Male vs Female in High School

	t-test for Equality of Means			
	t	df	Sig. (2-tailed)	Std. Error Difference
Miles in	-.138	775	.890	.7825
Minutes	-2.045	782	.041	5.0916

As shown in Table F-2, there is no statistical difference between males and females in miles run per week. However, minutes of exercise per week for females is significantly lower than males in high school.

Next, the results for Spring miles run and minutes of exercise per week are shown in Table F-3 for males and females.

Table F-3 Group Statistics: Male vs Female in Spring of Plebe Year

	gender	N	Mean	Std. Deviation
Spring miles per week	FEMALE	236	11.5085	9.2793
	MALE	1404	10.3344	9.4701
Spring:minutes of exercise per week	FEMALE	237	41.0802	35.2089
	MALE	1394	60.7626	46.0553

Table F-4 Independent Samples Test: Male vs Female in Spring of Plebe Year

	t-test for Equality of Means			
	t	df	Sig. (2-tailed)	Std. Error Difference
Spring miles per week	1.767	1638	.077	.6643
Spring:minutes of exercise	-6.274	1629	.000	3.1370

Table F-4 indicates that minutes of exercise per week is significantly lower for females than males. However, there is no significant difference in Spring miles for the two genders.

Paired t-tests are performed to determine if there is a significant difference in miles run and minutes of exercise per week while in high school and at the Naval Academy. The results for the males are presented in tables F-5 and F-6.

Table F-5 Male: Paired Samples Statistics

		Mean	N
Pair 1	Miles in HS	12.1308	344
	Miles in Spring	8.6017	344
Pair 2	Minutes of exercise per week in HS	78.4809	341
	Minutes of exercise in Spring	57.0469	341

Table F-6 Male: Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Miles in High School and Spring	3.5291	9.2865	7.048	343	.000
Pair 2	Minutes in High School and Spring	21.4340	67.5596	5.859	340	.000

Table F-6 indicates is a significant decrease in both fitness measures between high school and the Naval Academy.

Tables F-7 and F-8 are the paired comparisons for females.

Table F-7 Female: Paired Samples Statistics

		Mean	N
Pair 1	Miles in HS	12.5820	189
	spring miles per week	11.5661	189
Pair 2	Minutes of exercise per week in HS	65.3947	190
	Spring:minutes of exercise per week	39.6526	190

Table F-8 Female: Paired Samples Test

		Paired Differences				
		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Miles in High School and Spring	1.0159	9.3231	1.498	188	.136
Pair 2	Minutes in High School and Spring	25.7421	62.4904	5.678	189	.000

Table F-8 indicates that females do not show a significant change in miles ran per week between high school and the Naval Academy. There is, however, a significant decrease in minutes of exercise per week for the same period.

Finally, paired sample t-tests are provided in Tables F-9 and F-10 for the components of PRT for both the Fall and Spring terms.

Table F-9 Paired Samples Statistics for Women's PRT: Fall vs Spring

		Mean	N	Std. Deviation
Pair 1	Situps in Fall	82.1895	95	16.3995
	Situps in Spring	83.7053	95	14.3281
Pair 2	Push-ups Fall	49.9135	104	15.8194
	Push-ups in Spring	81.5481	104	16.1557
Pair 3	Fall run	11.9488	92	1.3644
	Spring run	10.8648	92	.9109

Table F-10 Paired Samples Test for women's Fall and Spring PRT

		Paired Differences				
		Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pair 1	Fall and Spring situps	-1.5158	12.4481	-1.187	94	.238
Pair 2	Fall and Spring pushups	-31.6346	17.7409	-18.185	103	.000
Pair 3	Fall and Spring run	1.0839	.9387	11.075	91	.000

Table F-10 indicates a significant improvement in pushups and run time. There was not however, a statistically significant improvement in the number of situps.

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