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Awareness of osteoporosis prevention and its relationship to bone health

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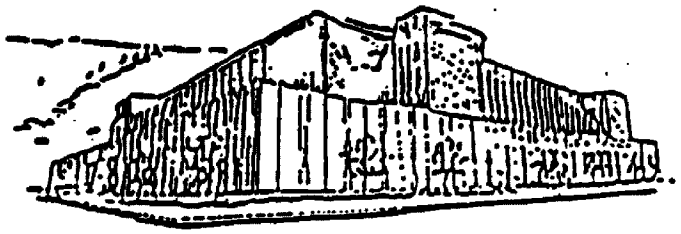

AWARENESS OF OSTEOPOROSIS PREVENTION AND ITS RELATIONSHIP TO BONE HEALTH

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Osteoporosis is a major public health problem in the United States. The purpose of this study was to determine the level of awareness among postmenopausal females regarding the methods necessary to prevent osteoporosis. It was also the purpose of this study to determine the relationship between a female's awareness of osteoporosis prevention and her bone health.

Subjects included 73 postmenopausal females, age 50 or older, who had not currently been diagnosed with osteoporosis. Subjects were chosen from women who volunteered to complete a questionnaire and to have a free screening bone density measurement.

Data was collected at a retirement community and at an osteoporosis awareness fair. Subjects were asked to complete a questionnaire to determine awareness of osteoporosis preventive measures, source of information on the disease, and perceived confidence of their knowledge of how to prevent the disease. Subjects then underwent a screening bone density measurement to determine their bone health.

Results indicate 77% of the women studied demonstrated an inadequate knowledge of measures necessary to prevent osteoporosis. While an insignificant relationship, r=.14, existed between a woman's overall awareness of how to prevent the disease and her bone health, significant differences between certain aspects of an osteoporosis prevention program and bone health may exist, specifically in the areas of hormone replacement therapy and exercise. The subjects' source of information did not appear to have an effect on their knowledge of preventive measures, but a relationship was observed between subjects' perceived confidence of how to prevent osteoporosis and their bone health. Furthermore, a discrepancy between perceived and actual confidence, as demonstrated by the questionnaire score, was seen.

ACKNOWLEDGMENTS

I'd like to dedicate this to my mother who was the inspiration for this project. Much gratitude is also extended to her for being such a terrific grandma to my daughters, especially during our stay here in Montana. Without her, and the help and support of the rest of my family, I don't know how this would have even been possible. Thanks Rusty, Sandi, River, Craig, Debra, Levi, Ahnna, Terra, Lori and Brian. You're the best. To my husband, Perry, and our daughters Mikayla and Darien, your love, patience and support mean the world to me.

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Chapter One

INTRODUCTION

Females over the age of 50 are more likely to develop osteoporosis than Alzheimer's disease, heart disease, breast cancer, or ovarian cancer (Dowd & Cavalieri, 1999). Osteoporosis increases a woman's risk of fracturing bones. The threat of a hip fracture is equal to the combined risk of developing ovarian, uterine, and breast cancer (National Osteoporosis Foundation, 1998). Of women who experience hip fractures, 24% will die within the year following the fracture. The lifetime risk of death for females, due to osteoporosis, is comparable to that of breast cancer (Merck & Co., 1998). The National Osteoporosis Foundation estimated that 80% of the 28 million Americans who have been affected by osteoporosis are females. Of that population, 10 million have the disease and another 18 million are at risk due to low bone mass.

In a recent study cited by Dowd & Cavalieri (1999), researchers at UCLA reported that a mere 28% of women surveyed were aware that they were more likely to develop osteoporosis than other more publicized diseases including heart disease, ovarian cancer, and breast cancer. Pal (1999) found in a British study of 82 patients with recent fractures that only 34 of them were aware of the disease and its risks.

Despite these statistics, a Gallup Survey reported that 75% of women between the ages of 45 and 75 had never spoken to their physician about the disease (National Osteoporosis Foundation, 1998). Although physicians should be a primary source of information about osteoporosis, Weiss and Sankaran (1998) reported that 27% of college women had no primary source of information on the disease, and 39% had no secondary source.

Osteoporosis, which literally means "porous bone," is a progressive disease that begins early in life (McArdle et. al., 1991). Throughout an individual's lifetime, bone is constantly being remodeled. During remodeling, both bone-formation and bone-

resorption occur. This takes place in specific areas called bone-remodeling units and consists of four phases. During the resting phase, inactive osteoblasts line the bone. This is followed by the resorption phase in which osteoclasts, after being activated, begin resorption. A resorption pit is left in the bone by the osteoclasts. This pit is filled in with a matrix synthesized by the osteoblasts. All of this occurs in the third phase known as the reversal phase. Finally, in the formation phase, mineralization of the unmineralized matrix takes place completing the remodeling sequence. Bone-resorption, which is mediated by osteoclasts, takes approximately seven to ten days. Bone-formation, which is mediated by osteoblasts, takes approximately three months (Allen, 1993). Initially, through these two processes of bone-resorption and bone-formation, bone density is increased with bone-formation being greater than bone-resorption. At about the age of thirty, peak bone density has been reached and bone-formation and bone-resorption balance out. In women, once estrogen levels decline due to either amenorrhea or menopause, bone-resorption overtakes bone-formation (Dowd & Cavalieri, 1999). At this point osteoporosis can begin.

Osteoporosis is characterized by reduced bone mineral density (BMD) and by brittle bones that break under normal stress or during falls (McArdle et. al., 1991). The most common fractures occur in the spine since vertebrae consist of trabecular bone that is spongy and more susceptible to loss. These spinal fractures can lead to pain, loss of height, and a humped back, also known as "dowager's hump" (Merck & Co., 1998). Frequent fractures also occur at the end of the radius in the wrist, and at the neck of the femur at the hip joint. Of the 1.5 million fractures that occur annually, 300,000 are hip fractures with 50% of the patients becoming disabled and 25% requiring long-term nursing care (Norland Medical Systems, 1998 and Merck & Co., 1998).

Although it is commonly thought of as an older woman's disease, osteoporosis can affect young females. Secondary amenorrheic women are also at risk. Members of

this group may include anorexics and female athletes such as gymnasts, dancers, and distance runners (American College of Sports Medicine, 1993). All of the aforementioned individuals suffer from a decrease in estrogen which is necessary for the uptake and utilization of calcium.

Decreased estrogen is the major cause of osteoporosis (Williams, 1992). Other contributing factors include a lack of calcium, heredity, lifestyle, decreased physical activity, certain medical conditions, and certain drugs such as steroids, anticonvulsants, and thyroid medications. Treatments for osteoporosis and its prevention include calcium and vitamin D supplements, hormone replacement therapy (HRT) or other medications used to prevent bone loss, and exercise. New medications shown to increase bone density are now also being used. In the past, it was disputed whether or not the effects of osteoporosis could be reversed. Through the use of these new medications, it appears it is indeed possible.

It is apparent that osteoporosis is a major public health problem. However, in many cases it is a preventable and treatable disease. Interest in this topic began when the researcher's mother was diagnosed with osteoporosis, after numerous fractures, about seven years ago. A search of the available literature on the disease produced extensive information on osteoporosis and its prevalence. Information was also available on women's lack of awareness for *developing* the disease. However, when searching for information regarding women's awareness of how to *prevent* osteoporosis, this was not the case. It appears minimal research has been done in the area of osteoporosis prevention awareness. Therefore, it is the intent of this study to add to the body of literature related to prevention awareness.

Problem Statement

The purpose of this study was to determine the level of awareness among postmenopausal females regarding the methods necessary to prevent osteoporosis. It was also the purpose of this study to determine whether a significant relationship existed between a woman's awareness of osteoporosis prevention and her bone health.

Significance of Problem

In women over the age of 50, one in every three already has osteoporosis (Merck & Co., 1998). However, there is an apparent lack of research concerning women's awareness of how to prevent the disease. If a significant correlation exists between a woman's lack of awareness regarding the measures necessary to prevent osteoporosis and her current bone health, it would suggest that education can be used as a preventive measure. The results of this research could help to further the awareness of osteoporosis prevention and increase the use of preventive measures by women to ensure good bone health.

Hypothesis I:

More of the women surveyed will be unaware of the measures necessary to prevent osteoporosis than less of the women surveyed.

Justification

Osteoporosis is a preventable and treatable disease. Despite this fact, 28 million Americans are affected by this condition (National Osteoporosis Foundation, 1998). In addition to uncontrollable risk factors such as genetics, race, frame size, allergies, and certain medical conditions, a lack of awareness among postmenopausal females regarding the methods necessary to prevent osteoporosis may be a contributing factor.

Hypothesis II:

The bone density of women who are not aware of the measures necessary to prevent osteoporosis will be less than the bone density of women who are aware of osteoporosis preventive measures.

Justification

In a study conducted by Nieves et. al. on the effect of calcium in addition to estrogen and calcitonin therapy on bone density, a substantial mean increase of bone density of the spine, hip, and forearm was seen (Dawson-Hughes, 1998). Furthermore, the muscular forces required in exercise appear to modify specific bone at the point of stress. The mechanical stress is converted to electrical energy. The electrical changes then stimulate activity of osteoblasts which leads to a build up of calcium (McArdle et. al., 1991). Therefore, if postmenopausal women are following a regimen of osteoporosis preventive measures including adequate calcium intake, hormone replacement therapy, and appropriate exercise, bone density should be positively affected.

Limitations

1. Certain risk factors for osteoporosis such as genetics, race, frame size, allergies and certain medical conditions exist and are not controllable.
2. An individual's awareness of steps necessary for the prevention of osteoporosis does not ensure her practice of them.
3. Nutrition, exercise, and other lifestyle practices prior to an individual's education on osteoporosis prevention can affect bone health and are not controllable.
4. Imaging tests using radioactive materials within five days prior to a DEXA scan, a diagnostic procedure used to assess bone density, will interfere with the accuracy of the

bone density measurement.

5. The DEXA scan being used will only measure bone density of the distal radius.

6. The results of the study will not be generalized to any population other than postmenopausal females over the age of 50 who have not currently been diagnosed with osteoporosis in Virginia and Maryland.

Definition of Terms

1. *DEXA scan*: Dual-energy x-ray absorptiometry uses a small amount of radiation to determine the bone density of the spine, hip, or wrist. These scans are more sensitive than ordinary X-rays and can diagnose bone loss at an earlier stage. Results of the scan are compared with the average bone mineral density of healthy young adults of the same sex at their peak bone mass.

2. *Osteoblast*: A cell of mesodermal origin concerned with the formation of bone.

3. *Osteoclast*: Giant multinuclear cell formed in bone marrow of growing bones. Found in depressions (called Howship's lacunae) on the surface of the bone. Concerned with the absorption and removal of unwanted tissue.

4. *Osteoporosis*: A disease in which bones become fragile due to an increased porosity of bone and a reduction in the amount of bone mass leading to fractures. These fractures can result in loss of height, stooped posture, and a loss of mobility and independence.

5. *T-score*: Test result of the DEXA scan. Compares bone density of the subject to that of the mean bone density of healthy young women of the same race who have reached peak bone mass. If the score is -1.0 or less, the subject may need therapy.

Chapter Two

REVIEW OF LITERATURE

Prevention awareness

Until the beginning of the 20th century, osteoporosis and its complications were relatively unknown due to the fact that the average life expectancy of women did not exceed menopause (Semla, 1999). Since that time much has been learned about the disease. Organizations such as the National Osteoporosis Foundation, National Institutes of Health, and the World Health Organization are all advocates for increasing the awareness and practice of osteoporosis prevention. Despite this push for increased awareness, 28 million Americans are affected with this disease (Dowd & Cavalieri, 1999). During the next 60 years, the number of cases of osteoporosis is expected to triple worldwide due to the increase in life expectancy (Lysen & Walker, 1997). Of the money spent on health care in the U.S., expenditures for rehabilitative care of osteoporosis related bone fractures are substantial (Kessenich, 1996). In fact, more than 10 billion dollars are currently spent annually and the figure is expected to exceed 62 billion dollars by the year 2020 (Lysen & Walker, 1997 and Kessenich, 1996). As the elderly population increases, so will the number of fractures. The number of hip fractures alone is predicted to triple between 1990 and 2040 according to Schneider and Guralnik (Lysen & Walker, 1997). The estimated cost associated with these hip fractures world wide is expected to reach 131.5 billion dollars by the year 2050 (Doube, 1999). The most cost-effective approach to managing this problem is prevention (Allen, 1993).

Currently, many physicians and much of the general public are unaware that women reach their peak bone mass at approximately the age of 30 (Andrews, 1998). In a survey of college women concerning their primary source of information on osteoporosis, 22% listed the media, 27% had no primary source, and 39% had no secondary source

(Weiss & Sankaran, 1998). A British study of 82 patients with recent fractures found that only 34 of them were aware of the disease and its risks. In only ten of these cases doctors were listed as the knowledge source. The media and friends or relatives were the source of information in the rest. It was also reported that these patients received incomplete or inadequate advice regarding occupational and physiotherapy, and only a few received specific treatment on how to reduce future fracture risk with hormone replacement therapy, bisphosphonates, or even calcium and vitamin D (Pal, 1999). This is occurring in spite of recommendations that the primary role of physicians in dealing with patients at risk for osteoporosis is to emphasize preventive strategies focusing on maximizing peak bone mass (Allen, 1993). The National Institutes of Health Consensus Conference on Optimal Calcium Intake in 1994 recommended that health professionals play a strong role in educating about bone health and calcium intake. Nevertheless, it has been reported that the average woman's diet in America contains less than 600 mg/day. The recommended minimum calcium intake is 1000 mg/day. A public health education program is necessary to ensure the desired intake of calcium in the American public according to an expert panel of the National Institutes of Health (Weiss & Sankaran, 1998). It seems apparent that an increase in the awareness of osteoporosis prevention is necessary. Osteoporosis is a major public health problem, and the answer to managing it is prevention (Allen, 1993).

Components of an effective preventive strategy are to ensure peak bone mass during childhood, adolescence, and early adulthood; maintaining acquired bone mass; and counteracting the age-related process of bone loss that occurs after age 40 to 45 (Kulak & Bilezikian, 1998). Studies have been conducted and programs implemented to assess and educate adolescent and young adult populations (Lysen & Walker, 1997 and Weiss & Sankaran, 1998). These studies and programs are vital to avoid a perpetuation of the devastating effects of this disease. The prevention focus must not stop there, however. For women, the average lifetime extends 25 to 35 years after menopause thus

placing many postmenopausal women at risk for osteoporosis and related fractures (Semla, 1999). Since no cure for osteoporosis exists and a 10% decrease in bone mineral density is associated with a doubling or tripling in the increase risk of fracture, optimizing peak bone mass and maintaining skeletal mass throughout adulthood must be the main focus of prevention (Lysen & Walker, 1997). Prevention counseling should include recommendations for calcium and vitamin D intake, weight-bearing exercise, and pharmaceutical interventions of hormonal therapy available for preventing bone loss (Kessenich, 1996).

Calcium and Vitamin D

Calcium is an important aspect of an overall program to prevent osteoporosis (National Osteoporosis Foundation, 1998). In fact, an inadequate calcium intake is said to be the most important nutritional risk factor for the disease (Allen, 1993). The National Osteoporosis Foundation (1998) recommends 1,200 mg/day for women over the age of 50. In postmenopausal women, the recommended daily intake for women not using hormone replacement therapy (HRT) is 1500 mg/day and 1000 mg/day for postmenopausal women who are using HRT. For best absorption, the dose should be divided throughout the day and taken with food (Dowd & Cavalieri, 1999). A decrease in bone loss of middle-aged postmenopausal women, and a decrease in the rate of vertebral fractures of women who have previously experienced vertebral fractures has been observed when using supplemental calcium (Dawson-Hughes et. al., 1997). In fact, calcium supplementation has been shown to reduce the rate of bone loss in postmenopausal women by approximately 0.8%/year. When compared with untreated women, this is a decrease of 40%. The greatest preservation of bone mass by calcium alone has been observed in the hip and forearm (Nieves et. al., 1998).

Due to a suspected decrease in the ability of the kidneys to produce 1,25(OH)2D3 in the elderly and postmenopausal women, absorption of calcium by the intestine is hindered. Because of this, bone becomes a greater source of the calcium necessary to

maintain extracellular fluid calcium levels. Only large amounts of calcium, 1500 to 2500 mg/day, can overcome this (Arnaud & Sanchez, 1990). Unfortunately, the intake of excessive amounts of calcium has side effects such as abnormal heart contractions, the development of kidney stones, constipation, and the possibility of interfering with the absorption of iron and zinc (Williams, 1992). These side effects are one reason calcium alone should not be used to prevent osteoporosis. Fortunately, synergistic effects between calcium and physical activity, and between calcium and estrogen have been observed resulting in increased bone mass.

Lysen and Walker (1997) cited that research exists supporting the existence of a positive increase in bone mass when calcium intake and physical activity are at intermediate or higher levels. In regards to the use of calcium and estrogen, Nieves et. al. (1998) cite a study in which doses of estrogen thought to be too low to preserve bone mass (0.3 mg) were found to be as effective as the optimal estrogen dose (0.625 mg) when taken with 1700 mg of calcium. This calcium dose is high, however, and the resulting side effects of too much calcium could occur. The same authors also cite a study in Hong Kong that found similar results when calcium was taken in addition to estrogen. A significant increase in bone mass of the femoral neck was observed when compared with the use of estrogen alone. In summation, estrogen and adequate calcium intake seem to be of greater benefit together than the sum of each effect alone. Specifically, an increase in bone mass of the femoral neck of 2.4%/year; an increase of 2.1%/year of the forearm; and an increase of 3.3%/year in the lumbar spine.

Calcium was also shown to have a greater effect when taken with vitamin D. Vitamin D aids in the absorption of calcium by allowing calcium to leave the intestine and enter the bloodstream. A dose of 400 to 800 IU/day is recommended, and massive doses are cautioned against (National Osteoporosis Foundation, 1998). In a three year study of men and women over the age of 65 using dietary supplementation of vitamin D and calcium, a moderate reduction in bone loss was observed at the femoral neck, spine

and total body as well as a decrease in the risk of nonvertebral fractures. Due to the small number of subjects, caution should be exercised when interpreting the nonvertebral fracture risk. However, similar results were observed in a French study (Dawson-Hughes et. al., 1997).

Additional research has shown that vitamin D alone can be useful in reducing bone loss. A reduction in bone loss of the femoral neck in postmenopausal women was reported, but not in the rate of hip fracture of elderly Dutch men and women when given vitamin D supplementation. A decrease in the rate of arm fractures among elderly Finnish subjects was observed following annual intramuscular injections of vitamin D (Dawson-Hughes et. al., 1997).

Exercise

In addition to an adequate intake of calcium and vitamin D, exercise should be part of an osteoporosis prevention program. An exercise prescription of 30 to 60 minutes of a weight-bearing activity three to four times/week is advised (Allen, 1993). Weight-bearing activities are ones in which the individual works against gravity such as walking, stair climbing, aerobic dance, racquet sports, and jogging (National Osteoporosis Foundation, 1998). While not a weight bearing activity, swimming has also been shown to increase bone mass (Dowd & Cavalieri, 1999). When compared with a nonexercising control group, a group of male swimmers was found to have a small increase in radial and vertebral bone mineral density (Niewoehner, 1993).

Wolff's law states that "stress or mechanical loading applied to the bone via muscle and tendons has a direct effect on bone formation and remodeling" (Layne & Nelson, 1998). Increased bone strength gained by exercise can prevent fractures. Additional benefits to an exercise program in the prevention of osteoporosis are an increase in muscle strength, flexibility, and coordination (Chesnut, 1993). However, the National Osteoporosis Foundation (1998) states that benefits of exercise only last as long as a program is maintained.

The types of exercises that should be included in a program to prevent osteoporosis are aerobic in nature. Layne and Nelson (1998) report that over the last ten years numerous studies, both cross-sectional and longitudinal in nature, have also shown a positive and direct relationship between the effects of resistance training and bone density. In contrast, few studies have shown resistance training to have little or no effect on bone density.

Results of these manifold studies supporting the existence of a positive and direct relationship between bone density and resistance training include the following information. While both aerobic and resistance training provide a weight-bearing stimulus to bone, it appears resistance training may have a more profound site specific effect. Male weight lifters have been found to have a greater BMD than nonathletes. Female athletes observed in cross-sectional studies also showed that resistance training is positively associated with bone density (Layne & Nelson, 1998).

Furthermore, the effects of resistance training and bone density have been reported in older populations. Postmenopausal women that were previously sedentary exhibited a positive effect on multiple risk factors for osteoporotic fracture after participation in resistance training (Evans, 1999). The common aspect of all these studies is a moderate- to high-intensity resistance training protocol and significant gains in strength (Layne & Nelson, 1998).

The benefits of resistance training for postmenopausal women go beyond a positive effect on bone density. A decrease in the risk for multiple risk factors for osteoporosis can be achieved through this activity. Muscle strength, balance, agility, and resilience are all critical in maintaining functional independence and resisting falls. These effects of resistance training can make a difference in a person's ability to climb stairs, rise from a chair, carry groceries, etc. (Layne & Nelson, 1998).

Hormone replacement therapy

The addition of hormone replacement therapy (HRT), or estrogen, to an osteoporosis prevention program of adequate calcium and vitamin D intake plus weight-bearing exercise makes it complete. HRT has been called the "gold standard" of therapy for the treatment of osteoporosis (Kulak & Bilezikian, 1998). After menopause, it is recommended as an antiresorptive agent to prevent bone loss (Galsworthy & Wilson, 1996 and Dowd & Cavalieri, 1999). In postmenopausal women, HRT remains the most effective measure for the prevention of osteoporosis (Andrews, 1998). In fact, the loss of bone seems to be prevented even when HRT is started 10 to 15 years after menopause (Galsworthy & Wilson, 1996). Estrogen increases the gastrointestinal absorption of calcium, thus sparing the bones as a calcium source and maintaining BMD when calcium intake is adequate (Barrett-Connor, 1992 and Dowd & Cavalieri, 1999). This adequate calcium intake is critical since it has been suggested that a greater calcium supply may be needed to fill the remodeling spaces of bone with new bone (Nieves et. al., 1998). Several studies have shown HRT is also effective in increasing bone mass and preventing osteoporotic fractures (Kessenich, 1996 and Andrews, 1998). In women who received oral estrogens for three years, a decrease in hip fracture rates of 50% was observed, and a significant decrease in crush fractures or wedge deformities of the spine was noted (Barrett-Connor, 1992).

Additional benefits of HRT include a reduction in menopausal symptoms, a decrease in the risk of colon cancer of about 50%, a decrease in the rate of death from coronary artery disease of about 30-50%, a possible decrease in the incidence of Alzheimer's disease, a decrease in tooth loss, the improvement of short-term verbal memory, and the prevention of collagen loss from the skin (Andrews, 1998).

Grodstein et. al. (1997) declared that current hormone users had a lower risk of death than subjects who had never taken hormones. However, this survival benefit was lower for women at a decreased risk for coronary disease. The inverse relationship to

coronary disease can be explained by the benefit of HRT in reducing the risk of coronary disease. This apparent benefit also decreased with long-term use of 10 years or more due to an increase in the risk of mortality from breast cancer. However, the researchers cited a hypothesis by Sturgeon et. al. that women who use hormones discontinue their use of them once they develop symptoms of a fatal disease. This would then classify them as recent or past hormone users leaving only healthy women classified as current hormone users. If this is true, the results of this study may not be valid.

The researchers also cite a study by Posthuma et. al. that reported a lower risk of some types of cancer among hormone users. It was suggested, however, that this lowered risk was not a result of the hormone therapy itself but rather a reflection of only healthy postmenopausal women being chosen for hormone therapy. While there may be validity to this suggestion, the recent studies that have found a significant reduction in the prevalence of colon cancer with hormone use cannot be ignored (Grodstein et. al., 1997).

Unfortunately, postmenopausal HRT has side effects and hazards associated with it as well as benefits. The National Osteoporosis Foundation (1998) reports side effects such as breast tenderness, weight gain, mood swings, and menstrual-like bleeding have been observed. The re-establishment of this vaginal bleeding will decrease and eventually stop, however (Andrews, 1998).

In the Nurses' Health Study, women taking hormones appeared to be at a greater risk for developing breast cancer. However, the risk for developing this cancer appeared to be greater than the risk of dying from it (Grodstein et. al., 1997). Andrews (1998) reviewed 55 studies in this area and concluded that the results of whether or not HRT increases a woman's risk for breast cancer have been inconsistent.

An increase in the risk of developing uterine cancer has also been associated with HRT. However, this risk can be offset by the concurrent administration of progestin with estrogen in postmenopausal women with a uterus (National Osteoporosis Foundation, 1998; Allen, 1993; and Andrews, 1998). This addition of progestin does not appear to

affect the efficacy of estrogen (Kessenich, 1996).

Conclusions

Osteoporosis is a major public health problem that affects the quality of life, especially for postmenopausal women. A continued effort to increase the awareness of both health care professionals and the general public about methods to prevent this disease is certainly warranted. A prevention program consisting of adequate calcium and vitamin D intake, weight-bearing exercise, and hormone replacement therapy has been shown to bring about positive results in maintaining and possibly increasing bone mass. Each of these therapeutic aspects appear to increase bone health separately, but the greatest effect has been observed when they are used together.

Chapter Three

METHODOLOGY

Subjects

Seventy-three females were chosen from volunteers registered for a screening bone density measurement through Bone Health Diagnostics of Fairfax, Virginia. Bone Health Diagnostics is a private practice specializing in rheumatology. This research was conducted with the cooperation of Bone Health Diagnostics who provided baseline data for the study.

Flyers were distributed at numerous local pharmacies and retirement homes informing women of the opportunity to receive a screening bone density measurement. Media coverage announcing an osteoporosis awareness fair with free bone density screening at a local shopping mall was also provided. Screening took place on site on the specific dates listed on the flyers and media announcements. Interested persons were asked to make an appointment in advance. From females who signed up, subjects were chosen based on meeting the following criteria: 1) at least 50 years of age, 2) postmenopausal, and 3) not currently diagnosed with osteoporosis. Individuals who did not meet the above criteria were still provided the screening bone density measurement, but were not included in the study. Subjects were required to complete and sign a consent form (See Appendix C) for Bone Health Diagnostics for the screening bone density measurement as part of Bone Health Diagnostic's protocol. An informed consent form was also completed for the study itself (See Appendix B). All subjects were assigned a numerical code and confidentiality was maintained by referring to subjects using code only.

Questionnaire completion

Prior to the screening bone density measurement, subjects were asked to complete a questionnaire (See Appendix D) concerning knowledge of measures necessary for osteoporosis prevention. The questionnaire consisted of eight questions (numbers five to twelve on the questionnaire), seven of which were multiple choice and one that was true or false. The questions focused on the major components of an osteoporosis prevention program: calcium and vitamin D intake, exercise, and hormone replacement therapy used for the preservation of bone mineral density. A score between zero and eight was assigned corresponding to the number of correct responses given on the questionnaire. Subjects were also asked to identify their primary information source on osteoporosis, and whether or not they were confident of their knowledge of the measures necessary to prevent osteoporosis. In addition, the questionnaire served as a screening tool and asked the subject's age, if they were postmenopausal, whether or not they had currently been diagnosed with osteoporosis, and if they had undergone any of several diagnostic procedures in the last five days that could interfere with the screening bone density measurement. The questionnaire scores of females, meeting eligibility criteria, were used in the study. Subjects with questionnaire scores of zero to five were classified as demonstrating an "inadequate knowledge of osteoporosis preventive measures," while subjects with questionnaire scores of six to eight were considered to possess an "adequate knowledge of osteoporosis preventive measures." These parameters were determined based on what is considered a reasonable score by academic standards. Five or less correct out of eight is the equivalent of 63% or less.

Screening bone density measurement

Upon completion of the questionnaire, each subject underwent a screening bone density measurement. The test was performed on site by a nurse practitioner employed by Bone Health Diagnostics of Fairfax, Virginia. The Norland pDEXA Bone

Densiometer was used. Due to its small size, the machine is portable. A scan was made of the distal radius in the wrist. The subject was asked to remove any items that may interfere with the test such as a bracelet or watch. According to Kanis and the World Health Organization Study Group, all tests regardless of whether they measure bone density of the wrist, hip, or spine provide important information to assess fracture risk (Norland Medical Systems, 1998). The subject then sat and placed her dominant arm under the Norland pDEXA Bone Densiometer. The subject was asked to remain still during the two or three minute duration of the test. Adjustable straps were also used to prevent movement. A printout of the subject's T-score was produced at the end of the test. The T-score compared bone density of the subject to that of the mean bone density of healthy young women of the same race who have reached peak bone mass. Both the size and direction of the T-score are indications of bone health. In other words, positive scores are better than negative scores. A T-score of -1.0 or less suggests the subject may need therapy. The T-scores of females, meeting eligibility criteria, served as the baseline data for this study.

Research Design and Statistical Procedures

Awareness of osteoporosis preventive measures as determined through completion of the questionnaire was rated on a scale of zero to eight. A score of five out of eight (63%) or less was considered to demonstrate an inadequate awareness of the measures necessary to prevent osteoporosis. T-scores from the bone density screen were standardized scores ranging from a -3.99 to +3.99. A score of -1.0 or less was considered to indicate possible poor bone health. The World Health Organization provides the interpretation for T-scores in Table 1.

Table 1. World Health Organization T-score interpretation

T-Score	Interpretation
>-1	Normal bone density
-2.5 to –1	Osteopenia - moderate fracture risk
<-2.5	Osteoporosis - high fracture risk

The frequency of each score was determined and a frequency distribution was constructed. Percentages were then calculated for the questionnaire scores, the perceived confidence responses, and osteoporosis information source responses.

A Pearson Product Moment Correlation, or Pearson r, and a scatter plot were used to determine the correlation between the overall questionnaire score and bone density T-scores. A Pearson r is used to determine the correlation between two sets of data. The correlation is given using the variable r which will range in value from -1.0 to 1.0. The closer r is to 1.0 in either the direction, the stronger the relationship. A scatter plot is a visual representation of where data falls. High concentrations in the shape of a diagonal parabola to either the left or right indicate a strong correlation. Descriptive statistics of mean and standard deviation were also used since correlation by itself is an incomplete description of two-variable data (Moore, 2000).

T-tests were then conducted for each individual question to establish if a significant difference existed between the average bone densities of individuals who answered the question correctly, and those who answered the question incorrectly. The function of a t-test is to establish the existence of a difference when dealing with the means, or averages, of two sets of data. A t-test was also used to determine the difference between the subjects' perceived and actual awareness of osteoporosis preventive measures.

When determining if a significant difference existed between the subjects' source of information and the mean questionnaire score, a one way analysis of variance, or ANOVA, was used. An ANOVA is used when dealing with multiple means as was the

case with data concerning the subjects' main source of information on osteoporosis.

Chapter Four

RESULTS

Data collection

Upon completion of the study, 73 subjects met eligibility criteria and were included in the research project. Data was collected at a retirement community as part of a health fair, and at a shopping mall as part of an osteoporosis awareness fair. After the first set of data was collected, an additional response choice of "I don't know" was added to the questionnaire (See Appendix D). This was done after a number of subjects stated that they couldn't answer a question because they didn't know the answer. All subjects were female, at least 50 years of age, postmenopausal, and had not been diagnosed with osteoporosis as of the collection date. Copies of individual bone density screens with T-scores were then obtained from Bone Health Diagnostics, and completed questionnaires were evaluated and scored.

Statistical analysis

The frequency of each score was determined and can be found in Table 2. Overall, 56 of the 73 subjects surveyed received scores of five or less, and thus were classified as possessing an inadequate awareness of osteoporosis preventive measures. Classification was based on scores of less than 65% generally viewed as failing by academic standards. This is equivalent to almost 77%, and supports Hypothesis I which states, "More of the women surveyed will be unaware of the measures necessary to prevent osteoporosis than less of the women surveyed."

Further statistical analysis revealed a mean score of 4.3 and a standard deviation of 1.71. The mean of 4.30 translates to a score of 54%. This definitely qualifies as demonstrating an inadequate knowledge of osteoporosis preventive measures for the group as a whole and provides further support for Hypothesis I.

Table 2. Questionnaire score frequency distribution

Questionnaire Score	Frequency	Percent	Cumulative Percent
0	3	4.1	4.1
1	3	4.1	8.2
2	5	6.8	15.1
3	7	9.6	34.7
4	17	23.3	47.9
5	21	28.8	76.7
6	12	16.4	93.2
7	5	6.8	100.0
8	0	0	100.0
Total	73	100.0	100.0

To test Hypothesis II, the Pearson r was used to determine the correlation between the subject's questionnaire score and her bone density T-score. A correlation, or r =.14, was calculated which indicated virtually no relationship since it was not close to 1.0 in either direction (See Figure 1). Furthermore, no real concentration or direction was observed in the scatter plot that was constructed and concurred with this finding (See Figure 2).

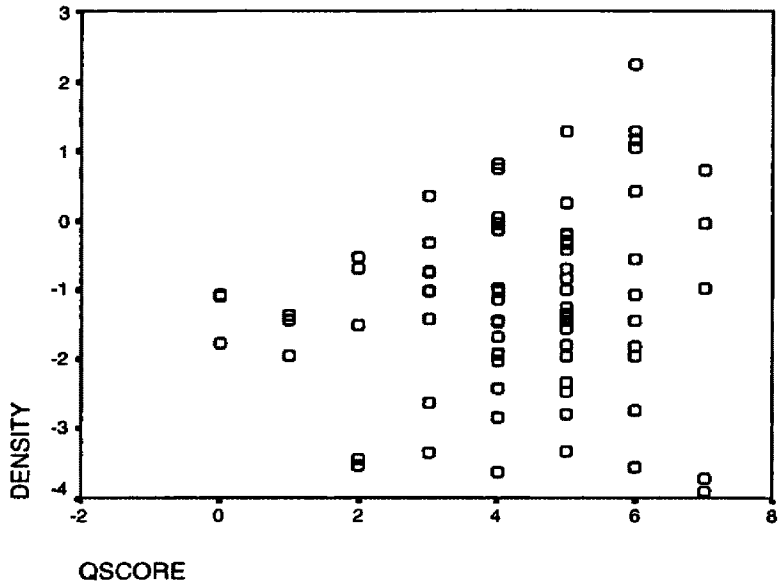
Figure 1. Results of Pearson r

Correlations

		QSCORE	DENSITY
QSCORE	Pearson Correlation	1.000	.141
	Sig. (2-tailed)	.	.235
	N	73	73
DENSITY	Pearson Correlation	.141	1.000
	Sig. (2-tailed)	.235	.
	N	73	73

These statistics do not support Hypothesis II which states, "The bone density of women unaware of the measures necessary to prevent osteoporosis will be less than the bone density of women who are aware of osteoporosis preventive measures."

Figure 2. Scatter plot results of Pearson r showing relationship between questionnaire score and bone density T-score



T-tests were then conducted for each separate question to see if a significant difference existed between the average bone densities of individuals who answered the question correctly, and those who answered the question incorrectly (See Table 3). For questions five and six that dealt with calcium intake, the t-tests revealed no significant difference. Question seven asked about Vitamin D intake. Surprisingly, subjects who answered the question incorrectly, had a higher mean bone density than those who answered it correctly. No significant difference was found to exist between Question eight, which dealt with the function of Vitamin D, and the mean bone density of the subjects studied. The t-test performed for Question nine did reveal a difference with the mean bone density of subjects who answered the question incorrectly being -1.43, and -0.83 for those who answered it correctly. However, p=.08 which is rather large. This question was concerned with hormone replacement therapy and its effectiveness in

preventing osteoporosis. Question ten also dealt with hormone replacement therapy, and no significant difference was found to exist using the t-test. Questions eleven and twelve were related to exercise and its role in preventing osteoporosis. Subjects who answered Question 11 incorrectly had a mean bone density score of -1.41 while subjects who answered it correctly had a mean bone density score of -0.74. This appears to show some difference between knowledge of exercise in prevention of osteoporosis and bone health, but p=.09 and is somewhat large. For the second question dealing with exercise, p=.04 was calculated which is much smaller. A difference was observed here with the mean bone density score of individuals who answered the question incorrectly being -1.83 as compared to -1.05 for those who answered correctly.

Table 3. Summary of t-test results for individual questions

Question #	Osteoporosis prevention program component	Mean T-score of subjects who answered incorrectly	Mean T-score of subjects who answered correctly	p value
5	Calcium intake	-1.22	-1.20	.95
6	Calcium intake	-1.11	-1.27	.61
7	Vitamin D intake	-.98	-1.86	**.03**
8	Vitamin D intake	-1.34	-1.14	.52
9	Hormone replacement therapy	-1.43	-.84	**.08**
10	Hormone replacement therapy	-1.41	-1.16	.45
11	Exercise	-1.41	-.74	**.09**
12	Exercise	-1.83	-1.05	**.04**

Because the main objective of this project was to determine awareness of osteoporosis prevention measures, two areas of interest related to awareness were

studied. The first was the subjects' source of information on the disease, and the second was if the subjects were confident of their knowledge of how to prevent osteoporosis.

In regards to their primary source of information on osteoporosis, 12% reported a family member or friend, 52% chose the media, 30% felt their physician was their main source, three questionnaires contained no response to the question, and one chose all three of the above (See Table 4).

Table 4. Subject self-reported information source on osteoporosis

Information source	Number of subjects reporting	Percent of total subjects
Family member/ friend	9	12%
The media	38	52%
Your physician	22	30%
Your pharmacist	0	0%
No response	3	4%
Multiple sources	1	1%

A one way analysis of variance, or ANOVA, was conducted to see if there was a connection between the subjects' source of information on osteoporosis and the mean questionnaire scores. No significant difference was observed between the subjects' source of information and the questionnaire score using the one way ANOVA ($p=.14$). However, mean questionnaire scores of the subjects, regardless of the reported information source, all demonstrate an inadequate knowledge of osteoporosis preventive measures. Subjects that did not choose an information source, or multiple sources were not included in the statistical analysis (See Table 5).

Table 5: Source of information and corresponding mean questionnaire score

Number of subjects reporting	Source of information	Mean questionnaire score
9	Family member/friend	3.6
38	The media	4.7
22	Your physician	4.4

When the subjects were asked whether or not they were confident of their knowledge of the steps to take to prevent osteoporosis, 53% answered yes, 45% responded no, and one questionnaire contained no response to the question. In addition, a t-test was conducted to see if a difference existed between the subjects' self-reported confidence, or lack of confidence, in their knowledge of how to prevent osteoporosis and their mean questionnaire scores. A p=.03 was calculated showing a difference between the subjects' confidence level in their knowledge of how to prevent osteoporosis and the mean questionnaire scores. The mean questionnaire score of subjects who reported feeling confident was 4.7 versus 3.9 for those who did not feel confident. While both mean scores still qualify as inadequate knowledge of osteoporosis preventive measures, subjects that were confident of their knowledge on the subject did obtain higher scores on the questionnaire (See Table 6).

Table 6. Perceived confidence vs. actual confidence of subjects concerning knowledge of how to prevent osteoporosis

Number of subjects reporting	Confident in knowledge of how to prevent osteoporosis?	Mean questionnaire score
39	Yes	4.7
33	No	3.9

Summary of results

Seventy-seven percent of the women studied demonstrated an inadequate knowledge of measures necessary to prevent osteoporosis. While an insignificant relationship was found to exist between a woman's overall awareness of how to prevent the disease and her bone health (r=.14), significant differences between certain aspects of an osteoporosis prevention program and bone health existed, specifically in the areas of hormone replacement therapy and exercise.

Concerning sources of information on osteoporosis, 30% of the subjects studied reported their physicians and 52% felt the media was their main source. Regardless, no significant difference was found to exist between the source of the subjects' information and their bone health.

A significant difference was found, however, between the subjects' perceived confidence of how to prevent osteoporosis and actual confidence as demonstrated by her questionnaire score.

Chapter Five

DISCUSSION

Relevance of findings

More and more, osteoporosis, a disease affecting millions of women and men, is regarded not only as a treatable, but also a preventable disease. This research supports the idea that a lack of awareness concerning certain preventive measures, specifically in the areas of hormone replacement therapy and exercise, may contribute to this.

Previous studies have shown that women were unaware of their risk of *developing* osteoporosis (Dowd & Cavalieri, 1999 and Pal, 1999). This study has contributed to the body of knowledge concerning osteoporosis by establishing that women were also unaware of what they could do to *prevent* it. While adolescents and young adults are being assessed and educated concerning their practice and knowledge of osteoporosis preventive measures, it is possible that older, postmenopausal females are being ignored (Lysen & Walker, 1997 and Weiss & Sankaran, 1998). This is unfortunate considering that current research has shown positive effects both on reducing bone loss and decreasing fractures in postmenopausal individuals when following different aspects of an osteoporosis prevention program (Dawson-Hughes et. al., 1997). Clearly, this population of postmenopausal females needs to be included when educating the public on preventive measures.

In regards to educating this target group, it is beneficial to consider what the participants report as their main source of information on osteoporosis. Fifty-two percent of the women in this study listed the media as their primary source. This is much larger than the 22% of college females that reported the media as their primary source of information in a previous study (Weiss & Sankaran, 1998). In order to promote greater awareness using the media, both the quality and the quantity of information disseminated

to postmenopausal women needs to be increased.

The media could also prove to be a useful tool in encouraging women to speak to their physicians about the disease. Physicians should be prepared to deal with these questions, and should include counseling on how to prevent osteoporosis, halt, or slow bone loss as part of routine check-ups of women even after they have reached menopause. Only 30% of the women who completed the survey listed their physician as their primary source of information on the disease. This coincides with an earlier Gallup Survey in which only 25% of women in approximately the same age group had spoken to their physician about osteoporosis (National Osteoporosis Foundation, 1998), but is larger than the 12% reported in a British study of recent fracture patients (Pal, 1999). This is the case in spite of the recommendation by experts in the field that physicians and health care professionals play a strong role in educating individuals about the disease (Allen, 1993 and Weiss et. al., 1998)

Regardless of their information source, 53% of the women in this study felt confident of their knowledge of how to prevent osteoporosis. While this is not a devastatingly low number, it does not coincide with questionnaire scores. None of the women received a perfect score, and only 23 % received a score that was considered to represent an adequate awareness of how to prevent the disease (See Table 1). This compounds the problem. Not only does it appear that many women actually do not know what they can do to prevent the disease, some of them are under the misconception that they do know. A discrepancy exists between perceived and actual awareness. A $p=.03$ was calculated from a t-test and shows a significant difference between the mean questionnaire scores of women who are confident of their knowledge of how to prevent osteoporosis, and those who are not.

This lack of awareness, however, is not the only factor contributing to bone health. Genetics, race, frame size, allergies, and certain medical conditions are all uncontrollable risk factors for osteoporosis. Therefore, any one of these, or a

combination of them, could result in a low bone density regardless of the subject's knowledge of how to prevent osteoporosis. This could be responsible in part for the lack of correlation between a subject's awareness as determined by the questionnaire score and her bone density. Also contributing to this could be the subject's lifestyle. For example, a woman may have a diet rich in calcium and Vitamin D, perform weight-bearing exercise, and be on prescription hormone replacement therapy for reasons other than osteoporosis prevention. In fact, she may do this without even being aware that these are all part of an osteoporosis prevention program. This too could contribute to the lack of correlation observed in this study.

However, when individual questions were analyzed for a connection to bone health, some differences in the areas of hormone replacement and exercise were found. Hormone replacement therapy is regarded as the most effective measure for the prevention of osteoporosis in postmenopausal women (Andrews, 1998). Nevertheless, only 27 of the 73 women surveyed, or 37%, were aware of this based on their answer to question nine (See Appendix D). Also, the mean bone density of the 63% who answered the question incorrectly was -1.43 as compared to -0.84 for those who answered it correctly. It is suggested that a bone density T-score of -1.0 or less requires therapy. A p=.08 was associated with this statistic which is somewhat large and therefore warrants caution when interpreting, however.

In the area of exercise, subjects were asked to choose which form was least likely to maintain bone mass (See Appendix D) in order to determine knowledge of what constitutes weight-bearing exercise. Only 22 of the 73 subjects, or 30%, answered the question correctly. The mean bone density of these individuals was -0.736 as compared to -1.41 for those who answered the question incorrectly. A p=.09 was calculated for this statistic and is once again somewhat large. This needs to be taken into consideration when determining significance of the difference. Subjects were also asked why exercise was helpful in the prevention of osteoporosis (See Appendix D). While more women

answered correctly than incorrectly, the average bone density of women who answered incorrectly was -1.83 as compared to -1.05 for those who answered correctly with p=.04. This value is smaller than the ones seen previously, and certainly is indicative of a more significant difference.

In summary, while a significant correlation between the overall questionnaire score and bone density was not observed, differences were observed between questions that dealt with specific components of an osteoporosis prevention program and the bone density score. These areas of hormone replacement therapy and exercise require further study.

Implications for future research

Seventy-seven percent of the women surveyed demonstrated an inadequate knowledge of measures necessary to prevent osteoporosis. This is similar to the 72% of women previously found to be unaware of their risk of getting this disease (Dowd & Cavalieri, 1999). This noted relationship between these two findings could be investigated through further research.

In addition, while no significant correlation was found to exist between a subject's awareness of how to prevent osteoporosis and her bone health, refining the questionnaire should provide more information. Including an answer choice of "I don't know" in all questionnaires may help to eliminate correct answers that were obtained by guessing. Furthermore, while the pattern of the scatter plot does not suggest that a larger sample would provide a different result, increasing the sample size is a possibility. Cost seems to be a determining factor in a subject's willingness to participate in the bone density screening measurement, and hence in determining sample size. Both instances of data collection included free screenings for this study. Additional screenings would have required a charge, and a lack of interest was observed when attempting to schedule these. However, Medicare has recently approved coverage of bone density screenings. Since many of the women being studied may be covered by Medicare, this could help alleviate

the situation. Also, a variety of pharmaceutical companies now have medications approved for treating osteoporosis and may be interested in subsidizing the cost of research in this area in order to promote awareness of their product. By eliminating the cost of the procedure to the subject, sample size could be increased.

These future studies could also focus on the hormone replacement and exercise components of an osteoporosis prevention program. Differences between a knowledge of these and the subjects' bone health were observed in this study, and continued research could help to determine the significance of these differences.

Continued and increased promotion of how to prevent osteoporosis by national and international groups such as the National Osteoporosis Foundation, the National Institutes of Health, and the World Health Organization will continue. The result of this should be an increase in awareness of what can be done to prevent osteoporosis. Future studies similar to this one could help assess to what extent awareness increases as these organizations continue their work. Since a majority of women chose the media as their main source of information, it is likely an increase would be seen.

Studying physicians' knowledge of osteoporosis preventive measures, and what amount of counseling they are giving patients in the area of osteoporosis prevention is also an area to research. This study supported previous findings in which physicians are not sited as primary sources of information in spite of recommendations to the contrary by researchers in this field. The education of health care providers may also be warranted to increase knowledge in this area.

This education of the public through the media and health care providers may also decrease the discrepancy between the perceived and actual awareness of osteoporosis measures observed in this study. Future studies similar to this one could help to assess not only to what extent awareness increases, but also if the discrepancy between perceived and actual awareness decreases.

As suggested previously, educating women of all ages concerning the components of an osteoporosis prevention program is certainly warranted. Taking it a step further and studying to what extent awareness relates to actual practice would also be a valid direction in which to take this research.

APPENDIX A

Osteoporosis
Are You at Risk?

Osteoporosis Screening will be available on Wednesday, May 5th, 1999 – 10:00am-4:00pm at

The Medicine Shoppe* 6960 Braddock Rd. – Annandale, Va

Advance appointments are required.

Sign up at the front desk or Call (703) 941-1410

Screening P-DEXA scans typically cost about $100 in a physician's office/hospital.

This screening is being offered at a special rate of $35.

Sign-up Today to Have a Screening Bone Density Measurement.

Osteoporosis
Are you at risk?

Osteoporosis is not just a concern for senior citizens.

Did you know that at the ripe "old" age of about 30 your bone balance shifts to greater bone loss than formation? "After 25 to 30 years of age the bones have reached their peak bone mass" reports Dr. Leila Zackrison a Rheumatologist and Osteoporosis specialist in Fairfax, Virginia.

From that point on bones are susceptible to a degeneration process and the early stages of Osteoporosis can begin. Osteoporosis is a condition in which bone mass (also known as bone strength or bone density) decreases to the point where loss of height and fractures occur.

WHO IS AT RISK?

Caucasian, Asian and Hispanic females are at the highest risk for Osteoporosis. But, many people do not realize that 20% of individuals diagnosed with Osteoporosis are **men**! Other risk factors include poor nutritional habits; lack of exercise, a family history of Osteoporosis, being small framed as well as eating disorders (Anorexia nervosa). Certain illnesses and medications such as steroids, thyroid medications and anticonvulsants can also increase an individual's risk for Osteoporosis.

Most importantly, a person's bone density is not visible or apparent. Bone loss is silent and occurs without symptoms. To identify individuals at risk for Osteoporosis, it is necessary to have a **BONE DENSITY TEST**. The test is quick and painless.

PREVENTION:

Osteoporosis is a **preventable** disease if identified in its early stages. Many physicians agree that the key to prevention is to have a screening bone density measurement after the age of 30. This test is classified under preventative medicine in most cases.

Most experts agree that it is very unlikely that an individual will continue to build bone density after the age of 30. However, maintaining healthy bone density levels are best achieved through regular weight bearing exercise (i.e. brisk walking, jogging, etc.), proper nutrition, absorbable calcium supplementation, and certain approved medications if indicated.

RISK APPRAISAL - Questionnaire (Check Yes or No)

1. Are you female?	☐ Yes ☐ No
2. Are you Caucasian, Asian or Hispanic?	☐ Yes ☐ No
3. Do you have a small frame?	☐ Yes ☐ No
4. Do you eat less than 3 servings of dairy per day?	☐ Yes ☐ No
5. Do you exercise less than 4 times a week for less than 30 minutes?	☐ Yes ☐ No
6. Do you smoke cigarettes or drink alcohol in excess?	☐ Yes ☐ No
7. Do you have a history of osteoporosis in you family?	☐ Yes ☐ No
8. Do you have a history of hip, wrist or spinal fractures in your family?	☐ Yes ☐ No
9. Do you have or have you had an eating disorder?	☐ Yes ☐ No

The more times you answer "yes" the greater your risk for developing osteoporosis.

APPENDIX B

Informed Consent Form

The purpose of this study is to assess if a person's awareness of measures to prevent osteoporosis is related to her bone health. The information that is collected from this investigation may help to further the awareness of osteoporosis prevention and increase the use of preventive measures by women to ensure good bone health.

Participation in this study will include responding to questions asked while having the screening bone density measurement performed and will take approximately five minutes to complete. These questions will include information on measures necessary to prevent osteoporosis.

No expected risks, discomforts, or benefits are expected with this study. Your decision to take part in this research study is entirely voluntary and you may withdraw at any time.

All data collected will remain confidential. Only the researcher and her faculty supervisor will have access to the files. Your name will not be associated with the study in any way.

Any questions may be addressed to Kathy A. Schneider, 12552 LeVau Court #106, Fairfax, VA 22033, phone number (703)322-9004. Questions may also be addressed to C. Gene Burns, Ph.D., Department of Health and Human Performance Chair, McGill Hall, University of Montana, Missoula, MT 59812, phone number (406)243-5241.

Although we do not foresee any risk in taking part in this study, the following liability statement is required in all University of Montana consent forms:
"In the event that you are injured as a result of this research you should individually seek appropriate medical treatment. If the injury is caused by the negligence of the University or any of its employees, you may be entitled to reimbursement or compensation pursuant to the Comprehensive State Insurance Plan established by the Department of Administration under the authority of M.C.A., Title2, Chapter 9. In the event of a claim for injury, further information may be obtained from the University's Claims representative of University Legal Counsel."

I have read the above description of this research study. I have been informed that there are no expected risks or benefits involved, and all my questions have been answered to my satisfaction. Furthermore, I have been assured that any future questions that I may have will also be answered by a member of the research team. I voluntarily agree to take part in this study and give permission to the researcher to obtain my bone density screening measurement. I understand I will receive a copy of this consent form.

_____
Printed name of subject

_____
Subject's signature

_____
Date

APPENDIX C

Bone Density Testing Consent Form

I understand that I have elected to have the DEXA bone density test to be performed at my request:

- The screening is a non-invasive procedure that uses the portable pDEXA or Apollo instrumentation
- The procedure will require me to be seated, but remain still. I should not experience any discomfort
- I am required to place my non-dominant arm on the surface of the pDEXA or in the case of the Apollo, place my non-dominant heel in the mouth of the DEXA instrument.
- I understand that the DEXA instruments use a very low dosage of X-Ray with an exposure signifi cantly less than a standard chest X-Ray (equivalent to 1/20th of that dosage received). The X-Ray will pass through my forearm on the pDEXA or through my heel on the Apollo.
- I understand that the X-Ray exposure may be harmful to a developing baby. If I am or may be pregnant, I must inform the technologist and not participate.
- I understand the DEXA instruments being used for this screening are approved by the FDA for general clinical use.
- I understand that the results of the above screening procedure will be made available to me immedi ately to consult with my physician. No medical advice will be dispensed to me at any time by the screening technicians.
- I understand that participation in this screening procedure will not prevent me from having os teoporosis.
- I understand I am responsible for any follow-up examinations with my physician.

Please answer "True" or "False" to the following questions:

_____I am female? _____I am Caucasian or Asian? _____I am over age 45?

_____I do/have smoked tobacco? Past? _____I do/have drank alcohol? Past? _____I do not take calcium?

_____I have a family history of osteoporosis? _____I have rheumatoid arthritis?

_____I do not exercise on a regular basis? _____I do not eat healthy on a regular basis?

_____I have had an eating disorder in the past? _____I do not consume 3 + dairy servings per day?

_____I have/do take one or more of the following medications: Steroids, Prednisone, Cortisone, Thyroid, anti-convulsants, hormones, or any of the approved osteoporosis medications)?

I understand that I must answer "TRUE" to three or more of the osteoporosis RISK factors listed above in order to have a bone density test today. I have read, understood and accept the above statements.

Signature_____Date_____

Please Print Name_____Date of birth_____

_____Are you right handed? What ethnic origin are you?_____
_____Are you left handed? Height_____Weight_____

Do you frequently visit this screening site for other reasons? _____YES _____NO

APPENDIX D

Osteoporosis Survey

Instructions: Please respond to the following by circling the one that is most correct answer for each question.

1. What is your age?
   A. 30-39
   B. 40-49
   C. 50 years & older

2. How long has it been since your last menstrual period?
   A. Less than 12 months
   B. 12 months or more

3. Have you been diagnosed with osteoporosis?
   A. Yes
   B. No

4. Circle any of the following procedures you have undergone within the last five days:
   A. MRI
   B. Barium enema
   C. X-ray
   D. CT scan
   E. Angiogram
   F. Myelogram

5. In which range does the recommended daily calcium intake for postmenopausal women fall?
   A. 500-800 mg
   B. 801-1200 mg
   C. 1201-1500 mg
   D. 1501-2000 mg
   E. I don't know

6. In order to increase calcium absorption, it is best to:
   A. Take all of the recommended calcium in one dose
   B. Divide doses of calcium and take throughout the day
   C. I don't know

7. The current recommended daily intake of Vitamin D is:
   A. 100-400 IU
   B. 401-800 IU
   C. 801-1000 IU
   D. I don't know

8. What is the function of Vitamin D in the prevention of osteoporosis?
   A. It increases the absorption of calcium
   B. It increases the rate at which bone if formed
   C. It decreases the rate at which bone is broken down
   D. I don't know

9. What is the most effective measure for the prevention of osteoporosis in postmenopausal women?
   A. Calcium intake
   B. Estrogen replacement therapy
   C. I don't know

10. Postmenopausal estrogen replacement therapy has both benefits and hazards associated with it.
    A. True
    B. False
    C. I don't know

11. Which exercise is least likely to help maintain bone mass?
    A. Walking
    B. Swimming
    C. Weight lifting
    D. I don't know

12. Exercise is helpful in the prevention of osteoporosis because:
    A. It promotes weight loss
    B. It increases muscle strength
    C. It helps to strengthen bone
    D. I don't know

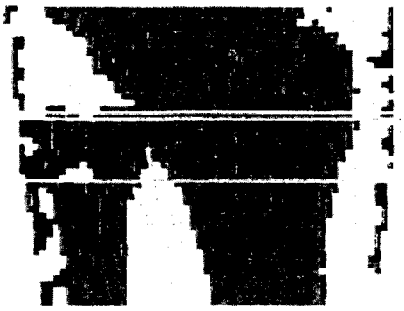
13. What is your primary source of information on osteoporosis?
    A. Family member / friend
    B. The media
    C. Your physician
    D. Your pharmacist

14. Are you confident of your knowledge of the steps to take to prevent osteoporosis?
    A. Yes
    B. No

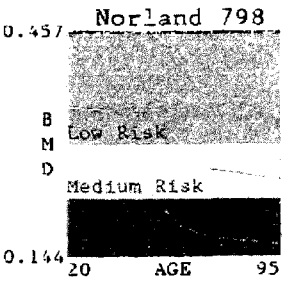
APPENDIX E

ID 3809 *Sex* Female *Ethnic* Caucasian *Height* *Weight*

L H L Forearm on 06/30/99 14:41

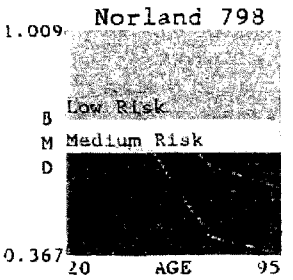


Dist. R+U Caucasian
Norland 798



06/30/99 0.154

Prox. R+U Caucasian
Norland 798



06/30/99 0.468

% Young Ref.	44.0	% Young Ref.	57.2
T - Score	-3.91	T - Score	-5.57
% Age Matched	58.7	% Age Matched	76.8
Z - Score	-2.32	Z - Score	-1.42

Bone image not for diagnosis

	BMD g/cm²	BMC g	LENGTH cm
Dist. R+U	0.154	0.722	1.00
Prox. R+U	0.468	1.077	1.00
Prox. R	0.463	0.573	1.00

STD CV for Distal R+U BMD: 1.4 See Guide for other CVs.
1.0 x 1.0 mm, 24 mm/s, 6.00 cm Rev. 3.8.0/1.1.1 Calib. 06/29/99

COMMENTS

NORLAND

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