Knowledge, Causes, and Risk Factors Associated with Fractures in the Elderly Population at Hospital Zacamil in El Salvador

Melissa Martinek

Dissertation submitted to the faculty of the Virginia Polytechnic Institute and State University in partial fulfillment of the requirements for the degree of

Doctor of Philosophy
In
Education, Curriculum & Instruction

H. Dean Sutphin
Kerry Redican
Delmas J. Bolin
Barbara Lockee

January 31, 2011
Blacksburg, Virginia

Keywords: osteoporosis, fractures, elderly, El Salvador

Knowledge, Causes, and Risk Factors Associated with Fractures in the Elderly Population at Hospital Zacamil in El Salvador

Melissa Martinek

ABSTRACT

As the Salvadoran population's life expectancy increases, fractures among the elderly are also increasing. There is a dearth of data available on the incidence and cause of fractures in the elderly within developing countries including El Salvador. Inadequate knowledge about bone health and osteoporosis among the elderly is contributing to health issues in the aging population. The purpose of this study was to investigate incidence, knowledge, causes, and risk factors affecting elderly patients admitted for fractures at Hospital Zacamil in order to develop programs targeted to prevention. Study objectives included: 1) determine incidence, causes, and treatment of elderly fractures including hip fractures, vertebral fractures, and forearm fractures and related post-morbidity and/or mortality; 2) compare patient knowledge, cause, treatment of fractures and related post-morbidity and/or mortality among those aged 45 to 65 years with those over 65 years; 3) determine the level of knowledge and presence of risk factors for fractures and osteoporosis among patients including diet, exercise, and environmental risk factors and compare by gender. The research was approved by IRB prior to data collection. The methodology included a researcher-designed and validated survey administered to an accepting sample of 155 patients presenting with fractures to Hospital Zacamil between January 2008 and May 2008. The data were analyzed with SPSS software. Findings indicate that the incidence of fractures in the study sample and those in developed countries are similar. Knowledge and presence of risk factors are similar by age and gender within the study sample. The primary conclusion was that education is needed to prevent falls and osteoporosis. Recommendations for further research include recognition of culturally-specific factors in prevention education and further study of the

methods of addressing prevention in the specified population and the outcomes of the educational intervention.

Dedication

To the journey may it be traveled with passion.

Acknowledgements

I would like to thank those at the Edward Via Virginia College of Osteopathic Medicine who helped me keep my passion for travel during medical school. Dr. Joe Cacioppo, thank you for always letting us travel along with you. Dr. Dixie Tookie-Rawlins, thank you for seeing something in my interview to allow me to be a part of VCOM's inaugural class and for the opportunity of this fellowship program. H. Dean Sutphin, thank you for pushing me along and all the encouragement. To everyone at the mission sites, thank you for taking me into your country and allowing me to be a part of your world.

To all the patients who have let me practice medicine, thank you. I have learned more from you than a library of books.

To Katie Lively Swartz thank you making this process and medical school so much fun and for being an excellent travel companion.

Thank you to my motivator, Angela, for encouragement and being a big reason for my finished dissertation. Most importantly, thank you for believing in me.

Thank you to my family for always being supportive. Thank you to my grandparents, Evelyn and Ken for demonstrating determination and hard-work and for always being behind me even though they would rather I never leave the country. Thank you to my parents, Wyman and Tami for endlessly supporting my endeavors no matter how crazy they may be, and for all your love and encouragement which has enabled me to pursue my goals.

Table of Contents

List of Tables

List of Figures

Chapter 1. Introduction

Background

Fractures among the elderly contribute significantly to morbidity and mortality in the United States and throughout the world. Many of the fractures can be attributed to osteoporosis, an increasing public health concern (Johnell & Kanis, 2006). Osteoporotic fractures are responsible for 0.83% of the disability in the world attributable to non-communicable diseases (Johnell & Kanis, 2006). Recognizing the impact of osteoporosis, the World Health Organization (WHO) has created a task force and committees to examine the problem and to evaluate the projected impact of osteoporosis and fractures on an aging world population (Johnell & Kanis, 2006). In addition, 2000-2010 has been designated as a decade devoted to the focus of musculoskeletal conditions around the world. This worldwide initiative includes 750 organizations, 63 national governments, the WHO, United Nations, and the Vatican (Bone and Joint Decade, 2009).

To date, the majority of studies of fractures among the elderly have focused primarily on the United States and other developed nations. Little data exists on the impact of fractures among the elderly and on osteoporotic fractures in much of the developing world. The Public Health and Social Assistance Ministry of El Salvador also lacks statistical data documenting the prevalence of elderly fractures or osteoporosis. Nonetheless, available global data demonstrate that fractures have been a high cause for morbidity and mortality among the population even in developing nations (Johnell & Kanis, 2006).

Of the three typical fractures that usually occur from osteoporosis (hip, vertebral, and distal radius), research in the United States has shown hip fractures result in the most detrimental and long lasting disability and morbidity, and the greatest mortality(Rockwood & Green, 2001).

In 1990, an estimated 1.7 million hip fractures were documented worldwide. This is concerning because in the year following hip fractures, the mortality rate is 17-37% (Morales-Torres & Gutierrez-Urena, 2004). Hip fractures occurring each year are predicted to increase as the life expectancy increases. Recent estimates predict there will be 2.5 million hip fractures worldwide in 2025 and an estimated 4.5 million by 2050 (Gullberg, Johnell, & Kanis, 1997).

In addition to affecting the health of individuals, osteoporosis and fractures among the elderly place a significant financial and human resource burden on health care systems. The economic costs associated with treatment, hospitalization, surgery, outpatient care, disability, and premature death all contribute to rising health care costs. The economic costs associated with fractures are especially detrimental to health systems in developing countries, where resources are particularly scarce. More research and education are needed to prevent the development of osteoporosis along with other causes of fractures among the elderly, particularly in developing countries that lack resources and the personnel to conduct research and disseminate results.

Statement of the Problem

Fractures among the elderly in El Salvador are increasing as the population's life expectancy increases. Inadequate knowledge of bone health, osteoporosis, and fracture risk factors leaves the aging population ill-prepared for the health issues that may lie ahead and lacking information for their preventive care.

Purpose

The purpose of this study was to investigate incidence, knowledge, causes, and risk factors affecting elderly patients admitted for fractures at Hospital Zacamil in San Salvador, El Salvador in order to develop programs targeted to prevention. This information will be used to enhance the knowledge base available to medical professionals providing treatment and to develop an educational program to advance the knowledge of the general public and reduce the incidence of fractures.

Research Objectives

The research objectives were to:

1. Determine the incidence, causes, and treatment of elderly fractures including hip fractures, vertebral fractures, and forearm fractures and related post-morbidity and/or mortality.
2. Compare patient knowledge, causes, treatment of fractures, and related post-morbidity and/or mortality among those aged 45 to 65 years with those over 65 years.
3. Determine the level of knowledge and presence of risk factors for fractures and osteoporosis among patients including diet, exercise, and environmental risk factors and compare them by gender.

Significance of the Study

Statistics on the prevalence and causes of fractures among the elderly in developing countries are limited. This study will provide Salvadorian officials quantitative data to aid in increasing the knowledge base about fractures in this specific population. Elderly fractures are a major public health problem worldwide accounting for a significant amount of morbidity and mortality. Mortality rates in the year following a fracture are estimated at 23-30% in North and South America (Genant et al., 1999).

This study will also evaluate the degree of knowledge of osteoporosis in the defined patient population. This will provide a baseline for the current level of knowledge on osteoporosis and will identify gaps where additional education is needed. Findings, conclusions, and recommendations will aid in advancing health care in El Salvador by increasing knowledge about osteoporosis and fractures in the elderly.

Limitations of the Study

This study is limited because it focused only on the specific population of patients admitted to the department of orthopedics at Hospital Zacamil in San Salvador, El Salvador between January 2008 and May 2008. It is also limited by the relatively homogenous ethnicity of the patient sample. Also, the study population was limited to consenting patients only, as patients were invited but not required to participate in the program. Another limitation was the risk factors selected for analysis. The chosen risk factors were identified from research performed in the United States and may not include risk factors that are unique to the Salvadorian population. Absence of medical records within the El Salvador health system limits access to patient history except through direct response from the patients. The health care system and culture in El Salvador limited further follow up with the population. Due to this limitation, all data collection had to occur in one interview. Another limitation was language barrier. In order to decrease the language barrier, specific measures were taken to translate and administer the surveys. The survey form content validity was established by a panel of experts. English and Spanish versions of the instrument were developed. The initial translation was performed by a fluent Spanish speaker with English as a first language. The initial translation was then verified for local dialect by Dr. Mauro Iglesias, a native El Salvadorian. This finalized the written survey. To further account for the difference in language and literacy level in the survey population, the survey was administered verbally. The orthopaedic residents at Hospital Zacamil asked the questions and then recorded answers on the survey forms. The survey answers were reviewed by Dr. Mauro Iglesias to ensure proper translation into the English language. The limited time series of the study may reduce the ability to generalize and apply the conclusions of the study to other populations.

Definition of Terms

Bone density: A measurement of bone strength reflecting calcium content, and the measurement commonly used in medicine to diagnosis osteoporosis. Bone mineral density is assessed by a bone scan including the hip and lumbar spine which gives measurements that express mineral mass per unit volume of bone. In the literature it is defined as the amount of bone tissue in a certain volume of bone (Genant, H.K., 1999). (Note: bone density will not be measured in this study but will be referenced using this definition in the literature review and discussion.)

Burden of disease: Combination of incidence/prevalence impact (including quality of life and disability), and cost of musculoskeletal conditions (United States Bone and Joint Decade, 2009). The WHO global burden of disease (GBD) measures burden of disease using the disability-adjusted life year (DALY). This time-based measure combines years of life lost due to premature mortality and years of life lost due to time lived in states of less than full health. The DALY metric was developed in the original GBD 1990 study to assess the burden of disease consistently across diseases, risk factors and regions (World health Organization, 2010).

Elderly population: Males or females over the age of 65.

Incidence: Measure of the risk of developing a new defined condition within a specified period of time. In this specific case the frequency at which fractures occur in the population.

Morbidity: An undesired result or complication resulting from the fracture.

Mortality: Complication from the fracture resulting in death.

Osteopenia: Bone mineral density that is lower than peak bone mineral density but not low enough to be classified as osteoporosis. This is considered pre-osteoporosis by the general population. The WHO defines osteopenia as a condition affecting people over the age of 50 who have lower than average bone density but who do not have osteoporosis (Genant et al., 1999).

Osteoporosis: A systemic skeletal disease that is identified by low bone density and deterioration of the bone tissue. Osteoporosis is defined by the literature as a systemic skeletal disease characterized by low bone density and micro architectural deterioration of bone tissue, with a consequent increase in bone fragility and susceptibility to fracture (Genant et al., 1999).

Prevalence: The total number of fractures in a specific population at a specific time.

Supplements: Nutrients in a concentrated form, usually in the form of pills or powder.

Summary

Osteoporosis and its affects have been identified as a significant burden in the developed world. This study will take current knowledge about osteoporosis risk factors, causes, morbidity/mortality, and prevention and apply this knowledge to a developing nation, specifically the defined population in El Salvador, to determine transferability. The gathered data will undergo statistical analyses to inform prevention efforts in this population based on their current situation.

Chapter 2. Review of Literature

Background on Fractures in an Elderly Population

Fractures are a significant source of morbidity and mortality among the elderly in the developed world. As life expectancy increases in developing nations, fractures as a source of significant morbidity and mortality in the elderly are increasing in these nations as well. Many of the fractures occurring in an elderly population in developing nations are associated with the disease osteoporosis (Genant et al., 1999).

Osteoporosis is a systemic skeletal disease that consists of low bone density and deterioration of the architectural structure of the bone tissue. The most commonly recognized clinical manifestations of osteoporosis are fragility fractures, which commonly occur as a consequence of a patient's fall or trauma, usually from standing height (Sandison, Gray, & Reid, 2003). Some fractures may even occur spontaneously in the absence of trauma.

People with osteoporosis more commonly sustain fractures in the hip, the vertebra, and the distal radius (Genant et al., 1999). In 2000, there were 9.0 million new osteoporotic fractures: 1.6 million in the hip, 1.7 million in the forearm, and 1.4 million in the vertebra. The greatest number of fractures occurred in patients age 50-59, and the peak number of hip fractures occurred between the ages of 75-79 (Johnell & Kanis, 2006).

Fractures occur more among the elderly with the disease process of osteoporosis, because of the decrease in bone density that occurs as people age. A normal rate of bone loss is 0.5-1% yearly after the age of 40 for both men and women (Sandison et al., 2003). After menopause the rate of bone loss in women will increase for a period of time due to decrease in estrogen production. Fewer males are affected by osteoporosis because they tend to have a higher bone mass than women initially and do not undergo the period of rapid bone loss experienced by postmenopausal women (Sandison et al., 2003). Forty percent of all women over the age of fifty are predicted to have at least one osteoporotic fracture in their lifetime (Bone and Joint Decade, 2009).

Osteoporosis has become such a significant problem that the World Health Organization has created a task force with the mission of developing a strategy for osteoporosis management and prevention worldwide (Genant et al., 1999). In addition to the effort of the WHO in advancing prevention throughout developing nations, 2000-2010 has been titled the Bone and Joint Decade. The Decade is a multidisciplinary global initiative to focus on the care of musculoskeletal conditions. While this encompasses a broad array of conditions, a major focus area is on osteoporosis. The three tenants of this Decade are: research, prevention, and education with the intent to decrease the burden of the disease. This is a significant initiative because musculoskeletal conditions are the most common cause of long-term disability and pain worldwide (Bone and Joint Decade, 2009).

The goals set forth by this Decade have gained support from all over the globe. Supporters include 750 organizations, 63 national governments, the World Health Organization, the United Nations, and the Vatican (United States Bone and Joint Decade, 2009). The Salvadorian Government is one of the participating members (Bone and Joint Decade, 2009).

Osteoporosis

Pathogenesis. Osteoporosis is a disease resulting in decreased bone mass with disruption of the bone microarchitecture. This disruption affects the bone's structural integrity and increases the risk of fracture (E. Seeman & Delmas, 2006). There are two types of osteoporosis: senile osteoporosis, which most commonly occurs as one ages; and postmenopausal osteoporosis, which only affects women as a result of the decrease in estrogen that occurs postmenopausally.

Additional secondary causes of osteoporosis include the extended use of glucocorticoid therapy, a form of steroids used in the treatment of a myriad of medical conditions. This may contribute to the development of osteoporosis in the elderly because of the increase of medical conditions as one ages. Osteoporosis resulting from glucocorticoid therapy is due to an increase in bone resorption and reduction in bone formation (Kumar, Abbas, & Fausto, 2005). This form is dose and therapy dependent, but usually develops very rapidly versus the slow onset of osteoporosis that is the result of aging.

Peak bone mass is reached during young adulthood; however, different parts of the skeleton reach their highest bone mass at different times. Many factors contribute to obtaining a high peak bone mass. Heredity plays a large role in determining the achievable height of bone mass. Some suggest that heredity may be 60-80 % responsible for bone mass (E. Seeman, Tsalamandris, Formica, Hopper, & McKay, 1994). Genetics are likely to play a role in both senile and postmenopausal osteoporosis, as evidenced by studies showing that people of the same age have different levels of bone porosity (Feik, Thomas, & Clement, 1997).

While both genetic and environmental factors play a role in bone density, the combination of the two may also be significant. Kiel et al. demonstrated the combined effect of genetic and environmental factors by showing whether or not the bone mass achieved with the different alleles for the vitamin D receptor is dependent on the amount of calcium ingested (Kiel, Myers, & Cupples, 1997). Some of the proposed genes that may play roles in the regulation of bone mass are the vitamin D receptor, collagen gene, estrogen receptor, transforming factor-beta, apolipoprotein E, and bone morphogenetic protein-2 gene (Raisz, Rosen, & Mulder, 2008). Another gene that has been shown to be linked to bone mass is the LRP-5 gene, which is associated with a protein in low-density-lipoprotein. The deletion of this gene leads to an autosomal recessive disorder called osteoporosis-pseudoglioma syndrome (Gong, Slee, Fukai, & Rawadi, 2001).

There are two possible processes that would result in a decreased bone mass: an increase of bone resorption or a decrease in bone formation. Current theories suggest that osteoporosis is more likely caused by the increased bone resorption, thus explaining the typical osteoporotic pattern of trabecular bone loss and increased porosity in the cortical bone (Raisz et al., 2008). The increase in trabecular bone resorption is due to the increase in resorption sites, to such a level that is leaves a void in the structure for the rebuilding of bone (Parfitt, Villanueva, Foldes, & Rao, 1995).

Hormones also play a role in the regulation of bone mass, particularly calcium-regulating, sex, and growth-regulating hormones (Raisz et al., 2008). Although these hormone levels may all be within normal range for an individual, their presence may lead to an increased susceptibility to osteoporosis (Raisz et al., 2008).

The pathologic changes seen with osteoporosis may also be related to calcium regulating hormones including excess parathyroid hormone (PTH), or vitamin D deficiency (Chapuy, Arlot, & Duboeuf, 1992). Vitamin D deficiency may manifest itself as hyperparathyroidism, rickets, or osteomalacia. Hyperparathyroidism results when an excess of parathyroid hormone is present in the body. This excess affects calcium metabolism and ultimately results in a loss of calcium from the bone (*Merriam-webster medical dictionary*.2009). Estrogen also inhibits bone resorption, hence the decreased bone mass seen in postmenopausal women when estrogen levels decrease (Cummings, Browner, & Bauer, 1998). Estrogen deficiency is not limited to women, and can also occur in males but on a smaller scale. Studies have shown that a deficiency in estrogen can occur either through a defect in the gene or a deficiency of aromatase. Aromatase changes testosterone to estrogen (Carani, Qin, & Simoni, 1997). A study was conducted analyzing a group of men with a mean age of 68 years. They were given both testosterone and estrogen then subsequently withdrawn from one or the other or both. The results of this study demonstrated that estrogen was the major sex hormone regulating bone resorption, but that both were needed for bone formation (Falahati-Nini, Riggs, & Atkinson, 2000).

In females estrogen therapy has shown to increase bone mass by affecting osteoclastogenesis and osteoclast function (Eriksen, Langdahl, & Vesterby, 1999). However, estrogen therapy is no longer used as a first line treatment for osteoporosis due to the effects of estrogen on the cardiovascular system (Heaney, 1994).

Other factors play a role in the effect of estrogen on bone mass, namely cytokines and growth factors. One way estrogen may have a protective effect on bone is through the increased release of transforming growth factor-beta from osteoblasts. Another protective mechanism is that estrogen blocks the release of tumor necrosis factor-alpha. This is protective because TNF-alpha increases the amount of osteoclasts and subsequently would increase bone resorption (Cenci, Weitzmann, & Roggia, 2000).

Androgen deficiency, which occurs with aging, can also lead to a decrease in bone mass through increasing bone turnover. Progestins are another group of hormones that can exert an effect on glucocorticoid receptors, and also have been shown to increase resorption in cell-culture studies (Ishida, Bellows, Tertinegg, & Heersche, 1997). Follicle stimulating hormone (FSH) and inhibin have been identified as also decreasing bone mass during the postmenopausal period (Perrien, Achenbach, & Bledsoe, 2006).

Although thyroid hormones have not been directly implemented in the pathogenesis of osteoporosis, studies have shown changes in bone mass in patients with hyperthyroidism. This could be caused by the treatment, thyroxine, which may cause high bone turnover (Jodear-Gimeno, Munoz-Torres, & Escobar-Jimenez, 1997).

Glucocorticoid excess, which affects the cycle of osteoblasts, has been identified as a cause of osteoporosis. Other previously discussed hormones also come into play with glucocorticoid excess: insulin-like growth factor (IGF), estrogen, and androgens. Glucocorticoid excess may show up in people diagnosed with depression, alcoholism, or anorexia nervosa (Raisz et al., 2008).

A deficiency in growth hormone or IGF-1 typically results in dwarfism and decreased bone mass. A decrease in these factors is also seen with aging. Patients with hip fractures have demonstrated decreased amounts of IGF-1(Boonen, Aerssens, & Dequeker, 1997).

Factors other than hormones regulate bone formation including cytokines, prostaglandins, and growth factors. These factors have shown to play a role with bone mass in many animal studies (Raisz et al., 2008). Interleukin-1 (IL-1) and tumor necrosis factor-alpha (TNF-α) are stimulators of bone resorption and inhibit bone formation. These factors are produced in marrow and bone cells. Interleukin-6 (IL-6) and its related cytokines are produced by osteoblasts and marrow cells. IL-6 increases osteoclastogenesis and bone resorption. People with osteoporosis have been shown to have an increase in IL-6 (Kania, Binkley, & Checovich, 1995). Other cytokines also play a role; IL-7 stimulates B cells and causes bone loss, IL-4 and IL-13 reduce prostaglandin synthesis in bone, thus inhibiting bone resorption. While all these factors discussed may play a role in osteoporosis, no significant research exists to directly support these theories (Raisz et al., 2008).

Prostaglandins have also been identified in affecting bone mass, especially the prostaglandin-E2, which has been shown to increase resorption and increase formation

(Kawaguchi, Pilbeam, Harrison, & Raisz, 1995). Local growth factors are involved with the differentiation and function of osteoblasts. Insulin-like growth factor-1 (IGF-1) causes a decrease in concentration within the bone and acts to inhibit bone resorption and stimulate bone formation. Because of this action, a decrease in TGF-β could cause osteoporosis (Raisz et al., 2008).

PTH-related protein (PTHrP) is made by bone and cartilage cells and acts in regulating their development. An increase in PTHrP seen in lactating women has been shown to increase bone resorption and turnover (Raisz et al., 2008). Fibroblast growth factor has been shown to stimulate bone formation in vivo (Hurley et al., 1993). As illustrated, many hormones and cell factors have been identified as possibly affecting bone formation and resorption.

Other factors contributing to bone loss and osteoporosis include physical activity, diet, muscle mass and strength, and hormonal states. Once peak bone mass is reached, subsequent resorption and formation cycles that occur between ages 30-50 result in bone loss at an estimated average rate of 0.7% each year. This rate of loss affects males and females equally (Kumar et al., 2005).

Clinical course. The symptoms resulting from osteoporosis depend on the part of the skeleton affected. Fractures in the vertebra, specifically in the thoracic and lumbar curves, are particularly painful. When fractures involve multiple layers of the vertebra, height loss or deformities of the spine such as kyphosis or lumbar lordosis may result (Kumar et al., 2005). Besides the obvious pain and pathology resulting from fractures of the femoral neck, spine, or pelvis, there are a variety of complications that can occur from the fracture itself. These complications, ranging from pulmonary embolism to pneumonia, cause forty to fifty thousand deaths a year in the United States (Kumar et al., 2005).

Assessment of bone mineral density. Osteoporosis is expensive and difficult to detect. Often it is not even detectable until the disease has significantly progressed. Plain radiographs will not show osteoporosis until the bone loss is at 30% to 40% (Kumar et al., 2005). Blood tests, including measuring levels of calcium, phosphorus, and alkaline phosphatase, are not diagnostic. Currently, the best way to assess osteoporosis is through specialized diagnostic imaging, including dual energy x-ray absorptiometry and quantitative computed tomography which give measurements of bone density (Kumar et al., 2005).

The World Health Organization has created a measurement called the T-score, which defines the number of standard deviations from the bone mineral density of a young adult. The T-score is obtained by analysis of a dual energy x-ray absorptiometry exam. Normal bone mass is defined as bone mineral density (BMD) within 1 standard deviation of the average young adult. Osteopenia is a BMD between 1 and 2.5 standard deviations below the average young adult value. A bone mineral density greater than or equal to 2.5 standard deviations below the average young adult normal mean indicates the presence osteoporosis (World Health Organization, 1994).

Dual energy x-ray absorptiometry (DEXA or DXA) was first introduced into the United States in 1987(Kelly, Slovik, Schoenfeld, & Neer, 1988). This method of measuring bone mineral density is considered superior because it allows for longitudinal follow up of BMD. In the United States DXA is the gold-standard for predicting risk of fractures in individuals with osteoporosis, diagnosing osteoporosis, selecting patients for therapy, and monitoring therapy effectiveness (Rockwood & Green, 2001). While the DXA is not used as a screening tool for fracture risk among the general population, it is used in those patients with multiple risk factors and patients who have had a suspicious low trauma fracture. In addition to DXA, quantitative ultrasound and quantified computer tomography are also used to screen for osteoporosis. However, these methods are less sensitive and specific when compared to the DXA exam for the diagnosis of osteoporosis (Rockwood & Green, 2001).

Bone mineral density is the best measure of bone strength. While there is not a BMD score that signifies a fracture threshold, decreased BMD increases the risk of fracture exponentially. Skeletal geometry is another measure that may help determine the risk of hip fracture. An example is using a hip strength analysis, which is a measure of the femoral neck mechanical strength shown on an anterior-posterior DXA scan. Early information indicates this method may be helpful in estimating the possibility of a future fracture (Rockwood & Green, 2001).

Another method of assessing bone metabolism is to examine biochemical bone markers. Biochemical markers, while not widely used and not as valuable as the DXA for long-term follow-up, play an important role in showing the processes the bones are under during remodeling phases. Bone formation can be measured in the blood through alkaline phosphatase (ALP), bone-specific alkaline phosphatase (BALP), osteocalcin, and the extension peptides of pro-collagen I. The measurement of the extension peptides of pro-collagen I is not specific to bone formation, however, because collagen is present in multiple tissues (Mallmin et al., 1993; Russell, 1997).

Additionally, markers such as urinary hydroxyproline (Hyp), can be used to show bone resorption. Urinary hydroxyproline (Hyp) measures the breakdown of bone collagen, but cannot be specifically tied to bone density since collagen is also broken down elsewhere in the body and in the food that we consume. There is also a higher clinical difficulty in interpreting Hyp results. While these biochemical markers may play a larger role in the diagnosis and follow-up of osteoporosis in the future, DXA remains the current gold standard to diagnose osteoporosis (Rockwood & Green, 2001).

Risk Factors

The risk factors that can be attributed to elderly fractures are the same risk factors that may lead to the development of osteoporosis. These include low body weight, previous history of fracture, family history of fracture, physical inactivity, tobacco use, high alcohol intake, use of glucocorticoid steroids, vitamin D deficiency, and low lifetime calcium intake (Genant et al., 1999). There are risk factors that pertain specifically to the loss of BMD and then there are other risk factors that accompany aging, such as immobility. Please refer to Appendix A for a thorough list of risk factors.

Heredity plays a major role in the bone mineral density that can be achieved for an individual. For example, the risk of suffering a hip fracture for women with a maternal history of hip fracture is twice that of women who do not have a family history (Genant et al., 1999). Recent studies have shown there is a polymorphic relationship between a variety of genes and BMD. Such genes include: type I collagen, transforming growth factor beta (TGF-beta), estrogen receptor, and type I collagen gene (COLIA1) (Rockwood & Green, 2001). An individual's vitamin D receptor gene, which accounts for up to 75% of achievable bone mass, has also been linked to heredity, and cannot be modified nor controlled by the individual (Kumar et al., 2005). In addition to family history, a personal history of fracture also results in increased risk of future fractures (Mallmin et al., 1993).

Age has been cited as a significant risk factor for sustaining an osteoporotic fracture as falls occur more frequently among the elderly. Annually, an estimated one third of the elderly population experiences a fall, and the risk of injury from falls increases with age. The risk factors for falls include: old age, female gender, low body mass, medical comorbidities, musculoskeletal diseases, cognitive impairment, gait and balance disorders, sensory impairments, postural hypotension, history of previous falls, and the use of certain medications. Environmental risk factors for falls include the presence of: rugs, wet floors, uneven floor surfaces, cords that run on the floor, poor lighting, poorly fitting footwear, and areas without hand rails (Rockwood & Green, 2001).

Fractures that are characteristic of osteoporotic fractures are those that occur due to a fall from standing height. Fractures that occur in this manner may show a predisposition to a tendency to fall, the existence of extra-skeletal risk factors, and defects in the bones other than low BMD. The risk for obtaining a hip fracture increases 1.5 to 2 times every 5 years (Cummings et al., 1993). Age related changes primarily affect bone metabolism. With aging, osteoblasts have a decreased ability to replicate and decreased ability to create new bone matrix. Other factors that aid in creating new bone also decrease with age, such as growth factors. When a person has low or decreased amount of physical activity this increases the rate of bone loss (Kumar et al., 2005). As an individual ages, the ability to absorb calcium decreases as does the amount of vitamin D that can be produced due to thinning of the skin and a decreased exposure to sunlight (Rockwood & Green, 2001).

Gender also is another risk factor for developing osteoporosis. Females are at a higher risk for multiple reasons; a lower peak BMD, smaller bone size, increased risk of falls, and a more rapid rate of bone loss due to a decrease in estrogen during the post-menopausal time period. The difference in bone geometry between genders may also contribute to the increased risk among females. Males have a larger cross-sectional area of their bones in comparison to females. This greater area adds to the strength of their bone structure (Raisz et al., 2008).

Low body weight also correlates with a lower BMD. Thus, being overweight may have a protective effect that goes beyond the stronger skeleton due to the extra loading. With obesity comes an increased amount of extra-glandular production of estrogen in the fat tissue, a larger amount of vitamin D due to its storage in fat tissue, and the local cushioning at the hip that adds protection during a fall (Rockwood & Green, 2001). However, these positive influences on bone mineral density maybe offset by the medical comorbidities that coincide with obesity. A person's height also influences the risk of fall. The reason could be twofold: a further distance to fall from standing height; and a longer hip axis length which increases the risk for a fracture (Tinetti, Doucette, Claus, & Marottoli, 1995).

Other risk factors are present in an individual's daily diets and habits. Some studies regarding the relationship between calcium intake and BMD have shown differing results. While some studies have shown that increased calcium intake partially prevents bone loss, other studies examining the impact of high dietary calcium intake have not shown a direct increase in the level of BMD (Dawson-Huges, Harris, Krall, & Dallal, 1997). Some studies show that calcium plays a larger role in bone production. Most importantly, calcium is influential during the teenage and young adult years when peak bone mass is achieved (Rockwood & Green, 2001).

Studies involving smoking and fracture rates have shown that smokers have a lower BMD and an increased rate of fractures when compared to a nonsmoking population. Many reasons for the link between smoking and low BMD are possible. Smokers have an earlier onset of menopause, are slimmer, have less extra-glandular production of estrogens, and have a quicker clearance of estrogens. In addition, smoking inhibits the functions of osteoclasts (Law & Hackshaw, 1997).

In addition to smoking, caffeine and alcoholic intake also impact the risk of falls. One study found that the elderly population's consumption of caffeine related more to an increased risk of sustaining an osteoporotic fracture than caffeine consumed in the younger years (Rockwood & Green, 2001). Alcohol consumption can also increase the risk of sustaining an osteoporotic fracture. Alcohol has a direct effect on osteoclasts and their proliferation. Alcohol may also increase the risk of fracture by causing poor balance in the consumer, increasing the possibility of falls and accidents, and other diseases that are associated with chronic alcohol use (Kiel, Felson, Hannan, Anderson, & Wilson, 1990). Hence, the promotion of cigarette smoking cessation and moderation of alcohol intake should be encouraged (Lewiecki, Rosen, Schmader, & Mulder, 2009).

One factor that helps prevent fractures is gravity and weight-bearing exercise, which aid in building a higher bone mass. The effects of gravity on the building of bone mass are evident when comparing athletes to non-athletes and also when observing astronauts who have spent extended lengths of time in a gravity-free environment. The skeleton is stressed by muscle loading and physical movement. This stress has direct impact on increasing the bone mineral density (Kumar et al., 2005). Immobility of an individual increases their risk for a fall because of the lack of mechanical loading that results in a lower BMD. Immobility will also lead to muscle wasting and decreased strength, which will increase the risk of a fall (Rockwood & Green, 2001).

Preexisting medical conditions can also play a large role in determining an individual's risk of sustaining an osteoporotic fracture. Chronic illnesses tend to make the individual less active while also decreasing their BMD, muscle function, and bone quality. Chronic conditions that have been found to have deleterious effects include: hyperthyroidism, malignancy, Paget's disease, osteomalacia, renal and hepatic diseases, hypogonadism, hyperparathyroidism, rheumatoid arthritis, organ transplantation, hypercortisolism, dementia or mental impairment, poor depth perception, decreased visual acuity, and impaired neuromuscular function (Tinetti et al., 1995).The treatment of these chronic diseases may also increase an individual's risk of sustaining a fracture. Medications that have shown to have a poor effect on BMD include: corticosteroids, long-acting benzodiazepines, anticonvulsants, gonadotrophin-releasing hormone agonists, tamoxifen, long-term heparin use, cytotoxic drugs, and lithium (Rockwood & Green, 2001).

Some of the aforementioned risk factors are modifiable, whereas others are hereditary or genetic and cannot be modified. Prevention has a role in helping individuals decrease the behaviorally-linked risk factors, in turn decreasing the risk of osteoporosis and of sustaining an osteoporotic fracture.

Prevention

Prevention has become a main tenet of health care strategies for much of the developed world in recent years. In the United States, there are many educational and other resources available to those who wish to obtain and maintain maximum health. Many in the United States and other developed nations recognize the importance of trying to prevent a disease from occurring and also recognize that it is typically easier to improve quality of life through prevention than through treatment (Sandison et al., 2003).

While prevention strategies are often second nature in the United States, the developing world is often unaware of many low-cost prevention techniques that could be implemented in one's daily lifestyle. Osteoporosis can be prevented through diagnostic services, education and health promotion, but diagnostic services and exams can be particularly costly (Sandison et al., 2003). The goal of prevention is to reduce the risk in the most cost-effective way possible by maintaining bone strength and preventing fractures from occurring. Prevention is more likely than treatment to reduce risk because once the change in bone structure occurs, it is mostly irreversible (Lewiecki et al., 2009). One method of preventing osteoporosis is nutrition education and bone density scanning. A study of 296 women to determine the extent to which women made lifestyle changes after having a bone scan and receiving education on lifestyle changes to reduce osteoporosis risk found that 58 (21.2%) of the respondents changed their diet after the education. The greatest change was a daily increase in milk consumption. Fifty-six point eight percent of respondents also reported participating in weight-bearing exercise at least three times a week for thirty minutes a session. Those diagnosed with low to moderate risk of osteoporosis were more likely to adopt healthy behaviors, whereas those diagnosed as high risk were less likely to change (Sandison et al., 2003). Thus, prevention and health education may be more appropriately focused on those groups labeled as low to moderate risk.

Prevention of osteoporotic fractures can be divided into two categories: non-pharmacological and pharmacological. Non-pharmacological prevention should focus on a healthy lifestyle during the years that bone mass is being established. The prevention during this time should place a focus on nutrition and physical activity.

Nutrition education interventions should focus on calcium and vitamin D intake and on encouraging people to adopt healthy dietary behaviors. Adding supplements to an individual's diet is a mainstay of osteoporosis prevention. Calcium should be added to the diet in the daily doses of 500 to 1000mg. There have been studies demonstrating an increase in bone mass in identical twins when supplements enhanced their diet. The study concluded that those who took calcium (1000mg/day) increased bone density compared with those who did not (Johnston, Miller, & Slemenda, 1992).

The recommended daily allowance of calcium intake is between 1200-1500mg for adolescents and 1000mg for adults up to age 65. This is generally safe with gastrointestinal disturbances and constipation being the largest complaints. Post-menopausal woman not taking estrogen replacement therapy should have 1500mg of calcium daily. Optimum calcium absorption is dependent on the presence of vitamin D (Lewiecki et al., 2009).

Vitamin D in the form of a supplement is generally safe. It may be added to the diet and does not need additional monitoring. If a patient is unable to take oral vitamin D or has low compliance with it, an intramuscular injection is available and this is administered twice a year. Several studies have been conducted looking at calcium and vitamin D supplementation and reduced fracture risk (Lewiecki et al., 2009). The recommendation for vitamin D intake per day is 400 to 800 IU, especially if an individual has a small amount of sun exposure. Other nutritional components required for optimum bone health include: phosphorus, magnesium, zinc, copper, iron, fluoride, sodium, and vitamins D, A, C, and K (Rockwood & Green, 2001). In addition to dietary supplementation, some dietary restrictions may be imposed; for example, limiting consumption of some food items, like carbonated soft drinks, that may impair bone mass when consumed in large quantities (Lewiecki et al., 2009).

Prevention of osteoporotic fractures in later years also depends on the level of physical activity throughout one’s life, even before puberty. Studies have shown that 30% to 50% of bone strength, BMD, and bone geometry are determined from the prepubertial period of life, the only time that a significant amount of bone is created (Golden, 2002). While bone tissue density is largely determined in adolescence, physical activity is also important in adults. Most studies have shown a 1% to 3% increase in BMD with adult physical activity. Physical activity during this time is deemed more bone-preserving rather than building. Exercises that seem to have the least effect on bone loading are endurance exercises such as: distance running, cycling, and swimming. Other exercises including aerobics, basketball, step exercises, weight training, soccer, and tennis are more effective at improving bone strength (Raisz et al., 2008).

Studies have also shown physical activity to be of benefit since bone responds in accordance to Wolff's law, which is the response of bone when stress is placed upon it (Rockwood & Green, 2001). Therefore, increasing weight bearing activity should increase bone density. However, it is important that physical activity is accompanied by proper nutrition. For example, a person with poor nutrition and decreased body fat that participates in excessive exercise will see a decrease in bone density (Golden, 2002).

Exercise can also decrease the risk of falling by helping to improve balance. For example, Tai Chi has been shown to reduce falls by 50%. Another way to prevent falls is to survey an individual's living environment. The "Prevention of Falls in the Elderly Trial" (PROFET) provided personalized interventions to individuals that presented to emergency departments with a fall. The study leaders examined each individual's particular case to identify the risk factors present and appropriately reduce medications, educate the individual, and provide exercise programs focusing on balance, strength, and aerobic capacity to reduce environmental hazards. The intervention resulted in a 70% reduction in fall risk (Close, Ellis, & Hooper, 1999).

Hip protectors are another described method of prevention. Hip protectors were created because 90% of hip fractures are related to direct trauma to the hip. Hip protectors function similarly to the additional weight in overweight individuals, where extra tissue helps absorb the force of the fall, thus decreasing the probability of sustaining a fracture. In nursing homes, there is a 24% compliance rate among those for whom hip protectors had been recommended. A randomized controlled trial conducted in a nursing home found that hip protectors had a 34% protective rate when they were worn (Lauritzen, Petersen, & Lund, 1993).

Other methods of prevention are pharmacological in nature. One type is diet supplementation, including the aforementioned calcium and vitamin D. Hormone replacement therapy (HRT) is a form of fracture prevention in post-menopausal women. HRT has shown to increase BMD by 5% over 3 years of use. This positive effect is potentiated by additional supplementation with calcium. It has also been shown that smaller doses of estrogen than those originally used for HRT still have beneficial properties for increasing BMD. A meta-analysis looking at 22 randomized trials showed a 27% reduction in vertebral fractures and a 40% reduction in fractures at the hip and wrist for those on HRT (Rockwood & Green, 2001). The "Women's Health Initiative Study" (WHI), which collected data from 161,809 women over a 5.2 year period, reported that estrogen reduced hip fracture incidence by 34%, vertebral fractures by 34%, fragility fractures by 24%, and all other fractures by 23 %. However, the study ended early due to the adverse negative side effects of HRT (Rossouw, Anderson, & Prentice, 2002). HRT side effects include; pulmonary embolism, deep vein thrombosis, breast tenderness, stroke, heart disease, gallbladder disease, and an increased risk of breast, endometrial, and ovarian cancer (Rossouw, Anderson, & Prentice, 2002). While these side effects mostly occur with long-term use, their serious nature has led to the reduction in use and prevented it from being used as a primary form of osteoporosis prevention. HRT is currently recommended only in women who are at a high risk for postmenopausal osteoporosis and are unable to take non-estrogen medications (Lewiecki et al., 2009).

"Selective Estrogen Receptor Modulators" (SERMs) are different from HRT in that their actions depend upon the tissue contacted. For example, SERMs act as estrogen agonists on bone and lipid metabolism, but as an antagonist in the breast and endometrium. The MORE study (Multiple Outcomes of Raloxifene Evaluation) of the SERM raloxifene has shown that it prevents postmenopausal bone loss and reduces the incidence of fracture, and also reduces the risk of breast cancer by 70%. However, raloxifene has similar side effects to HRT including pulmonary embolism and deep vein thrombosis. Another study is underway with raloxifene that will hopefully provide more information on its effects (Agnusdei & Iori, 2000).

Bisphosphonates inhibit bone resorption by decreasing the recruitment and activity of osteoclasts and increasing their apoptosis. The problem with bisphosphonates is that they are difficult to take and, therefore, have poor patient compliance. Alendronate is a bisphosphonate that is commonly used in postmenopausal women. In one study, 2,027 osteoporotic women who had sustained at least one vertebral fracture in their past history were given a dosage of 5mg of alendronate for 2 years and then 10mg for the third year, resulting in a 47% reduction in fractures at the vertebra, wrist, and hip. A similar study with males who had sustained a previous vertebral fracture showed that alendronate decreased the probability of future fractures (Cummings et al., 1998). The protective effect of alendronate has been shown to decrease quickly after stopping the therapy (Ravn, Weiss, Rodriguez-Portales, & McClung, 2000).

Risedronate, another bisphosphonate that prevents bone loss in postmenopausal women, has been shown to reduce the incidence of vertebral fractures by 65% after the first year of usage and by 41% after 3 years of use. Risedronate has also been shown to provide reduction in nonvertebral fractures by 30% to 40% (Reginster et al., 2000). Other types of bisphosphonates are on the market but alendronate and risedronate have been most heavily tested.

Calcitonin, produced in vivo by the thyroid C cells, acts on osteoclasts to reduce bone absorption. A meta-analysis has shown that calcitonin reduces the risk of vertebral fractures by 54%, but has little to no effect on other fracture locations (Shea et al., 2002) Calcitonin is available as a subcutaneous or intramuscular injection, which poses the side effects of diarrhea, facial flushing, and nausea. It also comes in the form of intranasal administration, which is not associated with these same side effects. Parathyroid hormone intermittently administered has been shown in patients with osteoporosis to stimulate bone growth and increase the BMD (Rockwood & Green, 2001). Multiple other drugs or variants of medications already discussed are currently in clinical trials to determine their relationship with increasing BMD or reducing fracture risk.

The pharmacological therapies that are on the market focus on reducing the risk of sustaining a fracture and do not actually raise the bone mass in an individual (Lewiecki et al., 2009). A proposed tier diagram designed by the U.S. Surgeon General recommends that tier one consist of a foundation of lifestyle changes, tier two of analyzing the drugs and diseases associated with bone loss and development of osteoporosis, and tier three of addressing pharmacological therapy (Lewiecki et al., 2009).

Hip Fractures

Hip fractures are common in patients with osteoporosis and have the highest morbidity and mortality rates. In 1990, 1.7 million hip fractures occurred throughout the world and the prevalence of hip fractures with disability was estimated to be at 4.48 million (Johnell & Kanis, 2004). By 2050, an expected 75 % of hip fractures will occur among populations in the developing world (Genant et al., 1999). The WHO and the World Bank estimated in 1990 that

1.75 million disability-adjusted life-years are lost each year globally due to hip fractures alone (Johnell & Kanis, 2004).

In 1990 in Latin America, an estimated 68,815 hip fractures were documented, with 21,886 of those in men and the remaining 41,929 in women. The estimated number of deaths in those patients with hip fractures was 37,384 with a 1.8 female to male ratio (Johnell & Kanis, 2004).

Economic and Social Impact

Health care systems around the world today are using all the resources and monies available. Due to the lack of financial resources, it is imperative that physicians and healthcare professionals utilize evidence-based medicine and identify means of preventing disease that can reduce healthcare system costs. Hip fractures and other fractures in the elderly represent a significant economic strain on the health care system in countries around the world. In 1992, the United States spent $7 billion during the year solely on hip fracture hospitalizations. Another $1.5 billion was spent on post-fracture nursing home care in 1992 (Rockwood & Green, 2001). In El Salvador the mean gross national income per capita is $1920. The direct cost of treatment for an acute visit with a hip fracture in other Latin American countries ranges from $4500 to $6000 (Morales-Torres & Gutierrez-Urena, 2004). Preventing hip fractures would be cost effective.

Another way that fractures and specifically hip fractures affect the elderly population is by taking away their freedom to live independently. This leads to more economic problems with the high cost of assisted living or the burden it places on family members, especially when fifty percent of those who suffer from a hip fracture are unable to take care of themselves after the fracture (Sandison et al., 2003). In many cultures elderly people fear the inability to look after themselves and being a burden on someone that they love (Hernandez-Rauda & Martinez-Garcia, 2004).

Methodological Studies

Hernandez-Rauda & Martinez-Garcia (2004) conducted a previous survey of women's knowledge of osteoporosis and collected information on their lifestyles. The results of the study indicated that the majority of women had a daily calcium intake level below 60% of the recommended amount. Some of the documented factors that may lead to this decrease in consumption are: lactose intolerance, socioeconomic status, age, and amount of coffee consumed. Furthermore, the study found that the knowledge of osteoporosis is poor among women and recommended the creation of an educational program focused on families, as healthy bone growth begins in the younger years (Hernandez-Rauda & Martinez-Garcia, 2004).

The majority of the research published has been on morbidity and mortality of hip fractures. However, one study conducted in Australia investigated the mortality of all major types of osteoporotic fractures in both men and women. The results of their study showed that there was an increased risk of mortality associated with all major osteoporotic fractures in both sexes. These fractures included pelvis, distal femur, proximal tibia, multiple rib locations, and proximal humerus. The researchers hypothesized that mortality rates are due to a combination of fractures with underlying health factors because most deaths occur within one year post-fracture (Center, Nguyen, Schneider, Sambrook, & Eisman, 1999).

This study will take their findings and look more deeply into the causes and types of fractures that are actually occurring in El Salvador. It will also survey those who sustain fractures to measure their knowledge of osteoporosis and gather demographic and environmental information.

Chapter 3. Methodology

Procedure

This study design was descriptive survey research. Areas of research included risk factors, outcomes of elderly fracture patients, and knowledge of bone health and osteoporosis among the elderly. Authorization to access the patient population was obtained through a signed agreement with the Edward Via Virginia College of Osteopathic Medicine (VCOM) and the Evangelical University in San Salvador, El Salvador. Hospital Zacamil is the teaching hospital of the medical school and was included in the signed agreement.

A formal agreement provides the contacts and experience base for successful sampling and data collection. VCOM has been sending a rotation of medical students and providing medical care throughout El Salvador under the umbrella of the Evangelical University. Mauro Iglesias M.D. was employed by VCOM during the time of this study as VCOM's liaison to the Evangelical University. Dr. Iglesias was in direct contact with the Dean of the Evangelical University, Alvaro Pleitez M.D. and, thus, in an appropriate position to assist the researcher. In addition, the orthopaedic surgeon, Eduardo Martinez-Melara M.D., a member of the faculty at the Evangelical University, agreed to participate in the research. These were key individuals who assisted in securing the population for this study and data collection.

Before beginning the research, a pilot study including 20 members from the defined patient population was conducted to establish instrument reliability. These were the first 20 individuals who completed surveys. Procedural and related insights gained from the pilot were included in the formal research. Participants in the pilot study were not included in the research study.

Following the successful pilot, the formal research began. The researcher participated in the data collection and in training others who aided in the collection of the data. Physicians and residents of the Department of Orthopaedics at Hospital Zacamil were trained to collect data across the time series when the researcher was not present. The training consisted of the protocol, the process of informed consent, and interview techniques. Researchers collected data using the survey forms during the primary researcher's absence.

The researcher systematically sampled the population using standard techniques and protocols approved by the VCOM IRB in January 2008 (Refer to Appendix B for IRB application). Population and sampling techniques along with instrumentation and data collection are described in the subsequent sections.

Population and Sample

The population of El Salvador in July 2007 was recorded as 6, 948,073 including 5.2% (158,276 male/ 202,602 female) over the age of 65. Life expectancy is 71.78 years with gender differentiation of 68.18 years for males and 75.57 years for females (*The world factbook*, 2007). The concentration of population lives in the capitol city of San Salvador, where approximately 2,198,200 people reside (*City population*, 2007). Within San Salvador, the population purposely selected for this study included patients at Hospital Zacamil presenting fractures during January 2008 to May 2008.

In consultation with the Virginia Tech statistical counseling center, the Primary Researcher used JMP software to determine the sample size needed in order to obtain statistically significant results. The minimal sample size needed in the patient population was calculated to be equal to or greater than 153.

The patient population is the subset of the El Salvador census over the age of 45 who presented to the Department of Orthopaedics at Hospital Zacamil in San Salvador with acute fractures between January 2008 and May 2008. Based on previous year data, this population was 200 patients. The actual number of patients in the population was determined during the time period of the research. The accepting patient sample included all patients who meet the age criteria and agreed to participate. One hundred and fifty-five patients agreed to participate in the study.

Data Collection

The researcher was in the Department of Orthopaedics at Hospital Zacamil during the months of January to March 2008. The physicians and residents were trained once final approval was granted by the Institutional Review Board. The training was provided to the Department of Orthopaedics physicians and residents to conduct the surveys. The physicians and residents helped distribute and fill out the information according to the physician-patient protocol from January 2008 to May 2008.

All entering patients received the standard of care for their specific injuries at Hospital Zacamil whether they accepted or declined participation in this study. All were invited to participate and to sign a letter of patient confidentiality and consent. At no time did the names or other personal identifiers appear on the surveys. The survey was to be conducted concurrently with patient discharge either from the Emergency Department or from an in-hospital stay. Dr. Martinez and Dr. Iglesias determined that it would be appropriate for the entire questionnaire to be completed as a single event within a time frame. This survey was given to each patient who met the previously stated criteria, and was given by means of an interview to avoid issues of literacy and language barrier. At no time were the medical records to be consulted because the medical files in El Salvador are typically inconsistent or non-existent.

Researcher follow-up in the traditional sense was not practical in this research setting because patients did not typically return. The ability to locate and maintain a population is dramatically different than in the United States. Dr. Martinez clearly stated that patient follow-up is impossible. Patient records are not sufficient to provide any contact information nor long-term observation and analysis. This may be difficult for United States-based researchers to understand, but it is the reality in a developing country such as El Salvador. Neither was a control group possible.

Separate from the research, medical follow-up was given as needed and as possible for this transient community. Cultural barriers to patient follow-up included no in-office follow-up, no telephone numbers, no street or mailing addresses, and no reliable manner in which to locate patients. Also, this is a national free health care hospital in the country of El Salvador. Because of this, many patients travel for long distances to receive the medical care on an as-needed basis, thus increasing the difficulty of locating patients for follow-up.

Instrumentation

A researcher-constructed questionnaire adapted from Hernandez-Rauda & Martinez-Garcia (2004) was the primary survey instrument. Questions addressed basic patient demographics, diet, exercise, medical history, risk factors, and knowledge of bone health and osteoporosis. An additional section addressed patient medical diagnosis, the incident that caused the fracture, immediate complications and any additional clinical interaction with the patients. This survey was administered by the researcher-trained physicians and residents in the Department of Orthopaedics at Hospital Zacamil. The survey instrument is located in Appendix

B and a copy of the informed consent in Appendix C. Before leaving the office, patients were given an educational handout; see Appendix D.

The questionnaire was created by the primary researcher to gather the most important patient information regarding osteoporosis and the identified risk factors. Due to the nature of this questionnaire and the reliability of patient histories, not every known risk factor for osteoporosis was addressed. The risk factors chosen for the research were: gender, age, family history, nulliparity, diet, excessive consumption of alcohol and/or caffeine, tobacco use, sedentary lifestyle, use of aluminum antacids, medical therapies, and an assessment of calcium in the diet. These risk factors were chosen due to their prevalence in scientific peer-reviewed literature. Many of the studies featured in this literature have taken place in the developed world. This study took those known risk factors in the developed world and determined if they are present in the defined research population.

Due to the financial limitations of this research, bone mineral density, intestinal absorption of calcium, and lactose intolerance were not measured. All three of these risk factors require costly diagnostic and laboratory testing. These patients were not told whether or not they have osteoporosis because it is outside of the financial resources of this study. In order to accurately diagnosis osteoporosis in an individual, costly scans such as the DXA must be performed. The survey portion on risk factors was used to gain background information into the types of risk factors that were present in the defined population.

The study assessed related environmental and personal factors that are most often associated with osteoporosis based on medical research that is currently available. Those factors and the reason for their inclusion will be discussed. Literature states that females are at a greater risk for developing osteoporosis than males. Women experience accelerated bone loss directly after menopause due to a decrease in estrogen levels (Johnell & Kanis, 2006). The individual's age is also a factor. Females are at greater risk for osteoporosis once they are age 55 or older, while males are at greater risk once they are at the age of 75 or older (Johnell & Kanis, 2006). Each individual's height and weight were recorded. From these figures the body mass index (BMI) was calculated. The equation was BMI= weight (kg)/ $\{\text{height (m)}\}^2$. A BMI under 18.5 is associated with a person being underweight along with an increased risk for developing osteoporosis (Barrera et al., 2004). Race and ethnicity of each individual were recorded. There is an increased risk of developing osteoporosis if the individual is Caucasian or of Asiatic race (Barrera et al., 2004; Melton, 2001).

Family history of osteoporosis or multiple fractures at an elderly age are also risk factors for future osteoporotic fractures. Each individual indicated if anyone in their family had been diagnosed with osteoporosis or if anyone had a problem with fractures as they aged. A person has an increased risk of osteoporosis when a positive family history of osteoporosis is present. Risk also increases if family members have obtained multiple fractures as they age, even if they have not been diagnosed with osteoporosis (Johnell & Kanis, 2006).

Nulliparity has also been described as a risk factor for developing osteoporosis. The number of pregnancies each female had was quantified to determine the presence of this risk factor. A study conducted among women defined as Old Order Amish and then non-Amish Caucasian women concluded that the higher parity of the "Old Order Amish" increased the BMD of that population in comparison to the non-Amish Caucasian women. The study suggested that was due to an increase of BMI during the times of pregnancy (Streeten et al., 2005).

Diet also affects the bone mass that is achieved in a lifetime. A diet low in calcium and vitamin D correlates to a decreased maximum bone mass. The questionnaire asked for the frequency and amount of selected high calcium foods in attempt to estimate the daily calcium intake in the population's diet. The questionnaire also asked if respondents were taking any calcium supplementation. The literature recommends 1000mg of calcium per day to build and maintain healthy strong bones. This recommendation increases for women going through and after menopause to 1200mg per day of recommended calcium. Vitamin D is necessary for proper processing of calcium. As a generalized population, Salvadorians have a significant daily source of sun exposure which allows for endogenous vitamin D production (Genant et al., 1999).

Another dietary element affecting bone mass is caffeine consumption. A daily quantitative number was calculated from survey responses to identify the daily consumption of caffeine in the defined population. Caffeine is a known promoter that depletes the calcium stores out of the bones. Caffeine also blocks the full absorption of calcium from the intestines. The Framingham Study (1990) found that women who were aged 50-84 and consumed two caffeinated beverages a day were at a 69% increased risk of obtaining a hip fracture. Caffeine consumption of around 352mg/d has been shown in men and women aged 50-70 to decrease absorption of calcium significantly (Massey & Whiting, 1993).

Excessive alcohol consumption also affects the bone mass achieved.
The respondents were asked if they consume alcohol. If the answer to this question was "yes", they then were asked how many alcoholic drinks per week they consume.
Alcoholism has been hypothesized to have a multifactorial affect on bone mineral density. Besides the direct actions of ethanol on the body, there are also other conditions that usually coincide with alcoholism, such as malnutrition, that express a deleterious effect on bone strength (Tannirandorn & Epstein, 2000). No specific amount of alcohol consumption has been identified as the point of bone mineral density decline. Any type of drinking, even social, has been shown

to decrease the osteoblasts in the body. Acute alcohol intoxication creates a hypocalcemia and hypercalciuria state. In chronic alcoholics, there is an increased level of parathyroid hormone which then leads to low levels of serum vitamin D and malabsorption of calcium (Laitinen & Valimaki, 1991). Chronic alcoholism has been found in men to increase the incidence of osteoporosis. It has also been shown to increase the fracture rates from 24-50 % (Tannirandorn & Epstein, 2000).

Lifestyle factors also play a role in the bone mineral density. Individuals participating in the study were asked if they use tobacco products. Cigarette use is a risk factor for decreased BMD through impairing the intestinal absorption of calcium while increasing the urinary excretion of calcium. The pathophysiology is that the nicotine destroys the intestinal villi. The vasoconstriction caused by nicotine decreases the absorption rates of calcium (Krall & Sawson-Hugehes, 1999). A meta-analysis was conducted on 86 studies analyzing nicotine's effects on bone mineral density. Smokers had reduced bone mineral density when compared to nonsmokers at all of the studied locations. The deficits of bone mineral density were most noticeable at the hip (Krall & Sawson-Hugehes, 1999; Ward & Klesges, 2001).

The questionnaire assessed daily activities and exercises. Respondents were asked about the nature of their employment and whether it requires any weight-bearing exercise. There also were questions about other types of exercise. These questions required qualitative answers. People who lead lifestyles that are sedentary in nature have been shown to have decrease bone mineral density. A study of ex-elite athletes verses a control population found that weight-bearing exercise does impact bone mineral density (Etherington et al., 1996). The athletes had a higher starting point of bone mineral density and their dominant arm had an increased density in comparison to their non-dominant arm. One hour or more a week of weight-bearing exercise is associated with an increase in bone mineral density within a normal population (Etherington et al., 1996).

Prolonged use of medications in the defined population will also play a role in bone mass achieved. The primary researcher discussed which drugs pose known osteoporosis risks with the physicians in the Department of Orthopedics at Hospital Zacamil along with Mauro Iglesias M.D. It was decided that not all noted drugs would be addressed in this study. This is because those drugs identified as increasing the risk of osteoporosis are not prescribed frequently nor for long durations within the defined population. Also, the duration of specific drugs prescribed could not be verified because of inadequate medical records.

One therapy that has been shown to increase bone mineral density is estrogen therapy. The physicians recommended including this question because at the time of the study, local physicians were just starting to promote estrogen therapy. In a double-blind placebo-controlled trial of estrogen therapy and bone mineral density, researchers found that postmenopausal women who were on estrogen therapy over a 36-month period had significant increases in their BMD (Writing Group for PEPI, 1996).

Another over-the-counter medicine that is widely available in the defined population is aluminum antacids. Physicians in the area indicated a large use of aluminum antacids among the population. Aluminum antacids cause hypophosphatemia, hypophosphaturia, and hypercalciuria. These changes lead to bone resorption. Aluminum antacids also cause a decrease in the activation of vitamin D which in turn stimulates osteoclastic activity on bone. Large doses of aluminum antacids on the scale of 2 grams or more for a period of time greater than a year and a half have shown side effects leading to osteomalacia; which is softening and weakening of the bone due to lack of vitamin D (Tannirandorn & Epstein, 2000).

Validity of the instrument used in the study has been established in previous research conducted by Hernandez Rauda & Martinez-Garcia (2004). However, a panel of experts was established by the researcher to determine content validity for the current study. The experts were provided the researcher-developed instrument and objectives to determine the validity of the instrument. These experts included; Mauro Iglesias M.D, Edward Martinez-Melara M.D, H. Dean Sutphin PhD, Hara Misra DVM, PhD, and Kerry Redican PhD.

Similarly, content validity was established for the educational materials. The same panel of experts reviewed the handouts to make sure they met the objectives of the study and the needs of the community and to the extent possible, the broader population through primary care offices in San Salvador. Feedback from the experts was incorporated in the survey instrument and educational materials.

A pilot test was conducted to ensure viability of the research design and data collection. These individuals were not included in the formal research study.

Reliability coefficient was not appropriate for the type of instrument used in this study.

Data Analysis

The data collected were labeled, coded, and transferred into a format for computer statistical analysis. In consultation with the statistical consulting group at Virginia Tech, the methods used for analyzing the data were determined. A power analysis was performed using JMP software to determine the population size necessary to obtain statistically significant results. An alpha level of significance of 0.5 was established. Formal statistical analysis of the research objectives was completed using logistic regression analysis and descriptive statistics.

Data analysis included descriptive statistics to summarize the characteristics of this specific study. Also inferential statistics were used including chi-squared test with a p-value=0.05. This was accomplished using the SPSS system and Microsoft Excel software.

Chapter 4. Results

Objective 1: Incidence, Causes, Treatment, and Post-mortality and Morbidity

The first objective was to determine the incidence, causes, treatment, and post-mortality and morbidity of fractures in elderly patients, including hip, vertebral, and forearm fractures.

The incidence of fractures in the defined population during the study period included 25 of the ankle, 25 of the forearm, 73 of the hip, and 1 of the tibia. The other 31 fractures, which did not fall into those categories, included 8 of the humerus, 6 of the fingers, 5 of the patella, 5 of the ribs, 4 of the clavicle, 2 of the femur, and 1 of the scapula. Table 1 shows that women had more fractures than men in the defined sample population of Latin American patients. The distribution of types of fractures for men was relatively uniform, except for the single tibia fracture. In contrast, the distribution of fracture types for females showed a much higher incidence of hip fractures (see Table 2).

A significantly ($p < 0.05$) greater number of women than men in the study population had sustained fractures from a fall. Figure 1 is a graphical representation of the probability that a fall versus another type of accident caused the fracture in the patient. Note that because all the patients in this study had fractures, Figure 1 shows the probability that the fracture was due to a fall as opposed to another form of accident like a car, truck, or motorcycle accident.

As shown in Table 3, hip fractures are primarily treated with surgery. Note that the chi-square statistic is significantly large to reject the null hypothesis that the distribution of treatments is independent of the type of injury.

Morbidity and gender were independent (0.05 alpha) of each other as indicated by the large probability associated with the chi-square statistic, as shown in Table 4. The morbidities experienced by this population included: pressure ulcers in 9 patients, foreign body reaction in 3

Table 1

Contingency Analysis of Type of Fracture by Gender

Gender	Ankle	Forearm	Hip	Other	Tibia	Total
Female						
Count	13.00	12.00	61.00	15.00	1.00	102.00
Total %	8.39	7.74	39.35	9.68	0.65	65.81
Col. %	52.00	48.00	83.56	48.39	100.00	
Row %	12.75	11.76	59.80	14.71	0.98	
Male						
Count	12.00	13.00	12.00	16.00	0.00	53.00
Total %	7.74	8.39	7.74	10.32	0.00	34.19
Col. %	48.00	52.00	16.44	51.61	0.00	
Row %	22.64	24.53	22.64	30.19	0.00	
Both						
Count	25.00	25.00	73.00	31.00	1.00	155.00
Total %	16.13	16.13	47.09	20.00	0.65	100.00

Note. $N = 155$, $DF = 4$, -loglike = 10.848062, and R-squared (U) = 0.0539. Likelihood-ratio chi-square = 21.696 ($p < 0.0002$). Pearson chi-square = 20.568 (prob. < 0.0004).

Table 2

Contingency Analysis of Cause of Fracture by Gender

Gender	Fall	Trauma	Total
Female			
Count	81.00	21.00	102.00
Total %	52.26	13.55	65.81
Col. %	73.64	46.67	
Row %	79.41	20.59	
Male			
Count	29.00	24.00	53.00
Total %	18.71	15.48	34.19
Col. %	26.36	53.33	
Row %	54.72	45.28	
Both			
Count	110.00	45.00	155.00
Total %	70.97	29.03	100.00

Note. N = 155, DF = 1, -loglike = 5.0157662, and R-squared (U) = 0.0537. Likelihood-ratio chi-square = 10.032 (prob. > chi-square = 0.0015). Pearson chi-square = 10.323 ($p < 0.0013$).

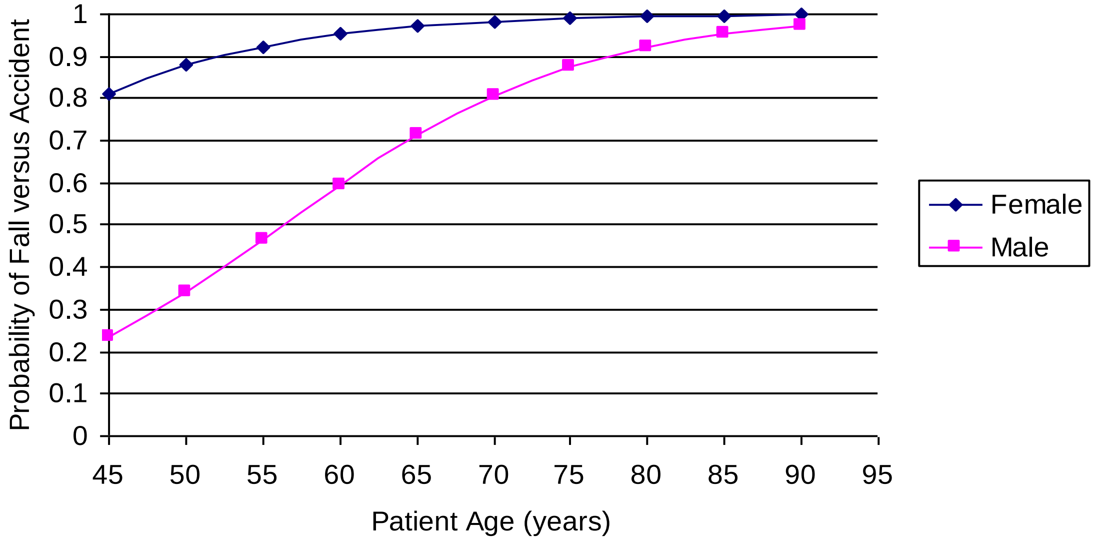

Figure 1. Logistic regression model for probability of fall versus another type of accident.

patients, excessive pain recorded in 3 patients, pulmonary emboli in 2 patients, and superficial infection in 2 patients The following occurred in one patient each; nonunion, limited range of motion, seroma, anemia, and contaminate of the incision.

Objective 2: Comparison of Patient Knowledge, Causes, Treatment, Morbidity, and Mortality by Age Group

The second objective was to compare patient knowledge, causes, treatment, morbidity, and mortality associated with fractures among participants 45 to 65 years of age and those over 65.

Knowledge of osteoporosis. Question 1 assessed participants' knowledge of osteoporosis as a disease of bones. Of the patients aged 45-65 years 91% answered Question 1 correctly, while patients over the age of 65 responded correctly 90% of the time. The results showed that age and response to Question 1 were independent (see Table 5).

Table 3

Contingency Analysis of Treatment by Type of Fracture

Location of fracture	Conservative	Surgery	Total
Ankle			
Count	14.00	11.00	25.00
Total %	9.09	7.14	16.23
Col. %	25.45	11.11	
Row %	56.00	44.00	
Forearm			
Count	15.00	9.00	24.00
Total %	9.74	5.84	15.58
Col. %	27.27	9.09	
Row %	62.50	37.50	
Hip			
Count	7.00	66.00	73.00
Total %	4.55	42.86	47.40
Col. %	12.73	66.67	
Row %	9.59	90.41	
Other			
Count	18.00	13.00	31.00
Total %	11.69	8.44	20.13
Col. %	32.73	13.13	
Row %	58.06	41.94	
Tibia			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	1.82	0.00	
Row %	100.00	0.00	
All			
Count	55.00	99.00	154.00
Total %	35.71	64.29	100.00

Note. $N = 154$, $DF = 4$, -loglike = 23.197222, and R-squared (U) = 0.2311. Likelihood-ratio chi-square = 46.394 (prob. > chi-square < .0001). Pearson chi-square = 10.323 ($p < 0.0001$).

Table 4

Contingency Analysis of Gender by Morbidity/Mortality

Morbidity/ mortality	Female	Male	Total
Allergic reaction to suture			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
Anemia			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
Contamination of incision			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
Excessive pain			
Count	2.00	1.00	3.00
Total %	1.29	0.65	1.94
Col. %	1.96	1.89	
Row %	66.67	33.33	
Foreign body reaction			
Count	3.00	0.00	3.00
Total %	1.94	0.00	1.94
Col. %	2.94	0.00	
Row %	100.00	0.00	
Incision infection			
Count	1.00	1.00	2.00
Total %	0.65	0.65	1.29
Col. %	0.98	1.89	
Row %	50.00	50.00	
None			
Count	82.00	48.00	130.00
Total %	52.90	30.97	83.87
Col. %	80.39	90.57	
Row %	63.08	36.92	

Table 4 (continued)

Morbidity/ mortality	Female	Male	Total
Non-union			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
Pain and ROM limitations			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
Pressure ulcers			
Count	7.00	2.00	9.00
Total %	4.52	1.29	5.81
Col. %	6.86	3.77	
Row %	77.78	22.22	
Pulmonary embolism			
Count	1.00	1.00	2.00
Total %	0.65	0.65	1.29
Col. %	0.98	1.89	
Row %	50.00	50.00	
Seroma			
Count	1.00	0.00	1.00
Total %	0.65	0.00	0.65
Col. %	0.98	0.00	
Row %	100.00	0.00	
All			
Count	102.00	53.00	155.00
Total %	65.81	34.19	

Note. N = 155, DF = 11, -loglike = 4.4978560, and R-squared (U) = 0.0452. Likelihood-ratio chi-square = 8.996 (prob. > chi-square = 0.6223). Pearson chi-square = 6.125 (prob. > chi-square = 0.8649); 20% of cells had expected count less than 5; chi-square suspect.

Table 5

Contingency Analysis of Responses to Question 1 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	43.00	4.00	47.00
Total %	27.92	2.60	30.52
Col. %	30.94	26.67	
Row %	91.49	8.51	
>65 years			
Count	96.00	11.00	107.00
Total %	62.34	7.14	69.48
Col. %	69.06	73.33	
Row %	89.72	10.28	
Both			
Count	139.00	15.00	154.00
Total %	90.26	9.74	

Note. N = 154, DF = 1, -loglike = 0.05950528, and R-squared (U) = 0.0012. Likelihood-ratio chi-square = 0.119 (prob. > chi-square = 0.7301). Pearson chi-square = 0.116 (prob. > chi-square = 0.7330).

Question 2 assessed participants' knowledge that having osteoporosis increases individual risk of fracture. Ninety-one percent of patients 45-65 years of age answered correctly, and 82% over the age of 65 answered Question 2 correctly. The results showed that age and response to Question 2 were independent. There was not a significant correlation (p =0.05) between age group and whether or not participants responded correctly (see Table 6).

Table 6

Contingency Analysis of Responses to Question 2 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	43.00	4.00	47.00
Total %	27.92	2.60	30.52
Col. %	32.82	17.39	
Row %	91.49	8.51	
>65 years			
Count	88.00	19.00	107.00
Total %	57.14	12.34	69.48
Col. %	67.18	82.61	
Row %	82.24	17.76	
Total			
Count	131.00	23.00	154.00
Total %	85.06	14.94	

Note. N = 154, DF = 1, -loglike = 1.2006246, and R-squared (U) = 0.0185. Likelihood-ratio chi-square = 2.401 (prob. > chi-square = 0.1212). Pearson chi-square = 2.198 ($p < 0.1382$).

Question 3 assessed participants' knowledge that women are more frequently diagnosed with osteoporosis than men. Of the patients aged 45-65 years old 54% answered the question correctly. Fifty-eight percent of the patients over 65 years of age answered Question 3 correctly. The results showed that age and response to Question 3 were independent. Therefore, there was no significant correlation ($p = 0.05$) between age group and knowledge that women have a higher risk of diagnosis with osteoporosis (see Table 7).

Table 7

Contingency Analysis of Responses to Question 3 by Age Group

	Incorrect	Correct	Total
45-65 years			
Count	21.00	25.00	46.00
Total %	13.73	16.34	30.07
Col. %	31.82	28.74	
Row %	45.65	54.35	
> 65 years			
Count	45.00	62.00	107.00
Total %	29.41	40.52	69.93
Col. %	68.18	71.26	
Row %	42.06	57.94	
Total			
Count	66.00	87.00	153.00
Total %	43.14	56.86	

Note. $N = 153$, $DF = 1$, -loglike = 0.08460388, and R-squared (U) = 0.0008. Likelihood-ratio chi-square = 0.169 (prob. > chi-square = 0.6808). Pearson chi-square = 0.170 ($p < 0.6805$).

Question 4 assessed participants' knowledge that calcium is important for strong, healthy bones. Ninety-eight percent of patients between 45 and 65 years of age answered Question 4 correctly, and 81% of the patients over 65 years answered the question correctly. The results showed that age and response to Question 4 were not independent. More patients over 65 (p = 0.0058) incorrectly answered the question than patients 65 or younger (see Table 8).

Table 8

Contingency Analysis of Responses to Question 4 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	46.00	1.00	47.00
Total %	29.87	0.65	30.52
Col. %	34.59	4.76	
Row %	97.87	2.13	
> 65 years			
Count	87.00	20.00	107.00
Total %	56.49	12.99	69.48
Col. %	65.41	95.24	
Row %	81.31	18.69	
Total			
Count	133.00	21.00	154.00
Total %	86.36	13.64	

Note. $N = 154$, $DF = 1$, -loglike = 4.9558290, and R-squared (U) = 0.0808. Likelihood-ratio chi-square = 9.912 (prob. > chi-square = 0.0016). Pearson chi-square = 7.608 ($p < 0.0058$).

Question 5 assessed participants' knowledge that height and spine changes occur with osteoporosis. Sixty-three percent of patients between the ages of 45-65 answered the question correctly while 64% of the patients over the age of 65 answered correctly. The results showed that age and response to Question 5 were independent. There was no significant correlation at 0.05 alpha between age group and knowledge that osteoporosis may lead to height and spine changes (see Table 9).

Table 9

Contingency Analysis of Responses to Question 5 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	29.00	17.00	46.00
Total %	18.95	11.11	30.07
Col. %	29.59	30.91	
Row %	63.04	36.96	
>65 years			
Count	69.00	38.00	107.00
Total %	45.10	24.84	69.93
Col. %	70.41	69.09	
Row %	64.49	35.51	
Total			
Count	98.00	55.00	153.00
Total %	64.05	35.95	

Note. N = 153, DF = 1, -loglike = 0.01450315, and R-squared (U) = 0.0001. Likelihood-ratio chi-square = 0.029 (prob. > chi-square = 0.8648). Pearson chi-square = 0.029 ($p < 0.8646$).

Question 6 assessed participants' knowledge that osteoporosis primarily affects the hip, spine, and forearm. Seventy-two percent of patients in both age groups answered Question 6 correctly. The results showed that age and response to Question 6 were independent. There was no significant correlation at 0.05 alpha between age group and knowledge of which bones are most affected by osteoporosis (see Table 10).

Table 10

Contingency Analysis of Responses to Question 6 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	34.00	13.00	47.00
Total %	22.08	8.44	30.52
Col. %	30.63	30.23	
Row %	72.34	27.66	
>65 years			
Count	77.00	30.00	107.00
Total %	50.00	19.48	69.48
Col. %	69.37	69.77	
Row %	71.96	28.04	
Total			
Count	111.00	43.00	154.00
Total %	72.08	27.92	

Note. N = 154, DF = 1, -loglike = 0.00115930, and R-squared (U) = 0.0000. Likelihood-ratio chi-square = 0.002 (prob. > chi-square = 0.9616). Pearson chi-square = 0.002 ($p <$ 0.9616).

Question 7 assessed participants' knowledge that people over the age of 50 are at increased risk of osteoporosis. Thirty-six percent of patients aged 45-65 answered the question correctly, while 61% of the patients over the age of 65 answered the question correctly. The results showed that age and response to Question 7 were not independent (p= 0.0049). A higher percentage of people over 65 than younger correctly responded that 50 years of age increased the risk of osteoporosis (see Table 11).

Table 11

Contingency Analysis of Responses to Question 7 by Age Group

	Incorrect	Correct	Total
45-65 years			
Count	30.00	17.00	47.00
Total %	19.48	11.04	30.52
Col. %	41.67	20.73	
Row %	63.83	36.17	
>65 years			
Count	42.00	65.00	107.00
Total %	27.27	42.21	69.48
Col. %	58.33	79.27	
Row %	39.25	60.75	
Total			
Count	72.00	82.00	154.00
Total %	46.75	53.25	

Note. N = 154, DF = 1, -loglike = 3.9879842, and R-squared (U) = 0.0375. Likelihood-ratio chi-square = 7.976 (prob. > chi-square = 0.0047). Pearson chi-square = 7.924 ($p < 0.0049$).

Question 8 assessed participants' knowledge that there is a way to reduce the risk of getting osteoporosis. Seventy-nine percent of patients between 45 and 65 years of age answered the question correctly, and 58% of the patients over the age of 65 answered correctly. The results showed that age and response to Question 8 were not independent. A higher percentage of people over 65 than people 65 or younger correctly responded (p = 0.0141) that there is a way to reduce the risk of osteoporosis (see Table 12).

Table 12

Contingency Analysis of Response to Question 8 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	37.00	10.00	47.00
Total %	24.34	6.58	30.92
Col. %	37.76	18.52	
Row %	78.72	21.28	
>65 years			
Count	61.00	44.00	105.00
Total %	40.13	28.95	69.08
Col. %	62.24	81.48	
Row %	58.10	41.90	
Total			
Count	98.00	54.00	152.00
Total %	64.47	35.53	

Note. N = 152, DF = 1, -loglike = 3.1725770, and R-squared (U) = 0.0321. Likelihood-ratio chi-square = 6.345 (prob. > chi-square = 0.0118). Pearson chi-square = 6.032 ($p < 0.0141$).

Question 9 assessed participants' knowledge that genetics play a role in an individual's risk for osteoporosis. Sixty percent of the patients 45-65 years of age answered the question correctly, while 56 % of patients over the age of 65 answered correctly. The results showed that age and response to Question 9 were independent. There was no statistically significant difference at 0.05 alpha between the two groups in terms of knowledge that osteoporosis has a genetic component (see Table 13).

Table 13

Contingency Analysis of Responses to Question 9 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	28.00	19.00	47.00
Total %	18.18	12.34	30.52
Col. %	31.82	28.79	
Row %	59.57	40.43	
>65 years			
Count	60.00	47.00	107.00
Total %	38.96	30.52	69.48
Col. %	68.18	71.21	
Row %	56.07	43.93	
Total			
Count	88.00	66.00	154.00
Total %	57.14	42.86	

Note. $N = 154$, $DF = 1$, -loglike = 0.08190346, and R-squared (U) = 0.0008. Likelihood-ratio chi-square = 0.164 (prob. > chi-square = 0.6857). Pearson chi-square = 0.163 ($p < 0.6861$).

Question 10 assessed participants' knowledge that medicine can treat osteoporosis. Eighty-three percent of patients between the ages of 45-65 answered the question correctly, and 67% of patients over the age 65 answered the question correctly. The results showed that age and response to Question 10 were not independent. A greater proportion of people over age 65 did not answer correctly (p = 0.0457) that medicine could treat osteoporosis (see Table 14).

Table 14

Contingency Analysis of Responses to Question 10 by Age Group

	Correct	Incorrect	Total
45-65 years			
Count	39.00	8.00	47.00
Total %	25.32	5.19	30.52
Col. %	35.14	18.60	
Row %	82.98	17.02	
>65 years			
Count	72.00	35.00	107.00
Total %	46.75	22.73	69.48
Col. %	64.86	81.40	
Row %	67.29	32.71	
Total			
Count	111.00	43.00	154.00
Total %	72.08	27.92	

Note. N = 154, DF = 1, -loglike = 2.1232001, and R-squared (U) = 0.0233. Likelihood-ratio chi-square = 4.246 (prob. > chi-square = 0.0393). Pearson chi-square = 3.994 (p < 0.0457).

Question 11 assessed whether or not a health promoter or a physician had told participants about osteoporosis prior to the study. Seventy-seven percent of the patients 45-65 years of age stated they have been told about osteoporosis, whereas 89% of patients over the age of 65 have been told about osteoporosis. The results showed that more people over the age of 65 reported being told about osteoporosis by a health promoter or physician. There was a significant relationship at 0.05 alpha after rounding p= 0.05 from 0.0507 (see Table 15).

Table 15

Contingency Analysis of Responses to Question 11 by Age Group

	Yes	No	Total
45-65 years			
Count	36.00	11.00	47.00
Total %	23.38	7.14	30.52
Col. %	27.48	47.83	
Row %	76.60	23.40	
>65 years			
Count	95.00	12.00	107.00
Total %	61.69	7.79	69.48
Col. %	72.52	52.17	
Row %	88.79	11.21	
Total			
Count	131.00	23.00	154.00
Total %	85.06	14.94	

Note. N = 154, DF = 1, -loglike = 1.7945762, and R-squared (U) = 0.0276. Likelihood-ratio chi-square = 3.589 (prob. > chi-square = 0.0582). Pearson chi-square = 3.819 ($p < 0.0507$).

Causes of fractures. Participants were asked about the cause of their fracture. Of the patients between 45 and 65 years of age, 57% of their fractures were caused by a fall and 43% of their fractures were caused by trauma. Of the patients over 65 years of age 77% had their fractures due to a fall and 23% were the result of trauma. The results showed that age and cause of fracture were not independent. Participants over 65 years of age were more likely to have a fracture due to a fall rather than due to trauma (p = 0.0159, see Table 16).

Table 16

Contingency Analysis of Type of Fracture by Age Group

	Fall	Trauma	Total
45-65 years			
Count	27.00	20.00	47.00
Total %	17.53	12.99	30.52
Col. %	24.77	44.44	
Row %	57.45	42.55	
>65 years			
Count	82.00	25.00	107.00
Total %	53.25	16.23	69.48
Col. %	75.23	55.56	
Row %	76.64	23.36	
Total			
Count	109.00	45.00	154.00
Total %	70.78	29.22	

Note. N = 154, DF = 1, -loglike = 2.8094618, and R-squared (U) = 0.0302. Likelihood-ratio chi-square = 5.619 (prob. > chi-square = 0.0178). Pearson chi-square = 5.814 (p < 0.0159).

Treatment of fracture. The type of treatment the patient received was recorded into one two broad categories. The patient's treatment was conservative or surgical. For those over the age of 65, treatment was 73% of the time surgical, compared with 44 % under the age of 65. There is statistical significance in the difference of treatment across the age groups. This study showed that surgical treatment occurred more than conservative treatment in those over the age of 65 (p = 0.0005; see Table 17).

Table 17

Contingency Analysis of Type of Treatment by Age Group

	Conservative	Surgery	Total
45-65 years			
Count	27.00	21.00	48.00
Total %	17.42	13.55	30.97
Col. %	48.21	21.21	
Row %	56.25	43.75	
>65 years			
Count	29.00	78.00	107.00
Total %	18.71	50.32	69.03
Col. %	51.70	78.79	
Row %	27.10	72.90	
Total			
Count	56.00	99.00	155.00
Total %	36.13	63.87	

Note. N = 155, DF = 1, -loglike = 5.9814336, and R-squared (U) = 0.0590. Likelihood-ratio chi-square = 11.963 (prob. > chi-square = 0.0005). Pearson chi-square = 12.199 (p < 0.0005).

Morbidity and mortality. Participants were assessed if they had suffered complications due to sustaining the fracture for which they were being treated. Eleven percent of the patients 45-65 years of age had suffered complications, while 19% of patients over the age of 65 suffered complications. The results showed that age and morbidity were independent at 0.05 alpha (see Table 18).

Table 18

Contingency Analysis of Morbidity by Age Group

	No	Yes	Total
45-65 years			
Count	42.00	5.00	47.00
Total %	27.27	3.25	30.52
Col. %	32.56	20.00	
Row %	89.36	10.64	
>65 years			
Count	87.00	20.00	107.00
Total %	56.49	12.99	69.48
Col. %	67.44	80.00	
Row %	81.31	18.69	
Total			
Count	129.00	25.00	154.00
Total %	83.77	16.23	

Note. N = 154, DF = 1, -loglike = 0.83134774, and R-squared (U) = 0.0122. Likelihood-ratio chi-square = 1.663 (prob. > chi-square = 0.1972). Pearson chi-square = 1.557 ($p < 0.2120$).

Participants were asked about the types of complications they had suffered due to sustaining the fracture. The morbidities included reaction to suture (*n* = 4), anemia (*n* = 1), surgical site infection (*n* = 3), pressure ulcers (*n* = 3), pulmonary embolism (*n* = 2), nonunion (*n* = 1), serotosis (*n* = 1), and excessive pain (*n* = 4). The patients 45-65 years of age had 0.04% nursing, 0.04% patient, and 0.02% surgical complications. Whereas the patients over 65 years had 0.07% nursing, 0.03% patient, and 0.09% surgical complications. The results showed that age and type of morbidity were independent (see Table 19).

Table 19

Contingency Analysis of Type of Morbidity Category by Age Group

	None	Nursing	Patient	Surgery	Total
45-65 years					
Count	42.00	2.00	2.00	1.00	47.00
Total %	27.27	1.30	1.30	0.65	30.52
Col. %	32.56	22.22	40.00	9.09	
Row %	89.36	4.26	4.26	2.13	
>65 years					
Count	87.00	7.00	3.00	10.00	107.00
Total %	56.49	4.55	1.95	6.49	69.48
Col. %	67.44	77.78	60.00	90.91	
Row %	81.31	6.54	2.80	9.35	
Total					
Count	129.00	9.00	5.00	11.00	154.00
Total %	83.77	5.84	3.25	7.14	

Note. $N = 154$, $DF = 3$, -loglike = 1.8579971, and R-squared (U) = 0.0196. Likelihood-ratio chi-square = 3.716 (prob. > chi-square = 0.2938). Pearson chi-square = 3.139 ($p < 0.3707$).

Objective 3: Level of Knowledge and Presence of Risk Factors for Fractures and Osteoporosis by Gender

The third objective was to determine the level of knowledge and presence of risk factors for fractures and osteoporosis, including diet, exercise, and environment, among patients according to gender.

Knowledge of osteoporosis. Question 1 assessed participants' knowledge of osteoporosis as a disease of bones. Ninety percent of the females answered the question correctly. Eighty-nine percent of the males answered the question correctly. The results showed that gender and response to Question 1 were independent at 0.05 alpha (see Table 20).

Question 2 assessed participants' knowledge that having osteoporosis increases individual risk of fracture. Eighty-four percent of the females answered this question correctly. Eighty-five percent of the males answered this question correctly. The results showed that gender and response to Question 2 were independent. There was not a significant ($p = 0.9230$) correlation between gender and whether or not participants responded correctly (see Table 21).

Question 3 assessed participants' knowledge that women are more frequently diagnosed with osteoporosis than men. Sixty-eight percent of females and thirty-six percent of males answered the question correctly. The results showed that gender and response to Question 3 were dependent. Therefore, there was a significant correlation ($p = 0.0001$) between gender and knowledge that women have a higher risk of being diagnosed with osteoporosis (see Table 22).

Question 4 assessed participants' knowledge that calcium is important for strong, healthy bones. Eighty-six percent of females answered the question correctly, and 85% of males answered the questions correctly. The results showed that gender and response to Question 4 were independent ($p = 0.8168$, see Table 23).

Table 20

Contingency Analysis of Responses to Question 1 by Gender

	Correct	Incorrect	Total
Female			
Count	92.00	10.00	102.00
Total %	59.35	6.45	65.81
Col. %	66.19	62.50	
Row %	90.20	9.80	
Male			
Count	47.00	6.00	53.00
Total %	30.32	3.87	34.19
Col. %	33.81	37.50	
Row %	88.68	11.32	
Total			
Count	139.00	16.00	155.00
Total %	89.68	10.32	

Note. $N = 155$, $DF = 1$, -loglike = 0.04279260, and R-squared (U) = 0.0008. Likelihood-ratio chi-square = 0.086 (prob. > chi-square = 0.7699). Pearson chi-square = 0.087 ($p < 0.7684$).

Table 21

Contingency Analysis of Responses to Question 2 by Gender

	Correct	Incorrect	Total
Female			
Count	86.00	16.00	102.00
Total %	55.48	10.32	65.81
Col. %	65.65	66.67	
Row %	84.31	15.69	
Male			
Count	45.00	8.00	53.00
Total %	29.03	5.16	34.19
Col. %	34.35	33.33	
Row %	84.91	15.09	
Total			
Count	131.00	24.00	155.00
Total %	84.52	15.48	

Note. N = 155, DF = 1, -loglike = 0.00468489, and R-squared (U) = 0.0001. Likelihood-ratio chi-square = 0.009 (prob. > chi-square = 0.9229). Pearson chi-square = 0.009 (prob. > chi-square = 0.9230).

Table 22

Contingency Analysis of Responses to Question 3 by Gender

	Incorrect	Correct	Total
Female			
Count	32.00	69.00	101.00
Total %	20.78	44.81	65.58
Col. %	48.48	78.41	
Row %	31.68	68.32	
Male			
Count	34.00	19.00	53.00
Total %	22.08	12.34	34.42
Col. %	51.52	21.59	
Row %	64.15	35.85	
Total			
Count	66.00	88.00	154.00
Total %	42.86	57.14	

Note. $N = 154$, $DF = 1$, -loglike = 7.5127007, and R-squared (U) = 0.0714. Likelihood-ratio chi-square = 15.025 (prob. > chi-square = 0.0001). Pearson chi-square = 14.962 ($p < 0.0001$).

Table 23

Contingency Analysis of Responses to Question 4 by Gender

	Correct	Incorrect	Total
Female			
Count	88.00	14.00	102.00
Total %	56.77	9.03	65.81
Col. %	66.17	63.64	
Row %	86.27	13.73	
Male			
Count	45.00	8.00	53.00
Total %	29.03	5.16	34.19
Col. %	33.83	36.36	
Row %	84.91	15.09	
Total			
Count	133.00	22.00	155.00
Total %	85.81	14.19	

Note. N = 155, DF = 1, -loglike = 0.02661338, and R-squared (U) = 0.0004. Likelihood-ratio chi-square = 0.053 (prob. > chi-square = 0.8175). Pearson chi-square = 0.054 ($p < 0.8168$).

Question 5 assessed participants' knowledge that height and spine changes occur with osteoporosis. Sixty-nine percent of females answered the question correctly, whereas 55% of the males answered the question correctly. The results showed that knowledge that a person with osteoporosis may look like he or she has a curved upper is not significant (p = 0.0726) for males and females (see Table 24).

Table 24

Contingency Analysis of Responses to Question 5 by Gender

	Correct	Incorrect	Total
Female			
Count	70.00	31.00	101.00
Total %	45.45	20.13	65.58
Col. %	70.71	56.36	
Row %	69.31	30.69	
Male			
Count	29.00	24.00	53.00
Total %	18.83	15.58	34.42
Col. %	29.29	43.64	
Row %	54.72	45.28	
Total			
Count	99.00	55.00	154.00
Total %	64.29	35.71	

Note. N = 154, DF = 1, -loglike = 1.5910081, and R-squared (U) = 0.0159. Likelihood-ratio chi-square = 3.182 (prob. > chi-square = 0.0745). Pearson chi-square = 3.223 (p < 0.0726).

Question 6 assessed participants' knowledge that osteoporosis primarily affects the hip, spine, and forearm. Seventy-four percent of the females answered the question correctly; whereas, 70% of the males answered the question correctly. The results showed that gender and response to Question 6 were independent (p = 0.6238). There was no significant correlation between gender and knowledge of which bones are most affected by osteoporosis (see Table 25).

Table 25

Contingency Analysis of Responses to Question 6 by Gender

	Correct	Incorrect	Total
Female			
Count	75.00	27.00	102.00
Total %	48.39	17.42	65.81
Col. %	66.96	62.79	
Row %	73.53	26.47	
Male			
Count	37.00	16.00	53.00
Total %	23.87	10.32	34.19
Col. %	33.04	37.21	
Row %	69.81	30.19	
Total			
Count	112.00	43.00	155.00
Total %	72.26	27.74	

Note. N = 155, DF = 1, -loglike = 0.11930241, and R-squared (U) = 0.0013. Likelihood-ratio chi-square = 0.239 (prob. > chi-square = 0.6252). Pearson chi-square = 0.241 ($p < 0.6238$).

Question 7 assessed participants' knowledge that people over the age of 50 are at increased risk of osteoporosis. Fifty-five percent of females answered the question correctly; whereas 51% of males answered the question correctly. The results showed that gender and response to Question 7 were independent (p = 0.6393, see Table 26).

Table 26

Contingency Analysis of Responses to Question 7 by Gender

	Incorrect	Correct	Total
Female			
Count	46.00	56.00	102.00
Total %	29.68	36.13	65.81
Col. %	63.89	67.47	
Row %	45.10	54.90	
Male			
Count	26.00	27.00	53.00
Total %	16.77	17.42	34.19
Col. %	36.11	32.53	
Row %	49.06	50.94	
Total			
Count	72.00	83.00	155.00
Total %	46.45	53.55	

Note. N = 155, DF = 1, -loglike = 0.10976802, and R-squared (U) = 0.0010. Likelihood-ratio chi-square = 0.220 (prob. > chi-square = 0.6394). Pearson chi-square = 0.220 (p < 0.6393).

Question 8 assessed participants' knowledge that there is a way to reduce the risk of getting osteoporosis. Sixty-six percent of females answered the question correctly. Sixty percent of males answered the question correctly. The results showed that gender and response to Question 8 were independent (p = 0.4904, see Table 27).

Table 27

Contingency Analysis of Response to Question 8 by Gender

	Correct	Incorrect	Total
Female			
Count	66.00	34.00	100.00
Total %	43.14	22.22	65.36
Col. %	67.35	61.82	
Row %	66.00	34.00	
Male			
Count	32.00	21.00	53.00
Total %	20.92	13.73	34.64
Col. %	32.65	38.18	
Row %	60.38	39.62	
Total			
Count	98.00	55.00	153.00
Total %	64.05	35.95	

Note. N = 153, DF = 1, -loglike = 0.23636475, and R-squared (U) = 0.0024. Likelihood-ratio chi-square = 0.473 (prob. > chi-square = 0.4917). Pearson chi-square = 0.476 ($p < 0.4904$).

Question 9 assessed participants' knowledge that genetics play a role in an individual's risk for osteoporosis. Fifty-six percent of females answered the question correctly; whereas 58% of males answered the question correctly. The results showed that gender and response to Question 9 were independent at 0.05 alpha. There was no statistically significant ($p = 0.7559$) difference between the two groups in terms of knowledge that osteoporosis has a genetic component (see Table 28).

Table 28

Contingency Analysis of Responses to Question 9 by Gender

	Correct	Incorrect	Total
Female			
Count	57.00	45.00	102.00
Total %	36.77	29.03	65.81
Col. %	64.77	67.16	
Row %	55.88	44.12	
Male			
Count	31.00	22.00	53.00
Total %	20.00	14.19	34.19
Col. %	35.23	32.84	
Row %	58.49	41.51	
Total			
Count	88.00	67.00	155.00
Total %	56.77	43.23	

Note. $N = 155$, $DF = 1$, -loglike = 0.04842120, and R-squared (U) = 0.0005. Likelihood-ratio chi-square = 0.097 (prob. > chi-square = 0.7557). Pearson chi-square = 0.097 ($p < 0.7559$).

Question 10 assessed participants' knowledge that medicine can treat osteoporosis. Seventy-five percent of females answered the question correctly. Sixty-six percent of the males answered the question correctly. The results showed that gender and response to Question 10 were independent (p = 0.2671, see Table 29).

Table 29

Contingency Analysis of Responses to Question 10 by Gender

	Correct	Incorrect	Total
Female			
Count	76.00	26.00	102.00
Total %	49.03	16.77	65.81
Col. %	68.47	59.09	
Row %	74.51	25.49	
Male			
Count	35.00	18.00	53.00
Total %	22.58	11.61	34.19
Col. %	31.53	40.91	
Row %	66.04	33.96	
Total			
Count	111.00	44.00	155.00
Total %	71.61	28.39	

Note. N = 155, DF = 1, -loglike = 0.60611616, and R-squared (U) = 0.0066. Likelihood-ratio chi-square = 1.212 (prob. > chi-square = 0.2709). Pearson chi-square = 1.231 (p < 0.2671).

Question 11 assessed whether or not a health promoter or physician had told participants about osteoporosis prior to the study. Eighty-five percent of females and males answered that they had previously heard about osteoporosis from a health care provider. The results showed that the probability of being told about osteoporosis by a health promoter or physician was independent of gender (p = 0.9485, see Table 30).

Table 30

Contingency Analysis of Responses to Question 11 by Gender

	Yes	No	Total
Female			
Count	87.00	15.00	102.00
Total %	56.13	9.68	65.81
Col. %	65.91	65.22	
Row %	85.29	14.71	
Male			
Count	45.00	8.00	53.00
Total %	29.03	5.16	34.19
Col. %	34.09	34.78	
Row %	84.91	15.09	
Total			
Count	132.00	23.00	155.00
Total %	85.16	14.84	

Note. N = 155, DF = 1, -loglike = 0.00207771, and R-squared (U) = 0.0000. Likelihood-ratio chi-square = 0.004 (prob. > chi-square = 0.9486). Pearson chi-square = 0.004 (p < 0.9485).

According to Table 31 the respondents of the survey were 66% female and 34% male. Seventeen percent of the patient's BMI were in the overweight to obese range, 65% were in the normal range, and 0.05% were underweight. In response to their highest achieved education, 21% did not attend school, 37% completed primary school, 28% completed high school, and 18% completed some type of post-secondary schooling. In regards to income level, 74% fall below the poverty level for El Salvador while only 25% earned greater than $254 per month. Sixty-one percent of the patients surveyed were unemployed, leaving 39% of the patients employed.

Table 32 shows the medical history of the patients. The mean number of pregnancies in the lifetime of female patients was 3.8. Eighty-two percent of the patients had not sustained a fracture prior to this incident. Eleven percent had experienced a fracture prior to this admission, and 0.05 % had experienced 2 previous fractures. Two patients had previously had 3 fractures, 1 patient had sustained 4 previous fractures, and 1 patient had had 6 prior fractures. Forty-three percent of the patients had a positive family history of fractures. Twenty-two percent of patients had a known family history of osteoporosis. Thirty-six percent of the patients use Maalox. Estrogen replacement was being used by or had been used by 0.06% of the patients. Fifty-four percent of patients used tobaccos products while 26% of patients consume alcohol. The use of medications that may contribute to bone density decline in this population were 0.1% using corticosteroids and 0.02% using anticonvulsants.

Table 33 exhibits the responses of the patients to questions about their diet and exercise habits. The average amount of caffeinated drinks consumed in a day is 1.2 per person. Sixty-five percent of patients consume at least one serving of milk a day while the mean was 0.98 servings of milk per person per day. Eighty-five percent of the patients consumed at least one serving of

Table 31

Demographics of the Defined Population

Demographic	Number of patients	Percentage
Gender		
Male	53	34%
Female	102	66%
BMI		
< 18.5	7	5%
18.5–24.9	100	65%
25–29.9	26	17%
> 30	14	9%
Highest educational level completed		
No school	33	21%
Primary	57	37%
High school	43	28%
Postsecondary	28	18%
Monthly income		
Less than $254	115	74%
Greater than $254	39	25%
Did not answer	1	<1%
Employment status		
Unemployed	95	61%
Employed[a]	60	39%

[a]Of those who were employed and answered the follow-up questions, 11 were day laborers, 7 were office workers, 5 were cooks, 6 were drivers, and 19 were vendors.

Table 32

Medical History of the Defined Population

History	Number of patients	Percentage
Number of pregnancies		
0	56	36%
1	6	4%
2	18	12%
3	25	16%
4	22	14%
5	7	5%
6	9	6%
7	7	5%
8	1	<1%
9	1	<1%
10	3	2%
Number of previous fractures		
0	127	82%
1	17	11%
2	7	4%
3	2	1%
4	1	1%
5	0	0%
6	1	1%
Family history of fractures		
No	89	57%
Yes	66	43%
Family history of osteoporosis		
No	121	78%
Yes	34	22%
Use of Maalox		
No	99	64%
Yes	56	36%
Use of estrogen replacement therapy		
No	145	94%
Yes	10	6%

Table 32 (continued)

History	Number of patients	Percentage
Use of tobacco		
No	71	46%
Yes	84	54%
Use of alcohol		
No	114	74%
Yes	41	26%
Use of a significant medication		
None	138	89%
Corticosteroids	15	10%
Anticonvulsants	3	1%

cheese per day, whereas, 12% of the patients consumed at least one serving of yogurt a day. Twenty-five percent of the patients take a multi-vitamin and 19% take calcium supplements daily. Ninety percent of the patients consumed at least one serving of vegetables a week, 9% said they consumed vegetables at least one a day. Nixamal tortillas are tortillas with calcium supplement added and were not consumed by 14% of the patients. Eighty-six percent of the patients consumed at least one Nixamal tortilla a day. When questioned about their exercise practices, only 10% stated they did aerobics, running, or other specific exercises. Whereas, 28% stated their work required them to carry heavy objects. Twenty-one percent of the patients use their head or back when they need to carry heavy loads, and 31% use their hands.

Table 34 displays a summary of the knowledge questions answered by the patients. They are arranged in descending order by the percentage that responded correctly to the question.

Table 33

Diet and Exercise Habits of the Defined Population

Dietary factor	Number of patients	Percent
Number of other caffeinated drinks per day		
0	54	35%
1	43	28%
2	36	23%
3	17	11%
4	3	1%
5	1	<1%
6	1	<1%
Number of servings of milk per day		
0	54	35%
1	53	34%
2	44	28%
3	4	3%
Number of servings of cheese per day		
0	24	15%
1	82	53%
2	39	25%
3	9	6%
4	0	0%
5	1	<1%
Number of servings of yogurt per day		
0	137	88%
1	16	10%
2	1	<1%
3	1	<1%
Supplements used		
None	102	66%
Calcium and multivitamins	16	10%
Only calcium	14	9%
Only multivitamins	23	15%

Table 33 (continued)

Dietary factor	Number of patients	Percent
Vegetables consumed		
Broccoli	53	34%
Spinach	68	44%
Lettuce	94	61%
None of the above[a]	39	25%
Frequency of vegetable consumption		
Once a week	139	90%
Once a day	14	9%
Twice a day	3	2%
Number of Nixamal tortillas a day.		
0	22	14%
1	6	4%
2	68	44%
3	36	23%
4	10	6%
5	2	1%
6	7	5%
7	2	1%
8	1	<1%
9	0	0%
10	1	<1%
Exercise		
Carry heavy objects at work	44	28%
Carry heavy objects on head or back	33	21%
Carry heavy objects with hands	48	31%
Run or jog	10	6%
Aerobics or other exercise	4	3%

[a]Other vegetables consumed were potatoes (*n* = 18), carrots (*n* = 11), corn (*n* = 11), tomatoes (*n* = 45), cauliflower (*n* = 1), squash (*n* = 2), radish (*n* = 4), pepper (*n* = 13), peas (*n* = 11), mushroom (*n* = 1), cucumber (*n* = 13), and cabbage (*n* = 1).

Table 34

Summary of Participants' Responses to Questionnaire

Question	True	False	Percentage answering correctly
1. Osteoporosis is a disease of the bones.	139	16	89.68%
2. Calcium is important to have in my diet if I want strong bones.	133	22	85.81%
3. I have been told about osteoporosis by a health promoter or physician	132	23	85.16%
4. If I have osteoporosis, I am at a greater risk of having fractures.	131	24	84.52%
5. Osteoporosis most likely affects the bones of the hip, wrist, and spine.	112	43	72.26%
6. Osteoporosis can be treated by medicine.	111	44	71.61%
7. There is a way to reduce your risk for osteoporosis.	100	55	64.52%
8. A person with osteoporosis may look like he or she has a curved upper back.	99	56	63.87%
9. Men are more likely to be diagnosed with osteoporosis than women.	66	89	57.42%
10. If your mother or father had osteoporosis, you have a greater chance of developing osteoporosis.	88	67	56.77%
11. Being over the age of 50 does not increase my risk of having osteoporosis.	72	83	53.55%

Chapter 5. Summary, Discussion, Conclusions and Recommendations

Summary

The purpose of this study was to investigate incidence, knowledge, causes, and risk factors effecting elderly patients admitted for fractures at Hospital Zacamil in San Salvador, El Salvador in order to develop programs targeted to prevention. The following objectives were investigated:

1. Determine the incidence, causes, and treatment of elderly fractures including hip fractures, vertebral fractures, and forearm fractures and related post-morbidity and/or mortality.
2. Compare patient knowledge, causes, treatment of fractures, and related post-morbidity and/or mortality among those aged 45 to 65 years with those over 65 years.
3. Determine the level of knowledge and presence of risk factors for fractures and osteoporosis among patients including diet, exercise, and environmental risk factors and compare them by gender.

Chapter Four presented findings of the patient's responses to the surveys. Chapter Five includes a summary, discussion of the findings, conclusions, and recommendations.

Discussion

Research objective one. Determine the incidence, causes, and treatment of elderly fractures including hip, vertebral, and forearm; and related post-morbidity and/or mortality.

Incidence of fractures. The incidence of specific fractures in this study correlates with similar populations in the developed world. During the data collection period the fractures presenting included; 47% of the hip, 16% of the ankle, 16% of the forearm, and 0.01% of the tibia. The other 20% of fractures that did not fall into those categories, included 8 of the humerus, 6 fingers, 5 patella, 5 ribs, 4 clavicle, 2 femur, and 1 scapula. Similarly, published figures for location of osteoporotic fractures in the United States are 27% vertebral, 21% hip and pelvis, 19% of the forearm, and 33% other locations (Burge et al., 2007). The current study did not include patients with vertebral fractures. While vertebral fractures are one of the most common types of osteoporotic fractures, their incidence in the defined population would have been difficult to identify because of the methods of medical records and difficulty identifying non-symptomatic vertebral fractures in the economically strained El Salvadorian health system.

Another similarity between this study and those conducted in the United States is the distribution of fractures between genders. In this study, 34% of the fractures occurred in males. In 2006 a study published in the United States, 29% of osteoporotic fractures occurred in men (Burge et al., 2007).

Cause of the fractures. The cause of the sustained fractures in this study were 110 (71%) resulting from a fall from a standing height and 45 (29%) occurring from trauma.

Treatment. The treatment of fractures is very individualized to the specific characteristics of the fracture and the overall condition of the patient. The results show in this population 99 (64%) of the fractures were treated with surgery and 55 (36%) were treated with non-surgical methods.

Morbidity and mortality. No mortalities were recorded in the study population during the data collection period. Morbidities ranged from a suture reaction to a pulmonary embolism. A total of 25 (16%) of the patients experienced a morbidity in relation to their injury.

Research objective two. To compare patient knowledge, causes, treatment of fractures, and related post-morbidity and/or mortality among those aged 45 to 65 years with those over 65 years.

Patient knowledge. The responses to the knowledge questions were similar overall; however, there were four questions with significant differences between the two age groups. Question 4 tested the knowledge that calcium was needed for strong bones. More of the patients in the 45 to 65 age group answered the question correctly compared to those over the age of 65. Also question 7 resulted in a significant difference. More patients over the age 65 correctly responded that people over the age of 50 were at an increased risk of osteoporosis. Question 8 had a significant difference with those over the age of 65 correctly answering that there were ways to decrease the risk of getting osteoporosis. Lastly, question 10 showed a significant difference with patients between the ages of 45 to 65 correctly answering that there are medicine to treat osteoporosis.

Cause of fracture. While in both age groups (45 – 65 and over 65) the majority (57% and 77%) of fractures were due to a fall from a standing height. A higher percentage of the fractures in those over 65 years occurred from a fall rather than trauma.

Treatment of fracture. Those over the age of 65 underwent surgery significantly more often compared to those in the 45 to 65 age group.

Morbidity and mortality. There was not a significant difference between age groups of 45-65 and over 65 pertaining to morbidity and mortality. Nineteen percent over the age of 65 had experienced associated morbidity. Eleven percent between 45 to 65 years of age experienced morbidity. There were no mortalities reported in this study.

Research objective three. Determine the level of knowledge and presence of risk factors for fractures and osteoporosis among patients including diet, exercise, and environmental risk factors.

Knowledge by gender. There was a statistically significant difference among genders on question 3 regarding the frequency of osteoporosis by gender. Sixty-eight percent of the females answered correctly whereas 36% of males answered correctly that females are more frequently diagnosed with osteoporosis than men.

Risk factors. Statistically the presence or absence of risk factors among the genders was not significant. Tables 31-33 show the risk factors in the defined population to be similar by gender.

Conclusions

Research objective one. The literature in the United States and other developed countries based on the literature review in Chapter 2 is similar to findings in this study regarding to incidence, causes, and treatment of elderly fractures including hip fractures, and forearm fractures and related post-morbidity and/or mortality.

Research objective two. There was not a significance difference between the age groups in their overall knowledge base. The difference in the cause of fractures was, as discussed previously, with the younger group having a higher percentage of fractures due to trauma in comparison to the older group. The treatment of the fractures among the groups was in line with what would be expected for each type of fracture based on the current literature. As one ages the bone density decreases. Therefore, fractures are more likely to need surgical stabilization as age increases.

There was not a statistically significant difference between the groups in terms of morbidity. The over 65 years of age group did have 19% morbidity whereas the younger group only had 11%. The increase percentage of morbidity in the older group could be explained due to an increased likelihood of comorbid condition in this group and their decreased ability to handle trauma to the body such as surgical procedure. These conclusions are supported by the current medical literature cited in this study.

Research objective three. The knowledge base of risk factors for fractures and osteoporosis is similar by gender with exception of the knowledge gap that females are more prone to osteoporosis. Risk factors are present in this population but not statistically different by gender.

General Recommendations

This study contributed to the general knowledge base of fractures occurring in the elderly of El Salvador. Prevalence and location of fractures in this study are similar to those in literature occurring in developed countries cited in Chapter 2.

In general, the recommendations that follow are based on consistency between findings in this research and the literature included in the Thesis. The lack of any major surprises allows the researcher to build on the current literature. However, this research makes an important addiction by providing data and findings from El Salvador where very little research or data of any type is available. This new dimension and patient population provides insights into consistency of prevention needs and treatment across cultures and settings. There are implications that prevention, detection, and treatment protocols could be developed and applied across cultures and settings, yet a cautious approach is suggested to test approaches within a particular setting.

The focus of prevention should be preventing hip, ankle, and forearm fractures. The prevention of these fractures is tied to the cause of the fractures. This study found that the majority (71%) of the fractures were sustained from a fall from standing height and a smaller portion (29%) were caused by high-energy accidents. The information gained from the above findings will enable a specifically targeted prevention program for this population to be created.

Education and prevention of falls from a standing height have been implemented throughout the developed world as shown in the literature review for this study. Prevention measures include walking aids in the elderly with gait disturbances or weakness. These aids are in the form of canes and four legged walkers. Environmental factors also play a role in prevention of falls such as rooms being well lighted and loose floor rugs being tacked down to the floor. Stairs or changes in floor elevation in the home are challenges found and should be converted by transforming small stairs or entry ways into a ramp. In addition to prevention of falls, prevention of sustaining a fracture after a fall also is of importance. Methods for attaining this goal include padded hip protectors and soft carpeted flooring instead of wood or tiled floors. The findings from this study suggest that future prevention measures can be taken from related literature.

This study also created a base line for current knowledge in this population with regards to osteoporosis and fractures occurring in the elderly. General education on osteoporosis needs to be conveyed to this population, similar to needs found in related literature. This information should focus on the gaps of knowledge found in this study. Education on the importance of calcium in this population's diet is important to increase their base line bone mineral density. Information should also include that osteoporosis is a disease of aging, and mostly affects those over the age of 50 years, typically affecting females more frequently than males.

Education on methods of treatment of the disease is just as important as identifying who is at risk of osteoporosis. Medications can help patients with osteoporosis decrease their risk in sustaining a fracture.

This education should be presented to the at risk population through a multi-venue approach. The education should include but not limited to primary care physician offices where the information is presented in both written and dictated forms. This assertion is substantiated by the related literature in this study.

A pertinent adjunct to this study would be forums and locations for educating those at risk of osteoporosis. This ideally would be a location other than a health care setting where the population over the age 50 could easily access and be made aware of scheduled educational forums.

Future Research Recommendations

Future research recommendations based on findings in this study build on a foundation well established in related literature presented in Chapter 2. The variables suggested for future research are very similar to those across the literature and highly consistent in their presentation.

Recommendations for future research include measuring the bone density of patients with fractures and comparing those results to the bone density of an age-matched population without fractures. A study comparing the bone densities of a population with fractures to a population without fractures would give insight to the importance of bone density in relation to fractures in the El Salvadorian population.

A comparative study based on age and health status of the patients between a developed country and El Salvador should be conducted to determine differences in frequency of surgical treatment for fractures. Such a study should also examine if there is a significant difference in morbidity or mortality outcomes between the population of a developed country and El Salvador. An extensive investigation should be undertaken to further examine the type of morbidities that are occurring in the El Salvadorian population and causes in order to develop a plan of prevention.

Further research should be done to identify the best method to safely and effectively implement lifestyle changes to known risk factors for osteoporosis in a high risk population. Physicians in the primary care setting could identify known risk factors of osteoporosis in their patients and counsel them on lifestyle changes in order to decrease their risk of getting osteoporosis and ultimately a fragility fracture. A study could examine various age groups, such as good nutrition in the younger age groups or dietary supplementation in the elderly.

Future research should pursue an educational program that includes a re-evaluation of knowledge of osteoporosis in the different age groups after age-specific knowledge of osteoporosis is taught.

Research should address strategies of preventing falls from standing height in the two groups (45-65 and over 65) by an in-depth examination of the patient's environment (i.e. stairs) or the patient's health status (i.e. weakness). This type of study could help explain the contributing factors to the occurrence of injuries.

Recommendations for Current Practice

The physician practice in this study has similarity in medical application present in the literature. Yet, variables such as limited access to resources for patient education and treatment, affluence of patients to return to the physician office after initial treatment and lack of ability to keep and apply information on patient records point to some stark difference between developed and developing countries. However, there are common elements that should be considered which are consistent in the related literature. The physicians should establish practices to identify possible risks in their individual patients in the primary care setting. These physicians could identify lower extremity weakness and balance issues and work with the individual to help them decrease their risk of a fall. Education by the nursing staff could decrease the morbidities experienced by patients after surgery. Education and implementation protocols should be developed to decrease skin reaction to staples and sutures. The orthopaedic surgeons at Hospital Zacamil should assess if drain usage would decrease hematoma or seroma creation. An evaluation by current physicians at Hospital Zacamil regarding deep venous thrombosis prophylaxis administration to prevent clot formation and in turn prevent the occurrence of pulmonary embolism would be valuable to this population.

While there are similarities between recommendations in this study and those present in related literature, there are also country specific recommendations with the current population. Future researchers should be cautious not to over generalize, but to be on guard for subtle differences reflected in specific populations and the ever present need for replication of research such as this.

References

Agnusdei, D., & Iori, N. (2000). Raloxifene: Results from the MORE study. *Journal of Musculoskeletal Neuronal Interaction, 1*(2), 127-132.

Bone and Joint Decade. (2009). *The bone and joint decade.* Retrieved October 8, 2009, from www.usbjd.org/news/pdf/USBJD_NL_WINTER09FinalWeb.pdf

Boonen, S., Aerssens, J., & Dequeker, J. (1997). Age-associated decline in human femoral neck cortical and trabecular content of insulin-like growth factor I-potential implications for age-related (type II) osteoporotic fracture occurrence. *Calcified Tissue International, 61*(3), 173-178.

Burge, R., Dawson-Hughes, B., Solomon, D., Wong, J., King, A., & Tosteson, A. (2007). Incidence and economic burden of osteoporosis-related fractures in the united states, 2005-2025. *Journal of Bone and Mineral Research, 22*(3), 465-475.

Carani, C., Qin, K., & Simoni, M. (1997). Effect of testosterone and estradiol in a man with aromatase deficiency. *New England Journal of Medicine, 337*(2), 91-97.

Cenci, S., Weitzmann, M. N., & Roggia, C. (2000). Estrogen deficiency induces bone loss by enhancing T-cell production of the TNF-alpha. *Journal of Clinical Investigation, 106*(10), 1229-1237.

Chapuy, M. C., Arlot, M. E., & Duboeuf, F. (1992). Vitamin D3 and calcium to prevent hip fractures in the elderly women. *New England Journal of Medicine, 327*(23), 1637-1642.

Cummings, S. R., Black, D. M., Nevitt, M. C., Browner, W., Cauley, J., Ensrud, K., Genant, H. K., Palermo, L., Scott. J., & Vogt, J. M. (1993). Bone density at various sites for prediction of hip fractures. *Lancet, 341*, 72-75.

Cummings, S. R., Browner, W. S., & Bauer, D. (1998). Endogenous hormones and the risk of hip and vertebral fractures among older women. *New England Journal of Medicine, 339*(11), 733-738.

Dawson-Huges, B., Harris, S. S., Krall, E. A., & Dallal, G. E. (1997). Effect of calcium and vitamin D supplementation on bone density in men and women 65 years of age or older. *New England Journal of Medicine, 337*(10), 670-676.

Eriksen, R. F., Langdahl, B., & Vesterby, A. (1999). Hormone replacement therapy prevents osteoclastic hyperactivity: A histomorphometric study in early postmenopausal women. *Journal of Bone and Mineral Research, 14*(7), 1217-1221.

Falahati-Nini, A., Riggs, B. L., & Atkinson, E. J. (2000). Relative contributions of testosterone and estrogen in regulating bone resorption and formation in normal elderly men. *Journal of Clinical Investigation, 106*(12), 1553-1560.

Feik, S. A., Thomas, C. D. L., & Clement, J. G. (1997). Age-related changes in cortical porosity of the midshaft of the human femur. *Journal of Anatomy, 191*, 407.

Golden, N. H. (2002). A review of the female athlete triad (amenorrhea, osteoporosis, and disordered eating). *International Journal of Adolescent Medicine Health, 14*, 9.

Gong, Y., Slee, R. B., Fukai, N., & Rawadi, G. (2001). LDL receptor-related protein 5 (LRP5) affects bone accrual and eye development. *Cell, 107*(4), 513-523.

Heaney, R. P. (1994). The bone-remodeling transient: Implications for the interpretation of clinical studies of bone mass change. *Journal of Bone and Mineral Research, 9*(10), 1515-1523.

Hurley, M., Abreu, C., Harrison, J. R., Lichtler, A. C., Raisz, L. G., & Kream, B. E. (1993). Basic fibroblast growth factor inhibits type I collagen gene expression in osteoblastic MC3T3-E1 cells. *Journal of Biogical Chemistry, 112*, 1429.

Ishida, Y., Bellows, C. G., Tertinegg, I., & Heersche, J. N. M. (1997). Progesterone-mediated stimulation of osteoprogenitor proliferation and differentiation in cell populations derived from adult or fetal rat bone tissue depends on the serum component of the culture media. *Osteoporosis International, 7*(4), 323-330.

Jodear-Gimeno, E., Munoz-Torres, M., & Escobar-Jimenez, F. (1997). Identification of metabolic bone disease in patients with endogenous hyperthyroidism: Role of biological markers of bone turnover. *Calcified Tissue International, 61*(5), 370-376.

Johnston, C. C., Miller, J. Z., & Slemenda, C. W. (1992). Calcium supplementation and increases in bone mineral density in children. *New England Journal of Medicine, 327*(2), 82-87.

Kania, D. M., Binkley, N., & Checovich, M. (1995). Evaluated plasma levels of interleukin-6 in postmenopausal women do not correlate with bone density. *Journal of the American Geriatric Society, 43*, 236.

Kawaguchi, H., Pilbeam, C. C., Harrison, J. R., & Raisz, L. G. (1995). The role of prostaglandins in the regulation of bone metabolism. *Clinical Orthopaedics, 313*, 36-46.

Kelly, T. L., Slovik, D. M., Schoenfeld, D. A., & Neer, R. M. (1988). Quantitative digital radiography versus dual photon absorptiometry of the lumbar spine. *Journal of Clinical Endocrinology & Metabolism, 67*(4), 839-844.

Kiel, D. P., Felson, D. T., Hannan, M. T., Anderson, J. J., & Wilson, P. W. F. (1990). Caffeine and the risk of hip fracture the framingham study. *American Journal of Epidemiology, 132*(4), 675-684.

Kiel, D. P., Myers, R. H., & Cupples, L. A. (1997). The BsmI vitamin D receptor restriction fragment length polymorphism (bb) influences the effect of calcium intake on bone mineral density. *Journal of Bone and Mineral Research, 12*(7), 1049-1057.

Lauritzen, J. B., Petersen, M. M., & Lund, B. (1993). Effect of external hip protectors on hip fractures. *Lancet, 341*, 11-13.

Law, M. R., & Hackshaw, A. K. (1997). A meta-analysis of cigarette smoking: Bone mineral density and risk of hip fracture: Recognition of a major effect. *British Medical Journal, 315*, 841-845.

Lewiecki, E. M., Rosen, C. J., Schmader, K. E., & Mulder, J. E. (2009). Prevention of osteoporosis. *Up to Date,* (17.2), 1-16.

Mallmin, H., Ljunghall, S., Persson, I., Naessen, T., Krusemo, U. B., & Bergstrom, R. (1993). Fracture of the distal forearm as a forecaster of subsequent hip fracture: A population-based cohort study with 24 years of follow-up. *Calcified Tissue International, 52*(4), 269-272.

Merriam-webster medical dictionary. (2009). Retrieved December 31, 2009, from http://www2.merriam-webster.com/cgi-bin/mwmednlm?book=Medical&va=hyperparathyroidism

Parfitt, A. M., Villanueva, A. R., Foldes, J., & Rao, D. S. (1995). Relations between histologic indices of bone formation implications for the pathogenesis of spinal osteoporosis. *Journal of Bone and Mineral Research, 10*(3), 466-473.

Perrien, D. S., Achenbach, S. J., & Bledsoe, S. E. (2006). Bone turnover across menopause transition: Correlations with inhibins and follicle-stimulating hormones. *Journal of Endocrinology and Metabolism, 91*(5), 1848-1854.

Raisz, L. G., Rosen, C. J., & Mulder, J. E. (2008). Pathogenesis of osteoporosis. *Up to Date,* August 19, 2009.

Ravn, P., Weiss, S. R., Rodriguez-Portales, J. A., & McClung, M. R. (2000). Alendronate in early postmenopausal women: Effects on bone mass during long-term treatment and after withdrawal. *Journal of Clinical Endocrinology and Metabolism, 85*, 1492.

Rockwood, C. A., & Green, D. P. (2001). Osteoporotic fractures. In R. W. Bucholz, J. D. Heckman & C. Court-Brown (Eds.), *Fractures in adults* (6th ed., pp. 614-637). Philadelphia: Lippincott Williams & Wilkins.

Russell, R. G. (1997). The assessment of bone metabolism in vivo using biochemical approaches. *Hormone and Metabolic Research, 29*, 138-144.

Seeman, E., & Delmas, P. D. (2006). Bone quality the material and structural basis of bone strength and fragility. *N Engl J Med, 354*(21), 2250-2261.

Seeman, E., Tsalamandris, C., Formica, C., Hopper, J. L., & McKay, J. (1994). Reduced femoral neck bone density in the daughters of women with hip fractures: The role of low peak bone density in the pathogenesis of osteoporosis. *Journal of Bone and Mineral Research, 9,* 739-743.

Shea, B., Wells, G., Cranney, A., Zytaruk, N., Robinson, V., Griffith, L., Ortiz, Z., Peterson, J., Adachi, J., Tugwell, P., Guvatt, G., the Osteoporosis Methodology Group, & the Osteoporosis Research Advisory Group. (2002). Meta-analysis of calcitonin for the treatment of postmenopausal osteoporosis. *Endocrine Reviews, 23,* 540-551.

Tinetti, M. E., Doucette, J., Claus, E. B., & Marottoli, R. (1995). Risk factors for serious injury during falls by older persons in the community. *Journal of the American Geriatrics Society, 43*(11), 1214-1221.

United States Bone and Joint Decade. (2009). *About the decade.* Retrieved August 18, 2009, from http://www.usbjd.org/about/index.cfm

World Health Organization. (1994). Assessment of fracture risk and its application to screening for postmenopausal osteoporosis. *World Health Organ Tech Rep Ser, 843*, 1-129.

World health Organization. (2010). *Health statistics and health information systems.* Retrieved January 22, 2010, from http://www.who.int/topics/global_burden_of_disease/en/

Appendix A. Risk Factors and Recommendations

Known Risk Factors for Osteoporosis

Female gender
Caucasian or Asiatic race
Increasing age
Family history of osteoporosis or fragility fractures
Low body mass index
Menopause before the age of 45
Nulliparity
Prolonged lactation
Prolonged amenorrhea unrelated to menopause
Diet low in calcium and vitamin D
Poor intestinal absorption of calcium
Lactose intolerance
Excessive caffeine consumption
Excessive alcohol consumption
Smoking
Sedentary lifestyle
Prolonged treatment with thyroid hormones
Prolonged treatment with glucocorticoids (i.e. cortisone)
Prolonged use of aluminum antacids
Use of anticoagulants

Known Recommendations for Prevention

Weight-bearing exercise
Diet or supplements with adequate levels of calcium and vitamin D
Absence or cessation of smoking
No greater than moderate alcohol or caffeine consumption
Maintaining a body mass index no less than 19 kg/m^2

Appendix B. Description of Research or Training Project

PI Name

Melissa Martinek

Title of Protocol

Fractures in the Elderly Population of El Salvador at Hospital Zacamil: Exploring Knowledge, Causes, Risk Factors, and Outcomes

Brief Summary/ Abstract

As the population's life expectancy increases, fractures among the elderly in El Salvador are also increasing. There is currently limited data specific to the incidence and cause of fractures in the elderly within developing countries, such as El Salvador. The problem of inadequate knowledge pertaining to bone health and osteoporosis among the elderly is contributing to this aging population's health issues. The purpose of this study is to investigate the incidence, prevalence, and risk factors affecting elderly patients admitted for fractures at the Hospital Zacamil in San Salvador, El Salvador. The study will also assess the current knowledge in two distinct populations on bone health and osteoporosis. The first population will be the patients over the age of 45 that present to Hospital Zacamil with acute fractures and are consulted by the department of orthopedics. The second population will consist of students at the Evangelical University over the age of 18 in non-medical track studies. All individuals will have to accept the invitation to participate in the study. In addition, educational materials will be developed on the prevention of fractures for medical professionals and for the elderly in El Salvador. The study objectives will determine incidence and prevalence of elderly fractures of patients over the age of 45 at Hospital Zacamil. Secondly, the study will look at demographic information, prevalent causes of fractures, treatment of the fractures, morbidity and mortality, and any complications that may arise in the fracture patients prior to their discharge from the hospital. Thirdly, the study will seek out the current level of knowledge on bone health, osteoporosis, and fracture prevention in the young, educated Salvadorians and patients over the age of 45 at Hospital Zacamil. Fourthly, the study will address the benefits of the information gained by use of educational materials with the patients and doctors of El Salvador.

Procedures include a researcher developed survey administered to students in non-health track studies at the Evangelical University in San Salvador, El Salvador to assess their knowledge level pertaining to bone health and osteoporosis. Incidence, prevalence, causes, and risk factors will be determined by the researcher, trained physicians, and residents in the department of orthopedics at Hospital Zacamil who will interview patients with an acute fracture between December 2007 and January 2008. The interview will be conducted with the patients who have agreed to participate, and have signed the informed consent form. It will be conducted during the time that discharge instructions are being given to the patient whether they are just leaving from the emergency department or from an in-hospital stay. This timing has been decided upon by Dr. Martinez and Dr. Iglesias so that the entire questionnaire is able to be filled in at one moment in time. This will allow any complications during the stay to be adequately recorded. The interview

will be between the patient and the protocol trained physicians and residents in the department of orthopedics at Hospital Zacamil. The protocol trained physicians and residents will verbally ask the patients the questions from the questionnaire and ask them to respond verbally to the questions. The interviewer will be the one writing the responses on the actual questionnaire form. Informed consent will be obtained by all who accept the invitation to participate in this study. Residents and doctors will be trained by the researcher on all aspects of consent and appropriate survey techniques. The patients will be invited to voluntarily respond to the survey instrument pertaining to bone health, osteoporosis, and their current fracture. The students and the hospital patients will receive a brochure on prevention of fractures in the elderly and bone health after each individual completes the survey. At the conclusion of the administration of the surveys the information gathered will be used to revise the educational material. After revision of the educational material it will be distributed to primary care offices in the area.

One of the target populations to determine the need for educational materials is Salvadorian students at the Evangelical University in non-health track programs. The other target population to assess the current incidence, prevalence, and contributing factors will be patients over the age of 45 at Hospital Zacamil that have been admitted to the department of orthopedics for acute fractures. In addition, for the fracture patients, information specific to the type of fracture, the cause of the fracture, type of treatment medical or surgical received, and any complications incurred before discharge from the hospital will be obtained by the process of the an interview by the trained physicians and residents in the department of orthopedics. A confirmation was obtained from Xiaowei Wang at the Virginia Tech statistical counseling center stating that to address the hypothesis the sample size needs to be equal to or greater than 153.018 patients. This power test was calculated using JMP software. To address the objectives logistic regression will be used as the statistical analysis so no power analysis is needed to determine the significant amount of participants needed. The sample size of each of the populations will be 200 completed questionnaires.

The research methodology will be a researcher developed survey of the young educated Salvadorians at the Evangelical University and patients over the age of 45 admitted to Hospital Zacamil with acute fractures. The student survey will address demographics, risk factors, and the current knowledge base of bone health and osteoporosis. The patient survey will in addition to demographics and risk factors determine specific types of fractures, the cause of fractures, type of treatment medical or surgery received, and any complications incurred before discharge from the hospital through an interview by the researcher and the trained residents and physicians in the department of orthopedics.

Instrument validity will be determined by a panel of experts in key areas associated with the survey. The experts who have determined the validity of the instrument used in this study include; Mauro Iglesias M.D., Eduardo-Martinez-Melara M.D., H. Dean Sutphin PhD, Hara Misra DVM, PhD, and Kerry Redican PhD. Instrument reliability will be determined for all instrument items that have interval data by a pilot test. The pilot test will consist of 20 individuals from each of the two defined populations. Cronbach's alpha coefficient will be used as the statistical reference for reliability. After the calculation of this any questions need to be revised or excluded in the study it will be corrected accordingly. The participants in the pilot study will be eliminated from the results of this study.

Educational materials and the program will be reviewed by a panel of experts to verify content accuracy, level of instruction and other areas of effective materials development and educational delivery.

SAS will be used to compute all statistical analysis. Logistic regression will be used to determine the significance and relationships found in the research objectives. Other descriptive and inferential statistical tests will be used such as the chi-squared test and other statistical tests to determine the relationship among variables. All statistical tests will be done with a $p\text{-value} < 0.05$.

Specific Hypotheses

Hypothesis One:
Fractures of the elderly at Hospital Zacamil are significantly associated with occurring at the hip, wrist, and vertebra in comparison to other fracture locations.

Subject Population(s)

There will be two populations for this study. Hospital patients, females and males, over the age of 45 that are admitted to the department of orthopedics at the Hospital Zacamil in San Salvador, El Salvador from December 2007 to February 2008 will represent one of the populations. All patients over the age of 45 presenting to the hospital due to an acute fracture will be invited to join the study. The care of the patient will be in line with the standard of care for their specific injuries at Hospital Zacamil. The individual's care will not be changed negatively or positively based on whether or not the individual decides to participate in this study.

The second population group will be the university students, females and males, over the age of 18 participating in non-medical studies at the Evangelical University in December 2007. No student will be negatively affected by not participating in this study. There will be no positive or negative influence on the student's grade or course assessment from participating or choosing not to participate in this study.

Sampling will occur in that those individuals who decide to participate in the study will be included and those who choose not to will be excluded. Sufficient sample size has been determined by the statistical consulting center at Virginia Tech. Xiaowei Wang, a statistician, used JMP software to conduct a power test to ensure the proper population sized would be used to receive statistically significant results from the study. It was determined that the population needed to address the study's hypothesis must be equal to or greater than 153.018 patients. The research objectives will be analyzed using logistic regression and therefore a power analysis is not needed. The goal of this study is to obtain 200 completed surveys from each of the two defined populations.

Both populations will be given complete disclosure on all aspects of the study and in no way will there be any threat or coercion to participate.

Study Procedure

What are the proposed procedures or interventions? Please describe all.

A standard questionnaire will be given to all study participants who volunteer; patients over the age of 45 with acute fractures who present to the department of orthopedics and the students at the Evangelical University. There will be an additional section to the questionnaire for the patients at the hospital on the type of fracture present, how the fracture occurred, treatment of the fracture, and any complications that occur post-treatment prior to discharge from the hospital. Data will be recorded by the researcher, or the trained physicians and residents.

This survey is an adaptation from Hernandez-Rauda & Martinez-Garcia, 2004. The questionnaire specific to this study has been reviewed by a panel of experts to validate its content. This panel includes; Mauro Iglesias M.D, Eduardo Martinez-Melara M.D, H. Dean Sutphin PhD, Hara Misra DVM, PhD, and Kerry Redican PhD.

Following the administration of the questionnaire, an educational brochure on the risk factors for fractures among the elderly and prevention measures will be given to each study participant.

How many subjects will be recruited?

There will be approximately 400 subjects invited to participate in this study, 200 from the hospital patient population and 200 from the student population.

How will the selection process be done?

Participants from the hospital will need to meet set requirements that include the initial visit being due to an acute fracture and their age being over 45 years, and they will need to accept the invitation to participate in this study. Student participants from the Evangelical University will be selected based on field of study and they will need to be over the age of 18. The university students will also need to accept the invitation to participate.

In the patient population the participants will be invited and given an overview of what the study is about and what participating entails. They will also be asked if they have any questions. After this if they would like to volunteer to participate informed consent will be obtained with a signature from them along with the signature of the physician or resident that is doing the interviewing. This will all be completed prior to starting the interview.

In the student population at the university they also will receive an overview of the study and what participation in the study would entail. There will be time for questions to be answered. After questions are answered those who are volunteering to participate will give informed consent by signing the form in the presence of the researcher. This will be done prior to disturbing the survey for them to fill out.

The researcher has gained permission from both Evangelical University and Hospital Zacamil through the partnership of the university with Virginia College of Osteopathic Medicine. The

Dean of the Evangelical University, Alvaro Pleitez M.D. has reviewed the research protocol and given permission for the study to take place at the Evangelical University and Hospital Zacamil. Hospital Zacamil is the hospital that is associated with the Evangelical University medical school. At Hospital Zacamil the permission of both Raul Herrera Sanchez M.D., chief of surgery, and Eduardo Martinez Melara, head of the orthopedic department, was obtained.

Describe randomization (or other method for intervention and control groups).

The ability to locate and maintain a population is dramatically different than in the United States. The head of the orthopedic department, Dr. Martinez-Melara, at the hospital clearly stated based on long term professional experience that patient follow up is impossible. Patient records are not sufficient to provide any contact information nor long-term observation and analyses. I will explain further.

The participants were initially located through a partnership the Virginia College of Osteopathic Medicine (VCOM) has with the Evangelical University in San Salvador, El Salvador. The Virginia College of Osteopathic Medicine sends rotating medical students and provides medical care throughout the country of El Salvador under the umbrella of the Evangelical University. Mauro Iglesias M.D. is employed by VCOM. He resides within San Salvador, El Salvador and is VCOM's liaison to the Evangelical University. Dr. Iglesias is in direct contact with the Dean of the Evangelical University, Alvaro Pleitez M.D.

There is a signed agreement of partnership to work together in academic activities between VCOM and the Evangelical University. The Dean of VCOM, Dixie Tookie-Rawlins D.O. was present at the signing of the agreement and her signature is on the agreement. Dean Tookie-Rawlins also has an original copy of the agreement in her possession. This partnership includes both the activities at the university itself and at Hospital Zacamil, as it is the teaching hospital of the Evangelical University. Due to Hospital Zacamil being the partnered teaching hospital Eduardo Martinez-Melara M.D. is a member of the faculty at the Evangelical University. This signed agreement of partnership therefore, also covers the academic activities that will occur within the Hospital Zacamil.

Dr. Iglesias spoke directly with Dr. Pleitez, at a meeting at the Evangelical University, specifically concerning the stated research project. Dr. Pleitez verbally agreed to allow this study's investigators to offer the questionnaire to the students enrolled in non-medical track studies at the Evangelical University in the fall of 2007. Dr. Pleitez has given permission through this previously mentioned agreement to use classroom time to explain and distribute the questionnaire to those students who accept the invitation to participate.

Dr. Pleitez has agreed to allow the primary investigator to administer the questionnaires with patients at Hospital Zacamil. On September 7, 2007 Dr. Martinez, Dr. Iglesias, and he primary investigator entered into a verbal agreement, after reviewing the proposed questionnaire and educational brochure, that the individuals presenting to the department of orthopedics could be approached about participating in this study. The patient population will be located through the patients that are consulted to the department of orthopedics for acute fractures at Hospital Zacamil between December 2007 and February 2008.

Due to the transient nature of the patient population there is an inability to have consistent follow up appointments with the patients. Therefore, the control group in this case will not be added for the purpose of following up with this population through the primary investigator. This is not saying that this population will not need follow up medical care in the future. This transient nature, as we defined it, is mostly due to culture barriers. The barriers include no in office follow up, patients without telephone numbers, no street or mailing addresses, and no reliable manner in which to relocate patients. Also this is a national free health care hospital in the country of El Salvador. Because of this, many patients travel for long distances to receive the medical care on an as needed basis thus increasing the difficulty of relocating patients. Therefore, all the patients that accept the invitation to participate in this study during their visit to the hospital at the time of conducting this research will be surveyed. The survey will assess their entry level knowledge on bone health and osteoporosis. For the purpose of this descriptive survey no individual follow up will be required. The control group will then be those patients who decide not to accept the invitation to participate in the study. The control group will not have the interview with the questionnaire nor will they receive the educational brochure. While the experimental group in the patient population will consist of the patients that accept the invitation to participate in the study. The experimental group will have the questionnaire given to them along with the educational brochure.

The student population will include 200 enrolled at the Evangelical University during the fall of 2007 in non-medical curricula. There are multiple classes that meet for an hour and a half on Tuesday's beginning at ten in the morning. These classrooms will be visited by the researcher in order of ascending class room numbers until 200 students have accepted the invitation to participate and have filled out the survey. The permission has been gained to enter the potential classrooms from the individual professors through the university's dean, Dr. Alvaro Pleitez. The Dean said there will be approximately seventy to one hundred students in each of these classes. In the time frame stated there will be ample time to visit the two to three classrooms necessary to obtain 200 completed surveys. The control group in this population will consist of those students in the classrooms not approached by the investigator to conduct the questionnaires in. These students will not receive the questionnaires or the educational brochure. The experimental group will be those students in the classrooms that accept the invitation to participate in the study.

This is a survey procedure to describe knowledge levels. Students will be given an informational packet after taking the survey in order to provide knowledge to improve bone health and reduce the risk of osteoporosis as part of the implementation phase required for the fellowship supporting the researcher.

What are the procedures and methodologies? Please describe in detail.

This study is designed as a descriptive survey research on the knowledge, cause, risk factors, and outcomes of elderly fracture patients. It is also a survey to determine the knowledge of bone health, osteoporosis, and fracture prevention already in the elderly and young adult populations.

Standard survey procedures will be used with the two different populations. The populations are the acute fracture patients over the age of 45 at Hospital Zacamil and the university students at the Evangelical University. The questionnaire will act as the research instrument. The researcher will be responsible for data collection either directly interviewing or by training those conducting interviews. The physicians and residents of the department of orthopedics will be taught the protocol of data collection for this study and in the absence of the primary researcher will collect the data until the return of the primary researcher in January 2008. The head of the orthopedic department will be trained by the researcher to be the on-site coordinator responsible for data collection when the researcher is absent. The residents will also be trained by the researcher to administer the instrument. The researcher will maintain contact to monitor quality through weekly email and skype conferences with the physicians and residents as needed. This contact will be important to maintain reliability and to ensure standard procedures apply to all respondents.

Initially a pilot test will be conducted to ensure instrument reliability. The pilot groups will consist of 20 members of each of the two groups. The Cronbach's alpha coefficient will be used as the statistical reference to ensure each question is reliable and should be included in the survey. After the statistical calculation of this if any questions need to be revised or exclude in the study it will be corrected accordingly. Then the participants in the pilot study will be eliminated from the results of this study.

The potential participants will be those who enter the department of orthopedics with an acute fracture and are over the age of 45. They will be invited to participate in the study and asked to sign a letter of patient confidentiality and consent. They will also be given clear instructions that their treatment will not be affected if they decide not to participate in the study. No names or other personal identifiers will appear on the surveys.

A survey will be administered by interviewing each patient to obtain basic demographic information, pertinent medical history, assessing risk factors, and to quantify any previous knowledge about bone health, osteoporosis, and fractures. The researcher and trained residents will be recording the data on the survey forms. This survey is an adaptation from Hernandez-Rauda & Martinez-Garcia, 2004. The questionnaire specific to this study has been reviewed by a panel of experts to validate its content. This panel includes; Mauro Iglesias M.D, Eduardo Martinez-Melara M.D, H. Dean Sutphin PhD, Hara Misra DVM, PhD, and Kerry Redican PhD.

The participant will be treated for their sustained fracture according to the normal treatment protocol for the department of orthopedics at Hospital Zacamil.

The interview will be conducted with the patients who have agreed to participate, and have signed the informed consent form. It will be conducted during the time the discharge instructions are being given to the patient whether they are just leaving from the emergency department or from an in-hospital stay. This timing has been decided upon by Dr. Martinez and Dr. Iglesias so that the entire questionnaire is able to be filled in at one moment in time. This will allow any complications during the stay to be adequately recorded. The interview will be between the patient and the protocol trained physicians and residents in the department of orthopedics at Hospital Zacamil. The protocol trained physicians and residents will verbally ask the patients the questions from the questionnaire and ask them to respond verbally to the questions. The interviewer will be the one writing the responses on the actual questionnaire.

The study will not require looking into any past or present medical records due to the inconsistency of medical recording at the hospital. The physicians and residents who will be helping with the administration of the questionnaires are employees of Hospital Zacamil; therefore, they have to follow the hospital's regulations on patient confidentiality. Albeit they are not required to follow the United States standards of HIPPA, however they are under their own hospital's rules and regulations.

As far as confidentiality of the questionnaires is concerned once they have been filled out they will be kept in a specific designated folder in a locked file cabinet in Dr. Martinez's office. They will be picked up by Dr. Iglesias on a biweekly basis until the primary investigator returns. They will be transferred to a locked file within the VCOM apartment. Dr. Iglesias is an employee of VCOM. When the primary investigator is present the questionnaires will be picked up daily as she will be present during the process of interviewing. The primary investigator has been trained in patient confidentiality and HIPPA multiple times during a variety of hospital training sessions and through her curriculum at VCOM.

At no time will the patient's name or other personal identifiers be placed on the survey form.

The second population is at the Evangelical University. The students will be invited to participate in a survey to assess their knowledge on bone health. They will be informed of the survey's intent and asked to sign an informed consent along with completing the survey. After they have filled out the survey they will be given an informational sheet on elderly fractures, their risk factors, and ways to prevent fractures in the elderly.

Their completed questionnaires will also be kept in the VCOM apartment in a locked file box.

How will the data obtained be utilized to test the proposed hypotheses?

I have consulted with Xiaowei Wang at the statistical counseling center at Virginia Tech. Mr. Wang has recommended logistic regression for the objective of determining the knowledge on bone health and osteoporosis among educated university students and among the elderly fracture patients based on a knowledge test. Mr. Wang also states that logistic regression will be the appropriate statistical test to describe the results in terms of the other study objectives as well. Objectives will be analyzed with descriptive statistics. The hypothesis will be analyzed by using single proportion tests such as the t-test and chi-squared. All statistical tests will use a $p\text{-value} < 0.05$.

How was the Estimated Number of Subjects Selected?

The number was estimated by taking the number of acute fracture patients presenting to the department of orthopedics on a monthly basis over the past 3 years and multiplying it by the number of months the data will be collected.

The number of student participants from the university is similar to the number of patients from the hospital. The sample of 200 patients and 200 students along with a description of the study was then verified as adequate by the power analysis performed by Xiaowei Wang, a statistician. The power analysis was used to ensure that the number of subjects would be sufficient to produce statistically significant results. It was calculated that for the results to be statistically significant the sample size of the patient population needs to be at or greater than 153.018 patients. Again for the study objectives logistic regression will be used as the method of analysis so a power test is not needed to ensure statistically significant results in regards to the sample size.

Will Studying this Number Result in Definitive Answers to Major Research Questions?

The sample of 200 patients and 200 students along with a description of the study was then verified as adequate by the Virginia Tech statistical consulting program. A power analysis was used to ensure that the number of subjects would be sufficient to produce statistically significant results. This confirmation concluded that the number of participants was adequate to answer the major research questions as they relate to the specific populations.

A confirmation was obtained from Xiaowei Wang at the Virginia Tech statistical counseling center stating that to address the hypothesis there needs to be a sample size equal to or greater than 153.018 patients. This power test was calculated using JMP software. To address the objectives logistic regression will be used as the statistical analysis so no power analysis is needed for the statistically significant amount of participants needed. The results will be statistically significant in size of the samples studied and this will give definitive answers to the specific populations participating.

Below is the list of research objectives.

1. To determine the incidence and prevalence of elderly fractures; including hip fractures, vertebral fractures, and forearm fractures.

2. Describe selected demographic information from the patients that obtain fractures.

3. Determine the prevalent causes of elderly fractures by a survey of the current cases consulted to the department of orthopedics at Hospital Zacamil from December 2007 to February 2008.

4. Describe the main treatment of the fractures including surgical and medical.

5. Determine post-fracture and post-surgical morbidity and mortality prior to discharge from the hospital.

6. To compare the 45 to 65 year old age group to the over 65 age group in terms of complications prior to their discharge from the hospital. (These are not separate populations rather a division by age of the patient population to analyze this specific objective.)

7. Determine the level of knowledge of risk factors of fractures and osteoporosis among patients in this study including diet, exercise, and environmental factors. Along with determining the extent to which diet, exercise, and environmental risk factors are present in their daily lives.

8. To take the information gained from the questionnaires and develop an educational program designed to reduce fractures in the elderly.

9. Determine the level of knowledge on bone health and osteoporosis among the students at the Evangelical University in El Salvador.

10. Develop an education program at the Evangelical University to educate the students on the risk factors and prevention of osteoporosis.

Investigator Experience

Melissa Martinek D.O., summer 2007, How do osteopathic medical students cope with stress; A qualitative study. Otherwise no specific past experience with this topic.

As the primary investigator I have limited research experience. I have thoroughly reviewed the literature, consulted with experts in the fields of orthopedics, and on the health care of El Salvador at the Virginia College of Osteopathic Medicine, Hospital Zacamil, and with Dr. Iglesias a physician trained and practicing in San Salvador, El Salvador. Moreover during my fourth year of medical school at VCOM, I successfully completed all academic and clinical work to complete my Doctor of Osteopathic Medicine degree. During this time I passed the relevant board exams. In addition, I am working in consultation with my graduate advisor, Dr. Sutphin and committee members who have expertise in graduate advising, medical specialization within the study, and experience in developing country research and medicine.

Mauro Iglesias M.D. has conducted medical studies in the country of El Salvador in the past but not pertaining to this specific topic. His area of study was on the prevention of Dengue Fever in El Salvador.

Dean Sutphin Ph.D. and other graduate committee members have no specific previous experience with this topic but have experience advising students and conducting research in an international setting. Each member has extensive experience with designing and implementing research proposals and ideas in each of their respective specialties. Dr. Sutphin has supervised over 50 PhD and master theses.

Benefits or Advantages

The direct benefit to the study participants will be the educational information they will receive about the risk factors, prevention of fractures, bone health, and osteoporosis. The other benefit to society is to advance the records and knowledge of prevalence and incidence of fractures in this population within El Salvador. Another benefit will be to discover the risk factors that are prevalent so an educational tool can be designed to help decrease the risk factors and furthermore to decrease the incidence of fractures in the future. The educational pamphlet that will be designed from the information gain in this study will then be made available to many of the primary care offices in San Salvador, El Salvador.

The cost to benefit of this research is clearly demonstrated because it advances medical research in a country where this type of research is pioneering. The body of knowledge in El Salvador on bone health from research is very limited.

Risks, Discomfort and Inconveniences

There are minimal risks. One risk may be the emotional discomfort of filling out the survey. Another may be the inconvenience of taking five minutes extra then the normal visit to fill out the survey.

Protection for Subjects

Subjects will be protected in their confidentiality and have minimal risks due to no treatment being applied in this study. The inconvenience of time will be considered and a streamlined way of administering the questionnaire will be created. There will be no association between any patient medical records and the survey form. The survey form at no time will have names or other personal identifiers placed on the form. There is not a need for a separate coding process as the patients will not need or be able to have follow-up.

Privacy and Confidentiality
At what stage will identifiers be removed from the data?

Subjects will be protected in their confidentiality and have minimal risks due to no treatment being applied in this study. The inconvenience of time will be considered and a streamlined way of administering the questionnaire will be created. There will be no association between any patient medical records and the survey form. The survey form at no time will have names or other personal identifiers placed on the form. There is not a need for a separate coding process as the patients will not need or be able to have follow up.

If identifiers must be retained, explain why.

Not applicable as per the above statement.

When will the research data be destroyed?

The raw data will be destroyed after the completion of the defense of the dissertation. This date is projected to be in May 2008.

If data will not be destroyed until the end of the study, describe where and in what format and for how long it will be stored.

The study information will be stored in a locked file cabinet at the VCOM apartment in San Salvador, El Salvador.

How might you use stored human material in the future, and how would you obtain the subjects' permission for future use of their data? How and when will the human material be destroyed?

No human material is being collected.

Are any of your data sources covered entities under HIPPA? If so, please identify the institution and explain what arrangements have been made to comply with the HIPAA Privacy Rule in order to access subject's protected health information.

No.

Subject Recruitment

Subjects will be invited to participate if they present to the department of orthopedics at Hospital Zacamil over the age of 45 and are presenting with an acute fracture. Whether or not they choose to participate will not influence their treatment or access to medical attention.

The second population in this study will be university students who also will be invited to participate in the survey during a class period. Whether they do or don't participate will not influence their grade in that course in any direction, nor will it represent any diminished service to them.

Informed Consent

The patients will receive an overview of the study and then be invited to participate. If they agree to be in the study they then will have a chance to look over the informed consent, ask any questions, and be reminded that this is voluntary and they may withdraw at any point in time. The patients will then be invited to sign the informed consent and proceed with the survey.

The second population is the students and they will have the survey explained along with the study's purpose at the beginning of a class period in December s2007. They then will get an overview of the informed consent, time to ask questions, and then be invited to sign the informed consent if they wish to take part.

All informed consents are attached to the proposal document submitted with this form in English and in Spanish.

Use of Study Results

The results are separate from the patient's medical records and will not be included in their records. The information gained will be used to revise the educational materials. The study results will be analyzed and reported in the format necessary for the researcher's dissertation. Relevant results may be submitted for publication at peer reviewed journals.

Alternatives to Joining Study

The alternative is not to participate. Either way the patient will receive medical treatment and services as needed. The student's grades in the course will not be affected in either direction if they choose not to participate.

Appendix C. Questionnaire on Bone Health for Fracture Patients

GENERAL

1. Age:
2. Gender: Male Female
3. Weight (Kgs): Height (cm):
4. Highest level reached in education (circle one):
   No school Primary Secondary
   Technical Schooling University
5. Household income per month (circle one): less than $254 greater than $254

6. Race/ Ethnicity:

MEDICAL

1. Past Medical History:
   If female, how many pregnancies have you had?
   Have you ever had a fracture before: No Yes
      If yes, how many?_______
      If yes, how old were you?_______

2. Do you have a family history of osteoporosis or fractures? No Yes
3. Aluminum antacid use: No Yes
4. Do you or have you been on estrogen therapy? No Yes
5. Have you ever smoked tobacco? No Yes
6. Do you drink alcohol? No Yes How many drinks per week? __________
7. Have you ever taken corticosteroids or anticonvulsants? Please circle

DIET- Amount of daily consumption.

1. Coffee (number of cups, one cup= 250ml):_________
2. Soda, tea, other caffeinated beverages (number of cups, one cup=250ml):_________
3. Milk (number of cups, one cup=250ml):__________
4. Cheese:________
5. Yogurt:________
6. Calcium supplements or multivitamin: None Both Calcium Multivitamin
7. Do you eat these vegetables? Broccoli Spinach Lettuce None of these
   If yes, how often? Once a week Once a day Twice a day
8. What vegetable do you eat most frequently?__________
9. Do you eat Nixtamal tortillas? No Yes If yes, how many a day?_________

PHYSICAL ACTIVITY

1. Are you employed? No Yes
2. If you are employed, what type of work do you do?_________
3. Do you carry heavy objects on a regular basis? No Yes
4. Do you use your head or back to carry heavy objects? No Yes
5. Do you usually use your hands to carry heavy objects? No Yes
6. Do you run or jog? No Yes

7. If yes, how many times in the week?
    Once   Twice   Three times or more
8. Do you do aerobics, swimming, or other type of exercise?   No   Yes

KNOWLEDGE OF OSTEOPOROSIS

1. Osteoporosis is a disease of bones.
   True   False
2. If I have osteoporosis it is easier for me to obtain fractures in my bones.
   True   False
3. Men are more frequently diagnosed with osteoporosis than women.
   True   False
4. It is important to have calcium in my diet to have bones that are healthy and strong.
   True   False
5. A person may have changes in their height and spine appearance if they have osteoporosis.
   True   False
6. Osteoporosis affects primarily the bones of the hip, spine, and forearm.
   True   False
7. Being over the age of 50 does not increase my risk of having osteoporosis.
   True   False
8. There is a way to reduce your risk for osteoporosis.
   True   False
9. If your mother or father had osteoporosis that increases the chance that you will also have osteoporosis.
   True   False
10. Osteoporosis can be treated by medicine.
    True   False
11. I have been told about osteoporosis by a health promoter or physician before?
    No   Yes

Current Medical Condition

What type of fracture did the patient have?______________________________

How did they sustain the fracture?_____________________________

What type of treatment was given?

Medical (i.e. pain medicine, casting, splint, brace)
____

Surgical (i.e. what was the name of the procedure performed)-__________
____

Upon release from the hospital were there any complications?

Cuestionario de salud de los huesos para pacientes con fracturas—español

DATOS GENERALES

1. Edad:

2. Sexo: Masculino Femenino

3. Peso (Kg): Alto (cm):

4. Nivel educativo alcanzado:
No fue a la escuela Primaria
Secundaria Bachillerato
Técnico Universidad

5. Ingreso mensual al hogar: Menor a $254 Mayor a $254
6. Etnia:

DATOS MEDICOS
1. Antecedentes Medicos:
Si es mujer, cuantos embarazos ha tenido? __________
Ha sufrido fracturas anteriormente? No Si
Si su respuesta es Si, cuantas?________
Si su respuesta es Si, a que edad(es)? ____________

2. Alguien en su familia ha sufrido Fracturas?
No Si

3. Alguien en su familia ha sufrido Osteoporosis?
No Si

4. Toma antiácidos de aluminio?
No Si

5. Si es mujer, ha tomado o está tomando tratamiento estrogenico sustitutivo?
No Si

6. Alguna vez ha fumado tabaco o cigarrillo?
No Si

7. Toma usted alcohol?
No Si Cuantas veces por semana?_________
8. Ha tomado corticoestorides o anticonvulsantes?

DIETA

12. Cuanto café toma al día (número de tazas, una taza = 250ml)?_________

13. Cuanta Soda, te, otras bebidas con cafeína toma al día?

    (numero de tazas, una taza = 250ml):_________

14. Cuanta Leche toma al día (número de tazas, una taza = 250ml)?________

15. Cuantas veces o porciones de Queso al día?___________

16. Cuantas veces come Yogurt al día?__________

17. Toma suplementos de Calcio o Multivitaminas?

18. Ninguna Ambas Solo Calcio Solo Multivitaminas

19. Come alguno de estos vegetales (marque el o los que come):
    Brócoli Espinaca Lechuga Ninguna de las anteriores

20. Si las come, que tan seguido?
    Una vez por semana Una vez al día Dos o más veces al día

21. Que vegetal o verdura come usted más frecuentemente?____________

22. Come tortillas blancas (Nixtamal)? No Si

23. Si su respuesta es Si, cuantas come al día?________

ACTIVIDAD FISICA

1. Trabaja? No Si

2. Si su respuesta es Si, que tipo de trabajo?_________

3. Carga cosas pesadas de forma regular? No Si

4. Usa su cabeza o espalda para cargar cosas pesadas? No Si

5. Usualmente usa sus manos para cargar cosas pesadas? No Si

6. Corre o trota? No Si

7. Si lo hace, cuantas veces a la semana?
   Una Dos Tres o más

8. Usted nada, hace aeróbicos u otro tipo de ejercicio? No Si

CONOCIMIENTO SOBRE OSTEOPOROSIS

1. La Osteoporosis es una enfermedad de los huesos?
   Verdadero Falso

2. Si yo tengo osteoporosis estoy en un gran riesgo de tener fracturas en mis huesos?
   Verdadero Falso

3. Los hombres son más diagnosticados con Osteoporosis más que las mujeres?
   Verdadero Falso

4. Es importante tener Calcio en mi dieta si quiero tener huesos sanos y fuertes?
   Verdadero Falso

5. Una persona puede verse encorvado en la parte alta de su espalda si tiene Osteoporosis?
   Verdadero Falso

6. La Osteoporosis afecta principalmente los huesos de la cadera, muñeca y columna dorsal?
   Verdadero Falso

7. Ser mayor de 50 años no aumenta mi riesgo de tener Osteoporosis
   Verdadero Falso

8. Existen formas para reducir el riesgo de Osteoporosis
   Verdadero Falso

9. Si su madre o padre tuvieron Osteoporosis, esto aumenta la oportunidad de que usted también tenga Osteoporosis
   Verdadero Falso

10. La Osteoporosis puede ser tratada con medicina
   Verdadero Falso

11. Mi medico o promotor de salud me han hablado sobre la Osteoporosis anteriormente?
   No Si

CONDICIÓN MÉDICA ACTUAL

1. Que tipo de fractura a padecido el o la Paciente?

____

____

2. Como sucedió la fractura?

____

____

3. Que tipo de tratamiento recibió?

No quirúrgico (yeso, muletas, medicinas, etc.)

____

____

Quirúrgico (nombre del procedimiento)

____

____

4. Al momento de ser dado, a de alta del hospital presenta alguna complicación (o causa de fallecimiento)?

____

____

Appendix D. Informed Consent for Participants

Virginia Polytechnic Institute and State University
Virginia College of Osteopathic Medicine

Informed Consent for Participants

Project: Fractures in the elderly population of El Salvador at the Hospital Zacamil: Exploring Knowledge, Causes, Risk Factors, and Outcomes

Investigators: Melissa Martinek D.O., Mauro A. Iglesias Velásquez, M.D., Dean Sutphin Ph.D.

I. Purpose of this Research

The purpose of this study is to investigate fractures that occur in the elderly their incidence and prevalence within the population of San Salvador that seeks medical attention at the Hospital Zacamil. To find what the principal causes of the fractures are and what morbidity and mortality result from the fractures. Then also to investigate the level of knowledge of bone health and osteoporosis. Then to use this information to develop and education program on the prevention of elderly fractures.

II. Procedures

Individuals will be asked to participate in this study by filling out a survey examining their present knowledge of bone health, osteoporosis, and risk factors along with having their type of fracture recorded along with any complications that may result from the fracture.

III. Risks

There will be minimal risks. The risk of emotional distress in filling out the survey and in recording any complications may occur. The individual's privacy and reputation will be upheld through confidentiality on the survey and forms that record information on their fractures.

IV. Benefits

The benefit to society will be to find out the prevalent causes of elderly fractures and to then be able to form prevention measures to protect others against obtaining these types of fractures. Along with discovering risk factors for these fractures that are prevalent in this population.

There is no promise or guarantee of benefits that have been made to encourage you to participate.

V. Extent of Anonymity and Confidentiality

Confidentiality will be kept by not including patient's name or other personal identifiers on the surveys. The surveys and raw data will only be accessible by the researchers named in this study and will be destroyed at the conclusion of the study.

It is possible that the Institutional Review Board (IRB) may review this study's information for the protection of human subjects involved in research.

If a subject is believed to be a threat to himself/ herself or others the investigator will have the responsibility to the person and society to notify the appropriate authorities.

VI. Compensation

There will be no compensation given for participating in this study.

VII. Freedom to Withdraw

Subjects are free to withdraw from this study at any time without penalty. Subjects are free not to answer any questions or respond to experimental situations that they choose without penalty.

VIII. Subject's Responsibilities

I voluntarily agree to participate in this study. I have the following responsibilities: To answer to the best of my ability questions from the survey that I am comfortable with.

IX. Subject's Permission

I have read the Consent Form and conditions of this project. I have had all my questions answered. I hereby acknowledge the above and give my voluntary consent:

Subject Signature _________________________________ Date ____________

Witness ____ Date ____________

This project has been reviewed and approved according to Virginia College of Osteopathic Medicine's procedures governing your participation in this research. Should I have any pertinent questions about this research or its conduct, and research subjects' rights, and whom to contact in the event of a research-related injury to the subject, I may contact:

Investigators: Melissa Martinek memarti2@vcom.vt.edu / 540-239-7139
Mauro Iglesias
Faculty Advisor: Dean Sutphin dsutphin@vcom.vt.edu
VCOM IRB Chairman
Hara P. Misra, D.V.M., Ph.D.
Tel: 540-231-3693
misra@vcom.vt.edu

Virginia Polytechnic Institute and State University
Virginia College of Osteopathic Medicine

Consentimiento Informado para Participantes

Proyecto: Fracturas en la población mayor de San Salvador en el Hospital Zacamil

Investigadores: Melissa Martinek D.O., Mauro A. Iglesias Velásquez, M.D., Dean Sutphin Ph.D.

I. Propósito de esta investigación

El propósito de este estudio es investigar fracturas mayores su incidencia y frecuencia dentro de la población de San Salvador que solicita atención médica en el hospital evangélico. A encontrar las causas principales de las fracturas y qué morbosidad y mortalidad resultan de las fracturas. También investigar el nivel de conocimiento de salud de los huesos y prevención de fracturas mayores.

II Procedimientos

Los individuos serán pedidos a participar en este estudio por llenar una encuesta que examina su conocimiento actual de salud de los huesos y factores de riesgo junto con su tipo de fractura documentado y cualquier complicación que resulte de la fractura.

III Riesgos

Habrá riesgos mínimos. El riesgo de la angustia emocional de llenar la encuesta y documentar las complicaciones puede ocurrir. La privacidad y reputación del individuo serán defendidas por medio del anónimo y en la confianza en la encuesta y las formas que registran sus fracturas.

IV. Beneficios

Los beneficios a la sociedad serán informarse de las causas corrientes de las fracturas mayores y luego poder a formar medidas de prevención para protejerse a otras personas contra estes tipos de fracturas. Junto con el descubrimiento de los factores de riesgo para estas fracturas que son corrientes en esta población.

No hay promesa ni garantía de beneficios que ha sido hecha para alentarle que participe.

V. La extensión del anónimo y confidencia

La confidencia será guardada por crear un código individual para identificar el paciente. Las encuestas y los datos serán accesibles solamente por los investigadores nombrados en este estudio y se destruirán a la conclusión del estudio.

Es posible que la Junta de Revisión Institucional (IRB) vea este estudio para la protección de los sujetos humanos embrollados en la investigación.

Si se cree que un sujeto sea una amanaza a él mismo/ella misma o a otros el investigador tendrá la responsabilidad a la persona y la sociedad de notificar a las autoridades apropriadas.

VI. Compensación

No habrá compensación dada por participar en este estudio.

VII. Libertad de retirar

Los sujetos pueden retirar del estudio en cualquier momento sin castigo. Los sujetos pueden no contestar cualquiera pregunta o responder a situaciones experimentales que eligen sin castigo.

VIII. Responsabilidades de los sujetos

Yo eligo participar voluntariamente en este estudio. Tengo las siguientes responsabilidades: Contestar a la mejor de mi capacidad las preguntas de la encuesta con qué estoy cómodo/cómoda.

IX. Permiso del sujeto

Yo he leído la forma de consentimiento y condiciones de este proyecto. Todas mis preguntas han sido contestadas. Yo, por este medio, reconozco el propósito y doy mi consentimiento voluntario:

Firma del sujeto: ________________________________ Fecha: _________

Testigo: ______________________________________ Fecha: _________

Este proyecto ha sido examinado y aprobado según el Colegio de Virginia de los procedimientos de la Medicina Osteopathic que gobiernan su participación en esta investigación.

Si yo tenga preguntas pertinentes acerca de esta investigación o su conducta, y los derechos de los sujetos de la investigación, y con quién comunicarme en caso de una herida conexo a la investigación del sujeto, puedo comunicarme con:

Investigatores: Melissa Martinek memarti2@vcom.vt.edu / 540-239-7139
Mauro Iglesias
Consejero de la facultad: Dean Sutphin dsutphin@vcom.vt.edu
VCOM IRB Chairman
Hara P. Misra, D.V.M., Ph.D.
Tel: 540-231-3693
misra@vcom.vt.edu

Appendix E. Osteoporosis Facts & Prevention

What is osteoporosis?

Osteoporosis is a disease that affects the bones. The bones become weak and are more likely to break, with little force.

What bones usually break?

Osteoporosis usually affects the hip, spine, and wrist.

Who gets osteoporosis?

Osteoporosis mainly affects women over the age of 50. Men can also be affected. Sometimes a pre-diagnosis is called osteopenia, where the person has low bone mass.

How can osteoporosis be diagnosed?

Your doctor can tell you whether or not you have osteoporosis. They may need to conduct a bone mineral density scan called a DXA scan; this can tell your doctor about the strength of your bones.

Risk Factors

- Gender– Women greater affect
- Age– older age greater the risk
- Body size– Smaller size greater risk
- Family history
- Ethnicity– Caucasian and Asian greater risk
- Smoking
- High amount of alcohol use
- Low amounts of sex hormones, in women low estrogen and in men low testosterone
- Amenorrhea– abnormal absence of menstrual cycle
- Certain use of medications
  (Chemotherapy, corticosteroids, anticonvulsants, and others.)
- Personal history of having a fracture over the age of 50.

- Anorexia nervosa
- Having a diet deficient in calcium and vitamin D

Prevention

- A diet rich in calcium and vitamin D
  - low fat milk, yogurt, and cheese
- Exercise (weight-bearing)
  -walking, jogging, lift weights, dance, hike
- Not smoking
- Not drinking excessive alcohol

Treatment

- A healthy lifestyle
- Diet rich in calcium and vitamin D
- Exercise
- If needed, medications from your doctor

Recommended Daily Calcium

Below is the daily recommended amounts of calcium and vitamin D for each specified age group.

Age	Calcium	Vitamin D
0 to 6 months	210mg	200 IU
7 to 12 months	270mg	200 IU
1 to 3 years	500mg	200 IU
4 to 8 years	800mg	200 IU
9 to 18 years	1,300mg	200 IU
19 to 50 years	1,000mg	200 IU
51 to 70 years	1,200mg	400 IU
Over 70 years of age	1,200mg	600 IU

These recommendations are from http://www.niams.nih.gov/bone/hi/ff_osteoporosis.htm (August 20, 2007)

If you have more questions about osteoporosis and your risk you should contact you doctor.