THE DEVELOPMENT AND EFFECTIVENESS OF AN OSTEOPOROSIS PREVENTION EDUCATION INTERVENTION

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by
VU H. NGUYEN

Dr. Alexander C. Waigandt, Dissertation Supervisor

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The undersigned, appointed by the Dean of the Graduate School,
have examined the Dissertation entitled

THE DEVELOPMENT AND EFFECTIVENESS OF AN OSTEOPOROSIS PREVENTION EDUCATION INTERVENTION

presented by Vu H. Nguyen,

a candidate for the degree of Doctor of Philosophy,

and hereby certify that, in their opinion, it is worthy of acceptance.

Dr. Alexander C. Waigandt

Dr. David A. Bergin

Dr. Steven J. Osterlind

Dr. Ze Wang

Dr. Deborah L. Hume

To my parents.

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Vu H. Nguyen

Dr. Alexander C. Waigandt, Dissertation Supervisor

ABSTRACT

Osteoporosis prevention education interventions intended to increase the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption in young individuals have been found to be ineffective. An osteoporosis prevention education intervention was developed and modeled after an effective health threat prevention education intervention based on the health belief model, which emphasized the health threat's visible severity and proximal time of onset. To test its effectiveness, it was experimentally researched in a sample of 109 college women who were students in an undergraduate health education course, and were randomly assigned to either the treatment or a control group to receive the osteoporosis prevention education intervention or a stress management intervention, respectively. The treatment group did not positively alter their osteoporosis health beliefs or increase self-reported weight-bearing physical activity and calcium consumption compared to the control group. And the control group who received the stress management intervention showed a significant increase in health motivation while the treatment group who received the osteoporosis prevention education intervention did not. A probable reason is that due to the distal time of onset of osteoporosis, young individuals may not be concerned with modifying their behaviors to prevent the disease. Recommendations for future research and effective ways to promote weight-bearing physical activity and calcium consumption are provided.

CHAPTER I

INTRODUCTION

Purpose of the Study

The purpose of this study was to test the efficacy of a developed osteoporosis prevention education intervention. Following the development of an osteoporosis prevention education intervention, an experimental research study was conducted to determine its effectiveness in altering osteoporosis health beliefs and increasing the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption.

Bone Health

Bones provide the structure of the human body. Bone health is important to overall health (see Appendix A) because bones need to be healthy to support everyday life. To be supportive, bones must stay strong and fracture resistant. To resist fracturing, bone strength must be enhanced from a combination of bone quality and bone quantity. Bone quality refers to its architecture and mineralization, while bone quantity refers to its mass and density (NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy, 2001). With current technology, the quality of bone is more difficult and expensive to determine than the quantity of bone. Therefore, bone mineral density (BMD), a measure of bone quantity that is the amount of bone mass per unit area/volume (Khan et al., 2001), is the most commonly used outcome measure for bone strength, used in both clinical and research settings (American College of Sports

Medicine [ACSM], 2004). Small increases in BMD result in large increases in bone strength, and a BMD increase of just 5-8% can result in a 64-87% increase in bone strength (Jarvinen et al., 1998; Turner & Robling, 2003). This increased bone strength, especially the ability for more bone to be strategically placed at the sites of highest strain, can result in increased resistance to fractures. Increasing BMD is the primary focus in promoting and enhancing bone health, but if BMD is reduced and becomes too low, then bone health is compromised which can lead to osteoporosis.

Osteoporosis

Osteoporosis is a disease in which BMD is 2.5 standard deviations below the young adult mean. It weakens bones and can result in an increased risk of bone fracture (Kanis, Melton, Christiansen, Johnston, & Khaltaev, 1994). Bone strength is reduced in individuals with osteoporosis because bone is lost at a higher rate than it is replaced. Osteoporosis deteriorates bone strength before signs and symptoms occur; therefore, the disease is usually not diagnosed until a bone fracture actually occurs. Although osteoporosis affects the whole skeleton, the most common sites for bone fractures due to osteoporosis (osteoporotic fractures) are the hip, spine, and wrist. Osteoporosis is a serious and debilitating disease that can have adverse effects on both the quality and quantity of life, and osteoporosis and osteoporotic fractures can lower self-esteem, while increasing fear, anxiety, and depression, and can lead to increased disability and mortality, especially with osteoporotic fractures in the hip and spine (see Appendix B). The disease is estimated to affect over 10 million Americans, while nearly another 35 million are at risk (U.S. Department of Health and Human Services [U.S. DHHS], 2004).

Currently, there are no treatments that can cure osteoporosis by fully replenishing reduced BMD affected by the disease.

Osteoporosis and osteoporotic fractures typically occur after 50 years of age or even later in life. Osteoporosis can happen to anybody, in both males and females of all races, but there are factors that increase the risk of the disease. Non-modifiable factors that increase the risk of osteoporosis are female gender (half of all women over 50 years of age will be susceptible to an osteoporotic fracture [U.S. DHHS, 2004]), Caucasian and Asian race, increased age, and family history of osteoporosis. Modifiable factors such as health behaviors that can lead to osteoporosis are cigarette smoking and excessive alcohol intake, and especially inadequate weight-bearing physical activity and inadequate calcium consumption (NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy, 2001). While these particular risk factors can lead to osteoporosis, there are health behaviors that can prevent osteoporosis.

Preventing Osteoporosis

Osteoporosis can be prevented by certain health behaviors that can enhance BMD, especially adequate (high-intensity/impact) weight-bearing physical activity and calcium consumption (see Appendix C). Weight-bearing physical activity includes activities that involve jumping and resistance training. Calcium consumption can come from calcium-rich or calcium-fortified foods and calcium supplements. Although osteoporosis typically does not occur until after 50 years of age, it can be prevented at any age before the disease does occur. But osteoporosis prevention is best done by engaging in both adequate weight-bearing physical activity and calcium consumption at an early age while

the skeleton is growing, especially during childhood and adolescence, because it is the time in the lifespan when bone is most efficiently built. And the combination of weight-bearing physical activity and calcium consumption at an early age have been shown to increase peak BMD and bone mass better than either weight-bearing physical activity or calcium consumption alone (Bass et al., 2007; Iuliano-Burns, Saxon, Naughton, Gibbons, & Bass, 2003).

BMD tends to reach its peak during approximately the third decade of life, usually up to 30 years of age. After 30 years of age, peak BMD has been shown to start decreasing due to age-related bone loss (Marcus, Kosek, Pfefferbaum, & Horning, 1983). Therefore, the optimal approach for preventing osteoporosis is to maximize peak BMD for the first 30 years of life with adequate weight-bearing physical activity and calcium consumption, then maintain peak BMD thereafter (ACSM, 2004; NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy, 2001).

However, many young individuals are not engaging in adequate weight-bearing physical activity and calcium consumption to effectively prevent osteoporosis. Cross-sectional studies of college women have found that although approximately eight to nine out of 10 of them knew that adequate weight-bearing physical activity and calcium consumption could prevent osteoporosis, fewer than one out of 10 of them actually engaged in adequate weight-bearing physical activity and calcium consumption (Kasper et al., 1994; Kasper, Peterson, and Allegante, 2001). These findings show an absolute need to encourage young individuals, or at least young women, to engage in adequate weight-bearing physical activity and calcium consumption to prevent osteoporosis.

Osteoporosis prevention education interventions are given with the intention to provide education and increase osteoporosis knowledge to lead to osteoporosis preventive behaviors, such as weight-bearing physical activity and calcium consumption (Werner, 2005). However, a review by Werner (2005) found that although providing osteoporosis education does increase osteoporosis knowledge, it has not been found to change behavior, such as increasing the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption. In addition, interventions have focused primarily on older women who are more vulnerable to osteoporosis, but they should focus more on younger individuals, or at least women under 30 years of age, to more effectively prevent the disease. To better prevent osteoporosis, there is a need to develop an effective osteoporosis prevention education intervention that will actually increase weight-bearing physical activity and calcium consumption in young women.

Developing an Effective Osteoporosis Prevention Education Intervention

Osteoporosis prevention education interventions have been developed based on the assumption that if osteoporosis health beliefs can be altered and osteoporosis knowledge can be increased, osteoporosis preventive behaviors, such as weight-bearing physical activity and calcium consumption, will be adopted.

To develop an effective osteoporosis prevention education intervention, it must be determined how to optimally disseminate it, what particular osteoporosis health beliefs need to be altered and knowledge need to be increased, and how to strengthen the intention to increase weight-bearing physical activity and calcium consumption. Next, an experimental research study must be conducted to determine its effectiveness.

CHAPTER II

REVIEW OF THE LITERATURE

Dissemination of an Osteoporosis Prevention Education Intervention

Kasper et al. (2001) found that the most preferred sources for receiving educational information on osteoporosis and osteoporosis prevention were printed materials such as magazines, handouts, and brochures. It is important to provide the target population, such as females under 30 years of age, and particularly Caucasian and Asian females, the osteoporosis prevention education intervention they prefer (e.g., magazines, handouts, brochures), because they will be more utilized, while other types of osteoporosis prevention education interventions that are less preferred may be less utilized. Providing other types of interventions, such as face-to-face persuasion interventions (i.e., lectures, counseling), may not be useful interventions if the target population may not have the time, patience, and interest to attend them, which is not as much of a concern with the use of magazines, handouts, or brochures. Printed materials such as magazines, handouts or brochures can be shared with others, and can be kept for reference and serve as useful reminders. They should provide adequate health-related educational information to encourage preventive behaviors, but must not be too extensive in length, because they may appear overwhelming and inhibit the recipient from reading them (Glanz & Rudd, 1990).

Regarding brief printed material, Schulman et al. (2007) investigated whether an osteoporosis prevention education intervention developed with minimal resource expenditure, such as a single-page page handout, would be effective in osteoporosis

prevention education. Their osteoporosis prevention education intervention was intended to increase osteoporosis knowledge and preventive behaviors and to encourage BMD scanning. Eighty healthy females, ranging from 15 to 73 years of age, with 26 who were less than 30 years of age, were given an 11-item questionnaire regarding basic facts on osteoporosis, then given a short, easy-to-read, single-page informational osteoporosis prevention education handout on bone health. The same questionnaire was given during a follow-up assessment about 2 to 11 months later, with an average of 6 months. Results showed that although participants did not significantly increase in participation in BMD scanning, participants did have significantly higher ability to define osteoporosis and identify major risk factors and preventive behaviors, and reported significant increases in levels of weight-bearing physical activity and calcium consumption. However, only one 3-item and one 5-item question measured weight-bearing physical activity per week and calcium consumption per day, respectively. The researchers of this study cited that other investigators have proposed and used more thorough and comprehensive osteoporosis prevention education interventions that require substantial time and monetary investments, but an intervention as simple as a single-page handout that required less time and monetary investment was shown to be effective.

Even if more thorough and comprehensive interventions, such as face-to-face persuasion techniques (i.e., lectures, counseling), are more effective in convincing a higher percentage of people, that type of intervention would be more difficult and costly to implement to the millions of individuals who a vulnerable to osteoporosis. Because a single-page handout can be implemented in a mass media campaign that can easily be disseminated to many individuals, it can be an effective intervention (Bauer, 1964).

Before researchers can provide effective osteoporosis educational information, they must determine what osteoporosis health beliefs need to be altered and knowledge needs to be increased.

Osteoporosis Health Beliefs and Knowledge

Johnson, McLeod, Kennedy, and McLeod (2008) researched various osteoporosis health beliefs in a study using the Osteoporosis Health Belief Scale (OHBS), and sampled various age groups, including a sample of 50 young female participants who were mostly Caucasian (94%), of ages 18 to 25 years (M_{age} = 19.76 years). Results of the study showed that the young participants did not believe they were susceptible to osteoporosis, nor did they believe it was a severe disease. In contrast, a sample of older participants in the study who were 50-plus years of age did believe they were susceptible to osteoporosis. The distal time of onset of osteoporosis may have caused the low susceptibility to and the severity of the disease in the younger participants, who may also not have been aware of the risks and negative health consequences associated with it. For young people, who may believe osteoporosis will affect them far in the future, it may be difficult to motivate them to adopt preventive behaviors to prevent a disease that may occur decades later. Young participants' low beliefs of the susceptibility to and severity of osteoporosis may lead to low motivation to prevent it; therefore, adopting preventive behaviors such as weight-bearing physical activity and adequate calcium consumption is unlikely. Kasper et al. (1994) found similar results in a study using the Multiple Osteoporosis Prevention Survey (MOPS) administered to 127 college women with the majority Caucasian (92%) with an average age of 19.6 years, along with a another study

by Kasper et al. (2001) that also used the MOPS administered to 321 college women with the majority Caucasian (63.5%) and African American (29.2%), with an average age of 21.6 years. Results of both studies also showed that participants did not believe they were susceptible to osteoporosis. They believed they were more susceptible to and had more concern for heart disease and breast cancer than osteoporosis, even though more women will be affected by osteoporosis than heart disease and breast cancer. Both studies also showed that participants did believe that osteoporosis was a severe disease, but they did not believe that it was as severe as heart disease and breast cancer, even though osteoporosis does increase mortality. The participants were also found to have low osteoporosis knowledge.

Also concerning osteoporosis knowledge, Martin et al. (2004) measured certain osteoporosis knowledge with the Health Bones Knowledge Questionnaire (HBKQ), which is a modified version of the Osteoporosis Knowledge Test (OKT) for younger participants, in 107 adolescent females of diverse ethnicities, of ages 11 to 17 years (M_{age} = 14 years). Results from their study found that participants did know osteoporosis risk factors, such as being female and lacking (weight-bearing) physical activity and calcium, but consistent with findings by Johnson et al. (2008), Kasper et al. (1994), and Kasper et al. (2001), their study also found that participants were unaware of the severity of osteoporosis and the health consequences associated with the disease. Participants knew that (weight-bearing) physical activity and calcium consumption could prevent osteoporosis, but could not specify what types of physical activity were osteogenic (bone-building) or what foods were calcium-rich. They knew that dairy foods were high in calcium, but had little knowledge of the calcium content of non-dairy foods. They

believed foods that were thought to be healthier also had more calcium, whether or not that was actually the case. Anderson, Chad, and Spink (2005) found similar results when they measured osteoporosis knowledge with the Osteoporosis Risk Factor Questionnaire, in 227 adolescent females with the majority Caucasian (61%), and of ages 12 to 16 years (M_{age} = 13.5 years). Their results also showed that participants knew that (weight-bearing) physical activity and calcium could prevent osteoporosis, but they could not specify what types of physical activity were osteogenic, what foods were calcium-rich and how much calcium to consume. Both Martin et al. (2004) and Anderson et al. (2005) showed that participants had general knowledge that weight-bearing physical activity and calcium consumption were good for bone health, but did not have specific knowledge on what actual physical activities and foods were best for bone health and osteoporosis prevention.

These findings display a need to educate and increase the beliefs of the susceptibility to and severity of osteoporosis, and to educate on specific ways to engage in weight-bearing physical activity and calcium consumption in order to increase those behaviors to prevent the disease. To alter these health beliefs of low susceptibility to and severity of osteoporosis, while increasing knowledge of weight-bearing physical activity and calcium consumption, an osteoporosis prevention education intervention can be designed and based on a theoretical model to predict an increase in weight-bearing physical activity and calcium consumption. A suitable theoretical model to base this type of osteoporosis prevention education intervention may be the health belief model (HBM).

Osteoporosis Prevention Education Interventions Based On the Health Belief Model

Rosenstock's (1966) classic HBM proposes that adopting certain health behaviors is based on, or can be predicted by, the perceptions of the particular health threat and health behaviors for preventing that particular health threat. The classic HBM was originally developed to predict the adoption of health behaviors to prevent a particular disease threat using four health beliefs (constructs):

1) a perceived susceptibility to a particular health threat,
2) a perceived severity of a particular health threat,
3) the perceived benefits of adopting health behaviors to prevent a particular health threat,

and

4) the perceived barriers to adopting health behaviors.

Later, the classic HBM became an expanded HBM with the addition of a fifth construct:

5) self-efficacy for health behaviors (Rosenstock, Strecher, & Becker, 1988).

When osteoporosis is the health threat that is applied to the HBM, osteoporosis preventive behaviors, such as weight-bearing physical activity and calcium consumption, are predicted by:

1) a perceived susceptibility to osteoporosis,
2) a perceived severity of osteoporosis,
3) the perceived benefits of weight-bearing physical activity and calcium consumption to prevent osteoporosis,
4) the perceived barriers to weight-bearing physical activity and calcium consumption,

and

5) self-efficacy for weight-bearing physical activity and calcium consumption.

Based on other research, the relationships among constructs of the HBM as applied to osteoporosis prevention are: the perceived susceptibility to and perceived severity of osteoporosis predict the perceived benefits of weight-bearing physical activity and calcium consumption to prevent osteoporosis (e.g., if perceived susceptibility to and/or perceived severity of osteoporosis increase, then perceived benefits of weight-bearing physical activity and calcium consumption to prevent the osteoporosis will also increase), and the perceived barriers to and self-efficacy for weight-bearing physical activity and calcium consumption to prevent osteoporosis are inversely related (e.g., if perceived barriers to weight-bearing physical activity and calcium consumption decrease, then self-efficacy for weight-bearing physical activity and calcium consumption will increase) (Schmiege, Aiken, Sander & Gerend, 2007). Perceived barriers to and self-efficacy for weight-bearing physical activity and calcium consumption are related, because the lack of self-efficacy is also seen as a perceived barrier (Strecher & Rosenstock, 1997).

Both the perceived susceptibility to (Kasper et al., 1994; Kasper et al., 2001; Johnson et al., 2008) and severity of osteoporosis (Kasper et al., 1994; Kasper et al., 2001; Johnson et al., 2008, Martin et al., 2004) are low, and osteoporosis prevention education that would increase both the perceived susceptibility to and severity of osteoporosis should also increase the perceived benefits of weight-bearing physical activity and calcium consumption to prevent the disease (Schmiege et al., 2007). Specific knowledge related to weight-bearing physical activity and calcium consumption is also low (Anderson et al., 2005; Martin et al., 2004), but increased knowledge has shown higher self-efficacy, which can lead to increased weight-bearing physical activity and

calcium consumption (Ievers-Landis et al., 2003). The more knowledge of examples of weight-bearing physical activity and sources of calcium should increase self-efficacy, which should also decrease barriers (Schmiege et al., 2007). For example, individuals may believe that they can only perform weight lifting exercises for weight-bearing physical activity and only consume dairy products for calcium, but may have limited access or ability for weight lifting exercises and are lactose intolerant, respectively. In that case, self-efficacy would be low and perceived barriers would be high. But if they knew that weight-bearing physical activity included other activities, such as jogging and activities that include jumping, and that there were other good sources of calcium besides dairy products, such as calcium-rich non-dairy products, calcium-fortified foods and calcium supplements, then they may realize they are capable of engaging in other ways of weight-bearing physical activity and calcium consumption, respectively, which can increase self-efficacy and decrease barriers.

Regarding the implementation of an actual osteoporosis prevention education intervention based on the HBM, Sedlak, Doheny, and Jones (1998) applied such an intervention in an experimental study with a convenience sample (from a freshman level prenursing course) of 31 college women who were mostly Caucasian (90%), and 87% were under 25 years of age. Participants were randomly assigned to a treatment or control group. All participants completed a pretest that assessed osteoporosis knowledge using the OKT, and assessed osteoporosis health beliefs with the OHBS and Osteoporosis Self-Efficacy Scale (OSES). Those in the control group did not receive any type of intervention. Those in the treatment group viewed a slide presentation developed by the National Osteoporosis Foundation (NOF) that included instructional material as an

educational intervention, along with participation in an osteoporosis prevention discussion that focused on the susceptibility to osteoporosis and barriers to osteoporosis preventive behavior. Three weeks after the pretest was administered, all remaining participants completed a posttest. Results for the control group showed no significant difference in osteoporosis knowledge and osteoporosis health beliefs, except for self-efficacy, from pretest to posttest, but inexplicably had higher self-efficacy for weight-bearing physical activity and calcium consumption in the posttest. Results for the treatment group showed that osteoporosis knowledge significantly increased, and the researchers reported a significant increase in total health belief score from pretest to posttest, but as for the individual constructs of the HBM, only a significant increase in the perceived benefits of weight-bearing physical activity to prevent osteoporosis was found from pretest to posttest, and no significant difference was found in self-efficacy for weight-bearing physical activity and calcium consumption from pretest to posttest. Although osteoporosis health beliefs based on the HBM (and osteoporosis knowledge) were measured in order to predict weight-bearing physical activity and calcium consumption, weight-bearing physical activity and calcium consumption behaviors were not measured from pretest to posttest.

A later study by Sedlak, Doheny, and Jones (2000) did measure weight-bearing physical activity and calcium consumption in addition to osteoporosis health beliefs and knowledge. Sedlak et al. (2000) researched 3 nearly identical osteoporosis prevention education interventions, and similar to Sedlak et al.'s (1998) previous study, all of the participants were women and nearly all were Caucasian, and the osteoporosis prevention education interventions were based on the HBM and all contained a slide presentation

developed by the NOF that included instructional material as an educational intervention, that also focused on the susceptibility to osteoporosis and barriers to osteoporosis preventive behavior. The 3 different treatments were an intense program, and intermediate program, and a brief program. Thirty-one college women, 27 (87%) who were under 25 years of age, were in an intense program and participated 3 educational sessions in a 3 week period. Thirty-five women, who were 22 to 83 years of age, were in an intermediate program and participated in a 3 hour education session. And 18 women, who were 35 to 59 years of age, were in a brief program and participated in a 45 minute education session. Before administration of the interventions, a pretest was administered with the OKT, OHBS and Osteoporosis Preventing Behaviors Survey (OPBS) to measure osteoporosis knowledge and health beliefs and osteoporosis preventive behaviors, respectively, and 3 weeks later, the OKT, OHBS and OPBS were administered as a posttest. Consistent with Sedlak et al.'s (1998) previous finding, there were significant increases in osteoporosis knowledge from pretest to posttest in all 3 treatment groups, but there were no significant differences in osteoporosis health beliefs from pretest to posttest in all 3 treatment groups, with the exception of significantly increased benefits of calcium consumption to prevent osteoporosis in the intermediate group, and no significant increase in the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption.

Sedlak et al. (1998, 2000) cited a recommendation from Salazar (1991) that health threat prevention education programs should focus on perceived susceptibility and perceived barriers, based on Janz and Becker's (1984) meta-analysis of 46 HBM studies that found perceived susceptibility to a health threat and perceived barriers to preventive

behaviors to have been the most powerful predictors for behavior change, while perceived severity of the health threat had the lowest significance. Therefore, Sedlak et al.'s (1998, 2000) osteoporosis prevention education interventions based on the HBM focused on and emphasized the susceptibility to osteoporosis and barriers to osteoporosis preventive behavior, but did not focus on or emphasize the severity of osteoporosis. But young women have been found to have low perceived severity of osteoporosis (Johnson et al. 2008; Kasper et al. 1994; Kasper et al. 2001; & Martin et al., 2004). And the perceived severity of osteoporosis may be one of the most important constructs of the HBM, because the more severe osteoporosis is perceived, the stronger the intentions to engage in osteoporosis prevention behavior such as weight-bearing physical activity and calcium consumption (Smith Klohn & Rogers, 1991). Therefore, an osteoporosis prevention education intervention based on the HBM should focus on increasing the perceived severity of osteoporosis.

Increasing the Perceived Severity of Osteoporosis

Investigating how to increase the perceived severity of osteoporosis, Smith Klohn and Rogers (1991) researched three dimensions of severity applied to osteoporosis: visibility, time of onset, and rate of onset. The visible severity of osteoporosis, or the disfiguring condition of osteoporosis, of either low-visibility or high-visibility, was the most emphasized dimension. The time of onset of osteoporosis, of either proximal or distal, was studied due to a proximal health threat being more imminent and may be perceived as more severe than a distal health threat. And the rate of onset of osteoporosis, of either gradual or sudden, was also studied to determine if

noticing a gradual or sudden occurrence of symptoms associated with osteoporosis may affect perceived severity. In a study of 170 Caucasian and African American women, of ages range 16 to 25 years (M_{age} = 18.6 years), participants received experimental messages of either a low- or high-visibility of osteoporosis, either a proximal or distal time threat of osteoporosis, and either a gradual or sudden onset of osteoporosis. The researchers found that the high visible severity of osteoporosis, proximal time of onset, and sudden rate of onset significantly increased the perceived severity of osteoporosis. The visible severity of osteoporosis had more impact on the perceived severity of osteoporosis than both its time of onset and rate of onset, and the visible severity of osteoporosis' interaction with the time of onset for osteoporosis strengthened the intention to increase weight-bearing physical activity and calcium consumption the most. Smith Klohn and Rogers (1991) concluded that in order to increase perceived severity of osteoporosis, the visible severity of osteoporosis should be emphasized along with a proximal time of onset, to increase intentions to engage in the osteoporosis prevention behaviors of weight-bearing physical activity and calcium consumption.

These findings by Smith Klohn and Rogers (1991) of emphasizing the visible severity of osteoporosis, such as looking frail and disfigured, having a hunch back (may also be known as Dowager's hump or kyphosis of the spine), and being shorter in height (shortened stature) along with a proximal time of onset, which was shown to increase the intention to engage in weight-bearing physical activity and calcium consumption, have not been applied and to an osteoporosis prevention education intervention based on the HBM, and this type of intervention has not been experimentally studied investigating changes in osteoporosis health beliefs and the osteoporosis preventive behaviors of

weight-bearing physical activity and calcium consumption. Although not related to osteoporosis, there was an experimental study investigating changes in health threat beliefs and health threat preventive behaviors in a health threat prevention education intervention based on the HBM that did emphasize the visible severity of the health threat with a proximal time of onset.

A Health Threat Prevention Education Intervention Based On the Health Belief Model That Emphasized the Visible Severity of the Health Threat with a Proximal Time of Onset

In a health threat prevention education intervention based on the HBM that emphasized the visible severity of the health threat with a proximal time of onset, Jackson and Aiken (2006) researched how the visible severity of sun exposure in an appearance-based sun-protection intervention based on the HBM would affect the use of sun-protection methods (e.g., sunscreen). They cited a study by Jones and Leary (1994) that found that emphasizing the visible severity of excessive sun exposure was more effective than emphasizing the negative health consequences of excessive sun exposure to increase the intention to use sun-protection methods in young adults, because they were more concerned with physical appearance rather than physical health. Jackson and Aiken's (2006) study, developed to increase the use of sun-protection methods, focused on increasing perceived severity along with susceptibility to increase perceived benefits of sun-protection methods, while educating on sun-protection methods was used for decreasing barriers and increasing self-efficacy for sun-protection methods.

The study sampled 211 Caucasian women of ages 18 to 25 years (M_{age} = 19.5 years), because Caucasians are more likely to suntan, and sun exposure to their lighter skin complexion early in life greatly increases skin cancer risk later in life. All participants were randomly assigned to either a stress management intervention (control) or an appearance-based sun-protection intervention (treatment), and completed a pretest questionnaire that pertained to sun-protection with the constructs of the HBM and sun-protection methods. Participants assigned to the stress management intervention attended a program that defined stress, its signs and symptoms, and techniques for stress management. Participants assigned to the appearance-based sun-protection intervention based on the HBM received a multi-component treatment that included education that pertained to the constructs of the HBM, which included education on the susceptibility to and severity of the proximal threat of photoaging, which is current UV photographing of sun damaged skin that begins after 20 years of age, and the distal threat of skin cancer that first typically occurs after 50 years of age, and both emphasized their visible severity with their unattractive appearance. It included education on the benefits of using sun-protection methods and their effectiveness to prevent photoaging and skin cancer. In addition, it provided education on effective and easy ways to use sun-protection methods to both decrease barriers and increase self-efficacy for sun-protection methods. Immediately following their interventions, participants in both groups were given the same pretest questionnaire used as a posttest. Pretest scores were similar for both the stress management (control) and appearance-based sun-protection (treatment) intervention groups. While posttest scores were similar to pretest scores in the control group, posttest results of the appearance-based sun-protection intervention showed that

there were significant differences across conditions in favor of using sun-protection methods on all constructs, with the exception for perceived severity of skin cancer and perceived barriers to sun-protection methods use. Participants in the appearance-based sun-protection intervention did significantly increase perceived susceptibility to and severity of photoaging, and significantly increased perceived susceptibility to, but not perceived severity of, skin cancer. Perceived benefits of sun-protection methods only significantly increased to prevent photoaging, not to prevent skin cancer, because the visible severity of photoaging is a more proximal health threat than the distal health threat of skin cancer. Researchers cited that this was consistent with smoking cessation programs where the proximal threat of wrinkles is much more effective than the distal threat of lung cancer in reducing smoking rates (Evans, Dratt, Raines, & Rosenberg, 1988). While self-efficacy for use of sun-protection methods significantly increased, barriers to the use of sun-protection methods did not significantly decrease, although not surprising to the researchers considering the intervention had a limited focus on barriers. At a two-week follow-up, participants in the appearance-based sun-protection intervention that emphasized the visible severity and proximal time of onset for photoaging had significantly exceeded controls in both their intention for, and most importantly behavior of, sun-protection methods (Jackson & Aiken, 2006).

Statement of the Problem

Osteoporosis prevention education interventions, even when based on a theoretical model such as the HBM that emphasized specific constructs such as the perceived susceptibility to osteoporosis and perceived barriers to osteoporosis preventive

behavior, have been found to be ineffective in increasing the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption (Sedlak et al., 2000).

Smith Klohn and Rogers (1991) found that education on the visible severity of osteoporosis with a proximal time of onset strengthened the intention to increase weight-bearing physical activity and calcium consumption. In applying the visible severity of a health threat with proximal time of onset, Jackson and Aiken's (2006) experimental study of an appearance-based sun-protection intervention based on the HBM found educating on the susceptibility to and emphasizing the visible severity of the proximal health threat of photoaging, and educating on sun-protection methods, was effective in altering health beliefs of, and most importantly increasing behaviors of, sun-protection methods. However, the problem is that this type of appearance-based health threat prevention education intervention based on the HBM that emphasizes the visible severity of a health threat with a proximal time of onset that was shown to be effective has not been applied to osteoporosis.

A gap in the research is that an osteoporosis prevention education intervention based on the HBM that is appearance-based, that educates the susceptibility to and emphasizes the visible severity of osteoporosis, suggests a more proximal time of onset, and educates on various types, examples and amounts of weight-bearing physical activity and calcium consumption, all on a single-page handout, has not yet been developed and experimentally researched to determine its effectiveness in altering osteoporosis health beliefs and increasing weight-bearing physical activity and calcium consumption.

Research Questions

Research questions to test the effectiveness of the developed osteoporosis prevention education intervention. The developed osteoporosis prevention education intervention would be based on the HBM that is appearance-based, that educates on the susceptibility to and emphasizes the visible severity of osteoporosis, suggests a more proximal time of onset, and educates on various types, examples and amounts of weight-bearing physical activity and calcium consumption, all on a single-page handout. After the osteoporosis prevention education intervention was developed, it was experimentally researched to determine its effectiveness in altering osteoporosis health beliefs and increasing osteoporosis preventive behaviors.

Research question 1: Would the osteoporosis prevention education intervention significantly increase perceived susceptibility to osteoporosis and perceived severity of osteoporosis, which would also significantly increase perceived benefits of weight-bearing physical activity and calcium consumption to prevent osteoporosis (exercise and calcium, respectively)?

Research question 2: Would the osteoporosis prevention education intervention significantly decrease perceived barriers to weight-bearing physical activity and calcium consumption (exercise and calcium, respectively) and significantly increase self-efficacy for weight-bearing physical activity and calcium consumption (exercise and calcium, respectively)?

Research question 3: Would the osteoporosis prevention education intervention significantly increase self-reported weight-bearing physical activity and calcium consumption (bouts of exercise per week and good sources of calcium per day, respectively)?

CHAPTER III

METHOD

Approval for the Study

For this experimental research study investigating the efficacy of a developed osteoporosis prevention education intervention, an application submission was processed through the Campus Institutional Review Board (IRB) at the University of Missouri (MU) where the research study was conducted. The research design, interventions, and instrumentation were reviewed by the Campus IRB for legal and research ethical standards. Because the participants were of the age of consent and at least 18 years of age, an informed written letter of consent was given (see Appendix D), and there were no foreseen risks to the participants, the Campus IRB determined the study met the criteria for exempt approval.

Participants

A sample of 109 undergraduate students from four sections of the undergraduate level health education course, Elements of Health Education, at MU during the Fall 2010 semester served as participants in this study. G*Power 3.1, a general stand-alone power analysis program for statistical tests (Faul, Erdfelder, Lang, & Buchner, 2007), was used for a priori power analysis for a 2 x 2 repeated measures analysis of variance (ANOVA), and determined that a sample size of at least 98 total individuals had sufficient power (at least 0.80) to detect medium effect size differences (0.25) at alpha = 0.05, with a correlation among repeated measures of at least 0.50. Therefore, the 109 undergraduate

students were a sufficient sample for the study. These students were chosen as participants because the study is related to health education, and the majority of students in this course are typically Caucasian females, who are one of the most vulnerable populations to osteoporosis. As undergraduate students, they are also typically much younger than 30 years of age, when they can still efficiently increase BMD to prevent osteoporosis.

Because the treatment intervention was developed specifically for females under 30 years of age, the relatively few male and individuals older than 30 years of age in the course were not included in the data for statistical analyses. Descriptive statistics determined the means for age, and frequencies for ethnicity, education level, and academic program from the demographic information (see Table 1). The study had a total of 109 female participants, 56 in the control group and 53 in the treatment group. The majority of participants were Caucasian for both groups. All of the participants were undergraduate students, and most of them were in the MU College of Education (COE). Those who were not in the COE were students in another academic program of a different college, department, and/or school, and majoring in a health-related program (e.g., Nutrition & Fitness, Health Sciences, Human Development and Family Studies).

Table 1

Demographic Information

	Control (n = 56)	Treatment (n = 53)
Age (Years)	18 - 21, M_{age} = 19.5	18 - 22, M_{age} = 19.7
Ethnicity		
Caucasian	52 (92.8%)	51 (96.2%)
African American	2 (3.6%)	1 (1.9%)
Hispanic	0 (0.0%)	1 (1.9%)
Asian	1 (1.8%)	0 (0.0%)
Other	1 (1.8%)	0 (0.0%)
Education Level		
Freshman	8 (14.3%)	9 (17.0%)
Sophomore	28 (50.0%)	18 (34.0%)
Junior	16 (28.6%)	17 (32.0%)
Senior	4 (7.1%)	9 (17.0%)
Academic Program		
COE	42 (75.0%)	39 (73.6%)
Outside the COE	14 (25.0%)	14 (26.4%)

Design

For this experimental study, prior to administration, all participants were randomly assigned to either a treatment intervention or control intervention group for each of the four sections. Half of the participants were randomly assigned to receive the treatment intervention of an osteoporosis prevention education intervention that was on a single-page handout (see Appendix D), and the other half were randomly assigned to receive a control intervention of a stress management intervention that was on a single-page handout (see Appendix D). During class, the researcher informed the participants of the study, that there was a pretest soon to be administered, an intervention (health-related handout) that should not be shared with others that would be given at the end of class, and there would be a posttest and quiz over the health-related handout in two weeks. Participants were also told that those with the highest quiz scores by answering the most

questions correctly would be entered into a drawing to win one out of 30 $10 gift cards to Walmart. Administration of a quiz at posttest was used to give reason for participants to look at their health-related handouts, with the offer of a chance to receive a gift card for the highest quiz scores as an extra incentive for participants to look at and perhaps more thoroughly review their health-related handouts. A pretest was administered to each participant, which included a written letter of consent, demographic information sheet, and survey that consisted of the OHBS, OSES, and Exercise and Calcium Behaviors Scale (ECBS) (see Appendix E). All participants were instructed to read the letter of consent, write their names, and fill out the surveys. At class dismissal, the interventions of either an osteoporosis prevention education intervention (treatment) single-page handout or stress management intervention (control) single-page handout were administered to each participant. The administrator instructed the participants to not share the health-related handout they received with others until after the study. To help prevent group contamination, all of the interventions were sealed in identical envelopes to conceal them, so that other participants could not see each others' health-related handouts, and the outside of each envelope had instructions to not share the information on their health-related handouts with anyone for the next two weeks until after the study. The envelopes that contained the health-related handouts had the participants' names labeled on them to ensure the participants received the correct intervention they were randomly assigned to.

Two weeks later, for the posttest, the same survey (OHBS, OSES, and ECBS) was administered with an attached quiz of either the Osteoporosis Prevention Quiz for the osteoporosis prevention (treatment) group or the Stress Management Quiz for the stress

management (control) group (see Appendix D) that had the participants' names already on them as indicators to ensure that the participants received the correct quiz. Participants in the osteoporosis prevention (treatment) group received the Osteoporosis Prevention Quiz and that those in the stress management (control) group received the Stress Management Quiz at the posttest. Participants completed both the survey (posttest) and quiz (treatment or control) and submitted them. After the completion of the posttest, the researcher explained to the participants the purpose of the study, and offered to give the participants the intervention that they did not receive for the study.

Treatment Intervention: Osteoporosis Prevention Education Intervention

Osteoporosis Prevention Education Intervention. The treatment intervention in this experimental study was an osteoporosis prevention education intervention based on the HBM that was appearance-based, and emphasized the visible severity of osteoporosis and suggested a more proximal time of onset, all on a single-page handout. It was developed by the researcher and was intended to be short and straightforward, and it could be kept for reference. It was designed to address the constructs of the HBM that were to be measured by the OHBS and OSES, and to increase the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption that were to be measured by the ECBS. The term "Exercise" was used in place of "weight-bearing physical activity," and "Calcium" was used in place of "calcium consumption," to make the terms simpler and less complex for the participants.

The intervention began by introducing a definition of osteoporosis: "Osteoporosis is a disease in which bones become excessively weak so that they break

easily." This was followed by items of information that corresponded to each of the five constructs of the HBM: perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise and calcium to prevent osteoporosis, perceived barriers to exercise and calcium, and self-efficacy for exercise and calcium.

The first construct, perceived susceptibility to osteoporosis, was stated immediately after the definition of osteoporosis. It simply stated: "Osteoporosis can happen to anybody, in both males and females of all races. But it does happen more in females, particularly those of Caucasian and Asian race, and especially those with family history of osteoporosis."

The emphasized construct of this study, perceived severity of osteoporosis, especially the visible severity of osteoporosis, was the focal point that made the osteoporosis prevention education intervention appearance-based. It first stated that "Osteoporosis increases disability and mortality." But then explained how "Osteoporosis is physically debilitating, and can lead to you to: Looking Frail and Disfigured, Having a Hunch Back, Being Shorter in Height." Most importantly, it illustrated those appearances with a large profile image of a woman with perfect posture and healthy appearance, compared to a large profile image of the exact same woman with the physical characteristics of osteoporosis: looking frail and disfigured, having a hunch back, and being shorter in height (shorter compared to the image of her with perfect posture and healthy appearance); with labels and markers pointing out those particular physical characteristics of osteoporosis. An arrow from the image of the woman with perfect posture and healthy appearance points towards the image of the exact same woman with the physical characteristics of osteoporosis with the statement, "What

osteoporosis can do to you!" Although osteoporosis typically occurs after 50 years of age, the intervention intentionally omitted that information in order to reduce the possibility that participants would consider osteoporosis as a distal health threat. The intervention instead included the statement: "Bone strength naturally starts to decrease in your 30's, resulting in weaker bones that can lead to osteoporosis." That statement was used to suggest a more proximal time of onset. Figure 1 illustrates how the treatment intervention emphasized the visible severity of osteoporosis while suggesting a more proximal time of onset.

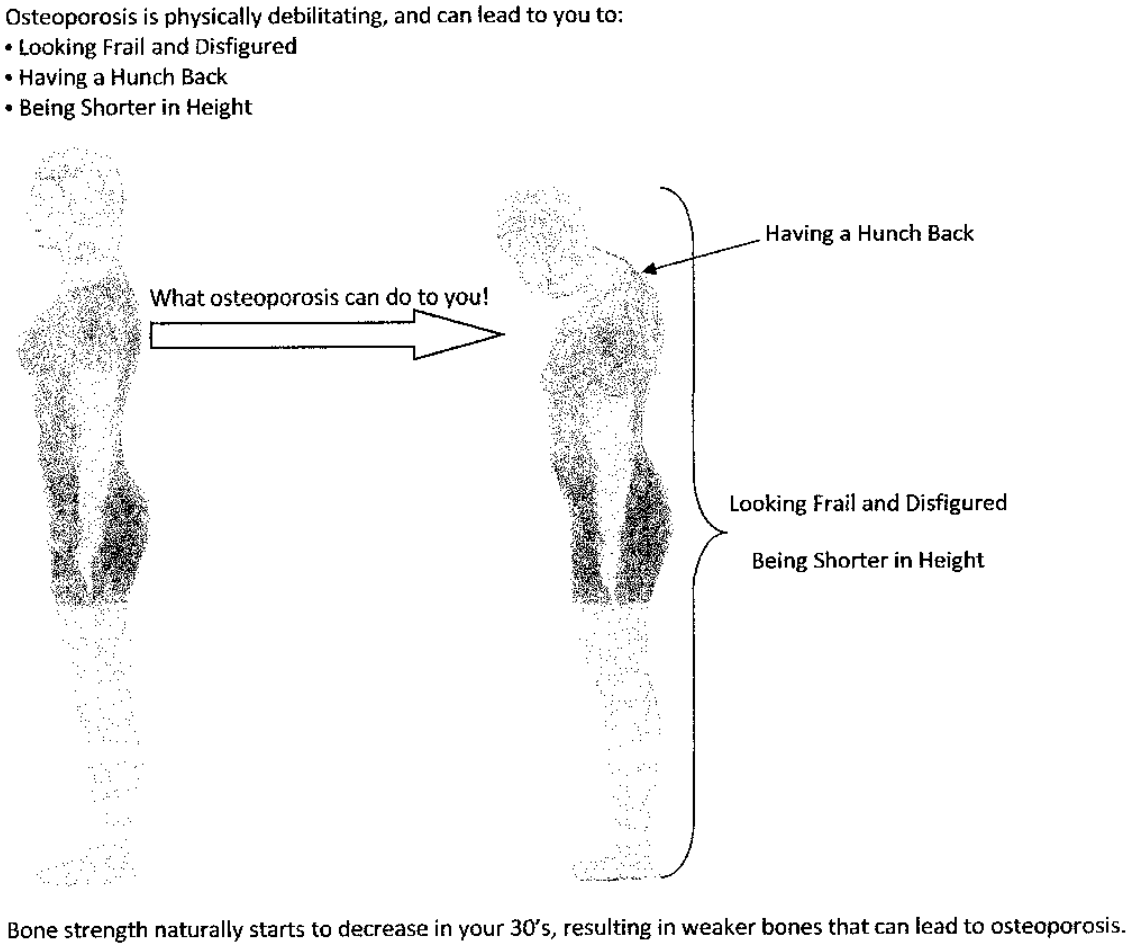


Figure 1. Emphasizing the Visible Severity of Osteoporosis While Suggesting a More Proximal Time of Onset.

Next was a statement that addressed the perceived benefits of both exercise and calcium to prevent osteoporosis, "Exercise and Calcium can strengthen your bones and prevent osteoporosis, especially when done before 30 years of age."

Finally, various types, examples and amounts of exercise and calcium needed to prevent osteoporosis were provided to decrease perceived barriers to and increase self-efficacy for exercise and calcium (see Figure 2). The intervention concluded with examples of exercise beneath "Types of Exercise you could do:" with what types of exercise and amounts such as activities that are weight-bearing and/or involve jumping (e.g., jogging, stair climbing, tennis, volleyball, basketball), 3-5 times per week; resistance exercise (e.g., weight-lifting, resistance exercise with elastic bands or tubing), 2-3 times per week, and examples of calcium beneath "Good sources of Calcium (Adequate Intake: 1,000-1,200 mg per day):" with types of calcium such as calcium-rich foods such as dairy products (e.g., milk, cheese), leafy greens (e.g., kale, collard, turnip, mustard greens), broccoli, sardines, canned salmon, tofu, calcium-fortified foods (e.g., orange juice, breakfast bars, etc.) and calcium supplements (e.g., calcium pills, chewable and liquid calcium supplements).

Types of Exercise you could do:

- Activities that are weight-bearing and/or involve jumping, 3-5 times per week:
  - examples: jogging, stair climbing, tennis, volleyball, basketball
- Resistance exercise, 2-3 times per week:
  - examples: weight lifting, resistance exercise with elastic bands or tubing

Good sources of Calcium (Adequate Intake: 1,000-1,200 mg per day):

- Calcium-rich foods:
  - examples: dairy products (milk, cheese), leafy greens (kale, collard, turnip, mustard greens), broccoli, sardines, canned salmon, tofu, calcium-fortified foods (orange juice, breakfast bars, etc.)
- Calcium supplements:
  - examples: calcium pills, chewable and liquid calcium supplements

Figure 2. Education on Various Types, Examples and Amounts of Exercise and Calcium.

Osteoporosis Prevention Quiz. The Osteoporosis Prevention Quiz was developed by the researcher and consisted of eight questions based on information considered to be important from the treatment intervention. A True/False question stated that osteoporosis can happen to anybody (True), with seven fill-in-the-blank questions: three blanks asked for the physical debilitating consequences of osteoporosis (looking frail and disfigured, having a hunch back, being shorter in height), one blank asked before what age to best build bone strength and prevent osteoporosis (30), one blank asked what can be used besides weight lifting for resistance exercise (elastic bands or tubing), and two blanks asked in for the range of the adequate intake of calcium (1,000, 1,200) (See Appendix D).

Control Intervention: Stress Management Intervention

Stress Management Intervention. In Jackson and Aiken's (2006) experimental study that used an appearance-based sun-protection intervention based on the HBM as a treatment intervention, a stress management intervention was used as a control intervention. The control intervention in this study was a stress management intervention on a single-page handout that was developed by the researcher. The handout discussed the definition of stress, consequences of stress, and how to avoid and relieve stress based on information from the health website, www.WebMD.com (WebMD, 2009).

Stress Management Quiz. The Stress Management Quiz was developed by the researcher and consisted of eight questions based on information considered to be important from the control intervention. A True/False question on the definition of stress, with seven fill-in-the-blank questions: three blanks asked for three examples of the

negative effects of stress, one blank asked about how to manage stress, and three blanks asked for three examples of ways to avoid or relieve stress (See Appendix D).

Measurements for an Osteoporosis Prevention Education Intervention Based On the Health Belief Model

Participants were asked to answer demographic questions on gender, age, ethnicity, education level, and academic program. The instruments used for this study were the OHBS combined with the OSES, and the ECBS. The OHBS was designed to measure the four original constructs of the classic HBM applied to osteoporosis and weight-bearing physical activity and calcium consumption to prevent the disease, and it was in development before self-efficacy was added to the expanded HBM as a fifth construct. The OSES was developed after the OHBS and was designed to measure self-efficacy for weight-bearing physical activity and calcium consumption, and it was combined with the OHBS to implement the expanded HBM. Permission was granted by the developers of the instruments for use in the study (see Appendix E). The ECBS was developed by the researcher and designed to measure actual osteoporosis preventive behaviors from the treatment intervention of weight-bearing physical activity and calcium consumption. In each instrument, for the osteoporosis preventive behaviors, the term "exercise" was used and referred to "weight-bearing physical activity," and "calcium" was used and implied "calcium consumption" in order to make the terms simpler and less complex for the participants.

Measures of Osteoporosis Health Beliefs

The OHBS is an instrument of 42 items developed by Kim, Horan, Gendler, & Patel (1991), with six items designed to measure each of the four constructs of the classic HBM: 1) perceived susceptibility to osteoporosis (items 1-6), 2) perceived severity of osteoporosis (items 7-12), 3a) perceived benefits of exercise to prevent osteoporosis (items 13-18), 3b) perceived benefits of calcium to prevent osteoporosis (items 19-24), 4a) perceived barriers to exercise (items 25-30), 4b) perceived barriers to calcium (items 31-36), and 5) health motivation (items 37-42, but not a construct of the HBM). Responses to each item are a 5-point Likert scale, where the participant rated each item by selecting one of the five following responses on the Likert scale with corresponding score: SD (STRONGLY DISAGREE) = 1, D (DISAGREE) = 2, N (NEUTRAL) = 3, A (AGREE) = 4, and SA (STRONGLY AGREE) = 5. The entire OHBS is divided into two subscales, the Osteoporosis Health Belief (OHB)-Exercise Subscale and OHB-Calcium Subscale.

In the OHB-Exercise Subscale, for reliability, internal consistency was established for each construct with Cronbach's alpha coefficients. Cronbach's alpha coefficients for perceived susceptibility to osteoporosis: 0.80, perceived severity of osteoporosis: 0.65, perceived benefits of exercise to prevent osteoporosis: 0.68, perceived barriers of exercise: 0.73, and health motivation: 0.61. The scale developers reported that they determined construct validity with factor analysis for each item, with factor loadings ranging from 0.45 to 0.80, and the five factors accounting for 49.3% of the total variance, with perceived susceptibility to osteoporosis: 15.9%, perceived severity of osteoporosis: 12.1%, perceived benefits of exercise to prevention osteoporosis: 9.2%, perceived

barriers of exercise: 6.4% and health motivation: 5.7%. Group exercise scores of low exercisers and high exercisers evaluated concurrent validity, and discriminant function analysis was able to differentiate participants by correctly classifying 62% of each participant to their group with 61.7% of low exercisers and 62.2% of high exercisers.

In the OHB-Calcium Subscale, for reliability, internal consistency was established for each construct with Cronbach's alpha coefficients. Cronbach's alpha coefficients for perceived susceptibility to osteoporosis: 0.80, perceived severity of osteoporosis: 0.65, perceived benefits of calcium to prevent osteoporosis: 0.74, perceived barriers of calcium: 0.72 and health motivation: 0.61. The scale developers reported that they determined construct validity with factor analysis for each item, with factor loadings ranging from 0.40 to 0.80, and the five factors accounting for 49.4% of the total variance, with perceived susceptibility to osteoporosis: 14.4%, perceived severity of osteoporosis: 12.4%, perceived benefits of calcium to prevent osteoporosis: 9.1%, perceived barriers to calcium: 7.7% and health motivation: 5.8%. Group calcium intake scores of those with calcium intake at least 50% of the Recommended Dietary Allowance (RDA) and those with calcium intake less than 50% of the RDA evaluated concurrent validity, and discriminant function analysis was able to differentiate participants by correctly classifying 72% of them to their group with 77.3% of those with calcium intake at least 50% of the RDA and 71.1% of those with calcium intake less than 50% of the RDA.

The OSES is an instrument of 12 items developed by Horan, Kim, Gendler, Froman, and Patel (1998), with six items designed to measure self-efficacy for each osteoporosis prevention behavior: 1) self-efficacy for exercise (items 1-6) and 2) self-efficacy for calcium (items 7-12). Each item has a response scale that was a 100mm

analog scale from “Not at all confident” to “Very confident,” where the participant placed an “X” onto the analog scale that best described level of confidence, which ranged from 0 to 100. (The OSES has two versions, a 12 item scale and the original 21 item scale. If the OSES is administered with additional instruments, such as the OHBS, the developers of the instruments recommend administering the 12 item OSES over the 21 item OSES. Also, the 12 item OSES provided 6 items for each construct (exercise and calcium), same as the OHBS.)

The OSES, like the OHBS, is also divided into two subscales, the Osteoporosis Self-Efficacy (OSE)-Exercise Subscale and OSE-Calcium Subscale. Internal consistency established reliability for each subscale, with Cronbach’s alpha coefficients at 0.90 for both subscales. The scale developers reported that construct validity was determined with factor analysis (not specified for the 12 item OSES, but factors of both subscales accounted for 86% of item covariation in the 21 item OSES) and discriminant function analysis established convergent validity (not specified for the 12 item OSES, but over 20% overlap in OSE-Exercise scores and about 5% shared variation with OSE-Calcium scores in the 21 item OSES).

For the OHBS and OSES, scores for each construct of the HBM were calculated by the average score of the six items for each construct. Scores of from the OHBS of perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, and perceived barriers to calcium (in addition to health motivation) ranged from 1 to 5. Scores from the OSES of self-efficacy for exercise and self-efficacy for calcium ranged from 0 to 100.

Measures of Osteoporosis Preventive Behaviors

The osteoporosis preventive behaviors measured were weight-bearing physical activity and calcium consumption, referred to as "exercise" and "calcium," respectively. The ECBS is an instrument of eight items developed by the researcher designed to measure two self-reported osteoporosis preventive behaviors: 1) exercise behavior (items 1 & 2), and 2) calcium behavior (items 3-8), with the types and examples of exercise and calcium on the instrument corresponding directly to the treatment intervention developed by the researcher. The ECBS is divided into two subscales, the ECBS-Exercise Subscale and ECBS-Calcium Subscale.

The ECBS-Exercise Subscale provides two items to measure the two types of self-reported exercise, 1) exercise that is weight-bearing and/or involved jumping but is not resistance exercise, and 2) resistance exercise. Both items had a 6-point response scale with corresponding score of times a week: "Never" = 0, "1 time a week" = 1, "2 times a week" = 2, "3 times a week" = 3, "4 times a week" = 4, and "5 or more times a week" = 5. To determine the total times of exercise per week, adding the number of times both types of exercise is done a week gives a "bouts of exercise per week" score with a range from 0 to 10.

The ECBS-Calcium Subscale provides six items to measure six different types of self-reported calcium sources, 1) dairy products, 2) broccoli and/or leafy greens, 3) sardines and/or canned salmon, 4) tofu, 5) calcium-fortified foods, and 6) calcium supplements. Each of the six items measuring calcium behavior had a 9-point response scale that mimicked a food frequency questionnaire (Willett et al., 1985): "Never," "Less than once a month," "1-3 times a month," "Once a week," "2-4 times a week," "5-6 times

a week," "Once a day," "2-3 times a day," and "4 or more times a day." To calculate the times a good source of calcium was consumed a day, each item response equaled a score of times a day. "Never" = 0. "Less than once a month" is very imprecise, and because its calculated times per day would be very minute and negligible, it also = 0. "1-3 times a month" was calculated by dividing the average of 1-3 (average of 2) by 30 (approximate days in a month) = 0.07. "Once a week" was calculated by dividing 1 (for "Once") by 7 (days in a week) = 0.14. "2-4 times a week" was calculated by dividing the average of 2-4 (average of 3) by 7 (days in a week) = 0.43. "5-6 times a week" was calculated by dividing the average of 5-6 (average of 5.5) by 7 (days of the week) = 0.79. "Once a day" = 1.00. "2-3 times a day" was determined by the average of 2-3 (average of 2.5) = 2.50. "4 or more times a day" = 4.00. To determine the total times calcium is consumed per day, adding the number of times a day for each item gives a "good sources of calcium per day" score with a range from 0 to 24.

All items of the ECBS-Exercise Scale and ECBS-Calcium Subscale were developed by corresponding from the types, examples and amounts of the "Types of Exercise you could do" and "Good sources of Calcium…" sections of the treatment intervention, respectively. Face validity was used to validate the ECBS.

Statistical Analyses

Statistical analyses for research questions. All statistical analysis was done on a computer program used for statistical analysis, PASW Statistics 18. Descriptive statistics are provided in Table 2 for control and treatment groups. The level for statistical significance was set at alpha = 0.05, and partial eta-squared (η_p^2) represented

effect size at small: 0.01, medium: 0.06, and large: 0.14 (Cohen, 1988). For the analysis for each research question, mean scores were used by adding the total score and then dividing by the number of items answered for each dependent variable measured: perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, perceived barriers to calcium, self-efficacy for exercise, self-efficacy for calcium, bouts of exercise per week, and good sources of calcium per day (and health motivation).

Statistical analysis for research question 1. To determine if the osteoporosis prevention education intervention significantly increased perceived susceptibility to osteoporosis and perceived severity of osteoporosis, which would had also significantly increased perceived benefits of exercise and calcium to prevent osteoporosis, 2 (Group: control versus treatment) x 2 (Time: pretest versus posttest) repeated-measures ANOVAs were used. For the 2 x 2 repeated-measures ANOVAs, one factor was group (control and treatment) and the other factor was time (pretest and posttest). ANOVA was used to determine if the treatment group who received the osteoporosis prevention education intervention had a significant increase from pretest to posttest in the perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, and perceived benefits of calcium to prevent osteoporosis.

Statistical analysis for research question 2. To determine if the osteoporosis prevention education intervention significantly decreased perceived barriers to exercise and calcium and significantly increased self-efficacy for exercise and calcium, 2 (Group:

control versus treatment) x 2 (Time: pretest versus posttest) repeated-measures ANOVAs were used. For the 2 x 2 repeated-measures ANOVAs, one factor was group (control and treatment) and the other factor was time (pretest and posttest). ANOVA was used to determine if the treatment group who received the osteoporosis prevention education intervention had a significant decrease from pretest to posttest in the perceived barriers to exercise and perceived barriers to calcium, and if only the treatment group had a significant increase from pretest to posttest in self-efficacy for exercise and self-efficacy for calcium.

Statistical analysis for research question 3. To determine if the osteoporosis prevention education intervention significantly increased self-reported bouts of exercise per week and good sources of calcium per day, 2 (Group: control versus treatment) x 2 (Time: pretest versus posttest) repeated-measures ANOVAs were used. For the 2 x 2 repeated-measures ANOVAs, one factor was group (control and treatment) and the other factor was time (pretest and posttest). ANOVA was used to determine if the treatment group who received the osteoporosis prevention education intervention had a significant increase from pretest to posttest in self-reported bouts of exercise per week and good sources of calcium per day.

Health motivation was also measured and calculated for significant differences with a 2 (group: control versus treatment) x 2 (time: pretest versus posttest) repeated-measures ANOVA was used. For the 2 x 2 repeated-measures ANOVA, one factor was group (control and treatment) and the other factor was time (pretest and posttest). ANOVA was used to determine if either or both the control group who received the stress management intervention or treatment group who received the osteoporosis prevention

education intervention had a significant increase from pretest to posttest in health motivation.

CHAPTER IV

RESULTS

Presentation of Data

The Osteoporosis Prevention Quiz and Stress Management Quiz were graded for each participant in the treatment and control groups, respectively. Results showed that the treatment group scored an average of 2.62 out of eight on the Osteoporosis Prevention Quiz, and the control group scored an average of 5.86 out of eight on the Stress Management Quiz.

Based on the HBM, the osteoporosis health beliefs that were measured with the OHBS and OSES at pretest and posttest for the control and treatment group were perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, perceived barriers to calcium, self-efficacy for exercise, and self-efficacy for calcium. The osteoporosis preventive behaviors measured with the ECBS at pretest and posttest for the control and treatment group were bouts of exercise per week and good sources of calcium per day. Health motivation was also measured with the OHBS at pretest and posttest for the control group. Table 2 shows the means and standard deviations for osteoporosis health belief and osteoporosis preventive behavior (and health motivation) results for the control and treatment groups at pretest and posttest.

Table 2

Measures of Osteoporosis Health Belief Means and Osteoporosis Preventive Behavior Means for Control and Treatment Groups at Pretest and Posttest

	Control		Treatment	
Measure	Pretest	Posttest	Pretest	Posttest
Osteoporosis Health Beliefs				
Perceived Susceptibility to Osteoporosis	2.49 (0.71)	2.53 (0.71)	2.81 (0.93)	2.87 (0.84)
Perceived Severity of Osteoporosis	3.05 (0.62)	3.00 (0.63)	3.15 (0.62)	3.12 (0.63)
Perceived Benefits of Exercise to Prevent Osteoporosis	3.77 (0.59)	4.02 (0.53)	3.82 (0.56)	4.13 (0.43)
Perceived Benefits of Calcium to Prevent Osteoporosis	3.92 (0.49)	4.00 (0.45)	3.89 (0.51)	3.99 (0.46)
Perceived Barriers to Exercise	1.62 (0.56)	1.73 (0.59)	1.64 (0.63)	1.78 (0.59)
Perceived Barriers to Calcium	1.89 (0.51)	2.04 (0.61)	1.98 (0.68)	2.17 (0.63)
Self-Efficacy for Exercise	72.41 (18.75)	73.68 (20.19)	73.01 (19.40)	73.57 (19.31)
Self-Efficacy for Calcium	68.63 (20.35)	68.83 (21.52)	67.44 (19.88)	68.87 (20.73)
Osteoporosis Preventive Behaviors				
Bouts of Exercise per Week	3.75 (2.35)	4.02 (2.32)	4.36 (2.32)	4.30 (2.32)
Good Sources of Calcium per Day	2.69 (1.56)	2.84 (1.99)	3.05 (1.77)	2.82 (2.02)
Health Motivation	3.71 (0.62)	3.85 (0.54)	3.78 (0.59)	3.87 (0.58)

Note. Range for the means of Perceived Susceptibility to Osteoporosis, Perceived Severity of Osteoporosis, Perceived Benefits of Exercise to Prevent Osteoporosis, Perceived Benefits of Calcium to Prevent Osteoporosis, Perceived Barriers to Exercise, and Perceived Barriers to Calcium is 1 to 5. Range for the means of Self-Efficacy for Exercise and Self-Efficacy for Calcium are 0 to 100. Range for Bouts of Exercise per Week is 0 to 10. Range for Good Sources of Calcium per Day is 0 to 24. Range for the means of Health Motivation is 1 to 5. Standard deviations are in parentheses.

For the control group, from pretest to posttest, perceived susceptibility to osteoporosis increased by 0.04 from 2.49 to 2.53, perceived severity of osteoporosis decreased by 0.05 from 3.05 to 3.00, perceived benefits of exercise to prevent osteoporosis increased by 0.25 from 3.77 to 4.02, perceived benefits of calcium to prevent osteoporosis increased by 0.08 from 3.92 to 4.00, perceived barriers to exercise increased by 0.11 from 1.62 to 1.73, perceived barriers to calcium increased by 0.15 from

1.89 to 2.04, self-efficacy for exercise increased by 1.27 from 72.41 to 73.68, self-efficacy for calcium increased by 0.20 from 68.63 to 68.83, health motivation increased by 0.14 from 3.71 to 3.85, bouts of exercise per week increased by 0.27 from 3.75 to 4.02, and good sources of calcium per day increased by 0.15 from 2.69 to 2.84.

For the treatment group, from pretest to posttest, perceived susceptibility to osteoporosis increased by 0.06 from 2.81 to 2.87, perceived severity of osteoporosis decreased by 0.03 from 3.15 to 3.12, perceived benefits of exercise to prevent osteoporosis increased by 0.31 from 3.82 to 4.13, perceived benefits of calcium to prevent osteoporosis increased by 0.10 from 3.89 to 3.99, perceived barriers to exercise increased by 0.14 from 1.64 to 1.78, perceived barriers to calcium increased by 0.19 from 1.98 to 2.17, self-efficacy for exercise increased by 0.56 from 73.01 to 73.57, self-efficacy for calcium increased by 1.43 from 67.44 to 68.87, health motivation increased by 0.09 from 3.78 to 3.87, bouts of exercise per week decreased by 0.06 from 4.36 to 4.30, and good sources of calcium per day decreased by 0.23 from 3.05 to 2.82.

Analysis of Data

Analysis of data to answer research questions. A 2 (Group: control versus treatment) x 2 (Time: pretest versus posttest) repeated-measures ANOVA was used to determine if observed differences between pretest and posttest scores were significantly different in the control and treatment groups for each osteoporosis health belief measured with the OHBS and OSES: perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, perceived barriers to

calcium, self-efficacy for exercise, self-efficacy for calcium, and health motivation. A 2 x 2 repeated-measures ANOVA was also used to determine if observed differences between pretest and posttest scores were significantly different in the control and treatment groups for each self-reported osteoporosis preventive behavior measured with the ECBS: bouts of exercise per week, good sources of calcium per day. The statistical test of the main effect of Group determined if there were significant differences between the control and treatment groups, the statistical test of the main effect of Time determined if there were significant differences from pretest to posttest, and the statistical test of Group*Time determined if the interaction was significant. Significance level was set at alpha = 0.05, and partial eta-squared (η_p^2) represented effect size at small: 0.01, medium: 0.06, and large: 0.14 (Cohen, 1988).

Table 3

Repeated-Measures Analysis of Variance for Perceived Susceptibility to Osteoporosis

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	5.165	0.025*	0.046	0.615
Time	1, 107	0.965	0.328	0.009	0.164
Group*Time	1, 107	0.006	0.940	0.000	0.051

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was a significant difference for Group, with the treatment group having significantly higher perceived susceptibility to osteoporosis than the control group at both pretest and posttest with $p = 0.041$ and 0.026, respectively. There was no significant difference for Time (pretest to posttest) in both groups.

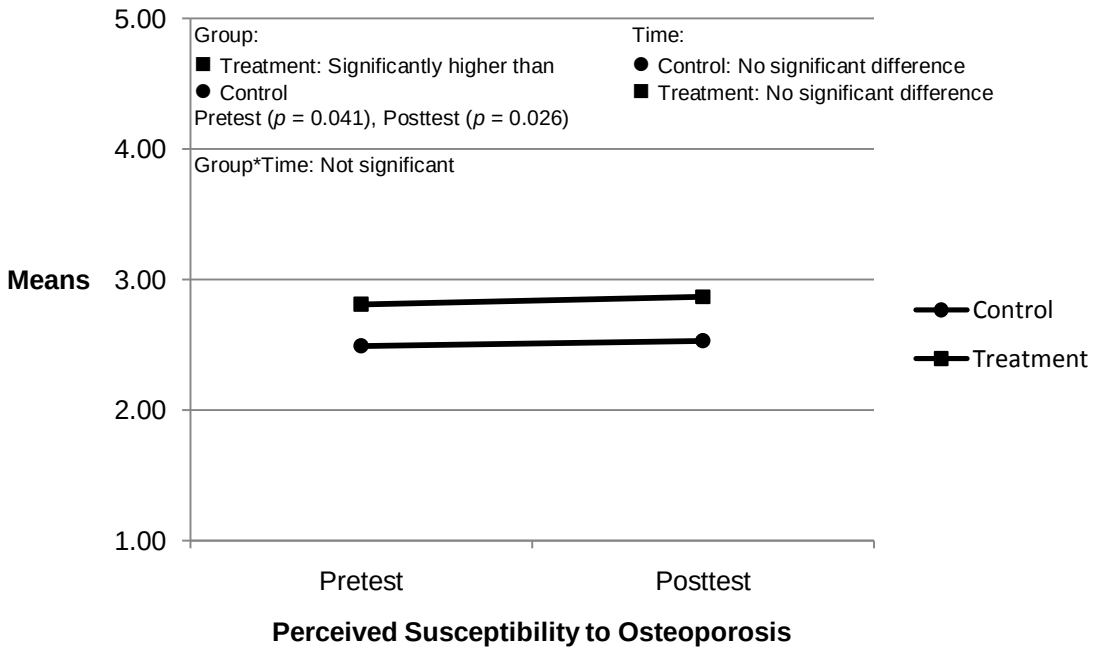


Figure 3. Profile Plot of Perceived Susceptibility to Osteoporosis Means for the Control and Treatment Groups at Pretest and Posttest.

Table 4

Repeated-Measures Analysis of Variance for Perceived Severity of Osteoporosis

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	1.032	0.312	0.010	0.172
Time	1, 107	0.627	0.430	0.006	0.123
Group*Time	1, 107	0.034	0.854	0.000	0.054

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

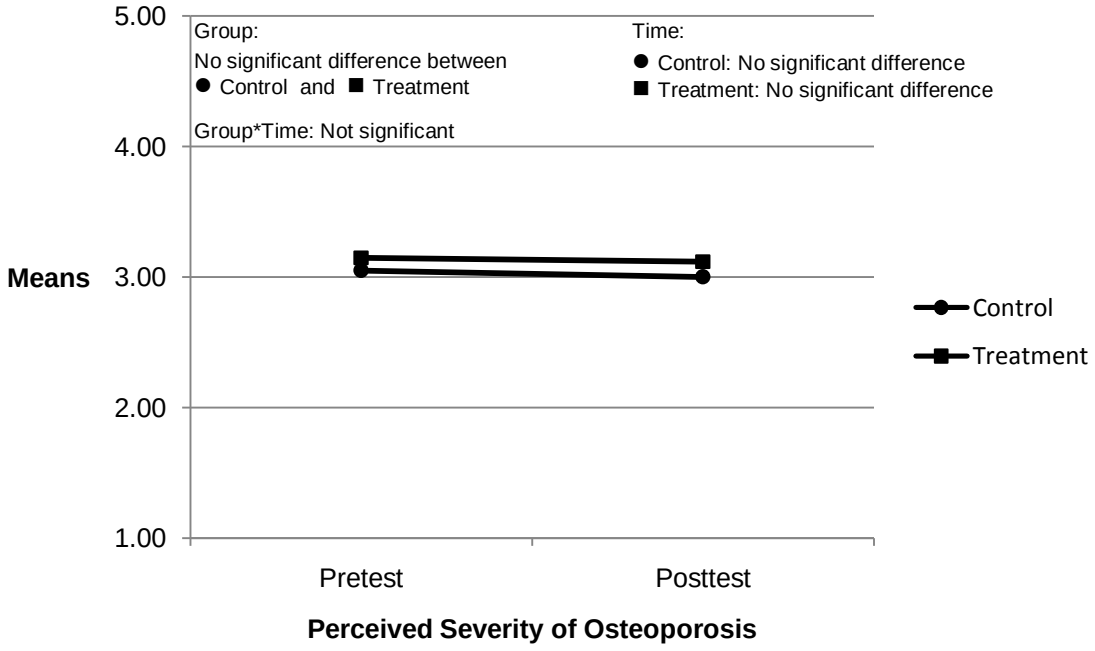


Figure 4. Profile Plot of Perceived Severity of Osteoporosis Means for the Control and Treatment Groups at Pretest and Posttest.

Table 5

Repeated-Measures Analysis of Variance for Perceived Benefits of Exercise to Prevent Osteoporosis

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.900	0.345	0.008	0.156
Time	1, 107	27.800	0.000***	0.206	0.999
Group*Time	1, 107	0.238	0.626	0.002	0.077

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). But there was a significant increase for Time from pretest to posttest in the control group and treatment group with $p = 0.000$ ($\eta_p^2 = 0.231$) and $p = 0.001$ ($\eta_p^2 = 0.192$), respectively.

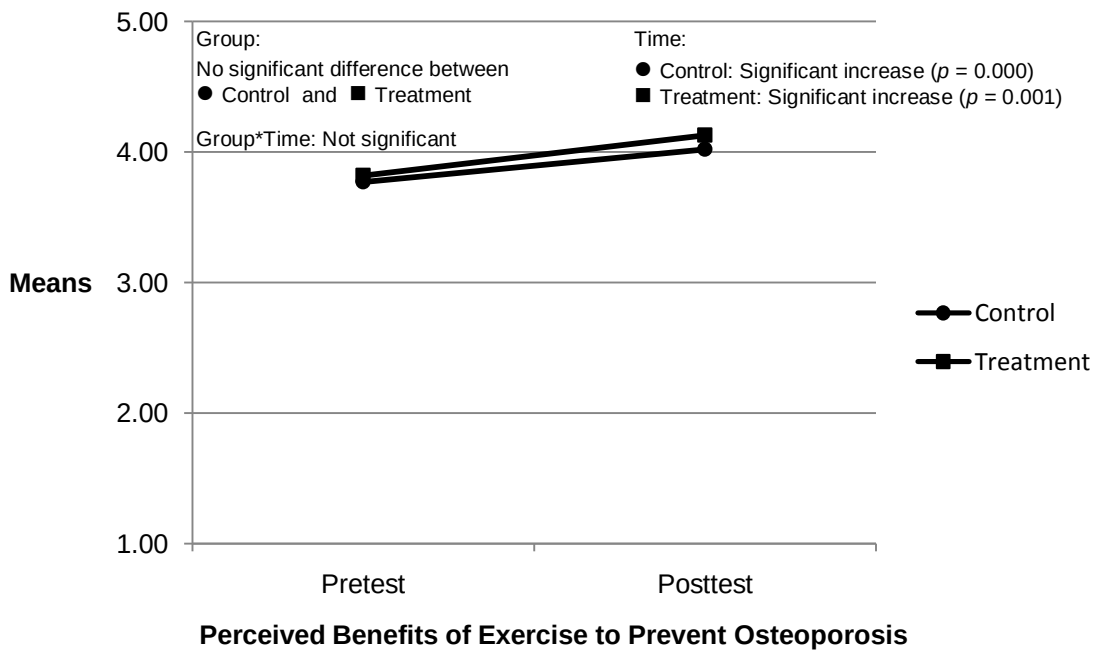


Figure 5. Profile Plot of Perceived Benefits of Exercise to Prevent Osteoporosis Means for the Control and Treatment Groups at Pretest and Posttest.

Table 6

Repeated-Measures Analysis of Variance for Perceived Benefits of Calcium to Prevent Osteoporosis

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.064	0.801	0.001	0.057
Time	1, 107	3.144	0.079	0.029	0.420
Group*Time	1, 107	0.039	0.843	0.000	0.054

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

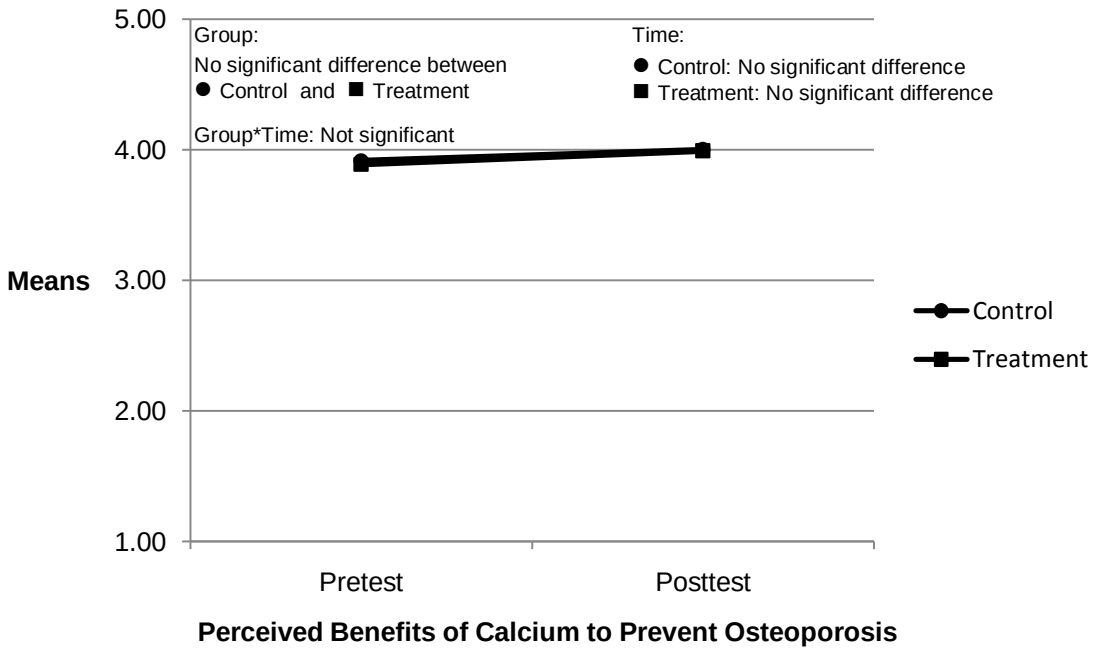


Figure 6. Profile Plot of Perceived Benefits of Calcium to Prevent Osteoporosis Means for the Control and Treatment Groups at Pretest and Posttest.

Table 7

Repeated-Measures Analysis of Variance for Perceived Barriers to Exercise

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.136	0.713	0.001	0.065
Time	1, 107	9.512	0.003**	0.082	0.864
Group*Time	1, 107	0.170	0.681	0.002	0.069

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). But there was a significant difference for Time from pretest to posttest, and although there was no significant difference in the control group, there was a significant increase in the treatment group with $p = 0.017$ ($\eta_p^2 = 0.106$).

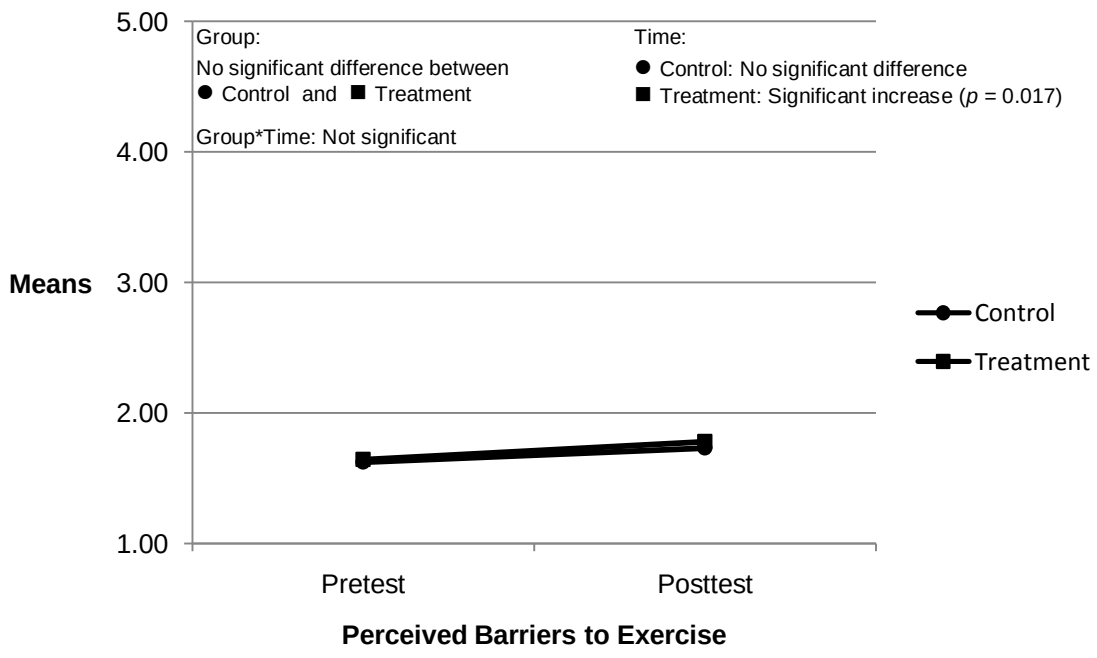


Figure 7. Profile Plot of Perceived Barriers to Exercise Means for the Control and Treatment Groups at Pretest and Posttest.

Table 8

Repeated-Measures Analysis of Variance for Perceived Barriers to Calcium

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.991	0.322	0.009	0.167
Time	1, 107	14.062	0.000***	0.116	0.960
Group*Time	1, 107	0.165	0.685	0.002	0.069

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). But there was a significant increase for Time from pretest to posttest in the control group and treatment group with $p = 0.023$ ($\eta_p^2 = 0.091$) and $p = 0.004$ ($\eta_p^2 = 0.145$), respectively.

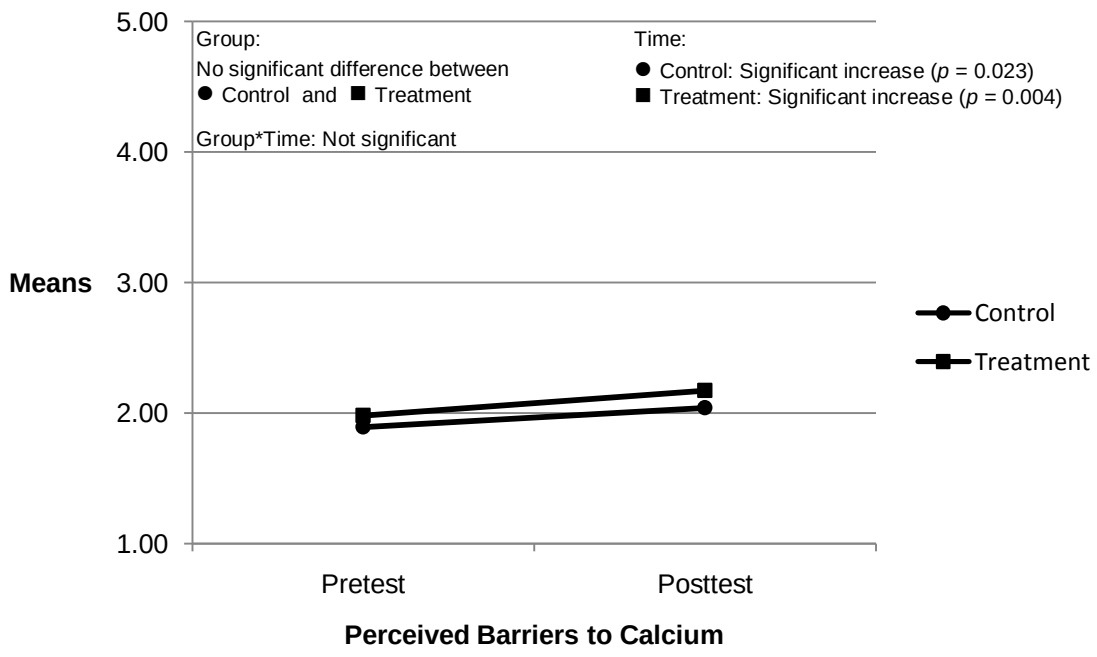


Figure 8. Profile Plot of Perceived Barriers to Calcium Means for the Control and Treatment Groups at Pretest and Posttest.

Table 9

Repeated-Measures Analysis of Variance for Self-Efficacy for Exercise

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.005	0.946	0.000	0.051
Time	1, 107	0.571	0.451	0.005	0.116
Group*Time	1, 107	0.088	0.768	0.001	0.060

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

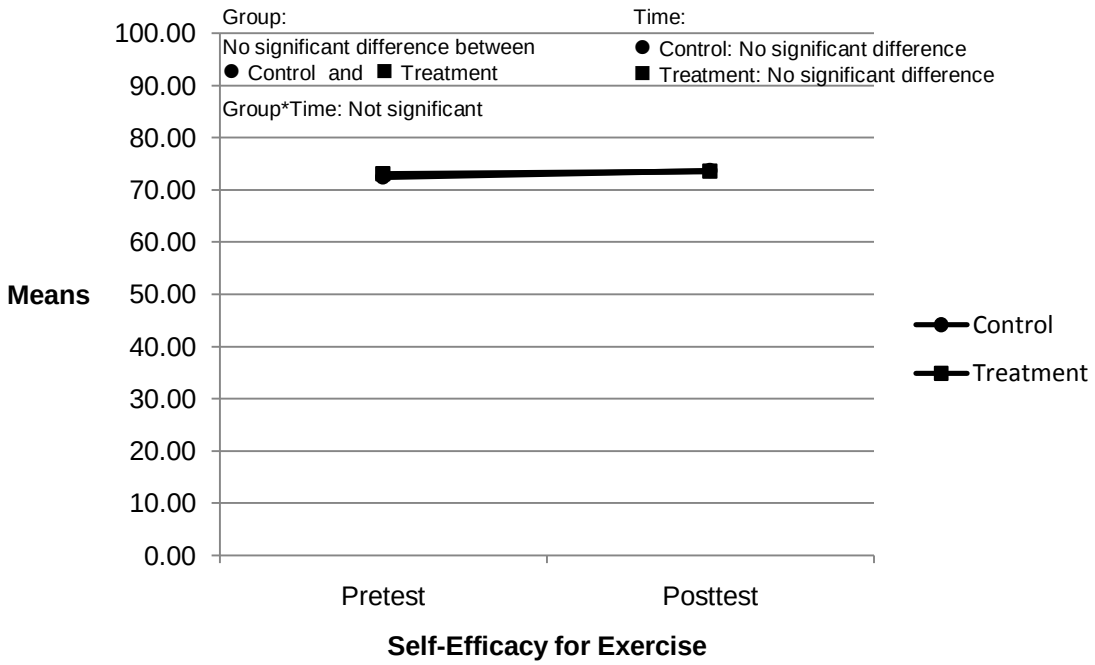


Figure 9. Profile Plot of Self-Efficacy for Exercise Means for the Control and Treatment Groups at Pretest and Posttest.

Table 10

Repeated-Measures Analysis of Variance for Self-Efficacy for Calcium

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.024	0.877	0.000	0.053
Time	1, 107	0.330	0.567	0.003	0.088
Group*Time	1, 107	0.184	0.669	0.002	0.071

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

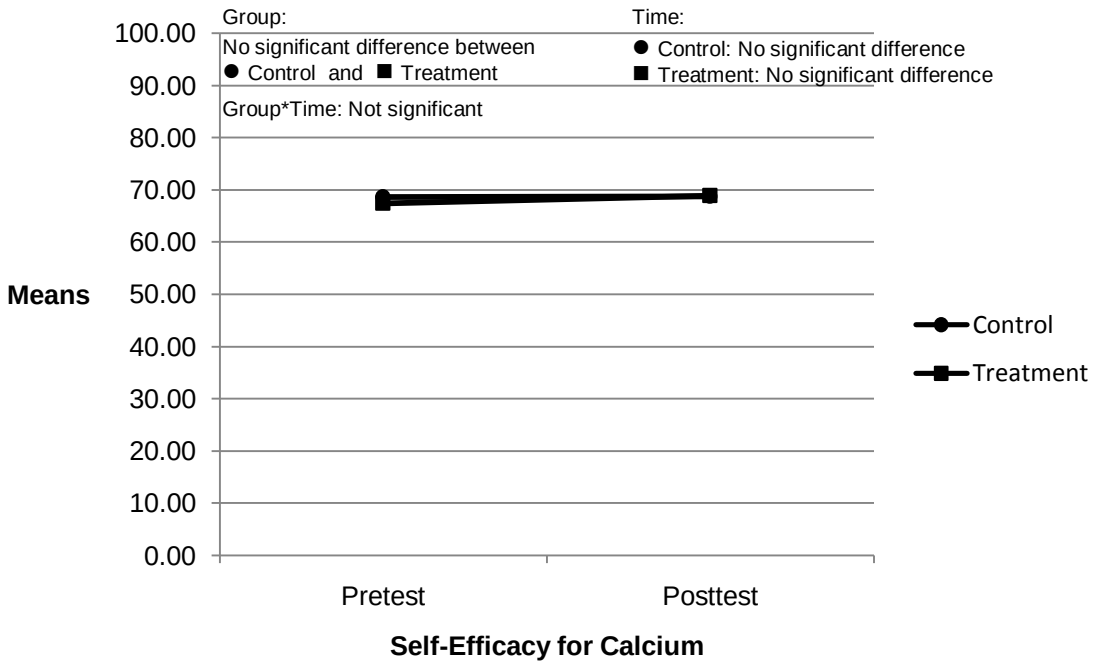


Figure 10. Profile Plot of Self-Efficacy for Calcium Means for the Control and Treatment Groups at Pretest and Posttest.

Table 11

Repeated-Measures Analysis of Variance for Bouts of Exercise per Week

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	1.095	0.298	0.010	0.179
Time	1, 107	0.671	0.415	0.006	0.128
Group*Time	1, 107	1.583	0.211	0.015	0.239

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

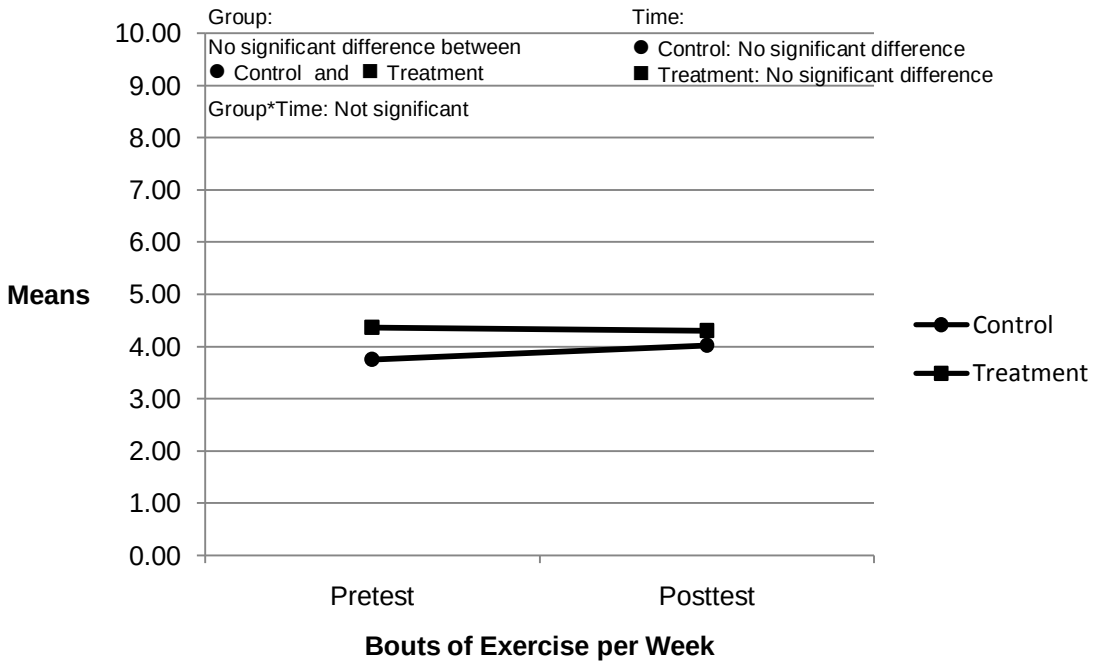


Figure 11. Profile Plot of Bouts of Exercise per Week Means for the Control and Treatment Groups at Pretest and Posttest.

Table 12

Repeated-Measures Analysis of Variance for Good Sources of Calcium per Day

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.282	0.596	0.003	0.082
Time	1, 107	0.087	0.768	0.001	0.060
Group*Time	1, 107	2.238	0.138	0.020	0.317

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). There was also no significant difference for Time (pretest to posttest).

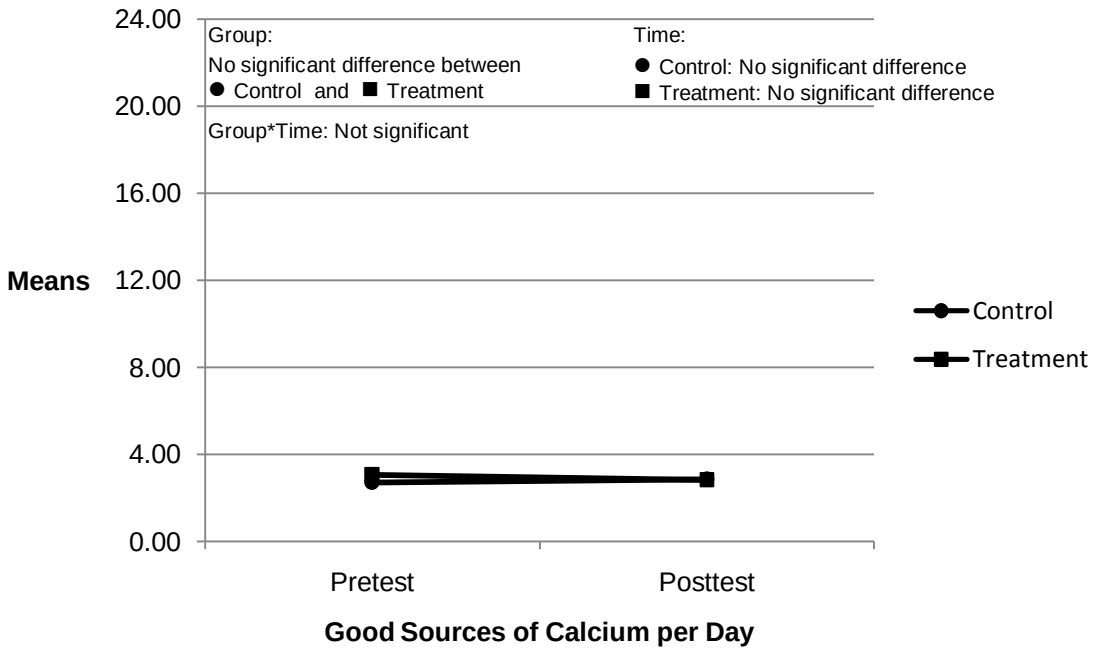


Figure 12. Profile Plot of Good Sources of Calcium per Day Means for the Control and Treatment Groups at Pretest and Posttest.

Table 13

Repeated-Measures Analysis of Variance for Health Motivation

Source	df	*F*	*p*	η_p^2	Power
Group	1, 107	0.214	0.644	0.002	0.074
Time	1, 107	8.172	0.005**	0.071	0.809
Group*Time	1, 107	0.449	0.504	0.004	0.102

Note. $*p < 0.05$, $**p < 0.01$, $***p < 0.001$.

Group*Time was not significant. There was no significant difference for Group (control and treatment). But there was a significant difference for Time from pretest to posttest, there was a significant increase in the control group with $p = 0.027$ ($\eta_p^2 = 0.086$), but there was no significant difference in the treatment group.

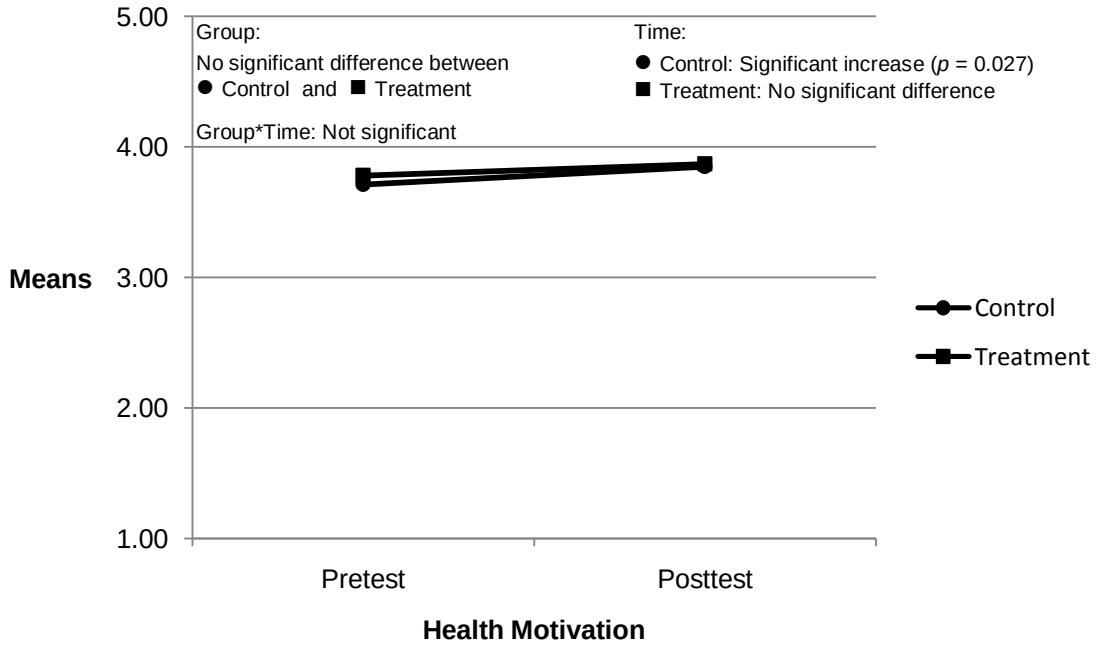


Figure 13. Profile Plot of Health Motivation Means for the Control and Treatment Groups at Pretest and Posttest.

Group*Time interactions were not significant for each osteoporosis health belief and osteoporosis preventive behavior (and for health motivation). In the control group, for the osteoporosis health beliefs, results of the study showed that there were no significant differences from pretest to posttest in perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of calcium to prevent osteoporosis, perceived barriers to exercise, self-efficacy for exercise, and self-efficacy for calcium. But there were significant increases from pretest to posttest in the osteoporosis health beliefs of perceived benefits of exercise to prevent osteoporosis with $p = 0.000$ and a large effect size with $\eta_p^2 = 0.231$, and perceived barriers to calcium with $p = 0.023$ and a medium effect size with $\eta_p^2 = 0.091$. For the osteoporosis preventive behaviors, there were no significant differences from pretest to posttest in self-reported bouts of exercise per week and good sources of calcium per day.

Answer to research question 1. Would the osteoporosis prevention education intervention significantly increase perceived susceptibility to osteoporosis and perceived severity of osteoporosis, which would also significantly increase perceived benefits of exercise and calcium to prevent osteoporosis? Results of the 2 x 2 repeated-measures ANOVAs showed that treatment group who received the osteoporosis prevention education intervention showed no significant difference in perceived susceptibility to osteoporosis or perceived severity of osteoporosis, but did show a significant increase in perceived benefits of exercise to prevent osteoporosis with an increase of 0.31 and $p = 0.001$ and large effect size with $\eta_p^2 = 0.192$ (but there was also a significant increase in the perceived benefits of exercise to prevent osteoporosis in the control group with $p =$

0.000 and a large effect size with $\eta_p^2 = 0.231$, and the interaction was not significant), but showed no significant difference in perceived benefits of calcium to prevent osteoporosis.

Answer to research question 2. Would the osteoporosis prevention education intervention significantly decrease perceived barriers to exercise and calcium and significantly increase self-efficacy for exercise and calcium? Results of the 2 x 2 repeated-measures ANOVAs showed that although perceived barriers to exercise and perceived barriers to calcium were thought to significantly decrease in the treatment group who received the osteoporosis prevention education intervention, there was instead a significant increase in perceived barriers to exercise with an increase of 0.14 and $p = 0.017$ and medium effect size with $\eta_p^2 = 0.106$, and also a significant increase in perceived barriers to calcium with an increase of 0.19 and $p = 0.004$ and large effect size with $\eta_p^2 = 0.145$ (but there was also a significant increase in perceived barriers to calcium in the control group with $p = 0.023$ and a medium effect size with $\eta_p^2 = 0.091$, and the interaction was not significant), but showed no significant difference in self-efficacy for exercise and self-efficacy for calcium.

Answer to research question 3. Would the osteoporosis prevention education intervention significantly increase self-reported bouts of exercise per week and good sources of calcium per day? Results of the 2 x 2 repeated-measures ANOVAs showed that the treatment group who received the osteoporosis prevention education intervention showed no significant difference in self-reported bouts of exercise per week or good sources of calcium per day.

Health motivation was also measured and calculated for significant differences from pretest to posttest. Results of the 2 x 2 repeated-measures ANOVA showed that the control group had a significant increase in health motivation with an increase of 0.14 and $p = 0.027$ and medium effect size with $\eta_p^2 = 0.086$, while the treatment group showed no significant difference.

CHAPTER V

DISCUSSION

Summary of Results

Results of this experimental research study showed that the osteoporosis prevention education intervention was not effective in increasing the osteoporosis preventive behaviors of self-reported weight-bearing physical activity and calcium consumption. The intervention used in this study was intended to be simple and brief. A more thorough and comprehensive intervention may or may not have shown better results, and would not have been applicable considering it would not be a desirable source for receiving osteoporosis prevention education. But even had the intervention been more thorough and comprehensive, results would likely have been similar due to Sedlak et al.'s (2000) findings that neither the briefness nor intensity of their osteoporosis prevention education interventions increased self-reported weight-bearing physical activity and calcium consumption.

It should be noted that some osteoporosis prevention education studies measure osteoporosis knowledge, but osteoporosis knowledge was not measured in this study at both pretest and posttest. Other osteoporosis prevention education interventions such as lectures and counseling sessions may require participants to remember what they are being taught, but because printed material was the osteoporosis prevention education intervention, it could be used for reference and the educational information did not necessarily need to be memorized. Therefore, low quiz scores do not necessarily reflect knowledge. Also, a review by Werner (2005) had already shown that osteoporosis

prevention education interventions do increase osteoporosis knowledge, but do not increase the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption. Therefore, the focus of this study was to measure and alter osteoporosis health beliefs, in order to predict an increase in weight-bearing physical activity and calcium consumption based on the HBM, and to also most importantly measure and increase the actual self-reported weight-bearing physical activity and calcium consumption behaviors that prevent osteoporosis.

The osteoporosis prevention education intervention was designed to significantly increase the osteoporosis health beliefs of perceived susceptibility to osteoporosis, perceived severity of osteoporosis, perceived benefits of exercise to prevent osteoporosis, perceived benefits of calcium to prevent osteoporosis, self-efficacy for exercise and self-efficacy, and to significantly decrease perceived barriers to exercise and perceived barriers to calcium, in order to predict an increase in, and actually increase, self-reported weight-bearing physical activity and calcium consumption. However, the osteoporosis prevention education intervention was not effective in altering osteoporosis health beliefs in favor of predicting osteoporosis preventive behaviors.

Perceived susceptibility to osteoporosis at pretest were just below neutral for both control and treatment groups with a score of 2.49 and 2.81 out of 5, respectively. The osteoporosis prevention education intervention was designed to increase perceived susceptibility to osteoporosis, but education on susceptibility to osteoporosis did not significantly increase perceived susceptibility to osteoporosis. Education on the susceptibility of osteoporosis may not have increased perceived susceptibility to osteoporosis due to the distal time of onset of the disease. In addition, Gerend, Erchull,

Aiken, and Maner (2005) had found that even when education on susceptibility to osteoporosis is provided, some individuals may have lower perceived susceptibility to osteoporosis than expected at either pretest or posttest, because they are already, or have begun, engaging in the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption to prevent osteoporosis, thus, lowering their perceived susceptibility to the disease.

Perceived severity of osteoporosis at pretest were just above neutral for both control and treatment groups with a score of 3.05 and 3.15 out of 5, respectively. The osteoporosis prevention education intervention was designed to increase perceived severity of osteoporosis, but emphasizing the visible severity of osteoporosis, while suggesting a more proximal time of onset, was shown not to significantly increase the perceived severity of osteoporosis. Smith Klohn and Rogers (1991) concluded that emphasizing the visible severity of osteoporosis with a proximal time of onset increases the perceived severity of osteoporosis and strengthens the intention for weight-bearing physical activity and calcium consumption. The osteoporosis prevention intervention did emphasize the visible severity of osteoporosis with images and markers pointing out looking frail and disfigured, having a hunch back, and being shorter in height. However, for proximal time of onset, in Smith Klohn and Rogers' (1991) study of women of an average age of 18.6 years of age, the proximal time of onset message was that osteoporosis occurs in the early 20's. That message that osteoporosis would occur very soon and within the next couple of years increased their participants' perceived severity of osteoporosis. But that message is inaccurate, osteoporosis does not typically occur until decades later in life, and the researcher did not want to use that message to deceive

the participants. Participants were still at an age in which they could still efficiently increase BMD with weight-bearing physical activity and calcium consumption for approximately another decade. Although osteoporosis typically occurs after 50 years of age, in an attempt to give osteoporosis a proximal time of onset, the message used was, "Bone strength naturally starts to decrease in your 30's, resulting in weaker bones that can lead to osteoporosis." Although the message is factual and accurate, and makes the onset of osteoporosis appear to be at least two decades more proximal, it may not have been a near and strong enough proximal time of onset message. Since it stated that osteoporosis will not be a concern for approximately a decade for the participants, as oppose to a couple of years from the message used by Smith Klohn and Rogers (1991), it did not significantly increase perceived severity. Participants in this study averaged 19.6 years of age, similar to both Jackson and Aiken's (2006) and Smith Klohn and Rogers' (1991) studies with females of a similar age mean (M_{age} = 19.5 years and M_{age} = 18.6 years, respectively), and Jackson and Aiken's (2006) effective sun-protection study found perceived severity of photoaging to significantly increase due to its time of onset in the early 20's, which was a consistent time of onset as the message used in Smith Klohn and Rogers' (1991) study. Although the best time to maximize peak BMD to prevent osteoporosis is during youth, possibly due to the distal time of onset of osteoporosis, young people may not believe that it is a severe health threat to be concerned with, and may just not feel the urgency to be motivated enough to engage in weight-bearing physical activity and calcium consumption for the purpose of preventing the disease.

Although perceived susceptibility to osteoporosis and perceived severity of osteoporosis did not significantly increase, perceived benefits to exercise to prevent

osteoporosis did significantly increase, but perceived benefits of calcium to prevent osteoporosis did not significantly increase. Consistent the findings of Martin et al. (2004) and Anderson et al. (2005), participants in this study already knew weight-bearing physical activity and calcium consumption could prevent osteoporosis. Perceived benefits of exercise to prevent osteoporosis were already high at pretest for both control and treatment group with a score of 3.77 and 3.82 out of 5, respectively, and perceived benefits of calcium were also high at pretest for both control and treatment group with a score of 3.92 and 3.89 out of 5, respectively. Participants who received the osteoporosis prevention education intervention did have a significant increase in perceived benefits of exercise to prevent osteoporosis with a score of 4.13, but the control group also had a significant increase in perceived benefits of exercise to prevent osteoporosis with a score of 4.02. Therefore, the significant increase in the perceived benefits of exercise to prevent osteoporosis in the treatment group may have been due to maturation and not necessarily the intervention. It is uncertain why both groups significantly increased their belief that weight-bearing physical activity could prevent osteoporosis. With "Osteoporosis" in the title of both the OHBS and OSES, and with "osteoporosis" being mentioned 23 times in the OHBS, perhaps participants in both groups did their own investigation on osteoporosis and learned of the benefits of weight-bearing physical activity to prevent the disease. While perceived benefits of exercise to prevent osteoporosis significantly increased in both groups, both groups did not have a significant increase perceived benefits of calcium.

Perceived barriers to exercise at pretest were already low for both control and treatment groups with a score of 1.62 and 1.64 out of 5, respectively, and perceived

barriers to calcium at pretest were also already low for both control and treatment groups with a score of 1.89 and 1.98 out of 5, respectively. Self-efficacy for exercise at pretest were already relatively high for both control and treatment groups with a score of 72.41 and 73.01 out of 100, respectively, and self-efficacy for calcium at pretest were also already relatively high for both control and treatment groups with a score of 68.63 and 67.44 out of 100, respectively. Therefore, the participants already felt that they could readily engage in weight-bearing physical activity and calcium consumption. The osteoporosis prevention education intervention was designed to decrease perceived barriers to exercise and calcium, and also increase self-efficacy for exercise and calcium. Specifically, educating on weight-bearing physical activity (exercise) and calcium consumption (calcium) with various types, examples and amounts was intended to decrease the perceived barriers to exercise and calcium, respectively, and to increase self-efficacy for exercise and calcium, respectively. Unfortunately, the perceived barriers to exercise and calcium did not significantly decrease but instead significantly increased in the treatment group with a score of 1.78 and 2.17, respectively, and with a perceived barriers to calcium score of 2.04 in the control group. And although the perceived barriers to exercise and calcium were thought to be inversely related to self-efficacy for exercise and calcium, respectively, self-efficacy for both exercise and calcium were not significantly different. It is uncertain why the perceived barriers to exercise and calcium would significantly increase and self-efficacy for exercise and calcium were not significantly different. Perceived barriers to exercise may have increased and self-efficacy for exercise may not have changed even though various examples of weight-bearing physical activity were provided to give the sense of many options, because non-

weight-bearing physical activities, such as cycling and swimming, were not listed. Therefore, the intervention may have limited the types of physical activity that could be done to prevent osteoporosis. In addition, the examples of weight-bearing physical activity may have been undesirable activities that the participants would not want to engage in. And the amount of weight-bearing physical activity listed, 2-3 or 3-5 times per week for resistance training or activities that are weight-bearing and/or involve jumping, respectively, may have seemed overwhelming, which may have also increased perceived barriers to exercise and not change self-efficacy for exercise. Perceived barriers to calcium showed a significant increase, and self-efficacy for calcium showed no significant difference in both control and treatment group. For the treatment group, perceived barriers to calcium may have increased and self-efficacy for calcium may not have changed even though various examples of good sources of calcium were provided to give the sense of many options, because many or all of the good sources of calcium listed may have been undesirable sources that the participants would not want to consume. And the adequate intake of calcium provided, 1,000-1,200 mg per day, may have seemed overwhelming, which may have also increased perceived barriers to calcium and not changed self-efficacy for calcium. While this may help explain why perceived barriers to calcium increased in the treatment group, it is difficult to determine why it significantly increased in the control group. But because there was a significant increase in the perceived barriers to calcium in the treatment group and control group, it may have been due to maturation and not necessarily the intervention. Nevertheless, these particular conclusions suggest that it may be beneficial to promote weight-bearing physical activity and calcium consumption that is both desirable and manageable to engage in.

In addition to osteoporosis health beliefs, health motivation was also measured. Health motivation at pretest was fairly high for both control and treatment groups with a score of 3.71 and 3.78 out of 5, respectively. While there was no significant difference at posttest for the treatment group, there was a significant increase at posttest for the control group with a score of 3.85. It was the stress management intervention, and not the osteoporosis prevention education intervention, that was shown to be effective in significantly increasing motivation to be and/or stay healthy. That shows that stress, and not osteoporosis, is a health concern that motivates healthiness, which may also be due to its much more proximal time of onset. As college students, the participants are likely already experiencing stress (D'Zurilla & Sheedy, 1991), but will not likely experience the symptoms of osteoporosis until decades later. But as important it is to increase health motivation and alter osteoporosis health beliefs, they do not necessarily predict osteoporosis preventive behaviors.

Although altering osteoporosis health beliefs would predict adopting the osteoporosis preventive behaviors of weight-bearing physical activity and calcium consumption based on the HBM, adoption of those behaviors is not guaranteed. For measuring actual osteoporosis preventive behavior, the ECBS was used. Although the ECBS did not measure exact exercise and calcium intake amounts, it did correspond directly to the treatment intervention and measured frequency to determine whether or not participants engaged in weight-bearing physical activity and calcium consumption listed on the treatment intervention more often. Engaging in weight-bearing physical activity and calcium consumption more often would demonstrate the effectiveness of the treatment intervention to not only alter health beliefs, but to also change behaviors to

most importantly increase the effort to actively prevent osteoporosis. Self-reported bouts of exercise per week at pretest were at 3.75 and 4.02 for the control and treatment groups, respectively, and good sources of calcium per day at pretest were at 2.69 and 2.84 for the control and treatment groups, respectively. The participants appear to have been engaging in adequate weight-bearing physical activity with approximately 4 bouts of exercise per week. However, it is possible, but not likely, that they were consuming enough calcium with approximately 3 good sources of calcium per day. There were no significant differences in self-reported bouts of exercise per week and good sources of calcium per day at posttest. Therefore, the osteoporosis prevention education intervention was not effective in most importantly increasing the osteoporosis preventive behaviors of self-reported weight-bearing physical activity and calcium consumption.

Application

Although the developed osteoporosis prevention education intervention based on the HBM that was appearance-based, and emphasized the visible severity of osteoporosis and suggested a more proximal time of onset, that was used in this study was not found to significantly increase self-reported osteoporosis preventive behaviors, it still may find suitability for health education in public health. Even if the osteoporosis prevention education intervention used in this study could increase osteoporosis preventive behaviors in only a small percentage of those who receive it, because it is relatively inexpensive and can be easily disseminated to the public in a mass media campaign means that it very economical and time efficient, and can reach out to countless millions of people at a time, which may still perhaps translate to a significant number of

individuals motivated to increase weight-bearing physical activity and calcium consumption.

Limitations

This experimental research study was not without limitations. Convenience sampling limited generalizing interpretation of the results to other demographics. The majority of participants were Caucasian female undergraduate students at one university. Therefore, the data and results may not be representative of minorities, males, non-undergraduate (or non-college) students, a younger or older population, and/or a population from another region of the nation.

Self-report method data may have inaccurate information reported by the participant. With the potential of social desirability, participants may have responded to items with something they believed others and/or the researcher wanted, especially after the intervention was administered. In addition, random responding (randomly responding to items due to no motivation or capability) is also a possible concern (Murphy & Davidshofer, 2005).

While the ECBS measured frequency of weight-bearing physical activity and calcium consumption behaviors, it did not measure actual amounts. It was assumed that increased frequency of weight-bearing physical activity and calcium consumption would equate to increased amounts of weight-bearing physical activity and calcium consumption, respectively, although that may not necessarily be the case. One may increase frequency of weight-bearing physical activity and calcium consumption, but if

the amounts for each time may have decreased, it may also possibly result in no change or a decrease in weight-bearing physical activity and calcium consumption.

With a chance to win gift cards to a specified large department store as an incentive to participate, those who were not or less interested in winning a gift card may not have been as motivated while participating in the study, which may not reflect their actual health beliefs concerning osteoporosis. However, participants from a health education course may be more health conscious, could possibly have higher health belief and behavior scores than that of the general population, and could also possibly be more easily persuaded to change their health beliefs and behaviors with given health information than the general population.

It is also a possibility that participants may not have opened their envelopes and/or reviewed their health-related handouts during this study; therefore, not receiving an intervention. Participants may also have waited until near the end of the 2 week study to review their health-related handouts shortly before the posttest in an attempt to attain high quiz scores to perhaps increase their chances of winning a gift card. In addition, although all participants in the treatment and control groups were instructed not to share and discuss their osteoporosis prevention or stress management handouts with each other, they still may have shared and discussed the handouts with other participants anyway. While it is not critical to the experiment if a participant in the osteoporosis prevention (treatment) group reviewed the stress management handout, it is critical to the experiment if a participant in the stress management (control) group reviewed the osteoporosis prevention handout, because that may have a possible effect on osteoporosis health beliefs and osteoporosis preventive behaviors from pretest to posttest.

Weight-Bearing Physical Activity and Calcium Consumption for Motives Other Than Osteoporosis Prevention

The goal of this study was to motivate young females to increase weight-bearing physical activity and calcium consumption for osteoporosis prevention, but because osteoporosis does not appear to motivate increased weight-bearing physical activity and calcium consumption, other benefits that are of result of physical activity (weight-bearing and/or non-weight-bearing) and calcium consumption that have been found to be motivating can be promoted to encourage weight-bearing physical activity and calcium consumption.

Kasper et al. (1994) and Kasper et al. (2001) found that young women believe they are more susceptible to and have more concern for heart disease and breast cancer than osteoporosis, and they believe that heart disease and breast cancer are more serious than osteoporosis. In this case, it can be promoted that the risk of heart disease can be reduced with physical activity (Stampfer, Hu, Manson, Rimm, & Willett, 2000) and calcium (Bostick et al., 1999), and the risk of breast cancer can also be reduced with physical activity (Thune, Brenn, Lund, & Gaard, 1997) and calcium (Lin et al., 2007), and osteoporosis prevention will be an additional health benefit.

Instead of for health benefits, young girls have been found to engage in physical activity and modify their diet to improve physical appearance and lose weight (McCabe & Ricciardelli, 2003). While physical activity is commonly known to improve physical appearance and lead to weight maintenance or even weight loss, it could be made aware and promoted that calcium may also lead to weight maintenance or even weight loss

(Davies et al., 2000; Jacqmain et al., 2003; Zemel, Thompson, Milstead, Morris, & Campbell, 2004).

If health benefits and/or physical appearance are not motivating enough, weight-bearing physical activity and calcium consumption can also be promoted for their enjoyment. Health benefits and/or physical appearance can help motivate young people to initiate physical activity (extrinsic motivation), but they will sustain physical activity if it is pleasurable, fun and enjoyable (intrinsic motivation) (Buckworth, Lee, Regan, Schneider, & DiClemente, 2007). In addition to fun and enjoyment, the opportunity to also hang out with friends also sustains physical activity (Huhman et al., 2010). And taste is the most important reason why people choose the foods they eat (Glanz, Basil, Malbach, Goldberg, & Snyder, 1998). Young people have been found to eat high calcium foods not only because they are good for you (extrinsic motivation), but mainly if they taste good and are fun to eat while hanging out with friends (intrinsic motivation) (Larson, Story, Wall, & Neumark-Sztainer, 2006). Therefore, weight-bearing physical activity and calcium consumption can also be promoted for the pleasure, enjoyment and social benefits of engaging in those behaviors.

Conclusion

This experimental research study showed that an osteoporosis prevention education intervention based on the HBM that was appearance-based, and emphasized the visible severity of osteoporosis and suggested a more proximal time of onset, although applying some of the same concepts of Jackson and Aiken's (2006) effective sun-protection intervention, was shown to be not effective in increasing self-reported

weight-bearing physical activity and calcium consumption. Results of not increasing self-reported weight-bearing physical activity and calcium consumption were consistent with findings of a study by Sedlak et al. (2000) and a review by Werner (2005).

Although this study was focused on females, because osteoporosis also occurs in males (20-25% of osteoporosis cases) (Szulc, Garnero, Marchand, & Delmas, 2001), increasing weight-bearing physical activity and calcium consumption should be promoted for both genders. While this study focused on the negative physical appearance of osteoporosis by emphasizing its visible severity while suggesting a more proximal time of onset to increase weight-bearing physical activity and calcium consumption, future research studies may choose to focus more on the positive physical appearance that weight-bearing physical activity and calcium consumption can result in while they are still in their youth. Although osteoporosis is best prevented by maximizing peak BMD with weight-bearing physical activity and calcium consumption at youth, possibly due to the distal time of onset of osteoporosis, osteoporosis does not appear to be a health threat that can motivate young individuals to increase weight-bearing physical activity and calcium consumption to prevent it. Therefore, researchers must continue to try to develop an effective osteoporosis prevention education intervention that will increase weight-bearing physical activity and calcium consumption to prevent osteoporosis.

However, if other health threats may be more of a concern, such as heart disease and breast cancer (Kasper et al., 1994, Kasper et al., 2001), then research studies should investigate if those particular health threats are motivating enough to increase of weight-bearing physical activity and calcium consumption. Losing weight and improving physical appearance has been shown to encourage behavior change (McCabe &

Ricciardelli, 2003), and those particular benefits and goals could be promoted since they can lead to an increase in weight-bearing physical activity and calcium consumption. Whether it may take heart disease risk reduction, breast cancer risk reduction, weight loss and/or improving physical appearance to initiate weight-bearing physical activity, physical activity that is fun and enjoyable with the chance to hang out with friends may initiate or increase, and ultimately sustain, physical activity (Buckworth et al., 2007; Huhman et al., 2010). And calcium foods that taste good and are enjoyable with the ability to enjoy them with friends can also increase calcium consumption (Larson et al., 2006).

Both weight-bearing physical activity and calcium consumption have numerous health benefits in addition to osteoporosis prevention. Physical activity (whether weight-bearing or non-weight-bearing) has many benefits, and in regards to disease reduction, prospective observational studies have shown other health benefits of physical activity in addition to osteoporosis prevention include, but are not limited to, reducing the risk of heart disease, stroke, hypertension, type 2 diabetes, obesity, breast cancer, colon cancer, anxiety and depression (Kesaniemi et al., 2001). Also regarding disease reduction, studies have shown other health benefits of calcium in addition to osteoporosis prevention include, but are not limited to, reducing the risk of heart disease (Bostick et al., 1999), obesity (Jacqmain, et al., 2003), breast cancer (Lin et a., 2007), colon cancer (Park et al., 2007), kidney stones (Williams et al., 2001), periodontal disease (Nashida et al., 2000), and premenstrual syndrome (Bertone-Johnson et al., 2005). The researcher recommends future research to determine if any of the other health benefits of weight-bearing physical activity and calcium consumption besides osteoporosis prevention can

also be promoted to initiate those behaviors. Other health benefits of weight-bearing physical activity and calcium consumption may be found to initiate and increase those behaviors, but reducing the risk of diseases may also end up not being of concern to young individuals due to their typical distal time of onset.

Therefore, until an effective osteoporosis prevention education intervention is developed that can increase weight-bearing physical activity and calcium consumption for the purpose of osteoporosis prevention, the researcher strongly recommends more emphasis in promoting the message of more proximal benefits that have been found to be motivating, such as improved physical appearance and weight loss/maintenance and the benefits that pertain to them, to aid in initiating or increasing weight-bearing physical activity and calcium consumption. And the researcher also strongly recommends that weight-bearing physical activity and calcium consumption should be emphatically promoted for the pleasure and enjoyment of engaging in them, that weight-bearing physical activity is fun and enjoyable and calcium-rich foods taste good, and that both behaviors can be enjoyed in the company of friends. Once young people find motivation to initiate or increase weight-bearing physical activity and calcium consumption, they may find what desirable weight-bearing physical activities they enjoy to do and which desirable calcium-rich foods they enjoy to eat to continue those behaviors. Promoting these messages may not only initiate adopting and increasing weight-bearing physical activity and calcium consumption, but can also ultimately sustain weight-bearing physical activity and calcium consumption to prevent osteoporosis.

APPENDIX A

IMPORTANCE OF BONE HEALTH

Bone health is important because bones provide structure for the human body, support the body's weight, anchor skeletal muscles, aid in its mechanical motion, protect vital organs, and are a storage and reserve for approximately 99% of the body's calcium (Heaney, 2002; Khan et al., 2001; National Osteoporosis Foundation [NOF], 2008a; Power et al., 1999; Wardlow, Hampl, & DiSilvestro, 2004)

APPENDIX B

HEALTH CONSEQUENCES OF OSTEOPOROSIS

Osteoporosis can have the appearance of frailty and disfigurement, Dowager's hump or kyphosis of the spine (hunch back), and shortened stature (height). Osteoporosis can limit both the quantity and quality of life, while osteoporotic fractures can lead to increased disability and decreased quality of life. Low bone mineral density (BMD), a result of osteoporosis, is a risk factor for death. There is an increase in mortality with osteoporotic fractures, especially in the hip and spine. And the highest risk of death for individuals with osteoporosis is found immediately after an osteoporotic fracture, but if the individual survives and recovers, risk of mortality fades after several months, but normal everyday function usually is never completely restored (Johnell et al., 2004). Events from normal lifting and bending to high-impact falls can be traumatic and lead to fractures (NIH Consensus Development Panel on Osteoporosis Prevention, Diagnosis, and Therapy, 2001). In the occurrence of a hip fracture, individuals with osteoporosis may die or be permanently disabled. Hip (and vertebral) fractures can cause pain and loss of everyday function, and almost always require some hospitalization with slow (and usually incomplete) recovery. The decreased quality of life due to osteoporosis can lead to disfigurement, pain, low self-esteem, reduced mobility, and decreased independence. Individuals with osteoporosis have higher amounts of fear and anxiety, which leads to a higher rate of depression. Osteoporotic fractures can increase pain and emotional problems, while decreasing physical function, mobility, social interaction, and well-being. And even long after the occurrence of an osteoporotic fracture, although the

quality of life can improve, it usually is never completely restored (Lips & van Schoor, 2005).

APPENDIX C

WEIGHT-BEARING PHYSICAL ACTIVITY, CALCIUM CONSUMPTION, AND BONE HEALTH

Weight-Bearing Physical Activity and Bone Health

Weight-bearing physical activity is physical movement in which the skeleton, or bones, are subjected to mechanical loading by the force of gravity (ACSM, 2004; Khan et al., 2001), and forces produced by muscles and/or other external forces (ACSM, 2004; Khan et al., 2001; NOF, 2008b). The force of gravity stresses the bone through high resistance ground reaction forces (GRFs) (ACSM, 2004) from the impact of physical activity (i.e., plyometrics). Forces produced by muscles (i.e., resistance training) produce forces to bone through joint-reaction forces (muscle contractions) rather than GRFs (ACSM, 2004; Cullen, Smith, & Akhter, 2001). It is the position of the American College of Sports Medicine (ACSM) (2004) that bone is influenced mainly by the type of bone-loading physical activity, intensity, duration, and frequency. Examples of weight-bearing physical activity that should be done for 30-60 minutes per day, 3-5 times per week, for bone health provided by the ACSM include weight-bearing endurance activities such as jogging, stair climbing, and tennis, and activities that involve jumping such as volleyball and basketball, in addition to resistance exercise such as weight lifting 2-3 times per week.

Bone responds to mechanical loading by adapting its structure to more adequately withstand future deformations (Robling et al., 2002), thus, increasing its strength (Wolff's Law). Mechanical loading provided by physical activity can alter bone strength

by effecting bone size and bone shape. Bone tissue adapts to increased mechanical loading of the skeleton by increasing bone mass, density, and material (strength stiffness, energy absorbing capacity) and bone structural (architecture, geometry) properties (Kannus et al., 1996). The mechanical loading provided by physical activity must be high-intensity/impact (Fuchs et al., 2001; Karlsson et al., 2001; Martin et al., 2004; Tsuzuku et al., 1998), dynamic (rather than static) (ACSM, 2004; Warden, 2006), and short duration (Martin et al., 2004; Warden, 2006) to increase BMD. Strain magnitude, site specificity, and strain distribution are also important for bone adaptation (Tsuzuku et al., 1998). Intensity (strain magnitude) is the greatest factor in bone response (Khan et al., 2001) that will increase BMD. In terms of intensity, weight-bearing physical activity must create an overload stimulus that exceeds normal loading conditions (ACSM, 2004) on bone. Increases in strain beyond the strain threshold leads to a relatively linear increase in bone adaptation (Warden, 2006). Strain that creates an overload stimulus must be applied to bone to stimulate an adaptive response, and continued adaptation requires a progressively increasing overload stimulus. Mechanical loading has osteogenic effects only if the stress to bone is unique, variable, and dynamic in nature. However, bone cells lose sensitivity to mechanical stimulation after a certain number of repetitions, and recovery periods are needed to restore sensitivity to the mechanical loading (ACSM, 2004). Weight-bearing physical activity of low- or moderate-intensity is not as effective as high-intensity (ACSM, 2004; Fuchs et al., 2001; Martin et al., 2004). The intensity of weight-bearing, high-impact loading increases BMD rather than duration (Karlsson et al., 2001; Martin et al., 2004). And increasing duration of physical activity adds no additional benefits to BMD (Karlsson et al., 2001), as bone formation response

tends to saturate and lose sensitivity (Robling et al., 2002; Turner, 1998) as duration increases. Weight-bearing physical activity only affects BMD at the loaded sites of the bone (ACSM, 2004; Bass et al., 2007; Kannus et al., 1996; Tsuzuku et al., 1998; Warden et al., 2007; Warden, 2006), but stress fractures can occur at the loaded sites if physical activity is overused (ACSM, 2004; Khan et al., 2001). Furthermore, gains in BMD are not preserved when weight-bearing physical activity is discontinued (ACSM, 2004; Khan et al., 2001; Warden et al., 2007).

Calcium Consumption and Bone Health

While weight-bearing physical activity affects BMD locally at the loaded sites of the bone (ACSM, 2004; Bass et al., 2007; Kannus et al., 1996), calcium has a more universal and systemic effect on BMD (Bass et al., 2007). Weight-bearing physical activity changes bone size and shape, while calcium optimizes physical activity's effect at loaded sites and has a systemic effect on non-loaded sites. And calcium may increase BMD, but it does not change its geometric properties (microarchitecture) as weight-bearing physical activity does (Bass et al., 2007).

Bone adaptations are constrained or enabled by nutritional (and endocrine) factors (ACSM, 2004; Kannus et al., 1996; Khan et al., 2001). Although many nutrients play a vital role in bone health, calcium is the most important and primary nutrient due to it being the storage, reserve, and main component of bone (Khan et al., 2001; NOF, 2008a). If calcium, along with vitamin D and other nutrients, is deficient, it can limit the osteogenic effects of weight-bearing physical activity (ACSM, 2004). Adequate calcium consumption must be maintained all throughout life in order to have a lasting impact on

bone health (Nieves, 2005). Because dietary calcium consumption is not constant and continuous, a reserve of calcium is essential for optimal concentrations in the circulating blood and extracellular fluid, and the constancy of calcium is ensured by adjusting movement of calcium into and out of bone in bone remodeling (Heaney, 2002). Bone mass is regulated by mechanical loading, with only as much bone as the mechanical loading requires is needed, and calcium consumption above the needed amount to sustain BMD has no added benefits and is simply excreted. However, when daily losses of calcium exceed absorbed input, the body draws upon the calcium reserves in bone (Heaney, 2002; NOF, 2008a), thus, reducing BMD. Only when consumption becomes adequate again, the depleted calcium reserves in bone are refilled (Heaney, 2002), thus, BMD is regained.

The adequate intake (AI) of calcium is 1,000-1,200 mg/d based on the Food and Nutrition Board. The human body cannot produce its own calcium; therefore, it must be obtained, generally by ingestion from (fortified) foods or supplements. Sources of calcium include calcium-rich foods include dairy products such as milk and cheese, leafy greens such as kale, collard, turnip, and mustard greens, broccoli, sardines, canned salmon, tofu, calcium fortified-foods such as calcium-fortified versions of orange juice, cranberry juice, other beverages, yogurt, breakfast cereals, breakfast bars, and bread, and calcium supplements, such as calcium pills (Wardlow et al., 2004). It is the position of the American Dietetic Association (ADA) (2005) that although nutrition for promoting health and chronic disease prevention is best when consuming a variety of foods, additional nutrients from fortified foods and/or supplements can aid in meeting

nutritional needs. The NOF (2008a) also recommends calcium supplements and/or calcium fortified foods for those who do not obtain enough calcium from their diet.

Commonly used calcium supplements compounds are calcium carbonate, calcium citrate, calcium lactate, and calcium phosphate (NOF, 2008a), but calcium carbonate and calcium citrate are the most common (Heaney, Dowell, and Barger-Lux, 1999; Wardlow et al., 2004). While calcium carbonate is insoluble (Heaney et al., 1999), calcium citrate is soluble and highly absorbable (Heaney et al., 1999; NOF, 2008a). While it has been reported that calcium citrate may absorb better than calcium carbonate (Miller et al., 1988), it has also been reported that there is no difference in absorption (Heaney et al. 1999). Most calcium supplements need to be taken with food in order for stomach acid to be released to help dissolve and absorb the calcium, but calcium citrate can absorb well taken anytime with or without food (NOF, 2008a; Wardlow et al., 2004). Calcium carbonate when taken with food may be as fully absorbable as calcium citrate (Heaney et al., 1999), and calcium absorption from calcium carbonate has been found to be as good as milk (Mortensen & Charles, 1996). Chewable and liquid calcium supplements dissolve well because they are already broken down before entering the stomach (NOF, 2008a). Absorption of calcium decreases as calcium load increases, thus, it is best absorbed when taken with meals in smaller doses (Mortensen & Charles, 1996; NOF, 2008a), around 500-600 mg or less (NOF, 2008a; Wardlow et al., 2004).

Vitamin D aids calcium absorption (Khan et al., 2001; Martin et al., 2004; Mortensen & Charles, 1996; NIH: Office of Dietary Supplements, 2009; NOF, 2008a; Wardlow et al., 2004). It can be obtained by sun exposure (Khan et al., 2001; NIH: Office of Dietary Supplements, 2009; Wardlow et al, 2004) and/or dietary sources. From

dietary sources, vitamin D is mostly obtained by fortification in foods (NIH: Office of Dietary Supplements, 2009), such as most milk which are vitamin D fortified (Nicklas, 2003), and it is often in combination with calcium in supplemental form (Nieves, 2005), but it does not need to be taken at the same time with calcium in order to be effective (NOF, 2008a).

Weight-Bearing Physical Activity, Calcium Consumption, and Bone Health

Weight-bearing physical activity increases calcium absorption (ACSM, 2004; Bass et al., 2007), and the combination of weight-bearing physical activity and calcium is better than either weight-bearing physical activity or calcium consumption alone. Studies on the effects of weight-bearing physical activity and dietary calcium consumption simultaneously and each independently have found that dietary calcium consumption alone aided bone health, weight-bearing physical activity alone also aided bone health, but the combination of weight-bearing physical activity and dietary calcium consumption resulted in the greatest improvements in bone health and strength than either weight-bearing physical activity or dietary calcium consumption alone (Bass et al., 2007; Iuliano-Burns et al., 2003; Welch et al., 2008). Therefore, it is important to promote both weight-bearing physical activity and calcium consumption in order to optimize bone health.

APPENDIX D

INTERVENTION

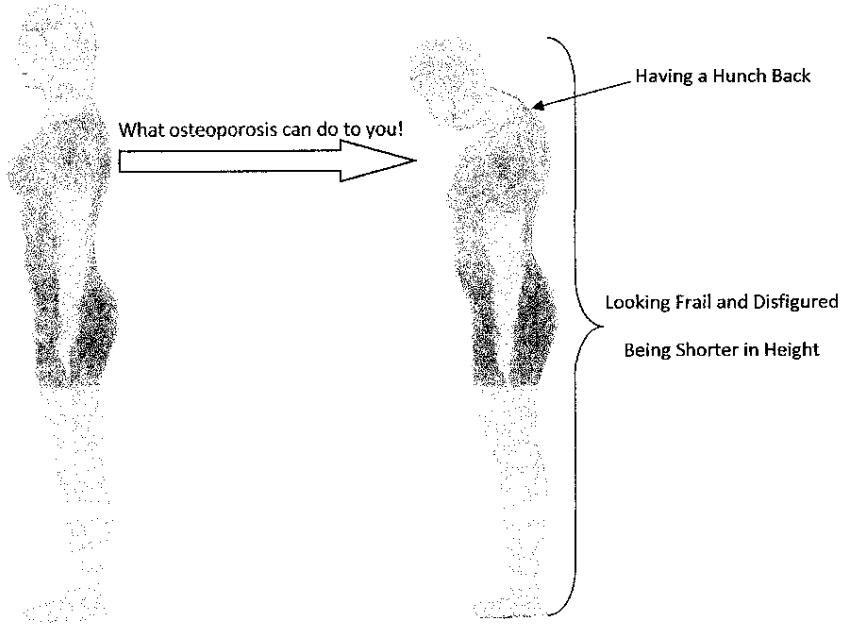
Treatment Intervention: Osteoporosis Prevention Education Intervention

Osteoporosis is a disease in which bones become excessively weak so that they break easily. Osteoporosis can happen to anybody, in both males and females of all races. But it does happen more in females, particularly those of Asian and Caucasian race, and especially those with family history of osteoporosis.

Osteoporosis increases disability and mortality.

Osteoporosis is physically debilitating, and can lead to you to:

- Looking Frail and Disfigured
- Having a Hunch Back
- Being Shorter in Height



Bone strength naturally starts to decrease in your 30's, resulting in weaker bones that can lead to osteoporosis.

Exercise and Calcium can strengthen your bones and prevent osteoporosis, especially when done before 30 years of age.

Types of Exercise you could do:

- Activities that are weight-bearing and/or involve jumping, 3-5 times per week:
  - examples: jogging, stair climbing, tennis, volleyball, basketball
- Resistance exercise, 2-3 times per week:
  - examples: weight lifting, resistance exercise with elastic bands or tubing

Good sources of Calcium (Adequate Intake: 1,000-1,200 mg per day):

- Calcium-rich foods:
  - examples: dairy products (milk, cheese), leafy greens (kale, collard, turnip, mustard greens), broccoli, sardines, canned salmon, tofu, calcium-fortified foods (orange juice, breakfast bars, etc.)
- Calcium supplements:
  - examples: calcium pills, chewable and liquid calcium supplements

Osteoporosis Prevention Quiz

Osteoporosis Prevention Quiz Name: _____

True or False: Osteoporosis can happen to anybody.

Osteoporosis is physically debilitating, and can lead you to:

_____

_____

_____

Building bone strength to prevent osteoporosis is best done before _____ years of age.

To do resistance exercise, one can do weight lifting, and/or resistance exercise with _____.

The Adequate Intake of Calcium is _____ to _____ mg per day.

Osteoporosis Prevention Quiz Answer Key

Osteoporosis Prevention Quiz Answer Key Name: _____

True or False: Osteoporosis can happen to anybody.
True

Osteoporosis is physically debilitating, and can lead you to:

Looking Frail and Disfigured

Having a Hunch Back

Being Shorter in Height

Building bone strength to prevent osteoporosis is best done before 30 years of age.

To do resistance exercise, one can do weight lifting, and/or resistance exercise with elastic bands or tubing.

The Adequate Intake of Calcium is 1,000 to 1,200 mg per day.

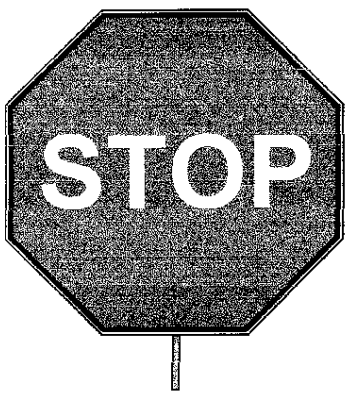
Control Intervention: Stress Management Intervention

Stress is what you feel when you are going through things that are more than you are used to dealing with. Some stress is normal, and it can even be useful and help you work harder at things.

But when stress happens too often and/or lasts too long, it can have negative effects like

- Upset stomach
- Back pain
- Trouble sleeping
- Weaken your immune system
- Make you moody, tense, or depressed
- May hurt your relationships
- May hurt your work or school

Learn how to



And turn to

Thankfully, you CAN learn ways to help manage your stress. To help control your stress:

- Find out what's causing your stress
- Learn healthy ways to reduce or relieve stress

Sometimes, what's causing your stress is clear, but at times it's not. You may want to keep a stress journal. By writing down things that makes you feel stressed, how you reacted to the stress and dealt with the stress, it can help you find out what's causing your stress and much of it you feel. This may help you take steps to better manage or relieve stress.

How to avoid or relieve stress:

- Find ways to cope (look at how you deal with stress, think about what works and doesn't and how to make them work better)
- Learn ways to better manage your time (make a schedule, prioritize)
- Take care of yourself (get plenty of rest, eat well, don't smoke, limit alcohol consumption)
- Try to stop worrying, let go of things you cannot change
- Communicate and express your thoughts with family and friends, or even a counselor
- Do something that you find enjoyable (a hobby, volunteering)
- Learn ways to relax (physical activity, breathing deeply, massage, aromatherapy, yoga, tai chi)
- Focus on the present (meditation, imagination, listen to relaxing music, look to humor and things that make you laugh)

Stress Management Quiz

Stress Management Quiz Name: _____

True or False: Stress is what you feel when you are going through things that are more than you are used to dealing with.

When stress happens too often and/or lasts too long, it can have negative effects. Give 3 examples.

_____

_____

_____

Sometimes, what's causing your stress is clear, but at times it's not.
You may want to keep a stress _____.

Give 3 examples of ways to avoid or relieve stress.

_____

_____

_____

Stress Management Quiz Answer Key

Stress Management Quiz Answer Key Name: _____

True or False: Stress is what you feel when you are going through things that are more than you are used to dealing with.
True

When stress happens too often and/or lasts too long, it can have negative effects. Give 3 examples.

Any 3 of the following: Upset stomach, Back pain, Trouble sleeping, Weaken your immune system; Make you moody, tense, or depressed; May hurt your relationships, May hurt your work or school

Sometimes, what's causing your stress is clear, but at times it's not.
You may want to keep a stress _____journal_____.

Give 3 examples of ways to avoid or relieve stress.

Any 3 of the following: Find ways to cope (look at how you deal with stress, think about what works and doesn't and how to make them work better), Learn ways to better manage your time (make a schedule, prioritize), Take care of yourself (get plenty of rest, eat well, don't smoke, limit alcohol consumption); Try to stop worrying, let go of things you cannot change; Communicate and express your thoughts with family and friends, or even a counselor ; Do something that you find enjoyable (a hobby, volunteering), Learn ways to relax (physical activity, breathing deeply, massage, aromatherapy, yoga, tai chi), Focus on the present (meditation, imagination, listen to relaxing music, look to humor and things that make you laugh)

APPENDIX E

INSTRUMENTATION

Written Letter of Consent without Signature

Dear Participant,

I am conducting this research study as part of my Dissertation in the Health Education and Promotion program at the University of Missouri. The purpose of this research study is to gain a better understanding of college students' opinions and behaviors on osteoporosis.

Participation in this research study is voluntary. If you choose to participate in this research study, there are no foreseen risks to you in participating, and the data collected from your participation on your opinions and behaviors on osteoporosis will help in promoting osteoporosis prevention by allowing Health Educators/Health Promotion Specialists to make better recommendations for individual and public health programs aimed to prevent the disease. Data on your opinions may also be used by the survey developers in order to do reliability and validity testing for their surveys, but any information that would identify you would be omitted.

If you choose to participate, please fill out your Demographic Information, answer the items to the survey that is attached, and turn them in. At the end of class you will receive an envelope containing a handout that is health-related. Two weeks from today, there will be another survey, and a short, 8-question quiz on the health-related handout you received. In addition, all of those who score the highest on their 8-question quizzes will have their names entered into a drawing to win 1 out of 30 $10 gift cards to Walmart.

You have been randomly assigned to receive different health-related handouts. You may also notice that your names are already on the envelopes containing your health-related handouts. This is only to keep track of who received which particular health-related handout and to give the appropriate health-related quiz 2 weeks from now.

If you choose to participate, for the sake of this research study, please do not share the information on your health-related handout with anyone else until the end of this research study, because it may ruin this research study. If you discuss the information on your health-related handout with anyone else, the data collected in this research study may not be useful in making recommendations for preventing osteoporosis. After this research study is complete (two weeks from now), all participants will be informed on the purpose of the health-related handout they received.

Because this study involves research with human participants, approval from the Campus Institutional Review Board (IRB) was attained. If you have questions regarding research with human subjects, you may contact the Campus IRB at (573) 882-9585. You may also contact me if you have certain questions regarding this research study at vhne9a@mail.mizzou.edu. I may be able to answer some questions related to this study, but if you have questions that may affect the outcome of this study, I will be able to answer them at the end of the study.

Thank you for your participation.

Sincerely,
Vu H. Nguyen (Ph.D. Candidate in Health Education and Promotion)

Student Investigator:
Vu H. Nguyen
vhne9a@mail.mizzou.edu

Academic Advisor:
Alexander C. Waigandt, Ph.D., CHES
Program Director of Health Education and Promotion
Certified Health Education Specialist
Office #: (573) 882-4741

Demographic Information

Demographic Information

Gender:
a. Male
b. Female

Age: _____

Ethnicity:
a. Caucasian
b. African American
c. Hispanic
d. Asian
e. American Indian
f. Other

Education Level:
a. Freshman
b. Sophomore
c. Junior
d. Senior
e. Graduate

Academic Program: _____

Letter of Permission to Use the Osteoporosis Health Belief Scale and Osteoporosis Self-Efficacy Scale

GRAND VALLEY STATE UNIVERSITY

www.gvsu.edu

March 26, 2009

Vu Nguyen
[redacted]
Columbia, MO 65203

Dear Vu Nguyen,

Thank you for your interest in the Osteoporosis Health Belief Scale (OHBS), Osteoporosis Knowledge Test (OKT), Osteoporosis Self-Efficacy Scale-21(OSES) and Osteoporosis Self-Efficacy Scale-12 (OSES). You have my permission to use the instruments. Please keep us informed of any publications and/or presentations and send us an abstract or summarize your study results when completed.

I wish you much success with your study.

Sincerely,

Phyllis Gendler

Phyllis Gendler, PhD, RN, NP
Professor
Cook-DeVos Center for Health Science
Kirkhof College of Nursing
Grand Valley State University
301 Michigan St. NE
Grand Rapids, MI 49503

Phone: 616-331-7161
Fax: 616-331-7362
E-mail: gendlerp@gvsu.edu

Osteoporosis Health Belief Scale

Osteoporosis Health Belief Scale: Page 1.

ID NO: _____

OSTEOPOROSIS HEALTH BELIEF SCALE

Osteoporosis (os-te-o-po-ro-sis) is a condition in which the bones become excessively thin (porous) and weak so that they are fracture prone (they break easily).

Below are some questions about your beliefs about osteoporosis. There are no right or wrong answers. We all have different experiences which will influence how we feel. After reading each statement, circle if you STRONGLY DISAGREE, DISAGREE, are NEUTRAL, AGREE, or STRONGLY AGREE with the statement.

It is important that you answer according to your actual beliefs and not according to how you feel you should believe or how you think we want you to believe. We need the answers that best explain how you feel.

Read each statement. Circle one best option that explains what you believe.

SD = STRONGLY DISAGREE

D = DISAGREE

N = NEUTRAL

A = AGREE

SA = STRONGLY AGREE

SD D N A SA	1. Your chances of getting osteoporosis are high.
SD D N A SA	2. Because of your body build, you are more likely to develop osteoporosis.
SD D N A SA	3. It is extremely likely that you will get osteoporosis.
SD D N A SA	4. There is a good chance that you will get osteoporosis.
SD D N A SA	5. You are more likely than the average person to get osteoporosis.
SD D N A SA	6. Your family history makes it more likely that you will get osteoporosis.
SD D N A SA	7. The thought of having osteoporosis scares you.
SD D N A SA	8. If you had osteoporosis you would be crippled.

Osteoporosis Health Belief Scale: Page 2.

SD = STRONGLY DISAGREE

D = DISAGREE

N = NEUTRAL

A = AGREE

SA = STRONGLY AGREE

SD D N A SA	9. Your feelings about yourself would change if you got osteoporosis.
SD D N A SA	10. It would be very costly if you got osteoporosis.
SD D N A SA	11. When you think about osteoporosis you get depressed.
SD D N A SA	12. It would be very serious if you got osteoporosis.
SD D N A SA	13. Regular exercise prevents problems that would happen from osteoporosis.
SD D N A SA	14. You feel better when you exercise to prevent osteoporosis.
SD D N A SA	15. Regular exercise helps to build strong bones.
SD D N A SA	16. Exercising to prevent osteoporosis also improves the way your body looks.
SD D N A SA	17. Regular exercise cuts down the chances of broken bones.
SD D N A SA	18. You feel good about yourself when you exercise to prevent osteoporosis.

For the following 6 questions, "taking in enough calcium" means taking enough calcium by eating calcium rich foods and/or taking calcium supplements.

SD D N A SA	19. Taking in <u>enough calcium</u> prevents problems from osteoporosis.
SD D N A SA	20. You have lots to gain from taking in <u>enough calcium</u> to prevent osteoporosis.
SD D N A SA	21. Taking in <u>enough calcium</u> prevents painful osteoporosis.
SD D N A SA	22. You would not worry as much about osteoporosis if you took in <u>enough calcium</u>.
SD D N A SA	23. Taking in <u>enough calcium</u> cuts down on your chances of broken bones.
SD D N A SA	24. You feel good about yourself when you take in <u>enough calcium</u> to prevent osteoporosis.

Osteoporosis Health Belief Scale: Page 3.

SD = STRONGLY DISAGREE

D = DISAGREE

N = NEUTRAL

A = AGREE

SA = STRONGLY AGREE

SD D N A SA	25. You feel like you are not strong enough to exercise regularly.
SD D N A SA	26. You have no place where you can exercise
SD D N A SA	27. Your spouse or family discourages you from exercising.
SD D N A SA	28. Exercising regularly would mean starting a new habit which is hard for you to do.
SD D N A SA	29. Exercising regularly makes you uncomfortable.
SD D N A SA	30. Exercising regularly upsets your every day routine.
SD D N A SA	31. Calcium rich foods cost too much.
SD D N A SA	32. Calcium rich foods do not agree with you.
SD D N A SA	33. You do not like calcium rich foods.
SD D N A SA	34. Eating calcium rich foods means changing your diet which is hard to do.
SD D N A SA	35. In order to eat more calcium rich foods you have to give up other foods that you like.
SD D N A SA	36. Calcium rich foods have too much cholesterol
SD D N A SA	37. You eat a well-balanced diet.
SD D N A SA	38. You look for new information related to health.
SD D N A SA	39. Keeping healthy is very important for you.
SD D N A SA	40. You try to discover health problems early.
SD D N A SA	41. You have a regular health check-up even when you are not sick.
SD D N A SA	42. You follow recommendations to keep you healthy.

Please check to see that you have answered all items.

Osteoporosis Self-Efficacy Scale

Osteoporosis Self-Efficacy Scale: Page 1.

ID NO: _____

OSTEOPOROSIS SELF-EFFICACY SCALE

We are interested in learning how confident you feel about doing the following activities. Everyone has different experiences which will make each person more or less confident in doing the following things. Thus, there are no right or wrong answers to this questionnaire. It is your opinion that is important. In this questionnaire, EXERCISE means activities such as walking, swimming, golfing, biking, aerobic dancing.

Place your "X" anywhere on the answer line that you feel best describes your confidence level.

If it were recommended that you do any of the following THIS WEEK, how confident or certain would you be that you could:

1. begin a new or different exercise program

Not at all Confident |————————————————————| Very confident

2. change your exercise habits

Not at all confident |————————————————————| Very confident

3. put forth the effort required to exercise

Not at all confident |————————————————————| Very confident

4. do exercises even if they are difficult

Not at all confident |————————————————————| Very confident

5. exercise for the appropriate length of time

Not at all confident |————————————————————| Very confident

6. do the type of exercises that you are supposed to do

Not at all confident |————————————————————| Very confident

Osteoporosis Self-Efficacy Scale -12 (OSES) 1

Osteoporosis Self-Efficacy Scale: Page 2.

If it were recommended that you do any of the following THIS WEEK, how confident or certain would you be that you could::

7. increase your calcium intake

Not at all confident |———————————————————————| Very confident

8. change your diet to include more calcium rich foods

Not at all confident |———————————————————————| Very confident

9. eat calcium rich foods as often as you are supposed to do

Not at all confident |———————————————————————| Very confident

10. select appropriate foods to increase your calcium intake

Not at all confident |———————————————————————| Very confident

11. stick to a diet which gives an adequate amount of calcium

Not at all confident |———————————————————————| Very confident

12. obtain foods that give an adequate amount of calcium even when they are not readily available

Not at all confident |———————————————————————| Very confident

Exercise and Calcium Behaviors Scale

EXERCISE AND CALCIUM BEHAVIORS SCALE

Please fill in the circle to how often you do the following types of exercise:

	Never	1 time a week	2 times a week	3 times a week	4 times a week	5 or more times a week
1. I do exercise that is weight-bearing and/or involves jumping (such as jogging, stair climbing, tennis, volleyball, basketball)	O	O	O	O	O	O
2. I do resistance exercise (such as weight lifting)	O	O	O	O	O	O

Please fill in the circle to how often you eat the following foods:

	Never	Less than once a month	1-3 times a month	Once a week	2-4 times a week	5-6 times a week	Once a day	2-3 times a day	4 or more times a day
3. I eat dairy products (such as milk and cheese)	O	O	O	O	O	O	O	O	O
4. I eat broccoli and/or leafy greens (such as kale, collard, turnip, mustard greens)	O	O	O	O	O	O	O	O	O
5. I eat sardines and/or canned salmon	O	O	O	O	O	O	O	O	O
6. I eat tofu	O	O	O	O	O	O	O	O	O
7. I eat calcium-fortified foods (such as calcium-fortified orange juice and breakfast bars)	O	O	O	O	O	O	O	O	O
8. I take calcium supplements (such as calcium pills)	O	O	O	O	O	O	O	O	O

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VITA

Vu H. Nguyen was born and raised in Columbia, Missouri. He earned his Bachelor of Science (Nutrition & Fitness), Graduate Certificate in Public Health, and Master of Education (Health Education and Promotion), all from the University of Missouri. This dissertation was in partial fulfillment of the requirements for earning his Doctor of Philosophy (Health Education and Promotion) at the University of Missouri.