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The Effects Of Carbonated Soft Drinks On Bone Mineral Density In College Age Women

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THE EFFECTS OF CARBONATED SOFT DRINKS ON

BONE MINERAL DENSITY IN COLLEGE AGE WOMEN

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ABSTRACT

Osteoporosis is a fast growing, worldwide public health problem. Also called, 'the silent disease' or 'fragile bone disease', osteoporosis results from low bone mass (Gammage & Klentrou, 2011; NOF, 2013; Swann, 2012). Currently, 44 million Americans have osteoporosis; 80% of which are women (NOF, 2011).

Few studies, most implemented in other countries, have been conducted examining the consumption of carbonated soft drinks (CSD) as a risk factor for low bone mineral density (BMD) (Ogur et al., 2007; Hostmark et al., 2011; McGartland et al., 2003). The global consumption of CSDs increased by four percent during 2009 to 2010. Within the US, 84% of American adolescents consume CSDs daily (Ratnayake & Ekanayake, 2012). The effect CSDs have on bone mineral density (BMD) may be of concern in the development of osteoporosis and related fractures (Danyliw et al., 2011). Therefore the purpose of this study was to investigate the relationship of CSD consumption and BMD.

Eighty 18-24 year old female college students participated in this study. Participants completed questionnaires regarding osteoporosis risk factors, oesteoporosis knowledge and health beliefs, physical activity, and CSD intake. Participants were also scanned for femur neck, total femur, and lumbar spine BMD using dual energy X-ray absorptiometry (DXA).

Data were analyzed to determine the relationship between CSDs and BMD. Simple descriptive statistics were used to provide overall characteristics of the sample. Correlations and/or Chi Square assessed relationship between variables.

No significant relationship was observed between BMD and CSD consumption, daily dairy intake, exercise, or knowledge of or health beliefs regarding osteoporosis ($p < 0.05$). Results from this study lead to the conclusion that CSDs do not alter BMD in young women.

LIST OF ABBREVIATIONS

Bone Mineral Density	(BMD)
Carbonated Soft Drinks	(CSDs)
Dual energy X-ray absorptiometry	(DXA)
Osteoporosis Health Belief Scales	(OHBS)
Osteoporosis Knowledge Test	(OKT)
Osteoporosis Risk Factor Assessment	(ORFA)

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God placed me on this path, beginning with a young lady that I taught in children’s church many years ago. It started with, “Ms Tina, I know this great program perfect for you at Ole Miss…you will love it.” So my journey began. Along this journey I was blessed with three strong, remarkable, and intelligent women, Dr. Bass, Dr. Ford-Wade, and Dr. Valliant, who provided me with support, guidance, and encouragement. Thank-you to Neokyee, my supportative collegue. Thanks to my dad. A very special thanks goes to my wonderful husband, Bobby, who provided encouragement, patience, and pushed me to complete this journey.

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CHAPTER I

INTRODUCTION

Osteoporosis is a fast growing worldwide public health problem. Also called, 'the silent disease' or 'fragile bone disease', osteoporosis results from low bone mass (Gammage & Klentrou, 2011; Swann, 2012). As a result, bones become weak and easily broken. A minor fall may result in a broken bone (NOF, 2013). In the US, there has been a significant increase in childhood bone fractures as well as osteoporosis later in life (NOF, 2013). Currently, 44 million Americans have osteoporosis; 80% of which are women. Twenty percent of postmenopausal women have osteoporosis (NOF, 2013).

The National Osteoporosis Foundation (2013) reports that a broken bone is often the first sign of osteoporosis. Twenty percent of senior citizens who break a hip usually die within one year. Survivors usually require long-term home health care or nursing home care (NOF, 2013). Every twenty seconds someone in the US breaks a bone due to low bone mineral density (BMD) or osteoporosis, resulting in approximately 2.5 million medical office visits per year (NOF Newsletter, 2011). One in two women and one in five men over the age of 50 years will break a bone due to poor bone health (Swann, 2012).

According to the US Surgeon General, treating hospitalized patients for osteoporosis cost $18 billion annually (NOF, 2014). It is estimated that 61.4 million Americans will suffer from osteoporosis and bone related fractures by the year 2020. Currently, an osteoporosis related hip fracture has been projected to cost an American citizen more than $81,000 during their lifetime

(NOF, 2014). Furthermore, the cost of treating osteoporosis will double or perhaps triple by 2040 (NOF, 2014). Additional costs include: time lost from work and inability to live independently (NOF, 2012).

Research has linked genetic determinants as important predictors of bone strength. Genetic determinants include: ancestry, gender and body frame size (Chen et al., 2012; Crespo, et al., 2011; Phillips, 2011). Badenhop-Stevens and Matkovic (2004) agree preventative measures such as implementing appropriate nutrition and weight bearing exercise during childhood may delay or prevent low bone mass. Nutrients essential to build healthy bones include calcium, vitamin D and phosphorous. Essential nutrients are usually obtained through consumption of a healthy diet adequate in all nutrients. Constant practice of preventative behaviors, such as a healthy diet, can increase quality of life and decrease the risk for osteoporosis (Badenhop-Stevens & Matkovic, 2004).

The lower an individual's bone density is the greater their risk of breaking a bone. Osteopenia is when your bone density is lower than normal, yet not low enough to be considered osteoporosis. Osteopenia does not mean osteoporosis will develop but the risk for future development of osteoporosis is increased. According to the National Osteoporosis Foundation (2014) if one's T-score is between –1.0 and –2.5 this is considered osteopenia.

Peak bone mass is the point at which one has developed the most bone they will ever have. Peak bone mass usually occurs between 25 to 30 years old (NOF, 2013). You are building up to peak bone mass during adolescent and early adulthood (Fricke et al. 2010; Gurney & Simmonds, 2007).

During puberty it is essential to implement preventive measures such as a calcium-rich diet along with weight-bearing exercises to increase peak bone mass. Welch and Weaver (2005)

state that impact exercise performed during puberty can enhance skeletal strength. Also, calcium intake of 1300 mg/d, during puberty, results in optimal calcium retention. Gurney and Simmonds (2007) add that achieving peak bone mass can be limited by genetics and negative behaviors.

The effect carbonated soft drinks (CSD) have on BMD may be a concern in the development of osteoporosis and related fractures (Danyliw et al., 2011). The global consumption of CSDs increased by four percent during 2009 to 2010. Within the US, 84% of American adolescents consume CSDs daily (Ratnayake & Ekanayake, 2012). Danyliw, et al. (2011) states between 1980 and 2000, the consumption of CSDs among adolescent Canadians doubled while the intake of milk decreased. Few studies, most implemented in other countries, have been conducted concerning the effects CSDs have on bone mineral density (BMD) (Ogur et al., 2007; Hostmark et al., 2011; McGartland et al., 2003). Therefore the purpose of this study was to investigate the relationship of CSD consumption and BMD.

Statement of the Problem

Despite the fact that osteoporosis is a preventable condition it continues to plague the lives of many postmenopausal women. Research findings are often conflicting concerning osteoporosis risk factors, and bone status. The problem addressed in this study was the relationship of CSDs and BMD. The purpose of this study was to examine the effect carbonated soft drinks has on BMD among college-aged women.

Research Questions

1. Is there a relationship between CSD consumption and dairy intake?
2. Is there a relationship between CSDs consumption and low BMD?

Hypotheses

Null Hypothesis:

Ho1 There is no relationship between CSD consumption and dairy intake.

Ho2 There is no relationship between CSD consumption and BMD.

Significance of the Study

There is a need to extend the presently available body of knowledge concerning the relationship of CSDs and BMD. This is especially true for college age females who have varying lifestyle habits. The importance of increasing the current understanding of the relationship of CSDs, dairy intake, and BMD is evident as women continue to explore their bone health through earlier and more preventative measures.

The results obtained from this study could be used in establishing recommendations for nutrient intakes in college age women for the prevention of bone loss resulting in osteoporosis. Optimistically, the hope is this study will yield results that will help women prevent the occurrence of unnecessary bone loss, which could lead to a fragile future.

Delimitations

The study population was limited to college-aged females aged 18 to 24 year-old currently attending The University of Mississippi.

Limitations

Inherent within this study, as well as other similar investigations, are limitations. The findings, interpretations of these findings, and subsequent discussion resulting from this study should be considered with the knowledge of the limitations described below.

The potential inaccuracy of self-reported data is a limitation in this study. Further limitations of this study include the absence of factors that may influence bone density. These include

childhood nutrition, such as routine intakes of dairy products and nutrient-rich foods, childhood physical activity, smoking, oral contraceptive use, and genetics.

CHAPTER II

REVIEW OF LITERATURE

Osteoporosis is often perceived as an old person's disease. Therefore it has become a global concern among our aging population (Feilder, 2009). Osteoporosis is also known as a geriatric disease with pediatric roots (AAOS, 2010). Osteoporosis means porous bones. It is characterized by low bone mass and microachitectural deterioration of bone tissue (Reventlow et al., 2001). Healthy bones look like honeycombs when examined under a microscope. In osteoprotic bones, the holes and spaces within the honeycomb are much larger (NOF, 2014). Furthermore, osteoporosis is treatable through drug therapies and lifestyle changes.

According to Stone (2012) hip fractures among the older population are a major health problem, which needs to be addressed by improving bone health. Thirty percent of individuals with hip fractures die within one year. An additional 50% are permanently disabled. It is never too late to improve bone health to decrease bone fractures and osteoporosis (CDC, 2013). Lanham-New et al. (2007) state that maintenance of bone health is essential throughout the life cycle.

Bone strength reflects the integration of bone density and bone strength. Bone density is expressed in volume and is determined by both bone development and bone loss. Bone loss occurs naturally as people age. A person who does not meet optimal peak bone mass during childhood and adolescence might develop osteoporosis without the occurrence of bone loss (National Institute of Health, 2000).

Childhood, Adolescents, and Bone Mineral Density

Poor bone development during childhood and adolescence has been linked to osteoporosis. Research indicates that peak bone mass is obtained during the first three decades of life (NIH, 2000). However, Gurney and Simmonds (2007) argue that peak bone mass occurs from 16 to 18 years old in both boys and girls. Childhood and early adulthood is an excellent time to initiate appropriate nutrition and physical activities and discourage negative behaviors (Chen et al., 2012; Hovell et al., 2008; Schrader, Blue & Horner, 2005). Furthermore, several studies indicate that adequate calcium intake during childhood and adolescent years enhance peak BMD (Badenhop-Stevens & Matkovic, 2004; Chen et al., 2012; Fisher et al., 2000; Lanham-New et al., 2007). The possibility of future low bone mass is set in the late teens and early twenties. Hip fractures at an older age are often related to previous history in maintaining maximum bone density and quality (AAOS, 2009).

An essential hardening ingredient of the bone is calcium, therefore, dietary intake of calcium is a major factor influencing peak bone mass and BMD. The National Diet and Nutrition Survey (NDNS), conducted in the UK, found 24% of girls eleven to fourteen years old and 19% of girls 15 to 18 years old have low intakes of calcium. Twelve percent of boys 11 to 14 years old have a low intake of calcium. Nine percent of boys 15 to 18 years old have a low intake of calcium (Lanham-New et al., 2007). Schrader, Blue and Horner (2005) report 9 out of 10 girls and 7 out of 10 boys in the United States do not meet the national calcium recommendation.

Risk Factors

Factors that can influence BMD are both modifiable and unmodifiable. A major unmodifiable factor is genetics. Current literature emphasizes ethnic differences in rate of bone loss and in bone acquisition. Osteoporosis is found to be more prevalent in women who are

Asian and Caucasian. It is less prevalent in African-American and Latino women. Genetics also is the main determinant in the development of optimal peak bone mass, therefore, it is important to know family history concerning osteoporosis (Crespo et al., 2011).

Through modification of controllable factors, one may slow down the onset of osteoporosis (Gurney & Simmonds, 2007). One controllable risk factor is diet, such as consuming adequate amounts of calcium and vitamin D, which are important in the development and maintenance of healthy bones. Although, consuming too much protein, sodium and caffeine are negative factors (Supplee et al., 2010).

Being sedentary is also a controllable risk factor. Additional controllable factors include smoking, alcohol consumption, and being underweight (Czecelewski et al., 2013; Gurney & Simmonds, 2007; Lanham-New et al., 2007; Supplee et al., 2010; Swann, 2012). Lower BMD values have also been reported in women who had taken oral contraceptives when compared with to women who had not taken oral contraceptives (Crespo et al., 2011). Oral contraceptives may compromise bone mass accrual. These negative risk factors are often the center of the lifestyle among college students.

Exercise

There is a strong relationship between regular exercise and increased BMD. Weight bearing exercises, which have been shown to enhance bone strength, include: low-impact aerobics, jogging, tennis, walking, dancing and strength training with weights (CDC, 2014; Chan & Ko, 2006). However, Gurney and Simmonds (2007) report that girls who are fifteen years old do not meet the national exercise requirements of 30 minutes of physical activity five times per week. Weight-bearing exercises and activities are beneficial to the skeleton. Lanham-New et al. (2007) stated that clarification is needed concerning the exact type, duration, and intensity

needed to achieve optional bone mass. Gammage et al. (2011) states that exercise increases an individual's self-confidence through mastery of skills in strength training and sports related activities. Exercise has numerous health benefits including slowing the decline of BMD (NIH, 2000).

Nutrition

In the absence of intervention, osteoporosis is expected to double or triple within the next 30 years because of unhealthy lifestyles and longevity. Lifestyle and environmental factors contribute 20% to 40% of bone mass. Nutrition is an important factor, which affects BMD throughout the life span (Hovell, et al., 2008).

Protein intake is critical to maintaining bone health. Insufficient protein intake is detrimental on bones. Beasley et al. (2010) conducted research concerning protein and BMD. Bone mineral density was measured semiannually, using dual energy X-ray absorptiometry (DXA). A food frequency questionnaire (FFQ) was also implemented. Weight-bearing physical activities were reported through a questionnaire and in-person interviews. Beasley's study suggests the source of protein is improtant in bone health. Animal protein was found to have a negative effect on bones. Beasley also reported that higher protein diets may increase urinary calcium excretion, resulting in reduced calcium availability to the bones (Beasley et al., 2010).

It is essential for individuals to become aware of the importance that vitamin D and calcium have on bone health (Lanham-New et al., 2007). Calcium and vitamin D are two of the major bone forming nutrients. An adequate supply of calcium, along with vitamin D is essential at all stages of life for a strong skeleton (Swann, 2012).

The National Osteoporosis Newsletter (2011), reports that individuals under the age of 70 years old should consume 600 IU of vitamin D daily. Individuals 70 years old and older should

consume 800 IU of vitamin D daily. There is evidence that even a mild vitamin D insufficiency can have detrimental effect on bone mineral density, especially among adolescent females (The National Osteoporosis Newsletter, 2011; Lanham-New et al., 2007).

Two important sources of vitamin D are sunlight (endogenous) and diet (exogenous) (Lanham-New et al., 2007). Sunlight, UV exposure, converts 7-dehydrocholesterol, to pre-vitamin D. It is then metabolized in the liver and kidneys to the active form of vitamin D (Lanham-New et al., 2007). Ten minutes of sun exposure daily, without sunscreen, is sufficient to meet the requirements of vitamin D (Swann, 2012). Chan and Ko (2006) disagree with Swann. Chan & Ko (2006) state 10-15 minutes of sun exposure to the hands, arms and face, three times per week is sufficient to meet the requirements of vitamin D.

Larson et al. (2006) report male adolescents have a higher intake of calcium than females. Both males and females reported their calcium intake was positively related to eating breakfast, availability of milk at meals, taste preference for milk, higher socioeconomic status, personal health and nutrition attitudes, and self-efficacy to make healthy choices. Cluskey et al. (2008) agrees that calcium intake among adolescents is associated with availability of milk with meals.

The Academy of Nutrition and Dietetics (2013) recommend a daily dairy product intake of three servings per day. Additional calcium sources are: milk, yogurt, cheese, sardines, calcium-fortified juices and cereals.

Children and young adolescent females often model their mother's health behaviors. Mothers who are concerned about healthy lifestyles have daughters who model healthy lifestyles such as intake of milk along with protein intake. Furthermore, Fisher et al. (2000) agree with Cluskey et al. (2008) that daughters often copy their mother's health behaviors in both nutrition and exercise. Fisher et al. (2000) also state that mothers who consume milk more frequently have

daughters who consume less CSDs. Daughters may learn to imitate their mothers beverage intake patterns through repeated modeling. A mother's beverage choice may exert a formative environmental influence on their daughters' intake of calcium or CSDs.

Smoking and Alcohol

Smoking and excessive alcohol consumption may lead to low bone mass resulting in an increase in risk of bone fractures (Czecelewski et al., 2013; Gurney & Simmonds, 2007; Lanham-New et al., 2007; Supplee et al., 2010; and Swann, 2012). Excessive consumption of alcohol (three or more drinks daily) and smoking among women has been shown to decrease BMD (NOF 2013,b).

According to Turner (2000) chronic alcohol consumption contributes to lower BMD and a higher risk for bone fracture. Monahan et al. (2012) states college students consume more alcohol than other adults. Approximately 80% of college students consume alcohol.

Butler et al., 2011 report that half of the students who consume alcohol also use cigarettes, while Wyshak and Frisch (1994) report the proportion of smokers among adolescent boys is 4% compared to 16% adolescent girls. According to Stone (2012), smoking is an independent risk factor for low BMD and smoking may have negative effects on peak bone mass during adolescence (NOF 2013,b; Stone, 2012). Research also reflects that older individuals who smoke double their risk for hip fractures (Stone, 2012).

Carbonated Soft Drinks

The global consumption of CSDs increased by 4% from 2009 to 2010. During 2010 the highest growth in the marketing of CSDs was observed in Asia (Ratnayake & Ekanayake, 2012). However, Hostmark, et al. (2011) report Norway has the highest consumption of CSDs in the world. Between 1980 and 2000, the consumption of CSDs among adolescent Canadians doubled

while the intake of milk decreased (Danyliw et al., 2011). Within the United States, 84% of American adolescents consume CSDs daily (Ratnayake & Ekanayake, 2012). Wyshak (2000) reported that nearly two thirds of high school girls consume CSDs. Teenage girls have doubled their consumption of CSDs and decreased their milk consumption by 40% or more (Wyshak, 2000). Research has been conducted with both rats and humans to determine what affect consumption of CSDs has on BMD (Molina-Perez et al., 2000; Ogur et al., 2007; Teofilo et al., 2010). Several researchers suggest intake of CSDs as a possible risk for lower peak bone mass (Danyliw et al., 2011; Hostmark, et al., 2011; Supplee, et al., 2010).

Ogur et al. (2007) conducted a 30-day study on Sprague-Dawley rats to assess the effect of CSDs on BMD. Results indicated the rats, which consumed CSDs, experienced bone erosion whereas the rats that did not consume CSDs did not. Teofilo et al., (2010) agree with Ogur et al. (2007) that there is an association between excessive consumption of CSDs and bone metabolism disorders. Teolilo et al. (2010) found that after tooth extractions, bone healing decreased by 25.75% in rats that consumed CSDs.

In Norway, CSD consumption has increased rapidly from 1959 and 2002. Hostmark et al. (2011) conducted The Oslo Health Study (HUBRO), which had an osteoporosis substudy component. Participants included 2,690 women age 59 years, who participated in the study during 1981. BMD of the nondominant forearm was assessed. They answered questions concerning intake frequency of food items, including CSDs, milk, fruit and vegetables. Results of the study indicated that CSDs were negatively associated with distal forearm BMD. They concluded that by decreasing the consumption of CSDs the risks for developing osteoporosis and related bone fractures may also decrease (Hostmark et al., 2011).

Tucker et al. (2006) conducted the Framingham Osteoporosis Study drawing from the Framingham Offspring Cohort. Participants included 1,125 men and 1,413 women. Bone mineral density of the right hip and lumbar spine was measured using DXA. A food frequency questionnaire was implemented to assess intakes of foods and nutrients. Results showed a consistent association with CSD consumption and low BMD in women. Regular consumers of CSDs had lower intakes of calcium than non-consumers of CSDs. Hostmark et al. (2011), Tucker et al. (2006) and Wyshak (2000) agree that CSDs have a negative affect on BMD.

Cultural differences also impact CSD consumption (Supplee et al., 2010). The research investigated the relationship of CSD consumption and osteoporosis risk among American-Indian women in the Northern Plains of Alaska. Carbonated soft drinks are in the top contributors of energy intake among this population, with milk being listed as fifth. Milk is part of the secondary food source among the population of American-Indians. However, no association was found between CSD consumption and BMD or the risk for osteopporosis (Supplee et al., 2010).

Consumption of carbonated soft drinks is popular among adolescents in European countries. McGartland et al. (2003) conducted The Young Hearts 2000 (YH2000) study in Ireland. BMD was measured by DXA of the non-dominant forearm and dominant heel in both girls and boys aged 12 and 15 years old. Included were 2,017 participants. Results showed that girls had an inverse relationship between heel BMD and consumption of CSDs. There was no significant relationship in boys concerning CSDs intake and BMD. However, the boys consumed more milk than girls and boys participated in more physical activities. This study supports Wyshak (2000) findings that consumption of CSDs was associated with bone fractures in physically active girls.

Libuda et al. (2008) agree that appropriate lifestyle, with an emphasis on an adequate diet, beginning in childhood, is necessary in the prevention of osteoporosis. They conducted a four-year longitudinal study to examine the relationship between long-term consumption of a variety of CSDs and variables of bone modeling and remodeling among German children and adolescents. Measurements of the non-dominant forearm for muscle and bone variables were measured by peripheral quantitative computer tomography (pQCT). Their findings suggest that the consumption of CSDs is negatively associated with indices of bone modeling and remodeling. Catabolic effects of bone appeared in both boys and girls with long-term consumption of carbonated soft drinks (Libuda et al., 2008).

Nowson (2006) addressed the issue of consumption of CSDs and the effect on bone during adolescence in Australia. Nowson (2006) reports a possibility that adolescents that consume CSDs have a displacement of milk-based drinks along with low levels of physical activity. Nowson suggests that it is not the CSDs but other behaviors including lack of calcium and exercise, which effects adolescence bones (Nowson, 2006).

Kim, Morton and Barrett-Conner (1997) examined the lifetime and current intake effects of CSDs on BMD, among older Caucasian females residing in Rancho Bernardo, California. Participants included 1,000 Caucasian ambulatory females 44 to 98 years old, residing in middle to upper class community. "Ever drinkers" were defined as those who consumed CSDs daily for a year or longer. "Current drinkers" were defined as those who drank at least one serving of CSDs per day. All other participants were classified as nondrinkers or occasional drinkers. Participants had their BMD levels checked at the hip and lumbar spine with a dual energy x-ray absorptiometry. Participants completed self-administered, standardized questionnaires concerning their medical history and lifestyle. The content included alcohol consumption,

smoking, exercise, use of medication, and consumption of CSDs. Results showed no significant association in BMD levels and CSD consumption among "ever drinkers". Current drinkers who consumed one serving per day and those who consumed 2 to 5 servings per day also showed no association between CSD intake and BMD levels. There was also no significant association found in BMD levels and consumption of CSDs among 625 postmenopausal women who did not take estrogen. Overall, there was no significant association between lifetime or current CSD drinkers and BMD levels. The authors concluded there was no effect of moderate intake of CSDs and BMD levels in older women (Kim, Morton & Barrett-Conner, 1997).

Health Belief Model & Osteoporosis Health Belief Scale

One of the first theories of health behavior is the Health Belief Model (HBM), an expectancy-value model. During the 1950s, at the US Public Health Service, psychologists Rosenstock, Hochbaum, Kegeles, and Leventhal, designed the HBM to understand the failure of screening programs for tuberculosis. The HBM was designed to predict and explain health-related behaviors. The HBM consists of five theoretical dimensions: Susceptibility, seriousness, benefits, barriers, and health motivation (Glanz, Rimer, & Lewin, 2002).

There are a few studies (Edmonds, et al., 2012; Endicott, 2013; Turner, BiBrezzo & Jones, 2004) which have concentrated on the use of the Health Belief Model and osteoporosis. Kim, Horan, Gendler, and Patel (1991) conducted a study to develop and evaluate The Osteoporosis Health Belief Scale (OHBS), based on the five theoretical dimensions or constructs of the HBM.

Kim et al. added the subscales exercise benefits, exercise barriers, calcium benefits and calcium barriers to examine the participant's health beliefs about developing osteoporosis by investigating the beliefs associated with exercise and calcium intake. The OHBS instrument was

tested on 150 individuals, 60 years or older, recruited from one large senior residential apartment complex and four senior centers. Not only did this study result in the development of a valid and reliable instrument for assessing beliefs regarding osteoporosis, they also found that barriers and health motivation are important in understanding calcium intake and exercise behaviors (Kim, Horan, Gendler, & Patel, 1991).

Based on the HBM, Endicott (2013) conducted a study to determine if family history of osteoporosis has an impact among women. Participants completed surveys measuring knowledge, health beliefs, and self-efficacy related to osteoporosis. Women with a family history of osteoporosis perceived a greater susceptibility for developing osteoporosis. There was no difference in knowledge of osteoporosis between women with a family history of osteoporosis and women without a family history of osteoporosis. However, research indicates women with a family history of osteoporosis have almost double the risk of developing osteoporosis (Endicott, 2013).

Edmonds et al. (2012) conducted a study, based on the HBM, to examine the level of osteoporosis knowledge, beliefs, and calcium intake among college students. Participants included 792 male and female college students ages 17 to 31 years. Instruments utilized included The Osteoporosis Knowledge Test (OKT), Osteoporosis Preventing Behaviors Survey and OHBS. Results indicated participants did not perceive themselves as susceptible to developing osteoporosis. Participants also lack knowledge related to bone health in physical activity and calcium consumption (Edmonds, et al., 2012).

Turner, Hunt, DiBrezzo, and Jones (2004) designed The Osteoporosis Prevention Program. The program followed the components of the HBM. Participants included 342 women, which completed the entire program. The three components consisted of educational classes,

bone mineral density testing and individualized consultation. The educational classes offered four classes designed to promote bone health and to promote healthy lifestyle modifications. Each participant received a bone mineral density testing, using DXA technology, of the spine, left hip, and total body. Participants received an individual consultation immediately after the bone density exam. Participants had an individualized physical activity program developed according to their bone density level and their activity preferences. Turner et al. examined the process evaluation of The Osteoporosis Prevention Program. They concluded that use of the HBM benefitted the focus on perceived barriers, perceived susceptibiity and percieved severity, therefore, enhancing strategies for preventing osteoporosis.

Summary

Low BMD and osteoporosis are health conditions commonly seen in the US. The influences of gender, body composition, genetics, physical activity, and nutrition have been well established. Lifestyle factors including consumption of CSDs, smoking and alcohol use have been investigated with conflicting results. It is essential to place emphasis toward more research on the effect CSDs have on BMD, especially among collage age women, since research suggest that their present college lifestyle often translates to their future lifestyle. Research studies are needed to investigate the relationship of CSDs with BMD. This study will benefit both individuals at risk and health care professionals.

CHAPTER III

METHODOLOGY

Females generally have lower BMD than males of the same age and loose bone mass more quickly as they age. Between 20 and 80 years of age, the average white female loses one-third of their hip bone density, compared to a loss of only one-fourth in men (NOF, 2013b). The International Osteoporosis Foundation (2013) estimates that osteoporosis affects about 200 million women worldwide. Therefore, this study focused on female participants.

Subjects

For the purpose of this study, only women ages 18 to 24 years were recruited. The purpose of this study was to explore the relationship between CSDs and BMD along with the differences in osteoporosis knowledge and health beliefs among female college students.

Procedure

After approval was gained from the Institutional Review Board of the University of Mississippi (Appendix A), instructors were contacted via e-mail with information concerning the study. Arrangements were made with the instructors in order for the researcher to recruit during class sessions. The researcher went to the designated classes and presented information about the study.

The study protocol was discussed along with the procedures for the dual energy X-ray absorptiometry (DXA) screening. Appointments were scheduled at this time. Participants were provided with a packet of questionnaires to complete and return at their DXA appointment. The researcher sent reminders to the participants, via e-mail, of their DXA screening appointment

and to bring their completed questionnaires. If a participant could not make their appointment, the researcher rescheduled their appointment at their convenience.

Participants brought their completed questionnaires to their DXA screening appointment. Scans were conducted at the Turner Center (Body Composition and Bone Mineral Density Laboratory, rm. 248A). Students who agreed to participate, read and signed the Informed Consent form prior to the scan. DXA scans were preformed and analyzed. Participants were given copies of their results. If their scan showed they had low BMD, participants received a briefing with the researcher, who then advised them to see their family physician and also offered to fax their scans to their physician.

Lumbar spine and total femur were assessed using DXA. Prior to screening, all females underwent a pregnancy test. The DXA technician gave a urine specimen cup to the participant along with directions for urine collection. The technician performed the urine analysis in the Body Composition and Bone Mineral Density Laboratory. If the pregnancy test was positive, the script for positive pregnancy test was read to the participant (Appendix B) and DXA would not be performed.

In preparation for the DXA scan, participants were asked to: 1) sign the Informed Consent, 2) remove all metal objects, including clothing containing metal, 3) have their height and weight measured, with shoes removed, using a standard doctor's scale, 4) lie on the DXA table, 5) a research technician positioned their body on the table, 6) lie still for about 30 seconds during each of two scans (hip and spine).

Survey Instruments

Participants completed five valid and reliable questionnaires: 1) Osteoporosis Risk Factor Assessment (ORFA), 2) Osteoporosis Knowledge Test (OKT), 3) Osteoporosis Health Belief

Scales (OHBS) (Kim, Horan, Gendler, & Patel, 1991), 4) The Bone-specific Physical Activity Questionnaire (Weeks & Beck, 2008), and 5) Beverage Questionnaire (Hedrick et al., 2010). The Osteoporosis Risk Factor Assessment (ORFA) is a 20-item instrument, which inquired participants age, ethnic group, and family history of osteoporosis, childhood milk consumption, current intake of milk and calcium, consumption of alcohol, if you smoke and how long.

The Osteoporosis Knowledge Test consists of 24 items that measure knowledge of osteoporosis (Kim, Horan, Gendler, & Patel 1991). The first part is a list of items that may or may not affect a person's chance of getting osteoporosis. Responses were on a Likert type scale where participants circled if they were more likely, less likely, neutral, or don't know to each statement. The remaining questions were multiple choice and gather knowledge of exercise, and calcium requirements, and calcium sources for the prevention of osteoporosis. The OKT is divied into two subscales: exercise and calcium.The OKT Exercise subscale has a reliability coefficient of $\alpha = .69$ and the OKT Calcium subscale measured at $\alpha = .72$.

The Osteoporosis Health Belief Scale (OHBS) (Kim, Horan, Gendler, & Patel, 1991b) is based on the HBM. The OHBS examined the participant's health beliefs about developing osteoporosis. This scale consisted of 42 statements with the Likert scoring responses that the participant circled if they strongly disagreed, were neutral, agreed, or strongly agreed to the statement. The OHBS consists of 42 items divided into 7 subscales of 6 items each. The subscales include: Susceptibility, seriousness, exercise benefits, exercise barriers, calcium benefits, calcium barriers, and health motivation.

Susceptibility measures the individual's perceived risk of developing osteoporosis. Seriousness is the perception of the threat of having osteoporosis, including harmful

consequences to personal physical health, role and social status, and ability to complete daily living task or desired task (Kim, Horan, Gendler, & Patel, 1991).

Benefits were altered in format to address both exercise and calcium benefits. Benefits of exercise and benefits of calcium assess the individual's belief in the efficacy of specific behaviors for preventing the occurrence of osteoporosis. Benefits of exercise focused on the preventative ability of exercise and the effects of regular exercise on bone health. Benefits of calcium focused on the belief that intake of adequate calcium reduces the risk of osteoporosis (Kim, Horan, Gendler, & Patel, 1991b).

Barriers include the beliefs concerning negative components of behaviors, which might be undertaken to prevent osteoporosis. Barriers to exercise evaluate the individual's mental and physical ability to exercise. Barriers to calcium assess the cost, individual preference, and digestive response to calcium (Kim, Horan, Gendler, & Patel, 1991b).

Health Motivation relates to the tendency for an individual to engage in health behaviors. Individuals are asked to rate their diet, the importance of being healthy, and their practice of obtaining regular check-ups, along with early diagnosis of health problems and following recommendations. Internal consistency of each scale and subscale, including exercise and calcium, were evaluated to establish reliability and validity (Kim, Horan, Gendler, & Patel, 1991b).

Measures for the internal consistency of the OHBS are as follows: susceptibility, $\alpha = 0.82$; seriousness, $\alpha = 0.71$; benefits from exercise, $\alpha = 0.81$; benefits from calcium intake, $\alpha = 0.80$; barriers to exercise, $\alpha = 0.82$; barriers to calcium intake, $\alpha = 0.74$; health motivation, $\alpha = 0.73$.

Using The Bone-Specific Physical Activity Questionnaire (Weeks & Beck, 2008), participants listed sports or other physical activities participated in during the past 12 months and indicated average frequency.

On the Beverage Questionnaire (Hedrick, Comber, Eastbrooks, Savia, & Davy, 2010) participants marked how often they consumed the beverage listed and amount consumed. It took 15 minutes or less for participants to fill out these questionnaires. These five questionnaires can be found in Appendix C.

Data Collection

Data was collected through self-reported questionnaires and DXA scans. Participants were scanned within four weeks of the initial contact. All of the examination data were recorded directly into the SPSS Version 21 (IBM, New York, USA).

Intake of CSDs was obtained from self-reported data collected through the Beverage Questionnaire (Hendrick et al., 2010). Participants provided responses to the following items: indicate how often/frequency you drink CSDs Never or less than one time per week; 1 time per week; 2-3 times per week; 1 time per day; 2+ times per day; 3+ times per day. Less than 6 fluid ounces; 8 fluid ounces; 12 fluid ounces; 16 fluid ounces; 20 fluid ounces. Indicate type of beverage: carbonated soft drink regular; diet carbonated soft drink; caffeine free carbonated soft drink; caffeine free diet carbonated soft drink; carbonated energy drinks (ie, Red Bull, Rock Star and Monster). Total ounces consumed per day were calculated for each participant.

Dairy intake was obtained from self-reported data collected through the ORFA. Questions included: how often do you eat or drink the following foods per week: chocolate milk and hot cocoa, yogurt or frozen yogurt. Total frequency of daily dairy intake was calculated. Participants

were then categorized as adequate consumers (those who consumed 3 or more servings per day), and inadequate consumers (those who consumed less than 3 servings per day).

Dual energy x-ray absorptiometry (DXA) was used to measure bone mineral density of the femoral neck and lumbar spine of non-pregnant participants 18 – 24 years.

Treatment of the Data

The data for this study were analyzed to determine if there was a relationship between CSD consumption and BMD. Influences of osteoporosis knowledge and health belief, as well as exercise and dairy intake, on BMD were also analyzed.

Data Analysis

Simple descriptive statistics were used to provide overall characteristics of the sample. Correlations and/or Chi Square assessed relationship between variables.

CHAPTER IV

RESULTS

The purpose of this study was to investigate the relationship between CSDs and BMD in a convenient sample of college women. The IRB Committee at The University of Mississippi approved this study. Participants completed questionnaires, addressing osteoporosis knowledge, health beliefs, exercise habits, and intake of CSDs. Each participant also received a DXA scan of the hip and lumbar spine.

Description of the Sample

The total sample for this study consisted of 80 women aged 18 to 24 years, who attended The University of Mississippi. Participants' mean age was 20.65 ± 1.28 years. The majority were Caucasian (73.8%), followed by African American (18.8%), Hispanic (3.8%) and Asian (2.5%). The mean height was 64.92 ± 2.28 inches and mean weight 142.84 ± 30.45 pounds. BMI assessments revealed, 27.5 % of the participants were classified as overweight or obese, 68.8 % were classified as healthy, and 3.8 % were underweight. (Table 1).

The use of tobacco and alcohol revealed 5% (n = 4) of the participants were classified as current smokers and 95% (n = 76) were classified as non-smokers. Twenty-five percent (n = 20) of the participants reported consuming the alcohol equivalent to one drink per setting while 31% (n = 25) reported consuming 2 to 3 alcoholic beverages per setting, and 27.6% (n = 22) reported consuming 4 or more alcoholic beverages per setting.

Results of the Osteoporosis Risk Factor Assessment (ORFA) indicated that 96 % (n = 77) of the participants had a menstrual period in the last twelve months. Sixteen percent (n = 13) reported in the past they had been amenorreahic, but only 3 reported not having a menstural period in the past 12 months. Sixty-six percent (n = 53) have taken birth control pills, while 2.5% (n = 2) had a Depo-Provera shot. When asked if your mother or grandmother ever had a diagnosis of osteoporosis, 20% (n = 16) reported yes, 57.5% (n = 46) reported no, and 22.5% (n = 18) reported don't know.

Table 1. Study Population Characteristics (n = 80)

Characteristics	Frequency (n %)	Mean ± SD	Range
Age (years)		20.65 ± 1.28	18 – 24
Ethnic Group			
Asian	2 (2.5 %)		
African-American	15 (18.8 %)		
Caucasian	59 (73.8 %)		
Hispanic	3 (3.8 %)		
Other	1 (1.3 %)		
Weight (pounds)		142.84 ± 30.45	107 – 258
Height (inches)		64.91 ± 2.28	60 – 70.5
Body Mass Index (BMI)			
Underweight	3 (3.8 %)		
Healthy	55 (68.8 %)		
Overweight	14 (17.5 %)		
Obese	8 (10.0 %)		

The Osteoporosis Knowledge Test (OKT) (Kim, Horan, Gendler, & Patel, 1991a) assessed knowledge of osteoporosis and the effects of exercise and calcium intake on BMD. Two questions were omitted due to ambiguity leaving 22 items on the questionnaire, with a possible

score of 22. The OKT results showed a mean score of 13.3 ± 2.65 or 60.45%. Scores for the OKT are reported on Table 2.

Responses to the OKT reflected that only 37.5% (n = 30) of the participants identified that white women with fair skin were more likely to get osteoporosis. Only 18.8% (n = 15) knew that having your ovaries surgically removed, resulted in a greater likelihood of getting osteoporosis. Participants were asked to select the best exercise for reducing the risk for osteoporosis. Forty-five percent (n = 36) answered correctly that walking briskly was more protective of bone health than swimming or performing kitchen chores. Forty-seven percent (n = 38) knew that exercise must be hard enough to make breathing much faster, but talking is possible.

The participants' knowledge of risk factors for low BMD were deficient when asked about calcium sources. Only 43.8% (n = 35) identified canned sardines as a better source of calcium than corn or watermelon. Thirty-one percent (n = 25) did not know that ice cream was a good source of calcium. When asked the recommended amount of calcium intake for an adult, only 16.3% (n = 13) knew adults need 800 mg or more daily. Furthermore, 67.5% (n = 54) did not know how much milk an adult should drink to meet the recommended amount of calcium. Only 32.5% (n = 26) correctly answered 2 or more glasses daily.

The OKT exercise subscale showed a mean score 9.18 ± 2.15 (of a possible 14) and a correlation with the femur neck BMD of $r = -0.033$, $p = 0.777$. The Pearson Correlation showed the total hip BMD and the OKT exercise subscale as also not significant at $r = -0.113$, $p = 0.317$. The lumbar spine and the OKT exercise subscale has a correlation of $r = -0.037$, $p = 0.747$.

Table 2. Responses to the Osteoporosis Knowledge Test (OKT)

Question, *correct response in italics*	# correct	% correct
1. Eating a diet low in milk product, *more likely* to get osteoporosis	66	82.5
2. Being menopausal, *more likely* to get osteoporosis	52	65.0
3. Having big bones, *less likely* to get osteoporosis	40	50.0
5. Have a mother or grandmother who has osteoporosis, *more likely*	73	91.3
6. Being a white woman with fair skin, *more likely* to get osteoporosis	30	37.5
7. Having ovaries surgically removed, *more likely* to get osteoporosis	15	18.8
8. Taking cortisone for long time, *more likely* to get osteoporosis	39	48.8
9. Exercising on a regular basis, *less likely* to get osteoporosis	71	88.8
10. Which exercise is best to reduce risk for osteoporosis, *walking Briskly*	36	45.0
12. How many days a week do you need to exercise to strengthen bones, *3 or more days*	75	93.8
13. Least amount of time to exercise on each occasion to strengthen bones, *20-3- minutes*	63	78.8
14. Exercise must be hard enough to make breathing, *much faster, but talking is possible*	38	47.5
15. Which exercise is best to reduce chance of getting osteoporosis, *jogging or running*	67	83.8
16. Which exercise is best to reduce chance of getting osteoporosis, *aerobic dancing*	70	87.5
17. Which is a good source of calcium, *cheese*	79	98.8
18. Which is a good source of calcium, *canned sardines*	35	43.8
19. Which is a good source of calcium, *broccoli*	43	53.8
20. Which is a good source of calcium, *yogurt*	76	95.0
21. Which is a good source of calcium, *ice cream*	55	68.8
22. What is recommended amount of calcium for an adult, *$\geq$ 800 mg daily*	13	16.3
23. How much milk must adult drink to meet recommended intake, *2 or more glasses daily*	26	32.5
24. Which is best reason for taking calcium supplement, not enough calcium from diet	74	92.5

The OKT calcium subscale revealed a mean of 9.83 ± 2.26 (of a possible 16 items). Pearson Correlation of the femur neck and calcium subscale revealed no signifance relationship (r = -0.125, p = 0.267). Total hip BMD and the OKT calcium subscale also had no significant relationship (r = -0.151, p = 0.180). Pearson correlation showed the lumbar spine BMD and calcium subscale (r = 0.064, p = 0.571). Knowledge of calcium and exercise showed no significant relationship with BMD.

The Osteoporosis Health Belief Scale (OHBS) (Kim, Horan, Gendler, & Patel, 1991b) examined the participant's health beliefs about developing osteoporosis by investigating the beliefs associated with exercise and calcium intake. Possibility for each subscale score range from 6 to 30 points.

Scores for the OHBS (Kim, Horan, Gendler, & Patel, 1991b), are reported in Table 3. According to the results of the susceptibility subscale, participants' scored 15.56 ± 4.37 out of a possible 30 points (51.8%). Participants' reported that 91.3% of them felt that it was not extremely likely they would get osteoporosis. According to the results of the seriousness subscale, participants' scored 17.88 ± 4.44 out of 30 possible points (59.6%). A total of 62.5% (n = 50) disagreed with the statement if you had

osteoporosis, you would be crippled while 76.3% (n = 61) agreed it would be very serious if you got osteoporosis (Table 3.1).

Regarding the benefits of exercise construct, the mean score was 20.70 ± 2.43 (69%). Seventy-seven percent of the participants agreed that regular exercise reduces the risk for broken bones. The mean total barriers of exercise score was 11.04 ± 3.85 (36.8%). Sixty-five percent (n = 52) of the participants disagreed with the statement, "exercising regularly would mean starting a new habit, which is hard for you to do" (Table 3.2).

Table 3.1. Osteoporosis Health Belief Scale: Responses for Questions Regarding Susceptibility and Seriousness of Osteoporosis in College Aged Females

	N = 80 Mean ± SD
Susceptibility (Total score, 30 possible points)	**15.56** ± **4.37**
(individual questions, 5 possible points)	
1. Your chances of getting osteoporosis are high	2.80 ± .82
2. Because of your body build, you are more likely to develop osteoporosis	2.75 ± .97
3. It is extremely likely that you will get osteoporosis	2.31 ± .88
4. There is a good chance that you will get osteoporosis	2.65 ± .96
5. You are more likely than the average person to get osteop	2.54 ± .93
6. Your family history makes it more likely that you will get osteoporosis	2.51 ± 1.14
Seriousness (Total score, 30 possible points)	**17.88** ± **4.44**
(individual questions, 5 possible points)	
7. The thought of having osteoporosis scares you	3.61 ± 1.02
8. If you had osteoporosis you would be crippled	2.34 ± .91
9. Your feelings about yourself would change is you got osteoporosis	2.74 ± 1.17
10. It would be very costly if you got osteoporosis	3.35 ± .98
11. When you think about osteoporosis you get depressed	2.26 ± .88
12. It would be very serious if you got osteoporosis	3.51 ± .28

Table 3.2. Osteoporosis Health Belief Scale: Responses for Questions Regarding Exercise Benefits and Barriers in the Prevention of Osteoporosis in College Aged Females

Exercise	N = 80 Mean ± SD
Benefits (Total score, 30 possible points)	**20.70** ± **2.43**
(individual questions, 5 possible points)	
13. Regular exercise prevents problems that would happen from osteoporosis	4.24 ± .62
14. You feel better when you exercise to prevent osteoporosis	4.16 ± .63
15. Regular exercise helps to build strong bones	4.41 ± .52
16. Exercise to prevent osteoporosis also improves the way your body looks	4.24 ± .62
17. Regular exercise cuts down the chances of broken bones	3.98 ± .76
18. You feel good about yourself when you exercise to prevent osteoporosis	4.09 ± .68
Barriers (Total score, 30 possible points)	**11.04** ± **3.85**
(individual questions, 5 possible points)	
25. You feel like you are not strong enough to exercise regularly	2.11 ± 1.04
26. You have no place where you can exercise	1.65 ± .71
27. Your spouse or family discourages you from exercising	1.38 ± .51
28. Exercising regularly would mean starting a new habit which is hard for you to do	2.28 ± 1.25
29. Exercising regular makes you uncomfortable	1.74 ± .89
30. Exercising regularly upsets your every day routine	1.89 ± 1.00

Table 3.3. Osteoporosis Health Belief Scale: Responses for Questions Regarding Calcium Benefits and Barriers in the Prevention of Osteoporosis in College Aged Females

Calcium	N = 80 Mean ± SD
Benefits (Total score, 30 possible points)	**23.17** ± **2.40**
(individual questions, 5 possible points)	
19. Taking in enough calcium prevents problems from osteop	4.01 ± .63
20. You have lots to gain from taking enough calcium to prevent osteoporosis	4.08 ± .63
21. Taking in enough calcium prevents painful osteoporosis	3.71 ± .73
22. You would not worry as much about osteoporosis if you took in enough calcium	3.70 ± .88
23. Taking in enough calcium cuts down your chances of broken bones	4.00 ± .57
24. You feel good enough about yourself when you take in enough calcium to prevent osteoporosis	3.86 ± .63
Barriers (Total score, 30 possible points)	**12.16** ± **3.40**
(individual questions, 5 possible points)	
31. Calcium-rich foods cost too much	2.01 ± .86
32. Calcium-rich food do not agree with you	2.28 ± 1.12
33. You do not like calcium-rich foods	1.94 ± .83
34. Eating calcium-rich food means changing your diet which is hard to do	1.93 ± .88
35. In order to eat more calcium-rich foods you have to give up other foods that you like	1.85 ± .84
36. Calcium-rich foods have too much cholesterol	2.16 ± .83

Table 3.4. Osteoporosis Health Belief Scale: Responses for Questions Regarding Health Motivation in the Prevention of Osteoporosis in College Aged Females

Health Motivation	N = 80 Mean ± SD
Health Motivation (Total score, 30 possible points)	**22.18** ± **3.46**
(individual questions, 5 possible points)	
37. You eat a well-balanced diet	3.34 ± 1.08
38. You look for new information related to health	3.66 ± .82
39. Keeping healthy is very important to you	4.24 ± .60
40. You try to discover health problems early	3.90 ± .74
41. You have a regular health check-up even when you are not sick	3.25 ± 1.16
42. You follow recommendations to keep you healthy	3.80 ± .77

For the total benefits of calcium construct the mean score was 23.17 ± 2.40 (77.2%). Responses for the statement, "you would not worry as much about osteoporosis if you took in enough calcium" showed 83.8% (n = 66) of the participants agreed. The barriers of calcium mean score was 12.16 ± 3.40 (40.5%) (Table 3.3).

The mean score for health motivation was 22.18 ± 3.46 (73.9%). Eighty-seven percent of the participants reported they eat a well-balanced diet, while only 67.5% (n = 54) felt that keeping healthy was very important. Eighty-six percent (n = 69) reported having a regular health check-up even when they were not sick. Furthermore, 83.8% (n = 67) believed you should follow recommendations to keep you healthy (Table 3.4).

Pearson Correlation was completed between the OKT and OHBS. A small, but significant, relationship was found between osteoporosis knowledge (OKT) and some of the

osteoporosis health beliefs (OHBS, $p < .05$). Correlation of osteoporosis knowledge and beliefs regarding the benefits of exercise showed a positive relationship ($r = 0.36$, $p < 0.05$) while knowledge of calcium benefits showed a negative relationship with knowledge ($r = -0.22$, $p < 0.05$). Furthermore, health motivation had a positive relationship with osteoporosis knowledge ($r = 0.22$, $p < 0.05$). No significant relationship was found between osteoporosis knowledge and the HBM constructs of susceptibility, severity, barriers to exercise, and calcium intake barriers ($p > 0.05$).

Pearson Correlation showed no significant relationship between femur neck BMD and the OHBS constructs suseptibility ($r = -0.004$, $p = 0.974$), exercise benefits ($r = - 0.15$, $p = 0.19$), calcium benefits ($r = -0.007$, $p = 0.948$), exercise barriers ($r = -0.165$, $p = 0.147$), calcium barriers ($r = -0.01$, $p = 0.96$), and health motivation ($r = -0.06$, $p = 0.61$).

Pearson Correlation also showed no significant relationship between total hip BMD and the OHBS constructs susceptibility ($r = 0.05$, $p = 0.685$), exercise benefits ($r = -0.02$, $p = 0.887$), calcium benefits ($r = -0.03$, $p = 0.776$), and health motivation ($r = 0.16$, $p = 0.158$).

Pearson Correlation showed no significant relationship between lumbar spine BMD and the OHBS constructs susceptibility ($r = -0.01$, $p = 0.92$), severity ($r = -0.18$, $p = 0.10$), exercise benefits ($r = -0.11$, $p = 0.32$), clacium benefits ($r = -0.029$, $p = 0.799$), exercise barriers ($r = -0.002$, $p = 0.983$), calcium barriers ($r = -0.04$, $p = 0.715$), and health motivation($r = -0.07$, $p = 0.56$).

The correlation between perceived severity and femur neck BMD revealed a relationship that approached significance ($r = -0.22$, $p = 0.053$), as did the relationship between perceived severity and the total hip BMD ($r = -0.21$, $p = 0.066$).

Using the Bone-Specific Physical Activity Questionnaire (Weeks & Beck, 2008), participants were scored as having met ACSM guidelines or not. Results indicated that 75% (n = 60) of the participants exercise five times or more per week. There was no significant relationship between exercise and femur neck BMD (X^2 = 27.64, p = .840), total hip BMD (X^2 = 24.63, p = .697), and lumbar spind BMD (X^2 = 30.04, p = .784).

The Beverage Questionnaire (Hedrick et al., 2010), participants marked how often they consumed the beverage listed and amount consumed. Frequencies are reported in Table 4. Results showed that 85% (n = 68) of the participants reported they consume less than 12 ounces of CSDs per day. Sixteen percent reported they consume more, with the greatest consumption at 31.3 ounces per day. The greatest intake of regular CSDs ounce per day was reported at 2.70 ± 3.92 ounces per day. Caffeine free diet CSD was reported as the least consumed CSD at 1.30 ± 1.31 ounces per day. The daily ounce per day intake of carbonated energy drinks was reported at .91 ± .36 ounces per day. Pearson

Table 4. Frequency of CSD Intake (n (%))

Intake	Regular CSD	Diet CSD	Caffeine-Free Regular CSD	Caffeine-Free Diet CSD	Energy Drinks
Never	39 (44.8)	56 (70.0)	60 (75.0)	71 (88.8)	65 (81.3)
1 x week	13 (16.3)	3 (3.8)	8 (10.0)	2 (2.5)	12 (15.0)
2-3 x week	17 (21.3)	9 (11.3)	8 (10.0)	4 (5.0)	0
4-6 x week	3 (3.8)	5 (6.3)	1 (1.3)	0	0
Total Daily Consumption Mean ± SD	2.70 ± 3.92	1.64 ± 2.14	1.30 ± 1.31	1.03 ± .78	.91 ± .36

Correlation showed no significant relationship between CSD intake and femoral neck BMD (r = 0.09, $p > 0.05$), total hip BMD (r = 0.09, $p > 0.05$) or lumbar spine BMD (r = 0.15, $p > 0.05$).

Bone mineral density measures were obtained through DXA scans. Participant's received a DXA screening of their spine and left hip. Results are shown in Table 5. Results of the study showed 25 % (n = 20) of the participants have low BMD (T Score ± -1.1) at one or both of the measured sites. Seventy-five percent of the participants had
healthy bones while 21.3 % have osteopenia and 3% have osteoporosis.

Table 5. Bone Mineral Density Categorization* of College Age Female Students (n = 80)

Category	N	%	Recommended
Total Femur			> 0.82 g/cm2
Low	5	6.3	
Healthy	75	93.8	
Femur Neck			> 0.74 g/cm2
Low	9	11.3	
Healthy	71	88.8	
Spine			> 0.0
Low	19	23.8	
Healthy	61	76.3	

*Looker et al., 1997

Dairy intake was obtained from the ORFA questionnaire. Daily dairy intake ranged from 0 – 4.86 servings per day. Twenty percent (n = 16) consumed less than one serving per day, 55% (n = 44) of the participants consumed between one and two dairy servings per day, and 25% (n = 20) consumed over 2 servings to 4.48 servings per day. Categorization of daily intake resulted in 93.8% (n = 75) of the participants not consuming the recommended amount of dairy per day.

Pearson Correlation showed no significance between dairy intake per day and the femur neck (r = -0.189, $p > 0.05$) or lumbar spine BMD (r = -0.03, $p > 0.05$) however, a significant negative relationship was found between total daily dairy intake and total hip BMD (r = -0.23, $p < 0.05$). Chi-square analysis of BMD categorized as healthy BMD, osteopenia, or osteoporosis, and dairy intake categorized as having met three servings per day requirement or not having met requirement, revealed no significant association between spinal BMD and dairy intake ($\chi 2 = 0.22$, $p > 0.05$).

Of the participants that did not have adequate dairy intake 56 (70%) had healthy bones and 16 (20%) osteopenia, and 3 (4%) osteoporosis. When considering the individual measurement sites, 58 (72.5%) participants with an inadequate dairy intake presented with healthy lumbar spine BMD. Fourteen (17.5%) of the inadequate dairy intake participants had osteopenia of the lumbar spine and 3 (4%) had osteoporosis. Of the participants in the femur neck BMD category that did not have adequate dairy intake, 67 (83.75%) of the participants had healthy bones and 8 (4%) osteopenia. In the total hip BMD category, participants that did not have adequate dairy intake 71 (88.75 %) of the participants had healthy bones and 4 (5 %) osteopenia.

Of the five participants reporting an adequate daily dairy intake, 4 (80 %) had healthy bones and 1 (20 %) osteopenia. When considering the individual measurement sites, 3 (60 %) participants with an adequate dairy intake, presented with healthy lumbar spine BMD. Two (40 %) of the adequate dairy intake participants had osteopenia of the lumbar spine. Of the participants in the femur neck BMD category that have adequate dairy intake, 4 (80%) of the participants had healthy bones and 1 (20 %) had osteopenia. In the total hip BMD category,

participants that have adequate dairy intake, 4 (80 %) of the participants had healthy bones and 1 (20 %) had osteopenia.

Pearson Correlation of BMI and specific site BMD revealed a significant relationship for femur neck ($r = 0.24$, $p < 0.05$), total hip ($r = 0.43$, $p < 0.05$), and lumbar spine ($r = 0.30$, $p < 0.05$). However, chi-square analysis for categorized BMI and BMD revealed no significant association ($\chi 2 = 0.23$, $p > 0.05$). For exercise and BMD, no significant association was found ($\chi 2 = 0.36$, $p > 0.05$). A review of the results of the analysis of BMD and selected risk factors can be found in Table 6.

Table 6. Results of BMD and risk factors analyses
(NS: No Significance; S: Significance)

Risk Factor	Femur Neck	Total Hip	Lumbar Spine
CSD	NS	NS	NS
Dairy	NS	NS	NS
BMI	S*	S*	S*
Exercise	NS	NS	NS

*$p < 0.05$

CHAPTER V

SUMMARY AND DISCUSSION

This research study addressed the relationship of carbonated soft drinks (CSD) and bone mineral density (BMD). The purpose of this study was to examine the effects CSDs has on BMD among college-aged women. In addition, this investigation explored the relationship between dairy intake, exercise, and osteoporosis knowledge and beliefs and BMD in these young women.

Summary of Procedures

Participants of this study included a convenience sample of 80 women aged 18-24 years, who were currently enrolled at The University of Mississippi. Participants completed five valid and reliable questionnaires: Osteoporosis Risk Factor Assessment (ORFA), Osteoporosis Knowledge Test (OKT) and Osteoporosis Health Belief Scales (OHBS) (Kim, Horan, Gendler, & Patel, 1991). The Bone-Specific Physical Activity Questionnaire (Weeks & Beck, 2008), and a Beverage Questionnaire (Hedrick et al., 2010). Lumbar spine, femur neck, and total femur were assessed using dual energy X-ray absorptiometry (DXA).

Of the independent variables examined in this study three were commonly cited as risk factors for osteoporosis. They include: BMI, physical activity, and dietary calcium intake. The influence of osteoporosis knowledge and health beliefs were also examined in relationship to BMD. The primary independent variable was CSD consumption. The dependent variables for this study included BMD measures of the lumbar spine, femur neck, and total femur.

The data for this study were analyzed through simple descriptive statistics to provide overall characteristics of the sample. Correlations and/or Chi Square were used to test the significance of these independent variables with BMD as either a continuous variable or categorized as: (1) healthy BMD, (2) osteopenia, or (3) osteoporosis.

Data results showed there was no significant relationship between CSDs and dairy intake. As CSDs consumption goes up, dairy consumption remained the same. Data results showed there was no significant relationship between CSDs consumption and BMD.

Discussions and Implications

This study assessed the significance of CSDs on BMD. Recognition of modifiable risk factors may result in early intervention in the treatment of bone mineral deficiencies as well as the prevention of bone loss.

Discussion of risk factors

The significant influence of advancing age on the loss of BMD is well documented (Hostmark et al., 2011; NIH, 2000; NOF, 2013;Tucker et al., 2006). It is essential for college age females to enhance their BMD through exercise and intake of dairy products (Hovell, et al., 2008; Swann, 2012; Tolomio et al., 2010). Our study showed no significance relationship between exercise and BMD. This is surprising since the majority of studies show a significant relationship between exercise and bone health.

Results showed that 82.5 % of the participants agreed that diet could influence osteoporosis. This supports Ford, Bass and Keathley (2007) findings. Eighty-seven percent of the women in their study agreed diet could influence osteoporosis. Also, participants' mean score of their perceived risk of getting osteoporosis was 2.65 ± .96, which supports Ford et al. (2007) findings, which showed a mean score of 2.43 ± .79 in their study.

Furthermore, 87.5 % of the participants reported they eat a well-balanced diet, whereas the data showed 94% (n = 75) of the participants had inadequate dairy intakes. Data also showed that 67.5% (n = 54) did not know how much milk an adult must drink to meet the recommended amount of calcium. Nowson (2006) addressed the issue of consumption of CSDs and the effect on bone in adolescents living in Australia. Nowson (2006) concluded it is not the CSDs but other behaviors including lack of calcium and exercise, which affects adolescence bones (Nowson, 2006). Findings of this study do not support Nowson's conclusion that calcium may influence BMD in adolescents, however, our findings do support the conclusion that CSD consumption is not detrimental to bone health.

This study supports the findings of Kim et al. (1997) and Ma and Jones (2004) in that CSD consumption was found to have no influence on BMD. Kim et al. examined older women than the current study but found not significant association between CSD consumption and BMD. Ma and Jones examined children ages 9 – 16 who had a previous upper limb fracture and reported a positive association between cola drinks and fracture risk, however, this association dissappered when adjusted for television, computer, and video watching. They concluded that cola consumption was correlated with television, computer and video watching, but not BMD.

Conclusions

Drawn from the findings of this study, the following conclusions are offered:

1. Twenty-five percent (n = 20) of the participants in this study have low BMD of at least one measured site. Seventy-five percent (n = 60) of the participants had healthy bones, 21.3 % (n = 17) osteopenia and 3% (n = 3) of these young women have osteoporosis.

2. The OHBS provided important information on the health belief of these women regarding osteoporosis, however its use was not benefical in predicting low BMD.
3. No significant association was observed between BMD of the spine, femur neck, or total hip and dairy intake. This is not one of the hypotheses to be studied in this study, however, it is an important finding in that dairy intake is often reported as significant in the maintance of healthy bones.
4. Data in this study supports the null hypothesis Ho1: There is no relationship between CSD consumption and dairy intake. Therefore, fail to reject the null hypothesis. Carbonated soft drink consumption has no effect on dairy consumption.
5. No significant relationship between CSD consumption and BMD was found in this study. This finding supports the null hypothesis Ho2: There is no relationship between CSD consumption and BMD. Therefore, fail to reject the null hypothesis. Carbonated soft drinks have no significant relationship on bone health.
6. Participants in this study showed there is a need for more education regarding bone health and daily dairy intake. Surprisingly, 67.5% (n = 54) of the participants did not know how much milk an adult should drink to meet the recommended amount of calcium.
7. Results of the study showed BMD to have a significant positive relationship with BMI. In every site measured, femur neck, total hip, and lumbar spine, the greater the BMI the greater the BMD.

In this study of female college students, there were no significant relationships between osteoporosis knowledge and the OHBS constructs susceptibility, exercise barriers, and calcium barriers. Results also indicated that 75% (n = 60) of the participants met the ACSM guidelines

for physical activities. Only 5 % of the participants reported an adequate daily dairy intake. Furthermore, 75% had healthy bones. There was no significant relationship between lumbar spine BMD and dairy intake. However, there was a significant relationship between total daily dairy intake and total hip BMD. Perason Correlation of BMI and BMD revealed a significant relationship for femur neck, total hip, and lumbar spine.

Results of The Beverage Questionnaire (Hedrick et al., 2010) showed that 85% of the participants consumed less than 12 ounces of CSDs per day. Pearson Correlation of CSDs and BMD of the femur neck, total hip, and lumbar spine showed no significant relationship. In conclusion, these data provide no evidence that CSDs consumption has any adverse effect on BMD levels in young college females.

In this study of female college students, there were no significant relationships between osteoporosis knowledge and the OHBS constructs susceptibility, exercise barriers, and calcium barriers. Results also indicated that 75% of the participants met the ACSM guidelines. Only 5 % of the participants reported an adequate daily dairy intake. There was no significant relationship between lumbar spine or femur neck BMD and dairy intake. However, there was a significant negative relationship between total daily dairy intake and total hip BMD. This contradicts the literature in that dairy intake is believed to be beneficial to bone health. Pearson Correlation of BMI and BMD revealed a significant relationship for femur neck, total hip, and lumbar spine. While Chi-Square analysis for categorized BMI and BMD revealed no significant association.

Results of The Beverage Questionnaire (Hedrick et al., 2010) showed that 85% of the participants consumed less than 12 ounces of CSDs per day. Pearson Correlation of CSDs and BMD of the femur neck, total hip, and lumbar spine showed no significant relationship. In

conclusion, this data provides no evidence that CSDs consumption has any adverse effect on BMD levels in young college females.

Limitations

Some limitations need to be acknowledged. First, the amount of CSDs consumed may be small when compared to other studies. Ratnayake and Ekanayake (2012) reported 84% of American adolescents consume CSDs daily. Participants in this study may not have consumed enough CSDs to demonstrate an impact on BMD. Ovrall consumption of CSDs was low.

Heredity and age are strong influences on BMD. Bone mineral density is also susceptible to lifestyle and dietary factors. Investigations, such as the present study, into the risk factors for low BMD and osteoporosis help to understand the effects of nutrients on BMD and perhaps meet the goals of Healthy People 2010.

Recommendations for Future Research

1. This study should be replicated using data collected from both college-age males and females as a baseline to create the baseline for a longitude study for the participants.
2. Conduct a similar study with college age males, to assess possible effects of CSDs among college age males and BMD.
3. Incorporate questions regarding osteoporosis knowledge and perceptions into the study recommended above. Focus on the importance of healthy bones throughout the lifespan along with the prevention of unnecessary bone loss. Such information will guide development of educational programs and materials.
4. The results of the data showed that there is a need to further educate college age females the need for dairy intake. Data showed that 67.5% (n = 80) did not know how much milk

an adult must drink to meet the recommended amount of calcium and 75 of the 80 participants had an inadequate dairy intake.

5. A replica of this study consisting of a larger research group of female participants, who might consume larger quantities of CSDs, to compare studies.

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APPENDIXES

APPENDIX A

INFORMED CONSENT

Informed Consent

Consent to Participate in an Experimental Study
Title: Effect of carbonated soft drink consumption on bone mineral density in college age women

Investigator
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Sponsor
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Description
We are investigating the effect of osteoporosis knowledge, perception, and carbonated soft drink consumption on bone mineral density (BMD). In order to answer our question, we are asking you to complete five short questionnaires. One looks at your dairy product intake as well as other risk factors for low BMD. The others are inquiries into your carbonated soft drink usage, physical activity, knowledge of osteoporosis, and perceptions of osteoporosis. It will take you about 20 minutes to finish these questionnaires. We will then have you come to the Turner Center where you will have your height and weight measured and receive a DXA scan (which uses low-dose radiation) to measure bone mineral density. This will take about 15 minutes.

Because the radiation could harm a fetus, we are required to give you a urine pregnancy test before doing a DXA. You will provide your urine sample in a cup in the restroom. The pregnancy test must be negative for you to participate in this study.

DXA Scan Procedure (15 minutes):

1) Remove all metal objects, including clothing containing metal
2) Remove at least your outer clothes and change into shorts and a t-shirt or wear a hospital gown
3) Measure height & weight
4) Lie on the DXA padded table
5) A research technician will position your body on the table
6) Lie still for about 30 seconds during each of two scans (hip and spine).
7) Receive DXA results (and an opportunity to sign a release form to fax results to your physician)

Risks and Benefits
The DXA device exposes you (and any unborn fetus) to a low dose of X-ray radiation – about 1/10 of the radiation from a chest x-ray and about as much radiation as you get from the sun from flying coast to coast. Some people experience anxiety during this test, just like any medical test.

You will find out if your bone mineral density (a contributor to bone strength) is within normal limits. If your bone mineral density appears to be low, we can fax the DXA results to your physician with your written permission.

Cost and Payments
The questionnaires will take about 15 minutes to finish and the DXA scan should also take about 15 minutes. There are no costs for helping us with this study

Confidentiality
All contact information (i.e. names and email addresses) will be kept under lock and key in Dr. Bass' office and the DXA laboratory (Turner 248A). Once all data has been collected, all names and identifying information will be destroyed.

Right to Withdraw
You do not have to take part in this study. If you start the study and decide that you do not want to finish, all you have to do is tell Dr. Bass.

The researchers may terminate your participation in the study without regard to your consent and for any reason, such as protecting your safety and protecting the integrity of the research data.

IRB Approval
This study has been reviewed by The University of Mississippi's Institutional Review Board (IRB). The IRB has determined that this study fulfills the human research subject protections obligations required by state and federal law and University policies. If you have any questions, concerns, or reports regarding your rights as a participant of research, please contact the IRB at (662) 915-7482.

Statement of Consent
I have read the above information. I have been given a copy of this form. I have had an opportunity to ask questions, and I have received answers. I consent to participate in the study.

Signature of
Participant

Signature of
Investigator

APPENDIX B

PREGNANCY SCRIPT

Script for Positive Pregnancy Test

The pregnancy test appears to be positive. We cannot do a bone density scan on you because of this positive reading. We recommend that you see your physician. If you find that our pregnancy test was incorrect and can provide a written statement from your physician that you are not pregnant and would like to receive a bone scan, you may contact Dr. Martha Bass at 915-5563 or mabass1@olemiss.edu.

APPENDIX C

QUESTIONNAIRES

Osteoporosis Risk Factor Assessment
(ORFA)

Please answer to the best of your knowledge.

How often do you eat or drink the following foods per week? DO NOT include their use in cooking.

1. Chocolate milk and hot cocoa? _____Time(s) per week

2. Milk to drink or on cereal? (Do not count small amounts of milk added to coffee or tea.) _____Times per week

3. Yogurt or frozen yogurt? _____Time(s) per week

4. Ice cream, ice milk, and milk shakes? _____Time(s) per week

5. Cheese, all types including American, Swiss, cheddar, and cottage cheese? _____Time(s) per week

6. Pizza, calzone, and lasagna? _____Time(s) per week

7. Cheese dishes such as macaroni and cheese, cheese nachos, cheese enchiladas, and quesadillas? _____Time(s) per week

8. During your childhood, approximately how many servings of milk did you drink each day?

   a. None (0 servings)
   b. 1 serving each day
   c. 2 servings each day
   d. 3 servings each day
   e. 4 or more servings each day

9. What is your birthday? (MM/DD/YY) _____

10. Which of the following best describes your ethnic group?

   a. Asian
   b. African American
   c. Caucasian
   d. Hispanic
   e. Native American

f. Other

11. Do you smoke?

a. Yes
b. No

12. How many alcoholic beverages do you generally consume in a setting?

a. 0
b. 1
c. 2
d. 3
e. 4+

12. Have you had a period in the last 12 months?

a. Yes
b. No

14. Have you ever been amenorreahic (lost your menstrual cycle for any reason, other than pregnancy for longer than 3 months)?

a. Yes
b. No

15. Have you had a hysterectomy (removal of the uterus)?

a. Yes
b. No

16. Have you ever taken birth control pills for any reason?

a. Yes
b. No

17. Have you ever had the Depo-Provera shot?

a. Yes
b. No

Osteoporosis Knowledge Test

The following is a list of things, which may or may not affect a person's chance of getting osteoporosis. For each item circle whether this person is:

MORE LIKELY TO GET OSTEOPOROSIS, or
LESS LIKELY TO GET OSTEOPOROSIS, or
IT HAS NOTHING TO DO WITH GETTING OSTEOPOROSIS.

	More Likely	Less Likely	Neutral	Don't Know
1. Eating a diet *low* in milk products	ML	LL	NT	DK
2. Being menopausal: "change of life"	ML	LL	NT	DK
3. Having big bones	ML	LL	NT	DK
4. Eating a diet high in dark green leafy vegetables	ML	LL	NT	DK
5. Having a mother or grandmother who has osteoporosis	ML	LL	NT	DK
6. Being a white woman with fair skin	ML	LL	NT	DK
7. Having ovaries surgically removed	ML	LL	NT	DK
8. Taking cortisone (steroids, e.g., Prednisone) for long time	ML	LL	NT	DK
9. Exercising on a regular basis	ML	LL	NT	DK

10. Which of the following exercises is the *best way* to reduce a person's chance of getting osteoporosis?

    a. swimming
    b. walking briskly
    c. doing kitchen chores, such as washing dishes or cooking
    d. don't' know

11. Which of the following exercises is the *best way* to reduce a person's chance of getting osteoporosis?

    a. bicycling
    b. yoga
    c. housecleaning
    d. don't know

12. *How many days a week* do you think a person should exercise to strengthen their bones?

    a. 1 day a week
    b. 2 days a week
    c. 3 or more days a week
    d. don't know

13. What is the *least amount of time* a person should exercise on each occasion to strengthen their bones?

    a. less than 15 minutes
    b. 20 to 30 minutes
    c. more than 45 minutes
    d. don't know

14. Exercise makes bones strong, but it must be *hard enough to make breathing*:

    a. just a little faster
    b. so fast that talking is not possible
    c. much faster, but talking is possible
    d. don't know

15. Which of the following exercises is the *best way* to reduce a person's chance of getting osteoporosis?

    a. jogging or running for exercise
    b. golfing using golf cart
    c. gardening
    d. don't know

16. Which of the following exercises is the *best way* to reduce a person's chance of getting osteoporosis?

    a. bowling
    b. doing laundry
    c. aerobic dancing
    d. don't know

Calcium is one of the nutrients our body needs to keep bones strong.

17. Which of these is a good source of calcium?

    a. apple
    b. cheese
    c. cucumber

d. don’t know

18. Which of these is a good source of calcium?

a. watermelon
b. corn
c. canned sardines
d. don’t know

19. Which of these is a good source of calcium?

a. chicken
b. broccoli
c. grapes
d. don’t know

20. Which of these is a good source of calcium?

a. yogurt
b. strawberries
c. cabbage
d. don’t know

21. Which of these is a good source of calcium?

a. ice cream
b. grapefruit
c. radishes
d. don’t know

22. Which of the following is the recommended amount of calcium intake for an adult?

a. 100 mg – 300 mg daily
b. 400 mg – 600 mg daily
c. 800 mg or more daily
d. don’t know

23. How much milk must an adult drink to meet the recommended amount of calcium?

a. ½ glass daily
b. 1 glass daily
c. 2 or more glasses daily
d. don’t know

24. Which of the following is the *best reason* for taking a calcium supplement?

a. if a person skips breakfast
b. if a person does not get enough calcium from diet
c. if a person is over 45 years old
d. don’t know

Osteoporosis Health Belief Scale

For 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.

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
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 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.	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

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
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.	SD	D	N	A	SA

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

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

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
24. You feel good enough about yourself when you take in enough calcium to prevent osteoporosis.	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

	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
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.	SD	D	N	A	SA

Bone-Specific Physical Activity Questionnaire (BPAQ)

SUBJECT ID:	DATE:

2. Please list the sports or other physical activities (be as specific as possible) you participated in regularly during the last 12 months and indicate the average frequency (sessions per week)?

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Activity: _____ Frequency (per week): _____

Beverage Questionnaire (BEVQ)

	How often (mark one)							How much each time (mark one)				
Type of Beverage	Never or less than 1 time per week	1 time per week	2-3 times per week	4-6 times per week	1 time per day	2+ times per day	3+ times per day	Less than 6 fl oz (3/4 cup)	8 fl oz (1 cup)	12 fl oz (1½ cup)	16 fl oz (2 cups)	More than 20 fl oz (2 ½ cups)
Carbonated Soft drinks (Regular)												
Diet Carbonated Soft Drinks												
Caffeine Free, Carbonated Soft drinks												
Caffeine Free, Diet Carbonated Soft drinks												
Carbonated Energy Drinks (ie, Red Bull, Rock Star and Monster)												

VITA

VITA

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EDUCATION

M.A., Applied Sciences, University of Mississippi, 2014
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EdS., Education, University of Mississippi, May 2005
Concentration: Curriculum and Instruction, Special Education

M.A., Education, University of Mississippi, May 2009
Curriculum and Instruction Addl Elementary Education

M.A., Education, University of Mississippi, May 2002
Curriculum and Instruction, Special Education

B.A., Education, University of Mississippi, May 1994

TEACHING EXPERIENCE

Teaching Assistant, 1988-1993
Lafayette Elemtary School, Developmentally Delayed

Special Education Teacher, 1994-1996
Lafayette Elementary School, Kindergarten

Academic Teacher, 1996-current
North Mississippi Regional Center, Adults

HONORS

The National Scholars Honor Society, 2008