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Comparison Of Osteoporosis Knowledge, Beliefs, Attitudes, And Behavior Among College Students Of Various Racial/Ethnic Groups

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COMPARISON OF OSTEOPOROSIS KNOWLEDGE, BELIEFS, ATTITUDES, AND
BEHAVIOR AMONG COLLEGE STUDENTS OF VARIOUS
RACIAL/ETHNIC GROUPS

A Dissertation

Presented to

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Department of Teaching and Learning

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In Partial Fulfillment

of the Requirements for the Degree

Doctorate of Philosophy in Teaching and Learning

by

Lauri DeRuiter-Willems

May 2018

Keywords: osteoporosis, college students, knowledge, attitudes, beliefs, behaviors

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ABSTRACT

Osteoporosis is known as a pediatric disease with geriatric consequences. The need for bone health, awareness of controllable risk factors and prevention of osteoporosis begins during one's youth (Campbell, 2012; Cannada, 2016; Evenson & Sanders, 2016; Edmonds, Turner, & Usdan, 2012; Ford et al., 2011; Gammage et al., 2009; Gammage et al., 2012). Currently, most health information and health campaigns focus on older adults. To promote measurable improvements in reducing the number of cases of osteoporosis, the focus for change needs to start as early as teenage and young adult age. In addition to the general population trends, rates specifically associated with the nonwhite U.S. population are expected to increase. Burge (2007) reported that the 2005 "distribution of fractures by race/ethnicity among women reveals that whites have 89% of the total, followed by black (4%), Hispanic (4%), and other women (3%)" (p. 468). Burge further reported that projections between 2006 and 2025 reveal that "fractures and costs among the nonwhite population will increase from 14% and 12% in 2005, respectively, to 21% and 19% in 2025" (p. 468). This study identified the need to increase knowledge, attitudes, beliefs and behaviors of college students of various racial/ethnic groups as related to osteoporosis.

PREFACE

Although I began writing this dissertation as the conclusion of my doctoral program, as I completed the literature review on osteoporosis and college students, and was analyzing the study results, I realized that we in the field of health promotion have a large task to educate and provide environments for young people to make actual positive changes in their behaviors. We must be the change agents for them so that they can establish positive health behaviors that will stay with them throughout their entire lives. This is important for the common yet very important health issues that may grab the headlines, but also for many others that we have thought of as issues of the elderly. Osteoporosis is such an issue. So, let's encourage our young people to build their bone banks and minimize the potential for devastating consequences of osteoporosis.

ACKNOWLEDGMENTS

As I add the final touches to this document, the Acknowledgements may be the most difficult part to write! The instructions suggested that I should only recognize real indebtedness. Let me begin by saying there will be many people who may not be specifically named that have been part of my village and my cheer team. Please know that any and all who have encouraged and supported me have my most sincere appreciation and gratitude, my real indebtedness. This six-year journey has been full of highlights and challenges. It's hard to believe that I've worked full-time, built a wonderful home with my husband, graduated two daughters from high school and buried my parents, all while completing the Teaching and Learning coursework and now, this dissertation.

My parents, Garret and Marilyn DeRuiter, are missed each and every day. They had such a strong sense of purpose in all they did, believed in education at all levels, and lived with integrity, humility, humor and faith. I wish they could have been with me through this whole journey, but I'm happy that they knew that I started the PhD program, and am sure they believed I would finish it. Thank you to them for guiding me and setting a great example to follow.

For my daughters, Danielle and Taylor, I want the world for you both! You two have been great cheerleaders. I love your passion for life and am so excited to see you continue to grow through college and know your futures will be full and rewarding. Thank you for understanding if I was glued to my computer and missed some events. I hope you know that even if I wasn't there, I was thinking about you and cheering for you. Love you both always.

John, my dear patient husband. You are always my steady stream of calm and confidence. I'm sure you wondered if this day would come, and you have to know that it is here because of your support and encouragement. Statistics and Excel? Wow, you are an amazing teacher. I may not tell you often, but thank you for absolutely everything. I love you.

What began as a bucket list idea, teaching a college course, became what I decided I wanted to do when I grew up, even though I was already an adult. Thank you to Barb Walker for suggesting I join the Department of Health (Studies) Promotion at Eastern Illinois University. Dr. Sheila Simons, thank you for your guidance, friendship and the occasional need to take a walk around the building. I am proud to be part of this great department with a fun and supportive group of faculty and staff. So many people at EIU have encouraged me and been very supportive of this process. Thank you to all in Health Promotion and across campus.

Those horror stories people share about writing a dissertation never would have happened with a committee like mine. Dr. Susan Kiger, my chair, was patient and persistent with me. Your editing abilities make you a superstar! Thank you for guiding me through this process and pushing me to expand my thoughts and clarify my writing. I really believe that this information will not just "sit on a shelf", but will be put to good use.

Dr. Kathy Phillips, my EIU mentor and committee member, how many times did you say, "Just do it"? I'm sure the next lines were "Get to the point and do it well". Thanks for going on this journey with me and for guiding me through this study as well as helping me become the teacher that I am today.

The courses I took with Dr. Cassandra Caruso-Woolard made the whole program click. Sandy, you are a great example of what quality teaching should be. Thank you for being part of my committee.

Well, my “little book report” is done. I may have done the writing, but it happened because of the love and support of so many people in my life, literally all around the world.

Thank you one and all.

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CHAPTER 1

INTRODUCTION

The commonly used phrase, “What you don’t know won’t hurt you,” does not apply to osteoporosis. This bone disease, osteoporosis, occurs when the bones become brittle and fragile because of loss of essential minerals like calcium. Unfortunately, it is also called the silent disease, because the first sign/symptom of one having osteoporosis is often a bone fracture, most often occurring in hips, spine or wrists (Kohrt, Bloomfield, Little, Nelson & Yingling, 2004; National Institute of Arthritis and Musculoskeletal and Skin Diseases [NIAMSD], 2014; NIAMSD, 2015; National Institutes of Health Osteoporosis and Related Bone Diseases, [NIHORBS], 2016). Osteoporosis is known as a disease that affects older people, but the need for bone health, awareness of controllable risk factors and prevention of this disease begins during one’s youth (Campbell, 2012; Cannada, 2016; Edmonds, Turner, & Usdan, 2012; Evenson & Sanders, 2016; Ford, Bass, Zhao, Bai, & Zhao, 2011; Gammage, Francouer, Mack, & Klentrou, 2009; Gammage, Gasparotto, Mack, & Klentrou, 2012). If one looks for the meaning in a modified version of “what you don’t know won’t hurt you, it may harm you” as it applies to osteoporosis, one finds that it is very important to start awareness and prevention steps at a young age. To date, most of the health information and health communication campaigns focus on older adults. To raise awareness that may promote measurable improvements in reducing the

number of cases of osteoporosis, the focus for change needs to start as early as teenage and young adult age.

In the United States, more than 53 million people either already have osteoporosis or are at high risk due to low bone mass (National Institutes of Health Senior Health [NIHSH], 2015). As of 2005, almost 2 million osteoporosis-related fractures occurred each year at an estimated cost of almost \$17 billion (Burge, 2007; Cannada, 2016). If the trend continues, by 2025, there will be an estimated 3 million osteoporosis-related fractures annually with an estimated cost of \$25.3 billion (Burge, 2007).

In addition to the general population trends, rates specifically associated with the nonwhite U.S. population are also expected to increase. Burge (2007) reported that the 2005 “distribution of fractures by race/ethnicity among women reveals that whites have 89% of the total, followed by black (4%), Hispanic (4%), and other women (3%)” (p. 468). Burge further reported that projections for the time period between 2006 and 2025 reveal that “fractures and costs among the nonwhite population will increase from 14% and 12% in 2005, respectively, to 21% and 19% in 2025” (p. 468).

A misconception exists in nonwhite groups including Black or African Americans and other racial and ethnic groups that the majority of osteoporosis cases occur in white women; therefore, members of these groups are not susceptible (Cauley, 2011; Nam et al., 2013; NIAMSD, 2015). One reason for this myth is that African American women have greater bone mineral density (BMD) than non-Hispanic white women (NIAMSD, 2015). Nam et al. (2013) found that BMD was 21-31% higher in Black or African American women and 13-23% higher in Afro-Caribbean women than U.S. White women. However, BMD was 4-7% lower among Hong Kong Chinese and South Korean women than U.S. White women (Nam et al., 2013). The rate of

hip fractures is expected to increase to 25% of all fractures occurring in nonwhites by 2025 (Cauley, 2011).

Although fractures and measures of bone mineral density are the most common evidence of osteoporosis, the consequences, specifically mortality and hospitalization, of osteoporosis-related fractures in Black or African Americans is greater (Cauley, 2011; Gillespie & Morin, 2016). The reasons for this are not completely clear, but may include older age, comorbidity, or disparities in health care (Burge, 2007; Cauley, 2011; Looker, Isfanhani, Fan, & Shepherd, 2017). Cauley (2011) reported a study that showed African American women were six times more likely to be non-ambulatory after a hip fracture than White women.

Osteoporosis screening increases the likelihood of an individual taking preventative measures. White, non-Hispanic Asian and Hispanic women were more likely to undergo screening than non-Hispanic black women. Personal net worth and comorbidity increased the likelihood of women in all groups to also have osteoporosis screenings (Cauley, 2011; Gillespie & Morin, 2016). The misconception that osteoporosis is primarily a disease affecting elderly White women is dispelled by the Geller and Derman (2001) study of minority women's risk factors for osteoporosis. Geller and Derman found that although African American and Hispanic women had more bone mass, bone loss patterns were similar in all groups at five years after menopause. This would indicate that the need for screening and prevention measure within the African American and Hispanic groups is just as important as it is for Whites (Geller & Derman, 2001). Of interest and a potential issue with the usual recommendations for calcium is that African Americans and Hispanics are more likely to be lactose intolerant; therefore, consume less calcium rich foods, which are primarily dairy based in the United States (Appleby, Roddam, Allen, & Key, 2007; Gammage et al., 2009; Rolfes, Pinna, & Whitney, 2009).

The World Health Organization (WHO; 2017c) defined a risk factor as “any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury” (para. 1). Some risk factors, such as genetics/family history, sex, ethnicity/race, age, and thinness/small frame are considered non-modifiable, meaning that it cannot be controlled or changed. Genetics and family history are the most likely predictors of one developing osteoporosis (Cauley, 2011; Gillespie & Morin, 2016). In addition to the ethnicity and race factors already discussed, the Asian population is generally thinner and has smaller frames than other groups (Cauley, 2011; Gillespie & Morin, 2016, Nam et al., 2013). It is important to note that sex is considered a non-modifiable risk factor. The rates of osteoporosis in men is much less than women, in part due to bone structure, and greater BMD and PBM (Campbell, 2012; Ford et al., 2007; Vasquez, Shaw, Gensburg, Okorodudu, & Corsino, 2013). The rates of bone loss in men occurs at similar rates as women five years after menopause (Campbell, 2012; Geller & Derman, 2001; Khosla et al., 2017).

Modifiable risk factors can be controlled or changed. These include nutrition, physical activity, smoking and the use of alcohol. Gammage et al. (2012) reported that “up to 10% to 50% of bone health is attributable to controllable lifestyle factors” (p. 58). The development of strong, healthy bones and the need for prevention of osteoporosis begin at a young age, even though the symptoms and consequences of osteoporosis are more likely to occur later in life.

The development of peak bone mass (PBM) is one argument that has been made for why prevention measures should start early in life. PBM is the maximum size and strength of bones. With 92% of total body bone mineral content attained by age 18 and 99% by age 26, early intervention is considered a window of opportunity (Campbell, 2012; Greenway, Walkley, & Rich, 2015; Nachtigall, Nazem, Nachtigall, & Goldstein, 2013). Bone density development is

best achieved during rapid growth periods of childhood, adolescence and young adulthood (Campbell, 2012; Gammage et al., 2012). Nachtigall et al. (2013) found that prepubertal children showed an increase BMD of 4-5% because of exercise and young athletes had higher BMD than nonathletes (p. 65). This trend continued for prepubertal girls through postmenopausal women.

Framework for the Study

The challenge health promotion educators and healthcare/medical providers face when encouraging premenopausal women and younger men to engage in positive health practices that relate to osteoporosis is that, although these younger adults have knowledge of osteoporosis, they do not believe they are threatened by the disease; therefore, they do not believe they need to engage in such preventative measures (Clark & Lavielle, 2015; Edmonds, 2009; Evenson & Sanders, 2016; Ford et al., 2011; Gammage et al., 2009; Gammage et al., 2012). Health behavior theories or health behavior change models were developed to assist individuals or groups make positive health behavior changes and adhere to interventions (U.S. Department of Health and Human Services, [USDHHS], 2004).

The theoretical basis for this study, the health belief model (HBM), was developed by social psychologists Rosenstock, Hochbaum, Kegeles, and Leventhal during 1950s while working in the U.S. Public Health Services (Mattson, 2014). As cited by Mattson (2014), Rosenstock added the self-efficacy component in 1984. The HBM contends that addressing osteoporosis prevention at younger ages may minimize the impact of osteoporosis or osteoporosis-related fractures as one ages and supports the need for action, more so than just increasing awareness. The HBM suggests that an individual's perception of the risk (perceived threat) of developing a health condition or disease determines the chances of that person

participating in disease detection, engaging in healthy behaviors and taking preventative measures (Edmonds, 2009; Evenson & Sanders, 2015; Gammage et al., 2012). The theory holds that perceived threat is influenced by how likely a person feels it is that they will develop the disease (perceived susceptibility) and also perceived severity, the seriousness of the disease (Edmonds, 2009; Gammage et al., 2012). Similar perceptions exist in younger men because they believe osteoporosis is primarily a disease that older women develop, not men (Campbell, 2012; Clark & Lavielle, 2015; Edmonds, 2009; Evenson & Sanders, 2016; Ford et al., 2011; Gammage et al., 2009; Gammage et al. 2012; Geller & Derman, 2001; Khosla et al., 2017).

In addition, individuals must believe that the benefits of participating in disease detection, engaging in healthy behaviors and taking preventative measures (perceived benefits) must be greater than the perceived barriers of such practices (Gammage et al. 2012). Knowledge, attitude and belief, demographics, social support, self-efficacy and health motivation are thought to influence action of preventative health behaviors. Self-efficacy is the belief in one's ability to influence events that affect one's life and control over the way these events are experienced (Buchanan, 2016). Health motivation is defined as "processes of choice, need for competency, and self-determination in one's health" (Xu, 2009, p. 20). Figure 1 shows a diagram of the HBM.

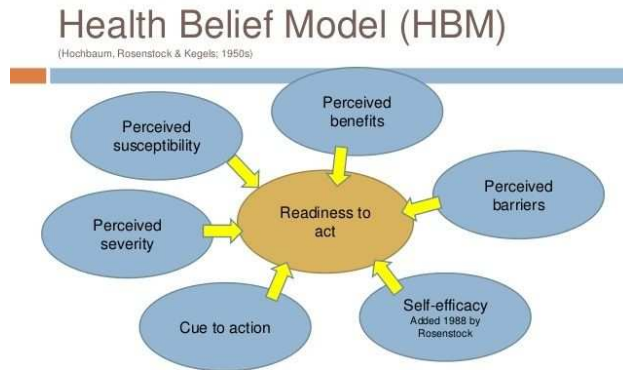


Figure 1. Diagram of reconceptualized health belief model. From Clipartsgram.
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Edmonds et al. (2012) stated that perceived barriers and perceived susceptibility were thought to be powerful components of the model while perceived severity was the least powerful. Applying the HBM to the study of osteoporosis showed that perceived susceptibility was low and that college women were more concerned with developing breast cancer, diabetes or heart disease than osteoporosis (Evenson & Sanders, 2016). In addition, the perceived threat and perceived severity of developing osteoporosis were low (Edmonds et al., 2012; Ford et al., 2011; Gammage et al., 2009; Geller & Derman, 2001). Similar perceptions exist in African American and Hispanic women (Clark & Lavielle, 2015; Geller & Derman, 2001). Therefore, the low perceptions and belief that osteoporosis is a disease of elderly white women may lead younger women as well as African American and Hispanic women of all ages to believe they are not as susceptible and be less likely to engage in healthful and preventative behaviors (Clark & Lavielle, 2015; Edmonds, 2009; Ford et al., 2011; Geller & Derman, 2001). This study determined if college-aged students had osteoporosis knowledge, had the attitude and believed that it is an important health issue, and actually participated in osteoporosis prevention measures.

The study further examined differences among college-aged students of different racial/ethnic groups.

Statement of the Problem

Research supports the fact that the development of peak bone mass and bone mineral density, both factors in minimizing the negative impact of osteoporosis, begins in childhood and reaches the highest levels by about 30 years of age (Campbell, 2012; Cannada, 2016; USDHHS, 2004). Osteoporosis research has traditionally focused on post-menopausal White women. However, there has been minimal research of osteoporosis knowledge, beliefs, attitudes, and self-efficacy of college-age students (women and men) or racial/ethnic groups. Edmonds et al. (2012) stated, “Osteoporosis in men and minority women is under diagnosed, undertreated, under-reported and inadequately researched” (p. 31). It was the hope of this study that by examining the knowledge, attitudes, beliefs and practices of college-aged students of different races/ethnicities, osteoporosis prevention programs may be developed or tailored to the needs of these specific groups with the goal of increasing participation in healthful behaviors and practices which will minimize the risk of developing osteoporosis.

Purpose and Significance of the Study

The purpose of this study was to explore the differences in knowledge of osteoporosis, health beliefs regarding osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of osteoporosis-preventing activities among college students of various race/ethnicities. If differences exist in knowledge of osteoporosis, health beliefs and attitudes regarding osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of osteoporosis-preventing activities among college students of various race/ethnicities, osteoporosis health education may be best tailored to different races.

Increasing knowledge of osteoporosis and encouraging prevention measures for younger adults in all racial and ethnic groups could significantly impact health, minimize consequences and reduce healthcare costs.

With osteoporosis being recognized as a public health threat, organizations have set goals to curb the rates of adults developing the disease. The Healthy People 2020 Campaign included objectives related to osteoporosis and hip fractures (Mullen, 2017). While objective AOCBC-10 seeks to reduce the percentage of adults with osteoporosis, only baseline data has been collected, and as such, no interpretation of reaching this target is available yet (National Center for Health Statistics [NCHS], 2016). Objective AOCBC-11 seeks to reduce hip fractures among older adults. Unfortunately, the midcourse report showed that there has been little detectable change in these rates for either women or men (NCHS, 2016). It is known that osteoporosis is a chronic disease that can be prevented or minimized by young people engaging in healthy behaviors such as regular physical activity and proper calcium intake.

Several studies included in this literature review examined the osteoporosis knowledge, beliefs, attitudes and behaviors of college students in various locations throughout the United States including Arkansas, Arizona, California, Iowa, Michigan, Missouri, New York, North Dakota, Ohio, and Pennsylvania as well as other countries including Canada, Denmark, Turkey, and the United Kingdom. Published studies from Illinois or Indiana that specifically included college students as participants were not found. By offering the perspectives related to osteoporosis of college students from a small Midwestern university, a group not previously investigated, it is hoped the knowledge base will be significantly extended.

Research Questions

In order to identify if differences exist in knowledge, attitudes, beliefs, self-efficacy, and performance along the lines of race/ethnicity of participants, the following research questions were developed. The categories used for the identification of different races/ethnicities reflect census categories used by the U.S. federal government (Compton, Bentley, Ennis, & Rastogi, 2010; Kaneshiro, Geling, Gellert, & Millar, 2011; National Institutes of Health [NIH], 2001). The categories included American Indian or Alaska Native, Asian, Black or African American, Hispanic or Latino, International/Non-Resident Alien, Multiple/Two or More Races, Native Hawaiian or Pacific Islander, Unknown/Other, or White.

1. Do significant differences regarding osteoporosis knowledge exist among racial/ethnic groups of college students?
2. Do significant differences regarding osteoporosis attitudes exist among racial/ethnic groups of college students?
3. Do significant differences regarding self-efficacy to perform osteoporosis prevention measures exist among racial/ethnic groups of college students?
4. Do significant differences regarding performance of osteoporosis prevention measures exist among racial/ethnic groups of college students?

Delimitations, Limitations, and Assumptions of the Study

A delimitation of this study was that participation was restricted to students at a small, Midwestern university, and only offered to those with valid email addresses. A limitation to the study was that selection of participants was dependent on the accuracy of the Planning and Institution Research undergraduate reports. It was possible that eligible students were not surveyed as a result, thereby limiting the generalizations that can be made from the data.

Participation in this study was promoted through email, which was dependent upon those receiving the messages actually completing the survey. Evenson and Sanders (2016) indicated that individuals with high health motivation and higher self-efficacy are more likely to engage in health-related activities; therefore, influence the results because they are already taking preventative measures and participating in healthful activities such as regular physical activity and more adequate consumption of calcium. A possible limitation of this study was also that the sample could not be generalized to represent the attitudes, knowledge, beliefs and practices of college-aged students of all racial/ethnic groups across the country. It was assumed that the participants in the study would respond accurately, honestly and truthfully to all questions. It was further assumed that the participants were a good representation of the general university population included in the study.

Summary

Osteoporosis is a debilitating bone disease with physical, emotional and financial consequences that many individuals are not aware of and are not taking preventive measures. This is in part due to the focus of research being primarily on older white women (Clark & Lavielle, 2015; Edmonds, 2009; Ford et al., 2011; Geller & Derman, 2001). Preventative health behaviors should begin in one's youth when peak bone mass and bone mineral density are developed. In the United States alone, more than 53 million people have osteoporosis or are at risk of developing it. This trend is unfortunately continuing to increase in the United States and around the world. There are also some misconceptions that people in racial/ethnic groups other than White are not at risk. The loss of independence as well as complications from fractures, the presence of more than one disease or condition, and disparities in health care insurance and access make osteoporosis a public health threat.

It is important for all individuals to understand their personal risk factors in order to prevent osteoporosis or minimize the debilitating effects. Although some risk factors are modifiable or controllable, such as nutrition, physical activity, smoking and the use of alcohol, other risk factors are non-modifiable and cannot be controlled or changed, such as genetics, family history, sex at birth, race/ethnicity, ages and frame size. Individuals must be aware of the risk factors, the negative impact of osteoporosis, and have the confidence and desire to make healthy behavior choices.

This study was based on the framework that suggests that although some college-age students have knowledge of osteoporosis preventing health behaviors, they do not believe they are at risk; therefore, they do not engage in the good health behaviors that could have benefits and prevent osteoporosis in their future. These attitudes, beliefs, knowledge and behaviors were identified through a survey that combines four surveys that are based on the HBM. The study results were expected to confirm the need for college students of various racial and ethnic groups to be aware of the importance of taking proper steps to maintain or promote the health of their bones so that they can prevent osteoporosis.

CHAPTER 2

LITERATURE REVIEW

This literature review will begin with a health issue description that will explore the impact of osteoporosis in the general population as well as minority groups. The risk factors related to the prevention or development of osteoporosis will be examined. Finally, the HBM will be explained, as well as its relevance to osteoporosis prevention and relation to Bandura's research on social learning theory and self-efficacy.

Health Issue

Chronic diseases, or noncommunicable diseases such as cardiovascular disease, respiratory disease, cancer, diabetes, and osteoporosis cannot be passed between people, but these diseases can afflict individuals for long periods of time, and sometimes develop slowly, over a lifetime. According to the WHO, noncommunicable diseases were the cause of 40 million deaths each year, or about 70% of all deaths globally (WHO, 2017a). While osteoporosis is not one of the top chronic diseases, it does have a serious impact worldwide in terms of financial costs, burden to communities, and diminished quality of life for patients.

Disease Background

Osteoporosis is a bone disease that occurs when bones become thin, brittle and fragile because of loss of essential minerals and structural deterioration. The framework of bone is made up of collagen—a protein that provides shape to the bones, and calcium—a mineral that

adds strength and hardens the bone structure. The combination of collagen and calcium make bones strong and flexible. The main location (99%) of a body's calcium is in bones and teeth, with only one percent of calcium being found in the blood (Institute of Medicine [IOM], 2010; NIAMSD, 2015). The process of formation or modeling (addition of new bone) and resorption or remodeling (removal of old bone) is a continuous process throughout one's life, but new bone formation occurs at a faster rate in children and young adults than it does in later years (USDHHS, 2004). Formation allows bones to become stronger with greater BMD and with PBM being reached at about 30 years of age (Dalz, Sliwicka, Huta-Osiecka, & Nowak, 2016; Gammage et al., 2012; IOM, 2010; NIAMSD, 2015). Gammage et al. (2012) reported that 85% to 90% of PBM is reached by age 18 in girls and age 20 in boys (p. 58). Cannada (2016) referred to adolescence and young adulthood as building the "bone bank" and emphasized that only a "5% increase in peak bone mineral mass" (p. 12) during this age significantly reduces the risk of osteoporosis. After age 30, the rate of resorption and bone deterioration is greater than bone formation. According to Campbell (2012), higher peak bone mass serves as greater protection against fractures.

The development of PBM is one argument that has been made for why prevention measures should start early in life. PBM is the maximum size and strength of bones. With 92% of total body bone mineral content attained by age 18 and 99% by age 26, early intervention is considered a window of opportunity (Campbell, 2012; Greenway et al., 2015; Nachtigall et al., 2013). Bone density development is best achieved during rapid growth periods of childhood, adolescence and young adulthood (Campbell, 2012; Gammage et al., 2012). Nachtigall et al. (2013) found that prepubertal children showed an increase BMD of 4-5% because of exercise

and young athletes had higher BMD than nonathletes (p. 65). This trend continued for prepubertal girls through postmenopausal women.

Rates and Costs of Osteoporosis

In the United States, more than 53 million people either already have osteoporosis or are at high risk due to low bone mass (NIHSH, 2015). Edmonds et al. (2012) supported these numbers and suggested that one in two Americans are at risk of developing osteoporosis with almost ten million already having the disease (p. 27). As of 2005, almost 2 million osteoporosis-related fractures occurred each year at an estimated cost of almost \$17 billion (Burge, 2007; Cannada, 2016; Vasquez et al., 2013). If the trend continues, by 2025, there will be an estimated 3 million osteoporosis-related fractures annually with an estimated cost of \$25.3 billion (Burge, 2007). This claim is supported by the concerns that the cost and number of people diagnosed with osteoporosis will continue to rise over the next several decades (Clark & Lavielle, 2015; Edmonds et al., 2012; Hovell et al., 2009; Looker et al., 2017; Nguyen & Wang, 2012; NIAMSD, 2015). Ford et al. (2007) estimated costs to exceed \$60 billion by 2030. Cannada (2016), reported that the American Academy of Orthopaedic Surgeons estimated “5500 fractures occurred every day due to osteoporosis” (p. 11) and that a 50-year-old woman has a 17.5% chance of having a fracture in her lifetime (Cannada, 2016).

An International Issue

The health problems related to osteoporosis are not limited to the United States. Nielsen, Huniche, Brixen, Sahota, and Masud (2013) noted that the estimated prevalence of osteoporosis in individuals 50 years of age and older is 41% in women, 18% in men in Denmark, including one in three European women over 50 years of age experiencing fractures (p. 516). According to Elliott (2012), the National Osteoporosis Society stated that 1150 people in the United Kingdom

died in 2010 due to “osteoporotic hip fractures” (p. 30). Dalz et al. (2016) stated that osteoporosis was diagnosed in 22 million women, 5.6 million men, including 3.5 million reported fractures in the European Union (p. 63). Clark et al. (2010) identified one in 12 women and one in 20 men in Mexico as sustaining hip fractures and as the population ages, the rates were expected to increase. According to Tarride et al. (2012), Canadian numbers follow a similar trend with more hospitalizations related to osteoporosis than stroke or heart attack, and 1.3% of the 2008 healthcare budget (p. 2597). McLeod and Johnson (2011) estimated that almost two million Canadians were affected with osteoporosis in 2010.

Silent Disease

Unfortunately, osteoporosis is also called the silent disease, because the first sign or symptom of one having osteoporosis is often a bone fracture, most often occurring in hips, spine or wrists (Ford et al., 2007; Kotz, Deleger, Cohen, Kamigaki, & Kurata, 2004; NIAMSD, 2014, 2015; NIHORBD, 2016). Okumus et al. (2013) declared the loss of BMD as asymptomatic. Schoenfeld, Ng, Henderson and Wu (2010) explained that “without any visible symptoms, the disease may go undetected as bone loss continues to mount” (p. 104). Ford et al. (2007) projected the development of the disease may go undetected for decades (p. 43).

Osteoporosis is known as a disease that affects older people, but the need for bone health, awareness of controllable risk factors and prevention of this disease begins during one’s youth (Campbell, 2012; Cannada, 2016; Edmonds et al., 2012; Evenson & Sanders, 2016; Ford et al., 2011; Gammage et al., 2009; Gammage et al. 2012). Hovell et al. (2009) stated that “osteoporosis may be considered a pediatric disorder that is manifested later in life” (p. 119). Schoenfeld et al. (2010) called osteoporosis a “pediatric disease with geriatric consequences” (p. 104). The IOM and other researchers, including Lei, Chen, Xiong, Li, & Deng (2006), McCurdy

and Galindo (2009), and Wilkin, Jackson, Sims, & Haddock (2010) have written similar statements.

Burden of Osteoporosis

Not only does osteoporosis pose a financial burden, the impact of the disease affects quality of life due to pain and disability, loss of independence (Cannada, 2016; Gendler et al., 2015; Gillespie & Morin, 2016; IOM, 2010; McLeod & Johnson, 2011). In fact, Gillespie and Morin (2016) noted that only 40% of patients who have had a hip fracture return to their previous level of independence, the chances of dying at a younger age increase for 10 years after a fracture, and 10% to 20% of those with fractures die within the first year of the injury (p. 306). This is supported by Khosla et al. (2017) who stated that “more than half of the patients who experience hip fractures are permanently incapacitated and up to 20% spend time in a skilled-care nursing facility” (p. 424). Quality of life and one’s ability to continue performing activities of daily living were noted as concerns for those with osteoporosis and after fractures. Symptoms that manifested included frailty, difficulty with balance, weakness, decline in social function participation and increased concern for quality of life and overall health (Kotz et al., 2004). Vasquez et al. (2013) explained that decline in daily function and quality of life may cause individuals to no longer be able to live independently in their communities. The Bone Health Index Loss survey conducted by the National Osteoporosis Foundation (NOF) in 2016 found that independence (42%) and lost mobility (25%) were the top two leading concerns of patients with osteoporosis (NOF, 2016). The potential impact and burden to individuals as well as communities and healthcare services, have led to osteoporosis being called a public health threat (Cannada, 2016; Edmonds et al., 2012; Ford et al., 2007; Gillespie, 2016; USDHHS, 2004).

Risk Factors

The WHO (2017c) defined a risk factor as “any attribute, characteristic or exposure of an individual that increases the likelihood of developing a disease or injury” (para. 1). The IOM report (2010) acknowledged that risk factors along with disease pathophysiology are part of the “broad set of determinants of women’s health” (p. 11). Some risk factors, including sex, age, body size (thinness/small frame), ethnicity/race, and genetics/family history are considered non-modifiable, meaning that it cannot be controlled or changed. Modifiable risk factors can be controlled or changed. These include nutrition, physical activity, smoking and the use of alcohol. Researchers and governmental health agencies such as the Centers for Disease Control and Prevention (CDC), IOM, NIH report that these non-modifiable and modifiable risk factors as well as other factors including fracture history, sex hormones, eating disorders, and medication use are generally considered as possible contributors to the development of osteoporosis. It is important for individuals to recognize which of the factors may have an impact on their own risk of disease development.

Non-Modifiable Risk Factors

Genetics/family history. According to Merriam-Webster.com, genetics is defined as “a branch of biology that deals with the heredity and variation of organisms” (“Genetics”, n.d., para. 1) and family history is defined as “past occurrences (of a medical or mental health condition) in family members or past incidences (of a type of behavior) by family members” (“Family History”, n.d., para.1). The terms are related and often used together when discussing health and included in osteoporosis research (Campbell, 2012; Elliott, 2011; Geller & Derman, 2001; Gillespie & Morin, 2016; Greenway et al., 2015; Kohrt et al., 2004; Lei et al., 2006; Nachtigall et al., 2013; Sedlak, Doheny, Estok, Zeller, & Winchell, 2007). Gendler et al. (2015),

stated that 60% to 80% of variance in PBM is attributed to genetics. The 2004 *Bone Health and Osteoporosis: A Report of the Surgeon General*, estimated that 50% to 90% of postmenopausal bone loss is associated with genetics (USDHHS, 2004). Genetics or family history is the most likely predictor of one developing osteoporosis (Cauley, 2011; Gillespie & Morin, 2016). Individuals with family history of osteoporosis or fracture history have an increased perceived risk of developing osteoporosis (Clark & Lavielle, 2015).

Age. Every stage of life has the potential to impact the risk of developing osteoporosis and severity of the disease. There are great opportunities during childhood and adolescence, which have periods of rapid growth, to build BMD and PBM (Campbell, 2012). Lifestyle choices can either enhance or impair this development. Calcium is stored in bones, and the maximum potential for these stores is reached by about the age of 30 (Campbell, 2012; Cannada, 2016; USHHS, 2004). Campbell (2012) reported that up to 50% of total calcium stores in women and 2/3 of the calcium stores in men are achieved by the end of puberty. Cannada (2016) explained that building the “bone bank” (PMD) by 5% significantly decreases the risk of osteoporosis (p. 12). People who have greater PMD have greater protection from developing osteoporosis and its complications.

No new bones are formed after about the age of 20, and PBM is reached between about 20 to 30 years of age. Good bone health behaviors such as proper calcium and vitamin D intake, plus weight-bearing and muscle strengthening physical activity are recommended (Campbell, 2012; IOM, 2010; Kohrt et al., 2004). The practice of good bone health behaviors continues to be recommended for both men and women as they move into older years in efforts to minimize bone loss. Exercise not only aids in maintaining muscle mass and strength, it has been shown to help prevent falls and aid agility and balance (Campbell, 2012; Kohrt et al., 2004). As women

enter peri-menopause and reach menopause, typically between mid 40s to mid 50s, estrogen levels, which are associated with rapid bone loss and increased risk of fracture, drop (Burge, 2007; Campbell, 2012; Cannada, 2016; Gillespie & Morin, 2016; International Osteoporosis Foundation [IOF], 2015). Bone loss continues in both men and women past age 70. In the United States, the risk of falls which may result in bone fractures is the leading cause of injury in the elderly. The development of strong, healthy bones and the need for prevention of osteoporosis begin at a young age, even though the symptoms and consequences of osteoporosis are more likely to occur later in life.

Sex. It is important to clarify the purpose for including sex in the demographic survey questions. The terms sex and gender are sometimes used interchangeably, but the Merriam-Webster online dictionary has distinct definitions. Sex is defined as “either of the two major forms of individuals that occur in many species and that are distinguished respectively as female or male especially on the basis of their reproductive organs and structures” (“Sex”, n.d., para. 1). According to the American Psychological Association Publication Manual, 6th edition, “Sex is biological; use it when the biological distinction is prominent” (p. 71). Gender is defined as “the behavioral, cultural, or psychological traits typically associated with one sex” (“Gender”, n.d., para. 2). As it relates to osteoporosis, men and women are both at varying degrees of risk of developing osteoporosis, but this is based on the non-modifiable risk factor of the individual’s biological makeup at birth.

A misconception that osteoporosis affects women only may be attributed to the higher number of cases in women (Ford et al., 2007). Men and women are both at risk of developing osteoporosis. Vasquez et al. (2013) acknowledged that the rates and risk of developing osteoporosis differ among men, women and racial/ethnic groups. The NOF (2016) reported that

in 2005, only 20% of those diagnosed with the disease were men (p. 43). Being female is considered a risk factor for developing osteoporosis. The NIHORBD (2015) explained that bone loss occurs in women at a faster rate than men's loss right after menopause, and it continues into the future. The impact of bone loss begins early in life when BMD and PBM is reached. According to Campbell (2012), men's bone structure (width and size), BMD, and PBM are typically greater than those of women—women's bones have a thinner cortex and smaller diameter—therefore, the losses are considered more detrimental. Although estrogen levels in women are higher pre-menopause, these levels drop at menopause or after a hysterectomy which can cause a dramatic increase in bone loss (Campbell, 2012; Elliott, 2011; Hamrick, Cao, Agbafé-Mosley, & Cummings, 2012; IOM, 2010; Neuman, Kennelly, & Tossi, 2011). The rates of bone loss begin to equalize between men and women about five years post menopause (Campbell, 2012; IOF, 2015; Geller & Derman, 2001; Khosla et al., 2017).

Race/ethnicity. In addition to the increasing general population trends, rates of osteoporosis specifically associated with the nonwhite U.S. population are also expected to increase. Another misconception exists in nonwhite groups, including Black or African Americans and other racial/ethnic groups, is that the majority of osteoporosis cases occur in white women (Cauley, 2011; Nam et al., 2013; NIAMSD, 2015). One reason for this myth is that African American women have greater BMD than non-Hispanic white women (Hamrick et al., 2012; Lee, 2015; NIAMSD, 2015; Putnam et al. 2013; Wilkin et al., 2010). Nam et al. (2013) found that BMD was 21–31% higher in African American women and 13–23% higher in Afro-Caribbean women than U.S. White women. However, BMD was 4–7% lower among Hong Kong Chinese and South Korean women than U.S. White women (Nam et al., 2013). Lei et al. (2005) stated that “hip fracture rates were lower in Asians than Caucasians in spite of Chinese

and Japanese women having lower BMD” (p. 38). The Asian population is generally thinner and has smaller frames than other groups (Cauley, 2011; Gillespie & Morin, 2016, Nam et al., 2013). Asian women who were using bisphosphonates, a medication used to treat osteoporosis, were found to have higher fracture rates, and the rate of hip fractures is expected to increase to 25% of all fractures occurring in nonwhites by 2025 (Cauley, 2011; Wang & Chen, 2011). Burge (2007) reported that the 2005 “distribution of fractures by race/ethnicity among women reveals that whites have 89% of the total, followed by black (4%), Hispanic (4%), and other women (3%)” (p. 468). Frech et al. (2012) found that the prevalence of osteoporosis in American Indian and Alaska Native women was similar to that of White women. Burge (2007) also reported that projections for the time period between 2005 and 2025 reveal that among the nonwhite population, fractures will increase from 14% in 2005 to 21% in 2025 and overall costs will increase from 12% in 2005 to 19% in 2025.

Although fractures and measures of bone mineral density are the most common evidence of osteoporosis in all racial/ethnic groups, the consequences, specifically mortality and hospitalization, of osteoporosis-related fractures in Black or African Americans is greater (Cauley, 2011; Gillespie & Morin, 2016). The factors for this are not completely clear, but may include older age, comorbidity, or disparities in health care (Burge, 2007; Cauley, 2011). Researchers reported that Black or African American women were six times more likely to be non-ambulatory after a hip fracture than White women (Cauley, 2011; Looker et al., 2017). Danielson et al. (2012) stated that “body size and bone structure may also explain the lower numbers of fractures and osteoporosis cases in African Americans” (p. 772). Redmond, Jarjou, Zhou, Prentice, and Schoenmakers (2014) concluded that “It appears that across the world,

White populations are consistently reported to be at a higher risk of fracture than other ethnic groups” (p. 341). Hamrick et al. (2012) concluded that race may be considered as a protective factor against osteoporosis.

Modifiable Risk Factors

Gammage et al. (2012) reported that “up to 10% to 50% of bone health is attributable to controllable lifestyle factors” (p. 58). While some factors promote bone health (physical activity and nutrition), other factors may be detrimental to bone health (smoking and excessive alcohol consumption). The choice individuals make and attitudes he/she has regarding positive or negative lifestyle factors and health behaviors may make the difference between suffering negative consequences of osteoporosis and fractures or leading a healthier, more comfortable life with strong bones (Campbell, 2012; Evenson & Sanders, 2016; Gammage et al., 2012; USDHHS, 2004). Making positive lifestyle choices has been shown to counter the non-modifiable or uncontrollable risk factors (Edmonds, 2009; Edmonds et al., 2012; Elliott, 2001; Ford et al., 2011; Gammage et al., 2015; Gammage et al., 2016; IOF, 2015; IOM, 2010; Khosla, et al., 2017; Kohrt et al., 2004; Looker et al., 2017; Mullen, 2017; Nachtigall et al., 2013; NCHS, 2016; Neuman et al., 2011).

Alcohol, caffeine, smoking. Consumption of alcohol or caffeine and smoking have also been associated with increased risk of osteoporosis (Wilkin et al., 2010). Heavy drinkers may have increased bone loss and fractures due to poor nutrition and a higher risk of falling. Ishii et al. (2012) offered the following definitions for drinkers: “abstainer (no drinks), infrequent (not abstainer but one or less drink per week), light (more than one drink per week but one or less per day), or heavy (more than one drink per day)” (p. 3595). While moderate consumption of

alcohol has not been associated with negative effects on bone, some reports suggest that light consumption of alcohol may have a positive effect on bone (Nachtigall et al., 2013).

High consumption of caffeine is associated with less intake of more healthful beverages. Travison, Chiu, McKinlay, and Araujo (2011) reported that among other factors, caffeine consumption may identify racial differences in BMD. Fulgoni, Keast and Lieberman (2015) found that the use of caffeine containing products was stable from 2001 through 2010 and that about 85% to 89% of U. S. adults consumed caffeine in some form at least once daily. Coffee beverages were the main sources of caffeine at 65% of intake, with soft drinks and tea adding 15% to 17% of intake (Fulgoni et al., 2015). It was also noted by Fulgoni et al. (2015) that energy drinks containing caffeine were becoming popular and were heavily consumed by certain age groups. Cannada (2016) suggested that research was inconclusive as to the direct impact of caffeine on bone development in younger people, but that it may lead to less healthy beverage choices and increase the chance of dehydration during exercise.

Smokers tend to reach menopause earlier, which could lead to earlier bone loss and less calcium absorption (NIHORBD, 2015). It is generally noted throughout research that smoking causes loss of BMD in heavy smokers and to a lesser degree in causal smokers or by second-hand smoke (IOM, 2010; Leclaire, 2002; Lupescu & Marcov, 2016; Wright et al., 2014). Nachtigall et al. (2013) found that the negative impact of cigarette smoking can be reversed and reported that after 10 years of non-smoking, BMD increased and fracture risk decreased.

Physical activity. Physical activity can improve overall health by lowering risk for noncommunicable diseases (e.g. cardiovascular disease, some cancers, Type 2 diabetes), increasing life expectancy, managing depression and weight; it may also improve academic achievement in students. The opposite is also true, that inactive adults have a higher risk for

early death or complications from the same health issues. Physical activity can be defined in several ways, but the categories of weight bearing and non-weight bearing are most relevant to the discussion of osteoporosis. Weight-bearing refers to an activity in which the individual's body weight is the source of load for the skeletal system (Dalz et al. 2016). Kohrt et al. (2004) explained the American College of Sports Medicine 2004 "Position Statement on Physical Activity and Bone Health" definitions of weight-bearing endurance activities as "tennis; stair climbing; jogging, at least intermittently during walking, activities that involve jumping like (volleyball, basketball), and resistance exercise (weight lifting)" (p. 1985). USDHHS (2004) suggested that individuals can significantly reduce the risk of bone disease and fractures by engaging in regular physical activity. Weight-bearing physical activity is effective for building and maintaining bone metabolism and in later years, minimizes fall risks by developing bone and muscle mass and strength (Dalz et al., 2016; Greenway et al., 2012; Kohrt et al. 2004). Greenway et al. (2015) determined that weight bearing and strenuous physical activity had a positive association with higher BMD (p. 12). The WHO (2017b) webpage on physical activity included the following key facts:

Insufficient physical activity is one of the leading risk factors for death worldwide.

Insufficient physical activity is a key risk factor for noncommunicable diseases (NCDs).

Physical activity has significant health benefits and contributes to prevent NCDs.

Globally, 1 in 4 adults is not active enough. More than 80% of the world's adolescent population is insufficiently physically active. (WHO, 2017b, para. 1)

Regular participation in physical activity is necessary for the benefits to offset potential consequences. Kohrt et al. (2004) reported that benefits from physical activity were noticeably lost if exercise was stopped. Participation in physical activity has been viewed in research

studies in terms of actively engaged or inactive. The USDHHS report (2004) and other studies, suggested regular participation in physical activity declines with age, in both men and women (Edmonds et al., 2012; Geller & Derman, 2001; Khosla et al., 2017; Kohrt et al., 2004; Kotz et al., 2004; Lupescu & Marcov, 2016; Nachtigall, et al., 2013; Schmiede, Aiken, Sander & Gerend, 2007; Sedlak et al., 2007). Several organizations review trends annually, with generally consistent findings.

The CDC (2017) “Fast Facts” on physical activity reported that “some Americans are getting enough, but too many are not” (para. 1). General trends showed that only one in five adults met the current guidelines and “less than 3 in 10 high school students get at least 60 minutes of physical activity every day” (CDC, 2017, para. 1). The report also found geographical differences with adults living in the South being less active than those living in the West, Northeast and Midwest. Racial/ethnic groups were found to have varying activity levels with 23% of non-Hispanic White adults, 18% non-Hispanic Black adults, and 16% Hispanic adults meeting the guidelines for aerobic and muscle-strengthening activity. Guidelines for aerobic activity were met by 54% of men and 46% of women, plus higher numbers of younger adults. Finally, the CDC report observed that adults with more education and family income above the national poverty line were more active.

The President's Council on Fitness, Sports and Nutrition (PCFSN) has been part of the Department of Health and Human Services since 1956. The mission is to “engage, educate, and empower all Americans to adopt a healthy lifestyle that includes regular physical activity and good nutrition” (PCFSN, 2017, para. 1). Most recent facts and statistics reported in January 2017 showed that only one in three children and one in three adults met recommended guidelines for daily and weekly activity while less than 5% of adults engaged in 30 minutes or more of daily

activity. It was further explained that more than 80% of adults did not meet the guidelines for both aerobic and muscle-strengthening activities, and more than 80% of youth did not meet the guidelines for aerobic activity (PCFSN, 2017; United Health Foundation, 2017). The overall national average for physical activity was reported at 51.6% but 28% of Americans were inactive. Specific investigation of elderly found that “only 35–44% of adults 75 years or older are physically active, and 28–34% of adults ages 65–74 are physically active” (PCFSN, 2017, para. 3).

Several fitness industry associations form the Physical Activity Council, (PAC), which produces an annual report on physical activity. The 2017 report reviewed participation in 118 types of physical activity (PAC, 2017). Overall findings, Figure 2, showed that fitness and team sports gained participation and one third of the total population engaged in healthy levels of activity (PAC, 2017, p. 6). Generations including Millennials, Gen X, and Baby Boomers, Figure 3, were most engaged in fitness related activities.

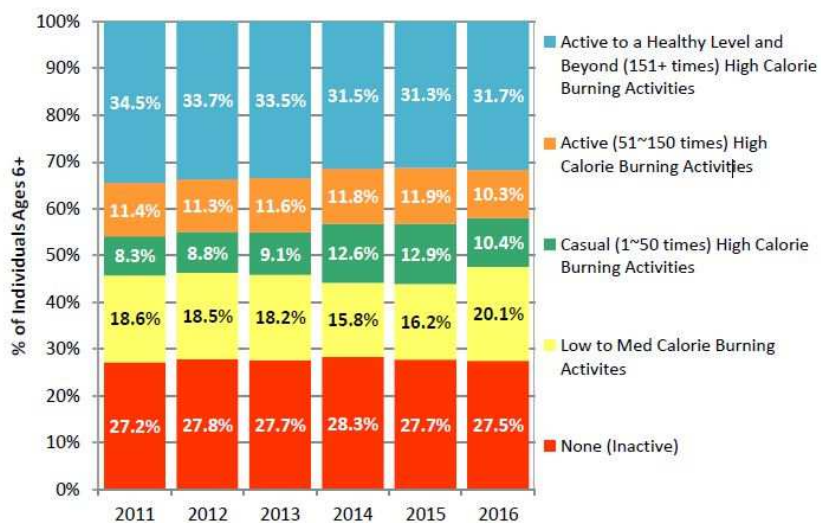


Figure 2. Five years of individuals age 6 and older and their level of activity by percentage from no activity to healthy levels of activity. Physical Activity Council. (2017). 2017 Participation report. Retrieved from <http://www.physicalactivitycouncil.com/>, p. 6. Reprinted with permission.

Participation by Generation

A look at activity levels by generation

Participation Rates Segmented by Generations

US Population, Ages 6+

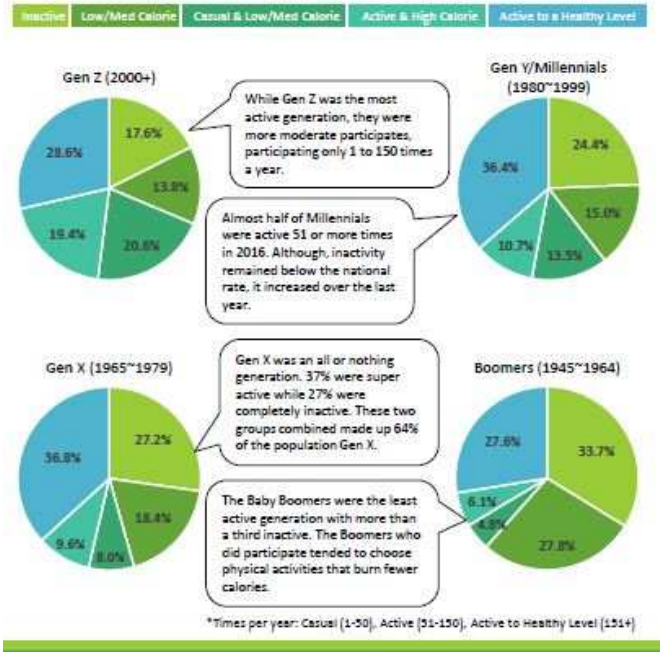


Figure 3. Activity levels by generation. 2017 Physical Activity Council Report, p. 8. Reprinted with permission.

The PAC report, Figure 4, also found that 27.5% of the population (about 81 million) was completely inactive (PAC, 2017, p. 11). This report showed similar findings from other organizations in that levels of physical activity decreased with age.

2011 – 2016 Inactivity by Age

Overall inactivity levels in the US

Inactivity Rates Segmented by Age

US Population, Ages 6+

The decrease of inactivity spread itself across most the age groups. Age segment 35 to 44 remained flat from 2015, while the following two age segments, ages 45 to 64, showed the most one year decline in inactivity rates than any other age segment. The youth age groups had slight decreases and still maintained the lowest inactive rates.

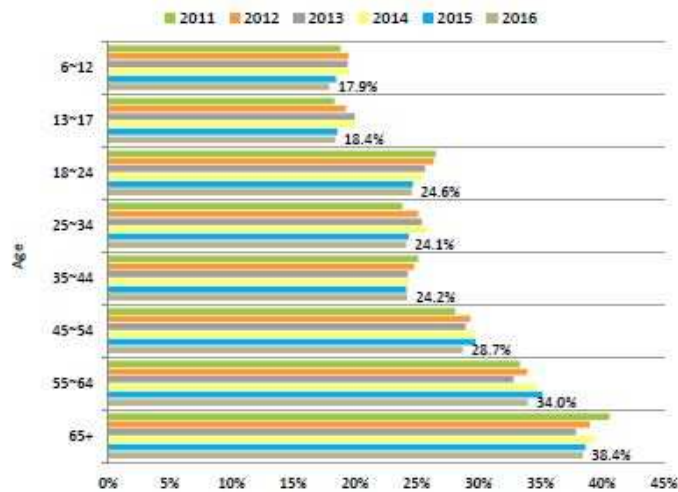


Figure 4. Inactivity rates segmented by age. 2017 Physical Activity Council Report, p. 12. Reprinted with permission.

The IOM (2010) found that rates of physical activity decreased over the past 50 years. This was attributed to Americans walking less and driving more because of infrastructure and longer work commutes; less access to parks and recreation facilities; less physically demanding work; less time to spend on dedicated fitness activities because of longer work hours, longer commutes, and increased household and family demands. Several researchers have found that women identified barriers to physical activity that included time constraints, fear of safety or pain, lack of knowledge or access to facilities, lack of encouragement or confidence (Dalz et al.,

2016; Edmonds, 2009; Elliott, 2011; Greenway et al., 2012; Greenway et al., 2015; Hovell et al., 2009; Kohrt et al., 2004; Nachtigall et al., 2013; Turner, Wallace, Hunt, & Gray, 2003; Vasquez et al., 2013; Wilkins et al., 2013).

In spite of the perceived barriers, there is vast support and information for encouraging individuals of all ages to engage in regular physical activity. In only 0.84 seconds, a Google search generated almost 764,000 results for the phrase *Why physical activity is important for osteoporosis*. Many credible government organizations including the WHO, CDC, several divisions within the USDHHS; professional and industry groups like the American College of Sports Medicine, Society of Health and Physical Educators, Society of Public Health Educators, and businesses support the efforts to encourage regular participation in physical activity.

Nutrition. There are many aspects of nutrition that play a role in the prevention of osteoporosis. According to information gleaned from the United States Department of Agriculture's (USDA) Choose My Plate website (USDA, 2015a) and Dietary Guidelines (USDA, 2015b), about half of all American adults have one or more chronic diseases which are often related to poor diet. The 2015–2020 Dietary Guidelines emphasize the importance of having variety in foods and beverages that are healthy and nutritious, in addition to being reflective of individual “preferences, culture, traditions, and budget” (USDA, 2015a, para. 1). Healthy eating patterns are important for maintaining good overall health and reducing the risk of disease. These healthy eating patterns should include a variety of choices from fruits, vegetables, grains, dairy, and protein categories which have limit saturated fat, sodium, and added sugars (USDA, 2015a). Rolfes et al. (2009) supported the need for variety by stating that “clearly, a well-balanced diet that depends on all the food groups to supply a full array of nutrients is central to bone health” (p. 436). They also explained that calcium and vitamin D

have been the primary focus in research, but other nutrients play important roles. In addition to calcium and vitamin D, which are two of the most important nutrients for developing and maintaining healthy bones, vitamin K, potassium, vitamin A, and Omega-3 fatty acids are important for bone strength and integrity, which minimize BMD, bone loss, and risk of fractures.

Bones are made of “a dense web of protein, fibers, and calcium” (U.S. Preventive Services Task Force, 2013, para. 2). The human body cannot produce enough calcium by itself and it is lost on a daily basis, so it must be consumed in order to have proper levels available for many body functions including bone health (Kessenich, 2008). In the United States, dairy products including milk, yogurts and cheeses, are the primary source of calcium. The USDA provides Dietary Guidelines for Americans and a food guidance system, currently ChooseMyPlate, to provide direction for citizens regarding proper nutrition intake (USDA, 2015a). Current recommendations suggest that three cups or the equivalent of dairy products each day can improve bone mass (USDA, 2015b). According to Edmonds et al., (2012),

inadequate intake represents zero to four servings of calcium a week. Moderate intake represents five servings of calcium a week to one serving of calcium a day. Adequate intake represents two servings to three servings of calcium a day. (p. 76)

Rolfes et al. (2009) suggested that daily intake of calcium be 1000 to 1200 milligrams. This is also supported by the Academy of Nutrition and Dietetics, CDC, NIHORBD, and USDA. The 2016 NOF survey found that 89% of participants understood the importance of calcium intake as an important factor for reducing the chances of developing osteoporosis. In a study reported by Evenson and Sanders (2016), young adult participants had an average daily calcium intake of about 1078 mg. Edmonds et al. (2012) established that although college students in their study identified good food sources of calcium being “cheese (89.0%), broccoli (50.8%),

yogurt (87.1%), and ice cream (66.2%), only 23.5% were able to identify alternative sources of calcium like sardines” (p. 30). Gammage et al. (2009) found that women identified with high dietary restrictions had lower calcium intake than those with low dietary restrictions. Later, Gammage et al. (2012) reported that college-aged women identified greater barriers to consuming calcium than college-aged men.

The average daily calcium intake and knowledge varies among racial/ethnic groups as well as geographically defined groups. Clark et al. (2010) reported that Mexican adults consumed less calcium than current international recommendations. McLeod and Johnson (2012) reported that Canadian adult participants agreed with the importance of calcium intake, but did not actually consume recommended levels. A national survey from 2006 found that Chinese adults consumed less than 35% of the daily calcium intake of western adults (Lei et al., 2006). When Ford et al. (2011) compared U.S. and Chinese college students, they found that U.S. students scored higher in identifying calcium rich foods; Chinese students had greater perceived barriers to calcium rich foods, and both groups had lower than recommended intake of daily calcium. In yet another study, Danielson et al. (2013) found that Japanese women had lower daily calcium intake than African American or Chinese participants. Greenway et al. (2015) found that Australian premenopausal adult women consumed only 66% of the recommended daily intake of calcium. Okumus et al. (2013) reported that both premenopausal and postmenopausal women in Turkey were able to identify foods rich in calcium, and although all had low calcium intake, premenopausal women consumed less than postmenopausal women. In contrast, Frech et al. (2013) found that almost 50% of American Indian and Alaskan Native survey participants consumed more than the daily calcium recommendations.

One component of dairy products is lactose, a natural sugar found in milk and other dairy products. Lactase is an enzyme produced in the intestines which aids the digestion of lactose. When individuals do not produce enough lactase, they may be called lactose intolerant. While it is common for adults not to regularly produce enough lactase, some racial and ethnic groups have higher rates of lactose intolerance. Black/African Americans, Hispanic, American Indian and Asian Americans are more prone to be lactose intolerant than White Americans (NIHORBD, 2016). Rolfes et al. (2009) estimated the prevalence of lactose intolerance at “more than 80% of Southeast Asian, 80% of Native Americans, 75% of African Americans, 50% of Hispanics, 20% of Caucasians and less than 10% of Northern Europeans” (p. 111). While assumptions have been made that if individuals with lactose intolerance avoid calcium rich dairy products, they will have an increased risk of osteoporosis; research has been inconsistent in determining the effects of lactose intolerance, calcium intake and the risk of low bone density (Evenson & Sanders, 2016; Geller & Derman, 2001; Kessenich, 2008; National Institute of Diabetes and Digestive and Kidney Diseases [NIDDKS], 2014; NIHORBD, 2015; NOF, 2004).

Vegetarians are another group of individuals that are at risk of lower-than-recommended daily calcium intake. According to the Academy of Nutrition and Dietetics (2016), there are various categories of vegetarians which are based on the types of foods consumed or avoided. A lacto-ovo vegetarian does not eat meat, fish or poultry. A lacto-vegetarian would not eat eggs. A vegan does not use any animal-based products—including foods, honey and sometimes not even shoes or clothing. Appleby et al. (2007) found that vegans had a higher risk of fracture than vegetarians, meat eaters and fish eaters. They concluded that regardless of dietary preference, it is important to consume proper amounts of calcium to minimize fracture risk.

With the established role of calcium in osteoporosis prevention, it is important that it be included in diets of individuals of all ages. In addition to milk and dairy products, many foods are good sources of calcium and other food and beverages are fortified with calcium, meaning that calcium was added. Kessenich (2008) recommended that foods that naturally have calcium be the primary source, but that calcium-fortified (calcium added) foods or beverages provide good alternative sources. Kessenich (2008) also reported sources of calcium such as bottled water fortified with calcium or mineral water with calcium or chocolate. Additional sources of calcium are dark green leafy vegetables (broccoli and kale), figs, legumes, some nuts (almonds), sesame seeds or tahini (sesame paste), tofu, or calcium-fortified drinks (Appleby et al., 2007; Rolfes et al., 2009). Geller and Derman (2001), and later Grey and Bolland (2015), challenged the notion that use of calcium and vitamin D supplements, not in the form of foods or beverages, was advantageous and cited other studies that did not find proof of expected benefits such as reduced fracture risk. The general consensus in research and on credible organization websites is to encourage individuals to consume food sources of calcium at the recommended daily levels.

Vitamin D plays an important role in helping the body absorb calcium, and as previously noted, vitamin D and calcium are discussed together regularly in research. However, vitamin D is not considered an essential nutrient as it is naturally produced by the body when exposed to sunlight (Rolfes et al., 2009). It may also be ingested from foods like egg yolks, some fishes, milk, mushrooms, and other fortified items like cereals and orange juice. However, Appleby et al. (2007) suggested, “dietary vitamin D intake is a poor indicator of overall vitamin D status because the majority of vitamin D is produced by the action of sunlight on the skin” (p. 1405). Vitamin D is sometimes called the “sunshine vitamin” (Corliss, 2014, p. 1; Harvard Women’s Health Watch, 2008). MacDonald et al. (2011) examined the association between limited sun

exposure due to higher latitudes or limited time outside and vitamin D deficiency. They explained that “there is insufficient intensity of sunlight at appropriate wavelengths to enable cutaneous synthesis of vitamin D from October to March, inclusive” (p. 2462). The Harvard article included the following map of the United States, Figure 5, which showed the dividing line for adequate sun exposure.

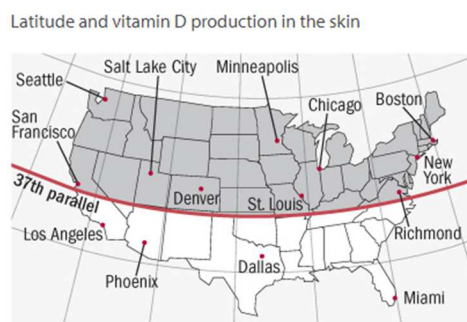


Figure 5. Latitude of sun exposure to produce vitamin D. Harvard Women's Health Watch. (2008). Time for more vitamin D. Retrieved from <http://www.health.harvard.edu/staying-healthy/time-for-more-vitamin-d>

Vitamin D is a fat-soluble vitamin; therefore, it can be accumulated and stored in the body. MacDonald et al. (2011) found seasonal variations in vitamin D levels in Caucasian women, with higher values in the summer than winter or spring. Cannada (2016) attributed lower levels of vitamin D in children to increased indoor screen time such as television. Frech et al. (2012) did not find lower vitamin D values in American Indian subjects than those in other racial/ethnic groups. It has been reported that African American individuals may have lower values of vitamin D due to reduced synthesis because of darker skin pigment (Rolfes et al., 2009). The challenge with having enough sun exposure for vitamin D synthesis is the negative impact of over exposure to the sun. Rolfes et al. (2009) suggested as little as five to 10 minutes, two to three days per week, yet individuals with darker skin may need as much as three hours of sun exposure to generate similar vitamin D levels that lighter skinned people can generate in

about 30 minutes (p. 380). Freedman et al. (2015) and Redmond et al. (2014) reported similar findings. As was discussed with calcium and the merits of supplementation, similar discussions have disputed the benefits of vitamin D supplementation and encouraged the consumption of foods rich in vitamin D (Grey & Bolland, 2015; IOM, 2010; Kanis et al., 2012; U.S. Preventive Services Task Force, 2013).

Screening

Osteoporosis screening increases the likelihood of an individual taking preventative measures. White, non-Hispanic Asian and Hispanic women were more likely to undergo screening than non-Hispanic black women. Personal net worth and comorbidity increased the likelihood of women in all groups to also have osteoporosis screenings (Cauley, 2011; Gillespie & Morin, 2016). Yet another misconception that osteoporosis is primarily a disease affecting elderly White women is dispelled by the Geller and Derman (2001) study of minority women's risk factors for osteoporosis. Geller and Derman (2001) also found that although African American and Hispanic women had more bone mass, bone loss patterns were similar in all groups at five years after menopause. This would indicate that the need for screening and prevention measure within the African American and Hispanic groups is just as important as it is for Whites (Geller & Derman, 2001). Of interest and a potential issue with the usual recommendations for calcium is that African Americans and Hispanics are more likely to be lactose intolerant; therefore, they consume less calcium rich foods, which are primarily dairy based in the United States (Appleby et al., 2007; Gammage et al., 2009; Rolfes et al., 2009).

Health Belief Model

The theoretical basis for this study, the HBM, was developed by social psychologists Rosenstock, Hochbaum, Kegeles, and Leventhal during 1950s while working in the U.S. Public

Health Services (Mattson, 2014). Rosenstock added the self-efficacy component in 1984 (Mattson, 2014). Health behavior theories or health behavior change models were developed to assist individuals or groups make positive health behavior changes and adhere to interventions (USDHHS, 2004). As Carpenter (2010) explained, the original goal of the HBM was to “focus the efforts of those who sought to improve public health by understanding why people failed to adopt preventive health measure” (p. 661). Four variables are included in the HBM which are used to predict individuals’ behaviors. The first two variables, susceptibility and severity, are related to individuals’ perceptions of negative health outcomes; while the other two variables, benefits and barriers, are related to individuals’ perceptions of target behaviors as related to reducing negative health outcomes (Carpenter, 2010; University of Twente, 2017). Carpenter (2010) also explained that the original HBM included an expectation of a “cue to action” (p. 662), which was described as an internal or external prompt to engage in a preventative health behavior. Oliver and Berger (1979) offered an explanation of the HBM which included three factors: benefits-barriers; perceived threat with susceptibility and severity; and a cue to action including normative influences.

The HBM suggests that an individual’s perception of the risk (perceived threat) of developing a health condition or disease determines the chances of that person participating in disease detection, engaging in healthy behaviors and taking preventative measures (Edmonds, 2009; Evenson & Sanders, 2015; Gammage et al., 2012). The theory holds that perceived threat is influenced by how likely people feel it is that they will develop the disease (perceived susceptibility) and also perceived severity, the seriousness of the disease (Edmonds, 2009; Gammage et al., 2012). When describing the HBM, Evenson and Sanders (2015) explained that when an individual perceives that the benefits of change are perceived greater than the costs,

most people will take action. In other words, if individuals believe they are more likely to develop a disease or negative health condition, they are more likely to engage in preventative practices or take preventative measures. If individuals believe the severity is greater, they are more likely to avoid the disease or negative health condition. According to the HBM, the opposite also holds true. If individuals do not feel they will develop a disease or negative health condition or do not feel the consequences will have much impact on their life, they are less likely to be motivated to engage in preventative practices or take preventative measures.

In addition, individuals must believe that the benefits of participating in disease detection, engaging in healthy behaviors and taking preventative measures (perceived benefits) must be greater than the perceived barriers of such practices (Gammage et al., 2012). Benefits or barriers to minimizing negative health outcomes were more important to individuals when considering taking preventative steps than when considering treatment for an existing condition or disease (Carpenter, 2010). However, Carpenter noted that if the barriers were perceived to be too great, individuals were unlikely to engage in preventative behaviors. Such barriers were thought to be too expensive, too painful, too challenging or inaccessible (Carpenter, 2010). The constructs of knowledge, attitude, beliefs, demographics and social support as well as self-efficacy and health motivation are thought to influence action of preventative health behaviors (Evenson & Sanders, 2015). Self-efficacy and health motivation were added to the expanded HBM (Sedlak et al., 2007).

The concept of self-efficacy relevant to this study was introduced by Bandura's social cognitive theory in 1986, which was designed to predict and explain behaviors. In Bandura's words, "Self-efficacy is defined as people's beliefs about their capabilities to produce designated levels of performance that exercise influence over events that affect their lives. Self-efficacy

beliefs determine how people feel, think, motivate themselves and behave” (Bandura, 1994, p. 1). Self-efficacy is the belief in one’s ability to influence events that affect one’s life and the ability to control the way these events are experienced (Bandura, 1994; Buchanan, 2016; Gammage et al., 2012). Another supporting definition is that “self-efficacy (or efficacy expectations) is the perceived ability to achieve an outcome through one’s own action” (Thompson, Dorsey, Miller, & Parrott, 2003, p. 481). The level of self-efficacy an individual has determines the amount of effort and level of performance put into a positive behavior (Leclaire, 2002). Self-efficacy is also related to one’s “perception of how his or her actions influence and are influenced by the environment” (Thompson et al., 2003, p. 481). Thompson et al. (2003) explained that self-efficacy also considers one’s belief in his or her ability to stop or deter a threat or encourage positive behavior. Not only must one believe one has the ability to make a behavior change, he or she must want to do so. This is called motivation.

As viewed through the social cognitive theory, a person is motivated based on the outcome expectation and efficacy expectation (Leclaire, 2002). Health motivation is defined as “processes of choice, need for competency, and self-determination in one’s health” (Xu, 2009, p. 20). Gammage et al. (2012) added that health motivation is “the value or incentive of overall health” (p. 59). Thompson et al. (2003) explained that motivation is closely related to self-efficacy, and may be positively or negatively affected by one’s previous success or failure of “knowing how to do something, . . . having tried something and previously failed . . . or feeling inhibited about doing something” (p. 482). In summary, if persons are to actually make behavior changes, they must perceive a benefit of the change, have a sense of self-determination to make the change, have high self-efficacy in their ability to make the change, and as associated with self-efficacy, expect to be successful.

As with any theoretical model, there are limitations. Carpenter (2010) and Edmonds et al. (2012) stated that perceived barriers and perceived susceptibility were thought to be powerful components of the model while perceived severity was the least powerful. Carpenter (2010) discussed the timing of variable measurements. He explained that when the length of time between measuring variables and measuring a predicted behavior was longer, the likelihood of finding effects decreased (p. 667). A cue to action or a message from other sources could have also influenced the individual's belief (Carpenter, 2010). Figure 1 on page 7 shows a diagram of the HBM.

The terms knowledge, attitudes, beliefs, and behaviors are commonly used in health-related research. The Merriam–Webster online dictionary defines knowledge as “the fact or condition of knowing something with familiarity gained through experience or association” (“Knowledge”, n.d., para.1). Knowledge is gained through experiences including education and life experience and may be measured through direct assessment tools. Attitude and belief are more difficult to measure through direct assessment tools and are most often determined by directly questioning a study's participants (Lovelace & Brickman, 2013). While the terms attitude and belief may sometimes be used interchangeably in writing, they are in fact distinct as the following Merriam–Webster definitions state. Attitude is defined as “a feeling or emotion toward a fact or state” (“Attitude”, n.d., para. 4). Thompson et al. (2003) stated “Attitudes are positive or negative evaluations of a person, object or event” (p. 485). As contrasted with attitude, belief is defined as “a conviction of the truth of some statement or the reality of some being or phenomenon especially when based on examination of evidence” (“Belief”, n.d., para. 2). Thompson et al. (2003) defined belief as “thoughts about a person, object, or event that are either true or false” (p. 486). Thompson et al. (2003) clarified how attitudes and beliefs are

linked in offering that “a person’s total set of salient beliefs, not just one, determine his or her attitude toward a behavior” (p. 486). The term perceive is used in this study’s survey questions and is defined by Merriam-Webster as “to attain awareness or understanding of” (“Perceive”, n.d., para. 1). A goal of health promotion efforts, in addition to increasing awareness and informing, is for individuals to voluntarily make behavior changes by adopting positive health behaviors or minimizing behaviors that are detrimental to good health. In other words, an individual must have the knowledge, as well as the right attitude, belief, and perceived value, to engage in a behavior. When all of these are in place, we may say that a person is motivated to act, which is necessary for one to have a strong sense of self-efficacy and health motivation.

Applying the HBM to the study of osteoporosis showed that perceived susceptibility was low and that college women were more concerned with developing breast cancer, diabetes or heart disease than osteoporosis. In addition, the perceived threat and perceived severity of developing osteoporosis were low (Edmonds, 2012; Ford et al., 2011; Gammage et al., 2009; Geller & Derman, 2001). Similar perceptions exist in African American and Hispanic women (Clark & Lavielle, 2015; Geller & Derman, 2001). Therefore, the low perceptions and belief that osteoporosis is a disease of elderly white women may lead younger women as well as African American and Hispanic women of all ages to believe they are not susceptible and be less likely to engage in healthful and preventative behaviors (Clark & Lavielle, 2015; Edmonds, 2009; Ford et al., 2011; Geller & Derman, 2001). The HBM contends that addressing osteoporosis prevention at younger ages may minimize the impact of osteoporosis or osteoporosis-related fractures as one ages and supports the need for action, more so than just increasing awareness. The challenge health educators and medical providers face when encouraging premenopausal women to engage in positive health practices that relate to osteoporosis is that, although these

younger women do have knowledge of osteoporosis, they do not believe they are threatened by the disease; therefore, they do not believe they need to engage in such preventative measures (Clark & Lavielle, 2015; Edmonds, 2009; Evenson & Sanders, 2016; Ford et al., 2011; Gammage et al., 2012; Gammage et al., 2015).

Summary

The conclusion one may make regarding osteoporosis after reading this literature review should be that although it may be a debilitating disease that strikes without notice, there are a number of criteria that are important to be aware of and health behaviors that may prevent or minimize the impact of the disease. As a chronic disease, osteoporosis continues to contribute to the large worldwide number of deaths that are attributed to chronic diseases. The evidence shows that osteoporosis is a preventable disease if youth build their peak bone mass throughout childhood, adolescence, and into their young adult life, or by about age 30. Individuals should not only know the general information about non-modifiable and modifiable risk factors, they should also be aware of their personal non-modifiable and modifiable risk factors. Although certain non-modifiable risk factors like sex and race/ethnicity increase the likelihood of one developing osteoporosis, the research showed that both men and women, and non-White race/ethnic groups can develop the disease, and that genetics is the highest predictor of disease development. If one does have non-modifiable risk factors, it is even more important to engage in healthy behaviors and pay attention to modifiable risk factors. Of these modifiable risk factors, physical activity, nutrition, screening, and use of alcohol and tobacco play an important role in reducing the development of osteoporosis. Regular physical activity is associated with lowering risk of developing chronic, noncommunicable diseases, and improving overall physical and mental health, increasing life expectancy, and improving academic achievement.

Specifically, weight-bearing activities help build bone and muscle mass, which are important for overall bone health and lowering fall and fracture risks. The opposite is also true; the gains of being physically active are diminished by inactivity. Poor diet is also associated with chronic, noncommunicable diseases, while healthy eating patterns are beneficial for many of the same reasons that physical activity are important. Specifically, a well-balanced diet is important for overall health and good bone health. It is important for good eating habits to be established early in life so that individuals know good food sources of calcium, consume enough of such calcium-rich foods, and minimize less healthy food choices. Research has established the importance of having enough exposure to sunlight to produce vitamin D, which aids calcium absorption.

For health promotion and medical professionals, it is important to understand the attitudes and beliefs of individuals' or groups as related to a disease, like osteoporosis, in order to design effective health communication efforts and health campaigns. Following a theory such as the HBM that addresses the perceived benefits and barriers of engaging in preventative behaviors or screenings as well as the perceived susceptibility and severity of osteoporosis may lead to meaning behavior changes. The premise behind this theory is that individuals must weigh their risk and the seriousness of a negative health outcome against the effectiveness and obstacles to participating in a target, disease preventing behavior. If the risk and seriousness are great enough, an individual is more likely to engage in the healthy behaviors. In addition, self-efficacy or feelings of confidence in one's ability, as well as motivation to act must be present in order for one to engage in healthy behaviors. Effective campaigns are those that not only increase awareness and knowledge, but encourage behavior change. Knowledge, beliefs, attitudes, and actually taking part in healthy behaviors is ultimately up to the individual, but when health

promotion and medical professionals understand these, they are more able to encourage individuals to make healthy lifestyle choices.

The issue of osteoporosis is beginning to be addressed in articles and by organizations as related to college students and younger people, as well as various racial/ethnic groups. This may be due to the understanding that earlier intervention, or development of osteoporosis preventing behaviors in young people will build their bone banks by improving BMD and PBM and be a step in the right direction of reducing the number of people developing this disease in their later years. Health education and health promotion efforts often focus on increasing awareness and knowledge of health issues. Although it is very important for younger individuals to be more aware of osteoporosis, understand the causes, as well as the individual risk factors and intervention strategies, it is equally important to increase the level of belief that this is an important issue in terms of each of the HBM subscales and to convert this belief into actual osteoporosis preventing behaviors. In addition to convincing young people that osteoporosis should be a current issue of importance, health promotion professionals also need to believe that osteoporosis should be addressed in young people. The benefits of increased physical activity and calcium intake are many, and not exclusive to the prevention of osteoporosis.

CHAPTER 3

METHODOLOGY

Osteoporosis is a bone disease that can affect women and men of any race or ethnic group in older years but can be prevented by individuals engaging in healthy behaviors beginning in their youth. The purpose of this study was to explore the differences in knowledge of osteoporosis, health beliefs regarding osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of osteoporosis-preventing activities among college students of various racial/ethnic groups. The study was submitted to the Institutional Review Board of the Indiana State University (ISU) and Eastern Illinois University (EIU) for review. Students from EIU were invited to participate, while ISU was the location of my academic program. Approval from both institutions was obtained prior to the start of data collection.

Research Questions and Hypotheses

The following research questions and hypotheses explored the differences in knowledge, beliefs and attitudes of osteoporosis; the self-efficacy to perform osteoporosis-preventing activities, and the actual performance of osteoporosis-preventing activities among college students as defined by race or ethnicity and sex.

1. Do significant differences regarding osteoporosis knowledge exist among racial/ethnic groups of college students?

H₀1: There are no statistically significant differences among racial/ethnic groups in osteoporosis knowledge for women.

H₀2: There are no statistically significant differences among racial/ethnic groups in osteoporosis knowledge for men.

H₀3: There are no statistically significant differences between men and women in osteoporosis knowledge.

2. Do significant differences regarding osteoporosis attitudes exist among racial/ethnic groups of college students?

H₀4: There are no statistically significant differences among racial/ethnic groups in osteoporosis attitudes for women.

H₀5: There are no statistically significant differences among racial/ethnic groups in osteoporosis attitudes for men.

H₀6: There are no statistically significant differences between men and women in osteoporosis attitudes.

3. Do significant differences regarding self-efficacy to perform osteoporosis prevention measures exist among racial/ethnic groups of college students?

H₀7: There are no statistically significant differences among racial/ethnic groups in self-efficacy to perform osteoporosis-preventing activities for women.

H₀8: There are no statistically significant differences among racial/ethnic groups in self-efficacy to perform osteoporosis-preventing activities for men.

H₀9: There are no statistically significant differences between men and women in self-efficacy to perform osteoporosis-preventing activities.

4. Do significant differences regarding performance of osteoporosis prevention measures exist among racial/ethnic groups of college students?

H₀10: There are no statistically significant differences among racial/ethnic groups in actual performance of osteoporosis-preventing activities for women.

H₀11: There are no statistically significant differences among racial/ethnic groups in actual performance of osteoporosis-preventing activities for men.

H₀12: There are no statistically significant differences between men and women in actual performance of osteoporosis-preventing activities.

Design

This quantitative, inferential study surveyed a sample of students attending a small four-year Midwestern university. Quantitative studies examine variables in numerical ways. By organizing and summarizing raw data through the use of descriptive statistics, patterns are identified and conclusions are made (Krathwohl, 2009). Inferential statistics are used to support or disconfirm “evidence for a hypothesis” (Krathwohl, 2009, p. 433). In addition, as these statistics are applied to a sample, estimates can be made for a larger population. In other words, the conclusions reached are inferred or judged through probability of being valid, beyond the sample to a general population with similar characteristics (Krathwohl, 2009; Leedy & Ormrod, 2013). This study examined the differences in means of various race or ethnic groups using analysis of variance (ANOVA) and independent-samples *t* test. ANOVA is preferred as several pairs of means will be analyzed. As stated by Krathwohl (2009), “the logic used by analysis of variance involves deriving two estimates of the population variance: first, an estimate that includes the effect of the one or more variables, and second, an estimate which is free of it” (p. 467). If differences exist in knowledge of osteoporosis, health beliefs and attitudes regarding

osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of osteoporosis-preventing activities among college students of different racial/ethnic groups, osteoporosis health education may be best tailored to different racial/ethnic groups, men, or women. The intention of such education would be to increase knowledge of osteoporosis and encourage prevention measures for students in specific racial/ethnicity groups.

Population Sample

This study was limited to university students at EIU. General demographic questions included age, race/ethnicity identification, sex (at birth), and declared major. It was the hope that the distribution of participants reflected that of the general student demographics of the university. Although declared major was not related to the research questions per se, gathering these data helped provide a fuller understanding of the representativeness of the sample.

Each fall, the EIU Office of Planning and Institutional Research prepares a report of student data, Databook, which is reported in various ways and based on 10th day of fall enrollment. The fall 2016 demographics were reported by student initial entry type as 60.4% female students and 39.6% male students (EIU, 2017). Table 1 shows the distribution of students by racial/ethnic group that was reported by the students. The fall 2016 Databook reported enrollment by degree program including over 90 separate programs. These programs are operated within approximately 30 academic units. Table 2 shows the percent of majors or programs within the academic units based on the total fall 2016 enrollment. It was my hope that the survey participant distribution for the current study reflected this general enrollment distribution of EIU in terms of age, racial/ethnic identification, sex (at birth), and declared major.

Table 1

EIU Student Distribution by Racial/Ethnic Group and Sex

Group	% Female	% Male	% Total
American Indian or Alaska Native	0.16	0.10	0.26
Asian	0.70	0.32	1.02
Black or African American	9.90	6.70	16.60
Hispanic or Latino	3.60	2.40	6.00
International or Non- Resident Alien	2.30	3.60	6.80
Multiple/Two or More	1.30	0.74	2.04
Native Hawaiian or Pacific Islander	0.01	0.05	0.06
Unknown/Not reported	1.30	0.73	2.03
White	41.20	24.90	66.10

Note. Percentages calculated from the fall 2016 Databook table: “Students by Level, Time Status, Ethnicity and Gender”

Table 2

EIU Student Distribution by Majors within Academic Units

Academic Unit	%
Art	2.70
Biological Sciences	5.50
Business	9.40
Chemistry	0.71
Communication Disorders & Sciences	2.20
Communication Studies	5.40
Counseling and Student Development	1.40
Early Childhood, Elementary, and Middle Level Education	6.10
Economics	0.84
Educational Leadership	3.20
English	1.80
Family and Consumer Sciences	5.80
Foreign Languages	0.32
General Studies	5.00
Geology/Geography	0.61
Health Studies	1.70
History	3.00
Journalism	0.96
Kinesiology and Sports Studies	8.10
Mathematics & Computer Science	0.98
Music	1.90
Nursing	0.55
Philosophy	0.12
Physics	0.22
Political Science	1.67
Psychology	5.30
Recreation Administration	0.84
Social Science Studies	0.16
Sociology/Anthropology	2.60
Special Education	2.50
Technology	7.10
Theatre Arts	0.38
Undecided/Undeclared	9.00

Note. Percentages calculated from the fall 2016 Databook table: “Students by Major, Level, Time Status, Ethnicity and Gender”

Recruitment

Students who were identified through university enrollment management and confirmed as being currently enrolled with a valid university email address were invited to participate in the study. An email message included the following information:

- A letter with an explanation of the study (Appendix A). The explanation was brief and highlighted the purpose, qualification of participants, voluntary participation, instructions for completing the questions and estimated completion time. This explanation also included a statement regarding the potential risk or non-risk and the available dates of the study.
- A consent form (Appendix A). The consent form included the explanation that was included in the letter as well as information related to data-collection procedures, data security, and steps taken to ensure participants confidentiality. Also included was a disclaimer that while all measures will be taken to ensure anonymity, absolute anonymity could not be guaranteed with online Internet-based surveys, as required by the Eastern Illinois University and Indiana State University Institutional Review Boards. A statement reminded subjects that participation was voluntary and that subjects could withdraw from participation at any time was also included.
- A web link to access the Qualtrics questionnaire (Appendix B).

In an effort to increase the response rate, promotional messages were posted on social media platforms used by university health education programs (Appendix C). Following social media marketing strategies, viewers were encouraged to participate and to share the social media posts. These messages were also shared by the author and colleagues through personal social media accounts and email. These efforts were included and approved in the IRB request.

Instrumentation

The choice to use a survey for this study was based on the fact that the survey instruments had been previously used by other researchers in osteoporosis studies. Moreover, a survey was most suited to providing the data necessary to answering the research questions associated with this study. The purpose of these surveys was to generalize sample findings to a population. The criteria of external generality are met by the instruments selected for this study (Krathwohl, 2009). A questionnaire was created by combining several existing surveys that were previously validated and found reliable. Demographic information was also included. Permission was granted to use the Osteoporosis Health Belief Scale (OHBS), the Revised Osteoporosis Knowledge Test (OKT), Osteoporosis Preventing Behaviors Survey (OPBS), and the Osteoporosis Self-Efficacy Scale (OSES). Each of these tools was previously validated and found reliable as evident in the literature. Details are included below. Permissions are included in Appendix D. The survey is included in Appendix B. To ensure the accuracy of this survey construction, the faculty and staff in the Department of Health Promotion at EIU were invited to preview it. The faculty and staff were asked to review the questions to assure they would be understood by the students they teach as well as student in other majors. They were also asked to check for grammatical errors and estimate the time needed to complete the survey.

OHBS The OHBS 42-item tool addressed seven health belief subscales including susceptibility, seriousness, benefits and barriers to calcium intake, benefits and barriers to exercise, and health motivation. Items were rated on a 5-point scale (1 = *strongly disagree*, 2 = *disagree*, 3 = *neutral*, 4 = *agree*, 5 = *strongly agree*). With six questions in each subscale, the possible score for the total scale ranged from 42 to 210, and 6 to 30 for each subscale (Edmonds, 2009; Sedlak et al., 2007). Edmonds (2009) and Sedlak et al. (2007) reported test-retest reliability of .90. Subscale

reliability ranges were reported by Sedlak et al. (2007) from .71 to .82 and by Edmonds from .52 to .84.

Revised OKT Gendler et al. (2015) developed the original OKT in the 1990s, revised the OKT in 2012, and subsequently tested the reliability and validity of the 2012 revised version. Point-biserial was used for validity with results of all items reaching a minimum of .15 and most .25, which is considered a good level. Reliability for internal consistency was evaluated by calculating Kuder-Richardson-20 (KR-20). The 32 item OKT KR-20 was .85. Calculated subscales found that the KR-20 Nutrition subscale was .83, the KR-20 Exercise subscale was .81, and test-retest analysis by “Pearson correlation coefficient was .87 ($n = 27$; $p < .0001$)” (Gendler et al., 2015, p. 1636) which is considered very good stability. Fourteen of the 32 questions were not changed. The modifications, by Gendler et al. (2015), to the remaining questions and content validity for the Revised OKT were established based on use of original OKT by experts in various disciplines and recent professional recommendations and guidelines (Gendler et al., 2015, p. 1636). (See footnote 1).

OPBS. The OPBS 27-item self-reported descriptive survey, originally developed by Doheny and Sedlak in 1995, addressed nutrition, physical activity, lifestyle behaviors including alcohol and tobacco use, hormonal therapy and self-reported history of fractures (Sedlak et al., 2007). Content validity and equivalent form reliability was reported for calcium intake of .734, $r^2 = .54$, and for exercise of .482, $r = .23$ (Sedlak et al., 2007).

¹Developed by Katherine Kim PhD, Mary Horan PhD, and Phyllis Gendler PhD (1991). Grand Valley State University, with support from the Grand Valley State University Research Grant-in-Aid. Revised by Phyllis Gendler PhD, Cynthia Coviak PhD, Jean Martin PhD, and Katherine Kim PhD (2011, 2012). Question 26 was developed as an addition to the Osteoporosis Knowledge Test by Pamela von Hurst (2006).

Edmonds (2009) modified the survey to include eight of the questions that related to college students and eliminated questions related to menopause. In addition to demographic questions, four questions related to calcium intake were grouped based on number of serving consumed. Less than four servings per week was considered inadequate; five servings per week to one serving per day was considered moderate, and two to three servings per day was considered adequate intake (Edmonds, 2009). Two questions related to physical activity did not include levels of adequacy. A seven-day physical activity recall was also included in Edmonds' study as part of the OPBS. Pearson correlation coefficient determined reliability of .67 and test-retest reliability of .90 (Edmonds, 2009). The 8-item survey questions are included in this study.

OSSES The OSSES has two versions available, a 12-item scale and a 21-item scale with each including two subscales (exercise and calcium). Self-efficacy (confidence) for changing exercise habits and self-efficacy for increasing calcium intake were analyzed. Participants were asked to rate their confidence on a scale of 0 = least confident to 10 = most confident (Sedlak et al., 2007). The 12-item scale was used for this study. A test-retest reliability coefficient was reported by Edmonds (2009) of .90. Sedlak et al. (2007) reported reliability coefficients for internal consistency for the total tool of .90 and the two subscales of .95–.96 for exercise and .96–.98 calcium (p. 748). According to Horan, Kim, Gendler, Froman, & Patel (1998) “reliability coefficients for internal consistency (Cronbach alpha) of each subscale was .94 and .93, respectively. Validity of the OSSES was evaluated by factor analysis and hierarchical regression analysis” (p. 395).

Although the purpose of rating confidence has been consistent, the way participants have been asked to rate confidence has varied based on the researcher and delivery method. Horan, Kim, and Gendler (1993) asked participants to mark an X on the paper. Sedlak et al. (2007) had

participants circle a number on the scale. Edmonds (2009) used the same questions but asked participants to choose the following responses: *strongly disagree*, *disagree*, *neutral*, *agree*, and *strongly agree*. The Qualtrics system used in this study had a sliding bar option for question responses. The directions stated “After reading each statement, move the slider on the bar to the place that best describes your confidence level.” Five grid lines were shown with corresponding numbers. The responses were recorded to two decimal points and were calculated as was done by Horan et al. (1993) and Sedlak et al. (2009).

Data Collection

Data were collected from all students who were identified through university enrollment management, confirmed as being currently enrolled with a valid university email address and who chose to participate in the study. The web-based survey program, Qualtrics, was used to collect data. The survey (Appendix B) began by repeating the explanation of the study, informed consent and reminder of completion time, then continued with the series of questions. Participants were asked questions about their knowledge, beliefs, attitudes and behaviors related to osteoporosis.

The data-collection process began when the students received an email invitation to participate. A hyperlink was included which directed participants to the Qualtrics survey. After clicking the link to participate, subjects were asked to read the informed consent and click that they agreed to participate. The subjects then answered 40 items, which was estimated to take less than 20 minutes. Participants were allowed to withdraw at any time from the survey by exiting their browser. It was my intention that no answers would be submitted or processed unless the entire survey was completed and the participant clicked “submit” at the end. However, all entries were submitted, whether all of the questions had been answered or not.

After the data were downloaded into Excel, it was organized based on inclusion rules I established, and the data were separated between valid responses that met the criteria for inclusion and those that did not meet the criteria. Only valid responses were analyzed. The details on inclusion rules can be found in Chapter 4. Results are available through a secure, password-protected Qualtrics account. Electronic data files and back-up files are stored on a secure server.

Data Analysis

This study used descriptive and inferential statistical analyses calculated through IBM SPSS Statistics software. Descriptive statistics organize and summarize the raw data which allows patterns to be seen and conclusions to be drawn (Krathwohl, 2009). Nominal level of measurement was used to identify the number of participants in the various categories or dependent variables included. Frequency distributions allowed the data to be analyzed in terms of how many participants answer the different answer choices.

Additional descriptive statistics, including mean score, range of scores, and standard deviation were used for Research Question 1 regarding the OKT, Research Question 2 regarding the OHBS, Research Question 3 regarding the OSES, and Research Question 4 regarding the OPBS. Krathwohl (2009) explained that further analyzing the data can be done with measures of central tendency which “describes the location of the bulk of the data” (p. 377). The measures of central tendency used in this study included mean or average—the point at which the distribution is equal above and below (Krathwohl, 2009). Krathwohl (2009) also explained that measures of variability are “the degree to which data are spread out or bunched up” (p. 377) or if the scores are dissimilar or inconsistent. This study also used range, the distance between the lowest and highest score, variance and standard deviation to measure the distance from a specific point

(Krathwohl, 2009). Reliability coefficients were calculated for Research Question 2, specifically for the OHBS-calcium and OHBS-exercise subscales.

To describe relationships between variables, or the correlation, measures of relationship are used. In this study, I was attempting to determine if the dependent variables of racial/ethnic group or sex at birth was related to the scores for each of the research questions. Correlation, which shows the extent of a relationship, is reported “by a number between +1.00 and -1.00” (Krathwohl, 2009, p. 387) that represents a pair of scores. A positive correlation shows that one variable is more likely to predict a score of another variable. The strongest possible scores are +1.00 or -1.00, which means that a perfect relationship exists between the scores. A zero correlation shows that two variables do not predict each other well, with the weakest correlation meaning “there is no regular relationship between the scores” (Krathwohl, 2009, p. 387). Scatterplots are often used to show correlations.

Inferential statistics are used to support or disprove a hypothesis and they also allow assumptions to be made about a population from a representative sample. These are used to judge internal integrity (Krathwohl, 2009). This calculation offers an estimation of the population and is expressed as a percentage. Confidence intervals are the range of values “that probably contain the population value” (Krathwohl, 2009, p. 439). Estimation concentrates on the values within the confidence intervals, while hypothesis testing concentrates on the differences in sample and population values (Krathwohl, 2009). This is used to determine if a hypothesis should be accepted or rejected and is expressed in terms of significance levels with a p for probability or α for alpha level. The null hypothesis assumes that a statistic “is typical of such differences from samples of those sizes taken from the same population” (Krathwohl, 2009, p. 461). If the value is within the range, the null hypothesis is assumed to be correct. Values that

are outside the typical range “are likely to have been influenced by something other than sampling or error variability” Krathwohl, 2009, p. 461). These values would allow the null hypothesis to be rejected. Typical inferential statistics used are *t* test and ANOVA. The *t* test examines differences between two means, and assumes that the groups are “independent samples of a population” (Krathwohl, 2009, p. 464). ANOVA is used when a study design includes more than two groups or conditions which are being compared. Krathwohl explained that this “allows us to partition the variance of the study to find the part that is attributable to each of the variables” (p. 467).

Each research question included three hypotheses. The purpose for including these three was first, to determine differences between female college students of various racial/ethnic groups for each of the independent variables; secondly, to determine differences among male college students of various racial/ethnic groups for each of the independent variables, and finally, to determine differences among male and female college students for each of the independent variables. ANOVA was used for the hypotheses determining differences with various racial/ethnic groups, as there are multiple categories. For the hypotheses determining differences among men and women, a *t* test was used, as there were only two groups being examined.

Variables

Dependent variable. Race/ethnicity of participants, sex at birth

Independent variables. Osteoporosis knowledge, attitude, self-efficacy to perform osteoporosis-preventing activities, actual performance of osteoporosis-preventing activities.

Summary

This quantitative, inferential study sought to determine if differences exist among college students of various racial/ethnic groups, as well as between men and women, in the independent variables of knowledge of osteoporosis, attitudes toward osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of such activities. Four research questions were developed based on these independent variables. Each question included hypotheses to determine if differences among female college students of various racial/ethnic groups, male college students of various racial/ethnic groups, and between male and female college students.

Students from EIU were invited to participate in this online survey. Demographic questions were asked with the hope that the population participating in this study reflected the general distribution of the student population. Invitations to participate were extended through the university email system with additional recruitment messages being posted to social media platforms, recruitment tabling events, and extended through personal email contacts. All IRB approval was granted before the survey was released, and only valid answers from completed surveys obtained from students who voluntarily choose to participate were included in the data analysis.

This study used a survey that includes questions from four surveys (OHBS, revised OKT, OPBS, OSES) that have been used in other studies and have been validated and found reliable for which permission was granted to use. The OHBS items consider the health belief subscales as related to osteoporosis as well as calcium intake, exercise, and health motivation. The revised OKT questions are based on expert knowledge and professional recommendations and guidelines related to osteoporosis, calcium intake, and physical activity. It has been updated within the past

five years. The OPBS items ask the participants to recall actual participation in physical activity or consumption of calcium. And, the OSES 12-item scale was included to examine confidence in changing exercise habits and increasing calcium intake.

A 40-item online survey using Qualtrics was the main data collection instrument. Data were analyzed through IBM SPSS Statistics software using descriptive statistics including mean score, minimum/maximum score, range of scores, standard deviation, and reliability coefficients. Frequency distributions showed the data for each question's answer choices. Correlations were included to determine if there is a relationship between dependent variables, racial/ethnic group or sex at birth, and the independent variable-based research questions. Inferential statistics were also used including *t* tests and ANOVA in order to support or disprove the hypotheses and consider assumptions of a population based on the study sample.

CHAPTER 4

DATA ANALYSIS

The purpose of this quantitative study was to determine if college-aged students of different racial/ethnic groups had osteoporosis knowledge, had the attitude and believed that it was an important health issue, and actually participated in osteoporosis prevention measures. The survey combined four tools that had been administered to college students in various locations throughout the United States, but none were found in Illinois or Indiana. This spurred my interest in finding out if the survey results of college students at a small Midwestern university would be similar to those found across the United States and other countries.

In order to identify if differences exist in knowledge, attitudes, beliefs, self-efficacy, and performance along the lines of race/ethnicity of participants, the following research questions were developed.

1. Do significant differences regarding osteoporosis knowledge exist among racial/ethnic groups of college students?
2. Do significant differences regarding osteoporosis attitudes exist among racial/ethnic groups of college students?
3. Do significant differences regarding self-efficacy to perform osteoporosis prevention measures exist among racial/ethnic groups of college students?

4. Do significant differences regarding performance of osteoporosis prevention measures exist among racial/ethnic groups of college students?

Descriptive and inferential statistical analyses were calculated through IBM SPSS Statistics software. Nominal level of measurement was used to identify the number of participants in the various categories or dependent variables included. Frequency distributions allowed the data to be analyzed in terms of the number of participants who answered the different answer choices. Additional descriptive statistics, reliability coefficients, and correlations were calculated for each of the research questions.

Design procedures

The study followed these design procedures:

1. During the fall of 2017, all students enrolled at EIU who were identified through the university enrollment management and confirmed as being currently enrolled with a valid university email address were sent an email with an explanation of the study and a hyperlink to the Qualtrics survey. This was coordinated through the university Information Technology Services.
2. The survey began by repeating the purpose of the study, estimated completion time, and a request to read the informed consent statement. By clicking and continuing to the questions, students agreed to participate. They were also reminded that the survey was confidential and they could exit at any time.
3. As discussed in chapter 3, demographic information plus four surveys that had previously been used and validated, were combined for this study into this Qualtrics survey.

4. In an effort to increase the response rate, several strategies were used.

Promotional messages were posted on social media platforms used by university health education programs including the Departments of Health Promotion and Communication Studies social media pages, Health Education Resource Center, as well as the university housing and dining social media pages. I sent an email message to faculty members across campus requesting that they remind and encourage their students to find the email with link and take the survey.

5. Tabling events were also held at various locations across campus to remind and encourage students to take the survey. The locations I chose included the Student Recreation Center, Student Union, and academic buildings that housed business, health, kinesiology, education, and fine arts. Several health promotion majors volunteered to help with these tabling events. We gave away small plastic glow in the dark skeletons to remind students to take the survey.
6. A second email was sent to the entire student population approximately three weeks after the initial message because many students reported that they found the original email in a spam folder. Information Technology Services determined that by adding a ruleset, the email blast would bypass the spam filter.

Participants

Through all of these recruitment efforts, 511 responses were collected. The distribution of respondents was similar to that reported in the fall 2016 Databook demographics of the general student population of EIU. Figure 6 shows the percent of women and men students for the survey respondents and the general student population.

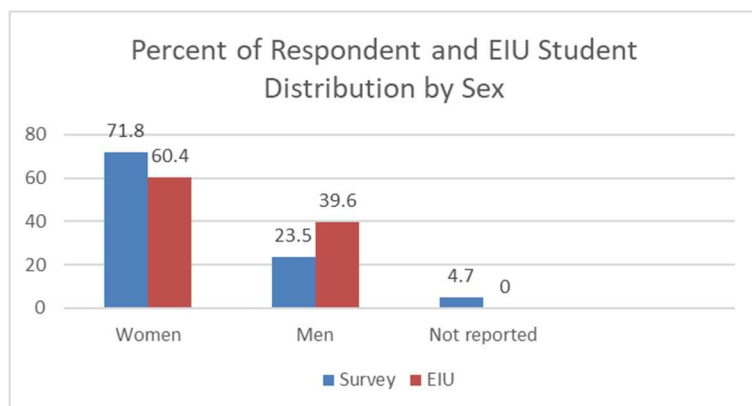


Figure 6. Percent respondent and EIU student distribution by sex at birth.

The demographic question of age was included to ensure all respondents were at least 18 years old; therefore, not a minor. One respondent marked under 18. A Qualtrics survey condition was established that if under 18 was selected, the survey would skip to the end and the respondent would not have access to any additional questions. The majority of respondents selected 18–20 or 21–24 for age range. Figure 7 shows the age distribution of all respondents.

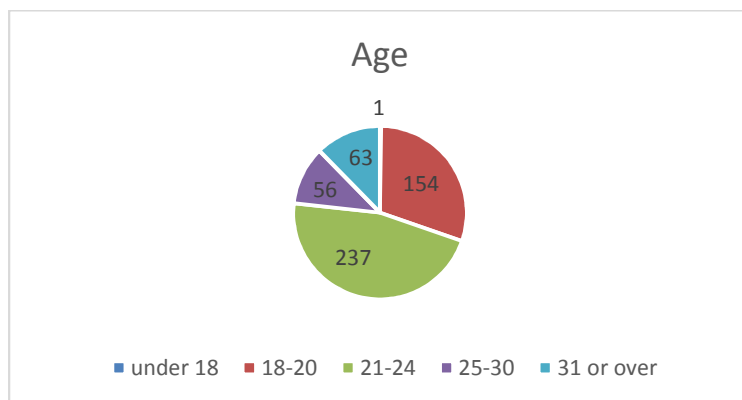


Figure 7. Respondent distribution by age.

Table 3 shows the distribution of students by racial/ethnic group reported in the survey and from the fall 2016 Databook. Table 4 shows the percent of majors or programs within the academic units as reported in the survey and based on the fall 2016 enrollment. It should be noted that the fall 2017 enrollment numbers were not available and some differences could be due to the difference in 2016 reported numbers and actual 2017 enrollment.

Table 3

Percent Respondent and EIU Student Distribution by Racial/Ethnic Group and Sex

Group	Survey Respondents	EIU Female	EIU Male	EIU Total
American Indian or Alaska Native	0.39	0.16	0.10	0.26
Asian	2.54	0.70	0.32	1.02
Black or African American	11.90	9.90	6.70	16.60
Hispanic or Latino	3.50	3.60	2.40	6.00
International or Non- Resident Alien	0.78	2.30	3.60	6.80
Multiple/Two or More	2.35	1.30	0.74	2.04
Native Hawaiian or Pacific Islander	0.39	0.01	0.05	0.06
Unknown/Not Reported	0	1.30	0.73	2.03
White	74.60	41.20	24.90	66.10

Note. EIU Female, Male and Total numbers calculated from the fall 2016 Databook table:
“Students by Level, Time Status, Ethnicity and Gender”

Table 4

Respondent and EIU Student Distribution by Majors within Academic Units

Academic Unit	Survey %	EIU %
Art	2.20	2.70
Biological Sciences	8.00	5.50
Business	12.70	9.40
Chemistry	0.59	0.71
Communication Disorders & Sciences	2.70	2.20
Communication Studies	3.70	5.40
Counseling and Student Development	4.70	1.40
Early Childhood, Elementary, and Middle Level Education	0.19	6.10
Economics	0.39	0.84
Educational Leadership	1.20	3.20
English	5.50	1.80
Family and consumer sciences	0.19	5.80
Foreign Languages	0.59	0.32
General Studies	10.20	5.00
Geology/Geography	0.78	0.61
Health Studies/Promotion	0.98	1.70
History	9.78	3.00
Journalism	1.20	0.96
Kinesiology and Sports Studies	2.20	8.10
Mathematics & Computer Science	2.35	0.98
Music	0	1.90
Nursing	0.39	0.55
Philosophy	2.20	0.12
Physics	7.83	0.22
Political Science	0.78	1.67
Psychology	0.19	5.30
Recreation Administration	1.76	0.84
Social Science Studies	2.35	0.16
Sociology/Anthropology	3.52	2.60
Special Education	0.39	2.50
Technology	0.39	7.10
Theatre Arts	8.02	0.38
Undecided/Undeclared	2.20	9.00

Note. Percentages calculated from the fall 2016 Databook table: “Students by Level, Time Status, Ethnicity and Gender”

An additional demographic question asked respondents if anyone in their family had ever been diagnosed as having osteoporosis. While this question does not fit into any of the research

questions, it could give an indication of an individual's awareness and knowledge of a family history of osteoporosis. As seen in figure 8, most respondents (72%) reported that they did not have a family history of osteoporosis, and 14% did not know; another 14% reported that they did have a family history.

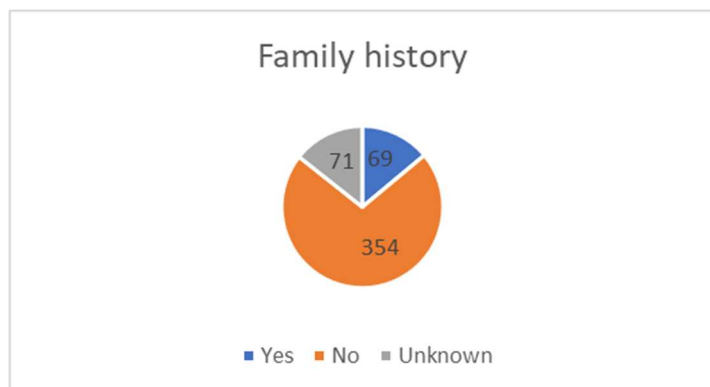


Figure 8. Respondent distribution by race/ethnicity of family history.

Establishing Data Rules

After the survey data were downloaded, several trends were identified. While the overall sample size of the survey was acceptable, the sample size for some of the racial/ethnic groups was too low to be included individually. Therefore, three racial/ethnic categories were used in the data analysis. These included Black or African American, Other, and White.

It was also determined that not all respondents had completed the entire survey. This survey combined four individual surveys that served as the basis for the four research questions. It was established that if 2/3 or more of the questions were answered for each section: knowledge (Revised-OKT, 32 items), health beliefs (OHBS, 42 items), preventing behaviors (OPBS, 27 items), and self-efficacy (OSES, 12 items), the responses would be included. After the valid responses were identified, the data sets were checked again to be sure that the demographic categories of sex at birth and race/ethnicity were selected which would allow the response to be included in the analysis. All analyses were conducted using IBM SPSS Statistics.

Research Question 1 Results

Research Question 1 determined if significant differences existed among college students regarding osteoporosis knowledge. The knowledge section included 364 responses. The distributions of women and racial/ethnic group is shown in Figure 9, men and racial/ethnic group is shown in Figure 10 and sex at birth is shown in Figure 11.

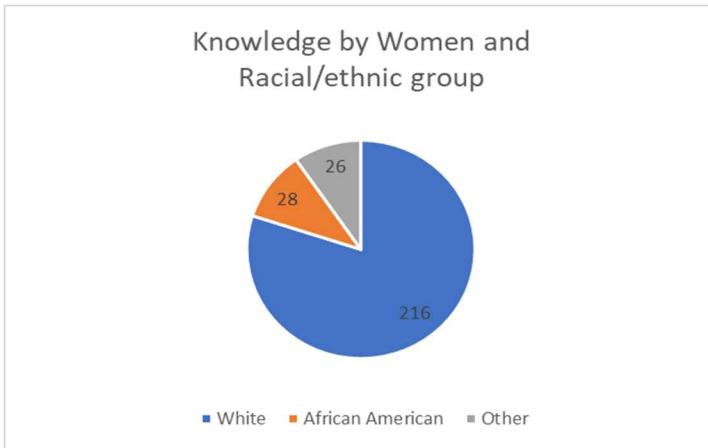


Figure 9. Knowledge by women and racial/ethnic group.

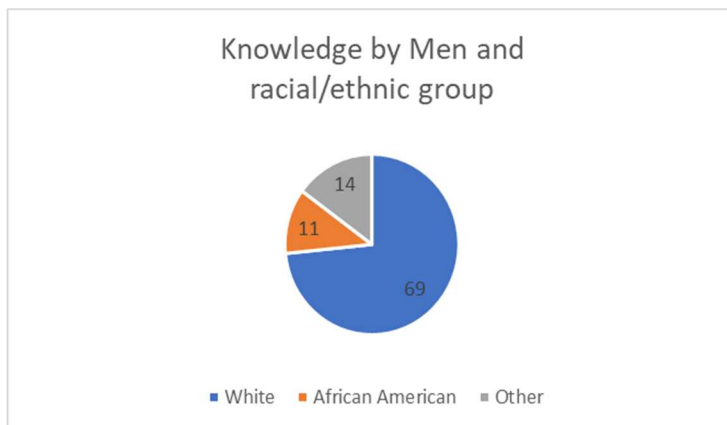


Figure 10. Knowledge by men and racial/ethnic group.



Figure 11. Knowledge by sex at birth.

Correct answers were calculated across all 32 knowledge questions. Hypothesis 1, which considered differences among women of various racial/ethnic groups, and Hypothesis 2, which considered differences among men of various racial/ethnic groups, were analyzed by one-way ANOVA. Hypothesis 3, which considered differences between women and men, was analyzed by independent-samples *t* test. There were no significant differences in any of the three hypotheses. Therefore, I accepted the null hypothesis that there was no difference in osteoporosis knowledge among students of various racial/ethnic group or sex at birth.

The highest possible score was 32. The range of scores was 4-29, with the average score being 16.38. According to one-way ANOVA, $F(2,267) = .795, p = .453$, there were no significant differences in the mean for women in the three racial/ethnic groups. According to one-way ANOVA, $F(2,91) = 2.289, p = .107$, there were no significant differences in the means for men in the three racial/ethnic groups. According to the independent-samples *t* test, $t = -.501, p = .616$, there were no significant differences in the means between women and men. Tables 5, 6, and 7 show the statistics for each hypothesis.

Table 5

Mean Score of Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	16.33	216	4.099	.279
Black or African American	16.64	28	3.402	.643
Other	15.35	26	4.907	.962
Total	16.27	270	4.114	.250

Table 6

Mean Score of Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	17.07	89	4.012	.483
Black or African American	15.55	11	4.967	1.498
Other	14.57	14	5.125	1.370
Total	16.52	94	4.359	.450

Table 7

Mean Score by Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	16.27	270	4.114	.250
Male	16.52	94	4.359	.450
Total	16.34	364	4.174	.219

Research Question 2 Results

Research Question 2 determined if significant differences existed among college students regarding osteoporosis attitudes including seven subcategories of susceptibility, seriousness, benefits of exercise, benefits of calcium intake, barriers to exercise, barriers to calcium intake and health motivation. The health belief section included 331 overall responses. The distributions for overall health belief of women and racial/ethnic group is shown in Figure 12, men and racial/ethnic group is shown in Figure 13 and sex at birth is shown in Figure 14.

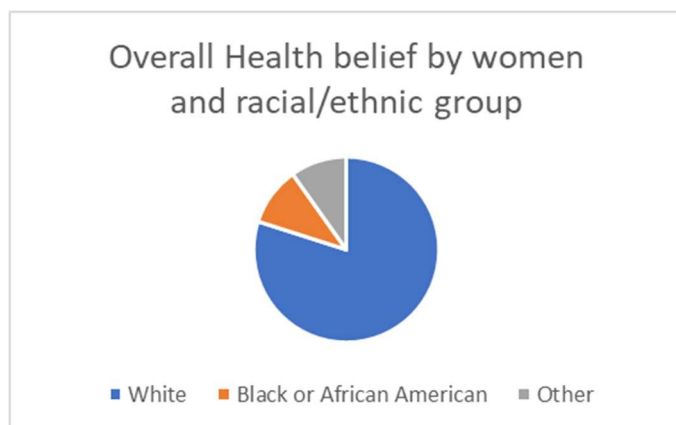


Figure 12. Attitude by women and racial/ethnic group.

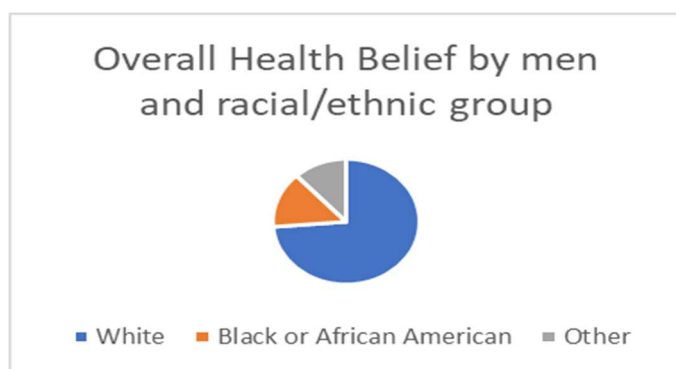


Figure 13. Attitude by men and racial/ethnic group.

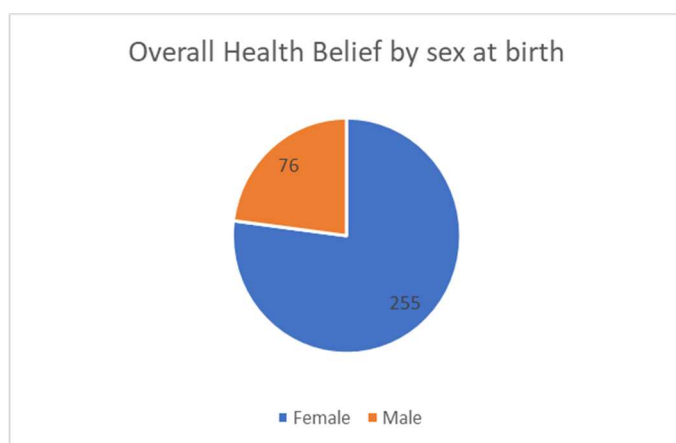


Figure 14. Attitude by sex at birth.

Respondents evaluated 42 questions including six questions in each of the seven subscales using a Likert scale of 1 = *strongly disagree*, 2 = *somewhat disagree*, 3 = *neither agree*

nor disagree, 4 = *somewhat agree*, and 5 = *strongly agree*. Average scores were recorded for overall health belief and each subscale. Hypothesis 1, which considered differences among women of various racial/ethnic groups, and Hypothesis 2, which considered differences among men of various racial/ethnic groups, were analyzed by one-way ANOVA. Hypothesis 3, which considered differences between women and men, was analyzed by independent-samples *t* test.

Overall Health Belief

There were no significant differences in overall health belief for Hypothesis 1; therefore, I accepted this null hypothesis that no difference in osteoporosis attitude existed among women of various racial/ethnic group. Significant differences were found in overall health belief for Hypotheses 2 and 3; therefore, I did not accept the null hypothesis that no difference in osteoporosis attitude existed among men of various racial/ethnic group or sex at birth. For overall health belief, the range of scores was 1.1–4, with the average score being 3.02. According to one-way ANOVA, $F(2,251) = .084, p = .919$, there were no significant differences in the mean for women in the three racial/ethnic groups. According to one-way ANOVA, $F(2,73) = 4.30, p = .017$, there was a significant difference in the mean for men by racial/ethnic group. The post hoc Tukey HSD and Bonferroni test revealed a difference for men in the White and Other racial/ethnic groups. According to the independent-samples *t* test, $t = 2.315, p = .021$, there was a significant difference in the mean between women and men. Tables 8, 9, and 10 show the statistics for each hypothesis of overall health belief.

Table 8

Mean Score of Overall Health Belief for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.07	203	.352	.025
Black or African American	3.05	26	.441	.086
Other	3.06	25	.447	.089
Total	3.07	254	.370	.023

Table 9

Mean Score of Attitudes for Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.03	56	.318	.043
Black or African American	2.83	11	.252	.076
Other	2.65	9	.802	.267
Total	2.96	76	.411	.047

Table 10

Mean Score of Attitudes for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	3.07	255	.369	.023
Male	2.96	76	.411	.047
Total	3.04	331	.382	.021

Susceptibility Subscale

For the subscale, susceptibility, significant differences were found for Hypotheses 1 and 3; therefore, I did not accept the null hypothesis that no difference in the osteoporosis attitude of susceptibility existed among women of various racial/ethnic groups or sex at birth. No significant differences existed for Hypothesis 2; therefore, this null hypothesis was accepted. The range of scores was 1–5, with the average score being 2.61. According to one-way ANOVA, $F(2,252) = 3.189$, $p = .043$, there was a significant difference in the mean for women

by racial/ethnic groups. The post hoc Tukey HSD and Bonferroni test revealed a difference for women in the White and Black or African American racial/ethnic groups. According to one-way ANOVA, $F(2,78) = .807, p = .450$, there were no significant differences in the mean for men in the three racial/ethnic groups. According to the independent-samples t test, $t = 3.255, p = .001$, there was a significant difference in the mean between women and men. Tables 11, 12, and 13 show the statistics for each hypothesis of susceptibility.

Table 11

Mean Score of Susceptibility for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.74	203	.902	.063
Black or African American	2.31	27	.847	.163
Other	2.49	25	1.02	.204
Total	2.67	255	.916	.057

Table 12

Mean Score of Susceptibility for Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.33	58	.794	.104
Black or African American	2.01	12	1.09	.313
Other	2.42	11	.961	.290
Total	2.29	81	.862	.096

Table 13

Mean Score of Susceptibility for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	2.67	255	.916	.057
Male	2.29	81	.862	.096
Total	2.58	336	.916	.050

Seriousness Subscale

For the subscale, seriousness, no significant differences were found for any hypothesis; therefore, I accepted the null hypothesis that no difference in the osteoporosis attitude of seriousness existed among various racial/ethnic group or sex at birth. The range of scores was 1 – 5, with the average score being 2.92. According to one-way ANOVA, $F(2,252) = .529$, $p = .590$, there were no significant differences in the mean for women by racial/ethnic group. According to one-way ANOVA, $F(2,77) = .149$, $p = .862$, there were no significant differences in the mean for men by racial/ethnic group. According to the independent-samples t test, $t = 0.216$, $p = .829$, there were no significant differences in the mean for sex at birth. Tables 14, 15, and 16 show the statistics for each hypothesis of seriousness.

Table 14

Mean Score of Seriousness for Women by Racial/ethnic Group, Hypothesis 1

Race/ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.91	204	.826	.058
Black or African American	3.03	26	.657	.129
Other	3.04	25	.706	.141
Total	2.93	255	.799	.050

Table 15

Mean Score of Seriousness for Men by Racial/ethnic Group, Hypothesis 2

Race/ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.94	57	.807	.107
Black or African American	2.86	12	.884	.255
Other	2.80	11	.968	.292
Total	2.91	80	.832	.093

Table 16

Mean Score of Seriousness for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	2.93	256	.798	.050
Male	2.91	80	.832	.093
Total	2.93	336	.805	.044

Benefits of Exercise Subscale

For the subscale, benefits of exercise, significant differences were found for Hypothesis 2; therefore, I did not accept the null hypothesis that no difference in the osteoporosis attitude of benefits of exercise existed among men of various racial/ethnic groups. No significant differences existed for Hypothesis 1 or 3; therefore, these null hypotheses were accepted. The range of scores was 1–5, with the average score being 4.06. According to one-way ANOVA, $F(2,252) = .944, p = .390$, there were no significant differences in the mean for women by racial/ethnic group. According to one-way ANOVA, $F(2,75) = 5.123, p = .008$, there was a significant difference in the mean for men by racial/ethnic group. The post hoc Tukey HSD and Bonferroni test revealed a difference for men in the White and Other racial/ethnic groups. According to the independent-samples t test, $t = -0.792, p = .429$, there were no significant differences in the mean for sex at birth. Tables 17, 18, and 19 show the statistics for each hypothesis of benefits of exercise.

Table 17

Mean Score of Benefits of Exercise for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	4.05	204	.675	.047
Black or African American	4.01	26	.813	.159
Other	3.85	25	.806	.161
Total	4.03	255	.703	.044

Table 18

Mean Score of Benefits of Exercise for Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	4.24	57	.667	.088
Black or African American	4.03	11	.843	.254
Other	3.35	10	1.410	.447
Total	4.10	78	.859	.097

Table 19

Mean Score of Benefits of Exercise for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	4.02	256	.704	4.07
Male	4.10	78	.859	4.21
Total	4.04	334	.742	4.11

Benefits of Calcium Intake Subscale

For the subscale, benefits of calcium intake, significant differences were found for Hypothesis 2; therefore, I did not accept the null hypothesis that no difference in the osteoporosis attitude of benefits of calcium intake existed among men of various racial/ethnic groups. No significant differences existed for Hypothesis 1 or 3; therefore, these null hypotheses were accepted. The range of scores was 1–5, with the average score being 3.75. According to one-way ANOVA, $F(2,251) = .815, p = .444$, there were no significant differences in the mean for women by racial/ethnic group. According to one-way ANOVA, $F(2,74) = 3.600, p = .032$, there was a significant difference in the mean for men by racial/ethnic group. The post hoc Tukey HSD and Bonferroni tests revealed a difference for men in the White and Other racial/ethnic groups. According to the independent-samples t test, $t = -0.313, p = .754$, there were no significant differences in the mean for sex at birth. Tables 20, 21, and 22 show the statistics for each hypothesis of benefits of calcium intake.

Table 20

Mean Score of Benefits of Calcium Intake for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.77	203	.717	.050
Black or African American	3.60	26	.724	.142
Other	3.67	25	.728	.146
Total	3.74	254	.718	.045

Table 21

Mean Score of Benefits of Calcium Intake for Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.89	57	.589	.078
Black or African American	3.59	11	.743	.224
Other	3.22	9	1.390	.463
Total	3.77	77	.764	.087

Table 22

Mean Score of Benefits of Calcium Intake for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	3.74	255	.717	.045
Male	3.77	77	.764	.087
Total	3.75	332	.727	.040

Barriers to Exercise Subscale

For the subscale, barriers to exercise, significant differences were found for Hypothesis 3; therefore, I did not accept the null hypothesis that no difference in the osteoporosis attitude of barriers to exercise existed between sex at birth. No significant differences existed for hypothesis 1 or 2; therefore, these null hypotheses were accepted. The range of scores was 1–5, with the average score being 2.06. According to one-way ANOVA, $F(2,251) = .549$, $p = .578$, there were no significant differences in the mean for women by racial/ethnic group. According

to one-way ANOVA, $F(2,73) = .542, p = .584$, there were no significant differences in the mean for men by racial/ethnic group. According to the independent-samples t test, $t = 2.077, p = .039$, there were significant differences in the mean for sex at birth. Tables 23, 24, and 25 show the statistics for each hypothesis of barriers to exercise.

Table 23

Mean Score of Barriers to Exercise for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.16	203	.912	.064
Black or African American	2.33	26	.964	.189
Other	2.08	25	.996	.199
Total	2.17	254	.924	.058

Table 24

Mean Score of Barriers to Exercise for Men by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	1.92	56	.984	.132
Black or African American	2.12	11	1.050	.317
Other	1.67	9	.755	.252
Total	1.92	76	.966	.111

Table 25

Mean Score of Barriers to Exercise for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	2.17	255	.923	.058
Male	1.92	76	.966	.111
Total	2.11	331	.938	.052

Barriers to Calcium Intake Subscale

For the subscale, barriers to calcium intake, significant differences were found for Hypothesis 3; therefore, I did not accept the null hypothesis that no difference in the osteoporosis

attitude of barriers to calcium intake existed between sex at birth. No significant differences existed for Hypothesis 1 or 2; therefore, these null hypotheses were accepted. The range of scores was 1–4.8, with the average score being 2.23. According to one-way ANOVA, $F(2,248) = 2.251, p = .107$, there were no significant differences in the mean for women by racial/ethnic group. According to one-way ANOVA, $F(2,73) = 1.045, p = .357$, there were no significant differences in the mean men by any racial/ethnic group. According to the independent-samples t test, $t = 1.988, p = .048$, there were significant differences in the mean for sex at birth. Tables 26, 27, and 28 show the statistics for each hypothesis of barriers to calcium intake.

Table 26

Mean Score of Barriers to Calcium Intake for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.27	201	.810	.057
Black or African American	2.62	25	.958	.192
Other	2.45	25	.916	.183
Total	2.32	251	.841	.053

Table 27

Mean Score of Barriers to Calcium Intake for Men by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	2.12	56	.911	.122
Black or African American	2.30	11	.928	.280
Other	1.72	9	.894	.298
Total	2.10	76	.912	.105

Table 28

Mean Score of Barriers to Calcium Intake for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	2.32	252	.840	.053
Male	2.10	76	.912	.105
Total	2.27	328	.861	.048

Health Motivation Subscale

For the subscale, health motivation, no significant differences were found for any hypothesis; therefore, I accepted the null hypothesis that no difference in the osteoporosis attitude of health motivation existed among various racial/ethnic group or sex at birth. The range of scores was 1–5, with the average score being 3.63. According to one-way ANOVA, $F(2,248) = 1.080, p = .341$, there were no significant differences in the mean for women by racial/ethnic group. According to one-way ANOVA, $F(2,73) = 2.678, p = .075$, there were no significant differences in the mean for men by any racial/ethnic group. According to the independent-samples t test, $t = -0.113, p = .910$, there were no significant differences in the mean for sex at birth. Tables 29, 30, and 31 show the statistics for each hypothesis of health motivation.

Table 29

Mean Score of Health Motivation for Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.63	200	.813	.058
Black or African American	3.46	26	.817	.160
Other	3.79	25	.723	.145
Total	3.63	251	.805	.051

Table 30

Mean Score of Health Motivation for Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.79	56	.888	.119
Black or African American	3.18	11	.944	.285
Other	3.28	9	1.300	.433
Total	3.64	76	.970	.111

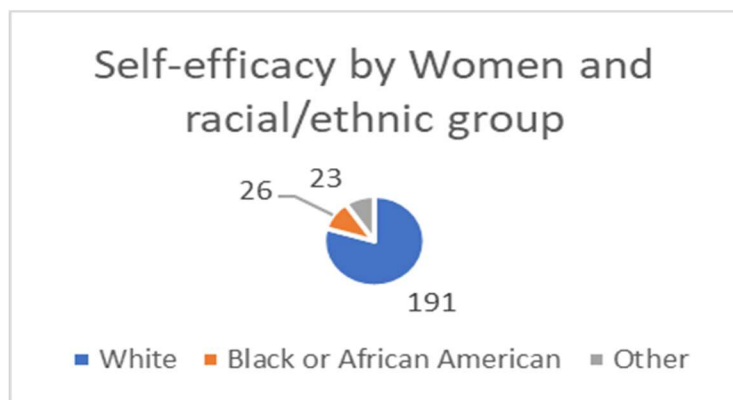
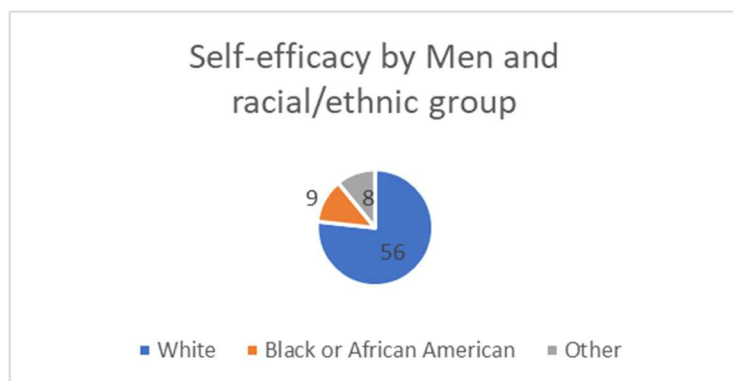
Table 31

Mean Score of Health Motivation for Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	3.63	252	.804	.051
Male	3.64	76	.970	.111
Total	3.63	328	.844	.047

Research Question 3 Results

Research Question 3 determined if significant differences existed among college students regarding osteoporosis self-efficacy. The self-efficacy section included 319 responses. The distributions of women and racial/ethnic group is shown in Figure 15, men and racial/ethnic group is shown in Figure 16, and sex at birth is shown in Figure 17.

*Figure 15. Self-efficacy by women and racial/ethnic group, hypothesis 1.**Figure 16. Self-efficacy by men and racial/ethnic group, hypothesis 2.*

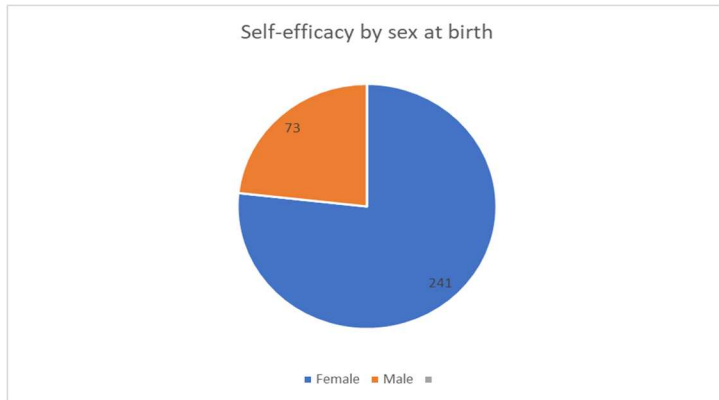


Figure 17. Self-efficacy by sex at birth, hypothesis 3

Respondents evaluated 12 questions including six questions in two subscales of exercise and calcium intake using a sliding bar scale of 0 *not at all confident* to 10 *very confident*. Each point on the scale was assigned a value and an average score for overall self-efficacy, exercise self-efficacy and calcium intake self-efficacy was recorded. Hypothesis 1, which considered differences among women of various racial/ethnic groups, and Hypothesis 2, which considered differences among men of various racial/ethnic groups, were analyzed by one-way ANOVA. Hypothesis 3, which considered differences between women and men, was analyzed by independent-samples *t* test.

Overall Self-Efficacy

There were no significant differences in either Hypothesis 1 or 2. Therefore, I accepted the null hypothesis that no difference in overall osteoporosis self-efficacy among students of various racial/ethnic group. There were significant differences in Hypothesis 3; therefore, I do not accept the null hypothesis that there are no differences in overall osteoporosis self-efficacy between women and men.

The range of scores was 0.43–10, with the average score being 6.51. According to one-way ANOVA, $F(2,237) = 1.050, p = .351$, there were no significant differences in the mean for women by racial/ethnic groups. According to one-way ANOVA, $F(2,70) = .563, p = .572$, there

were no significant differences in the mean for men by racial/ethnic groups. According to the independent-samples t test, $t = -3.595$, $p = .000$, there were significant differences in the mean for sex at birth. Tables 32, 33, and 34 show the statistics for each hypothesis.

Table 32

Mean Score of Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	6.21	191	2.03	.147
Black or African American	5.93	26	1.72	.337
Other	5.62	23	2.04	.426
Total	6.13	240	2.00	.129

Table 33

Mean Score of Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	7.17	56	2.00	.267
Black or African American	6.41	9	2.24	.747
Other	7.20	8	1.87	.660
Total	7.08	73	2.00	.234

Table 34

Mean Score of Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	6.11	241	2.01	.130
Male	7.08	73	2.00	.234
Total	6.33	314	2.05	.116

Self-Efficacy Subscale Exercise

There were no significant differences in either Hypothesis 1 or 2. Therefore, I accepted the null hypothesis that no difference in osteoporosis self-efficacy for exercise among students of various racial/ethnic group. There were significant differences in Hypothesis 3; therefore, I do

not accept the null hypothesis that there are no differences in osteoporosis self-efficacy for exercise between women and men.

The range of scores was 0.63–10, with the average score being 6.63. According to one-way ANOVA, $F(2,235) = .059, p = .943$, there were no significant differences in the mean for women by racial/ethnic groups. According to one-way ANOVA, $F(2,70) = 1.050, p = .351$, there were no significant differences in the mean for men by racial/ethnic groups. According to the independent-samples t test, $t = -3.660, p = .000$, there were significant differences in the mean for sex at birth. Tables 35, 36, and 37 show the statistics for each hypothesis.

Table 35

Mean Score of Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	6.14	191	2.60	.188
Black or African American	6.14	25	1.67	.335
Other	6.33	22	2.26	.482
Total	6.16	238	2.48	.161

Table 36

Mean Score of Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	7.41	56	2.06	.276
Black or African American	7.09	9	2.13	.709
Other	6.92	8	2.48	.875
Total	7.32	73	2.09	.245

Table 37

Mean Score of Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	6.15	239	2.48	.161
Male	7.32	73	2.09	.245
Total	6.42	312	2.45	.139

Self-Efficacy Subscale Calcium Intake

There were no significant differences in either Hypothesis 1 or 2. Therefore, I accepted the null hypothesis that no difference in osteoporosis self-efficacy for calcium intake among students of various racial/ethnic group. There were significant differences in Hypothesis 3; therefore, I do not accept the null hypothesis that there are no differences in osteoporosis self-efficacy for calcium intake between women and men.

The range of scores was 0.27–10, with the average score being 6.42. According to one-way ANOVA, $F(2,238) = 2.879, p = .058$, there were no significant differences in the mean for women by racial/ethnic groups. According to one-way ANOVA, $F(2,70) = 1.290, p = .282$, there were no significant differences in the mean for men by racial/ethnic groups. According to the independent-samples t test, $t = -2.253, p = .025$, there were significant differences in the mean for sex at birth. Tables 38, 39, and 40 show the statistics for each hypothesis.

Table 38

Mean Score of Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	6.30	192	2.34	.169
Black or African American	5.90	26	2.00	.393
Other	5.11	23	2.28	.476
Total	6.14	241	2.32	.149

Table 39

Mean Score of Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	6.91	56	2.44	.326
Black or African American	5.73	9	2.48	.828
Other	7.48	8	1.78	.629
Total	6.83	73	2.40	.281

Table 40

Mean Score of Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	6.12	242	2.34	.150
Male	6.83	73	2.40	.281
Total	6.29	315	2.36	1.33

Research Question 4 Results

Research question 4 determined if significant differences existed among college students regarding actual osteoporosis behaviors including subscales of exercise and calcium intake. The health behaviors section included 321 responses. The distributions of women and racial/ethnic group is shown in Figure 18, men and racial/ethnic group is shown in Figure 19 and sex at birth is shown in Figure 20.

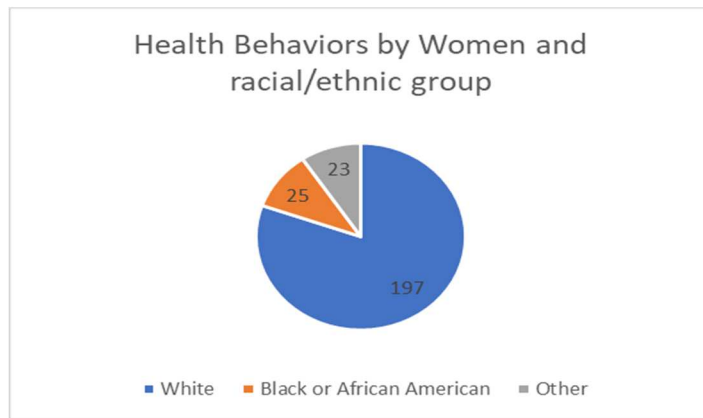


Figure 18. Health behaviors by women and racial/ethnic group.

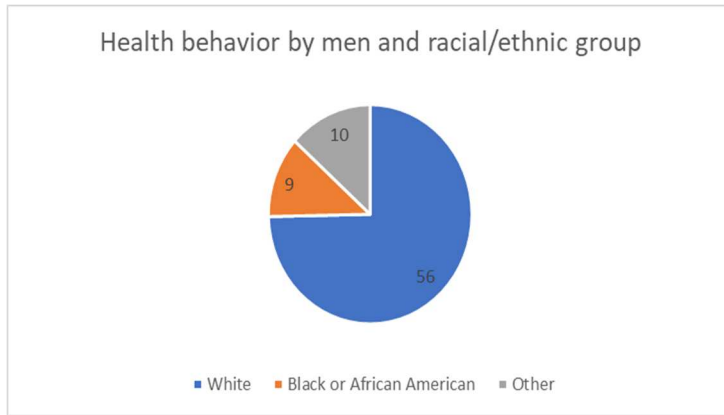


Figure 19. Health behaviors by men and racial/ethnic group.

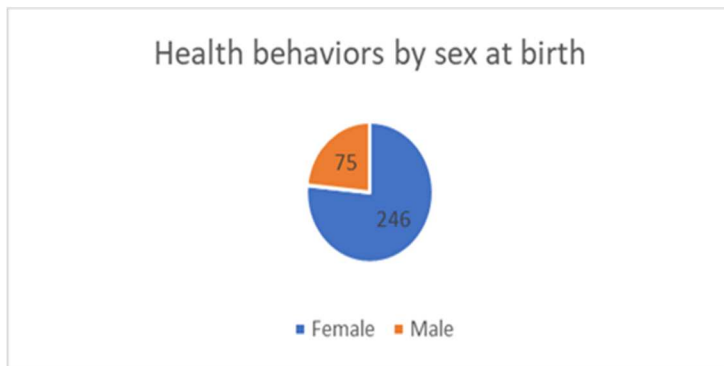


Figure 20. Health behaviors by sex at birth.

Calcium Intake Subscale

The subscale of calcium intake included questions in which the respondents reported the number of servings of milk, yogurt or cheese consumed during an average week from none per week to three per day. For these questions, Hypothesis 1, which considered differences among women of various racial/ethnic groups, and Hypothesis 2, which considered differences among men of various racial/ethnic groups, were analyzed by one-way ANOVA. Hypothesis 3, which considered differences between women and men, was analyzed by independent-samples *t* test.

For the subscale, calcium intake, significant differences were found for hypothesis 3; therefore, I did not accept the null hypothesis that no difference in the osteoporosis attitude of barriers to calcium intake existed between sex at birth. No significant differences existed for

Hypothesis 1 or 2; therefore, these null hypotheses were accepted. Based on the calcium intake guidelines (Edmonds, 2012) and results from this survey, figure 21, 76.7% of women and 53.7% of men recorded inadequate levels, 14.7% of women and 24.4% of had moderate levels and 8.6% of women and 21.9% of men had adequate levels.

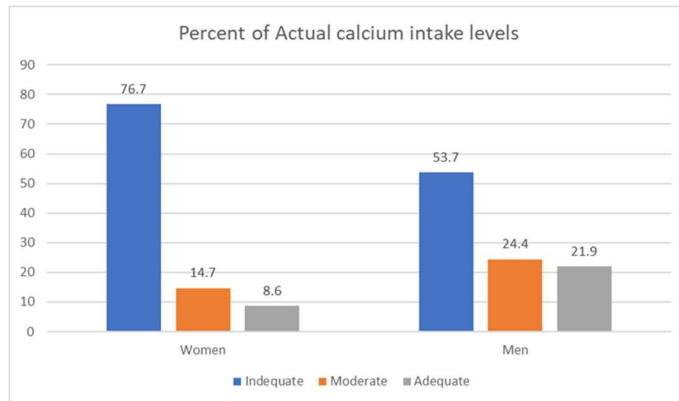


Figure 21. Actual intake of calcium by women and men.

According to one-way ANOVA, $F(2,242) = 1.483$, $p = .229$, there were no significant differences in the mean for women by racial/ethnic groups. According to one-way ANOVA, $F(2,72) = .698$, $p = .501$, there were no significant differences in the mean for men by racial/ethnic groups. According to the independent-samples t test, $t = -2.090$, $p = .039$, there were significant differences in the mean for sex at birth. Tables 41, 42, and 43 show the statistics for each hypothesis of barriers to calcium intake.

Table 41

Mean Score of Women by Racial/Ethnic Group, Hypothesis 1

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	3.18	197	2.57	.183
Black or African American	2.33	25	2.31	.462
Other	3.43	23	2.11	.440
Total	3.11	245	2.51	.160

Table 42

Mean Score of Men by Racial/Ethnic Group, Hypothesis 2

Race/Ethnicity	Mean	N	Std. Deviation	Std. Error
White	4.02	56	2.69	.360
Black or African American	2.81	9	2.22	.741
Other	4.00	10	4.10	1.300
Total	3.87	75	2.85	.329

Table 43

Mean Score of Sex at Birth, Hypothesis 3

Sex at Birth	Mean	N	Std. Deviation	Std. Error
Female	3.11	246	2.51	.160
Male	3.87	75	2.85	.329
Total	3.29	321	2.61	.145

The question regarding the use of a calcium supplement was answered by yes or no.

Therefore, the data could not be analyzed by ANOVA or independent-samples *t* tests. Figures 22, 23, 24, and 25 show the distribution of women and racial/ethnic group, men and racial/ethnic group, and sex at birth who took a calcium supplement or did not. The majority of women, 88%, and men, 93%, in all racial/ethnic groups did not take a calcium supplement.

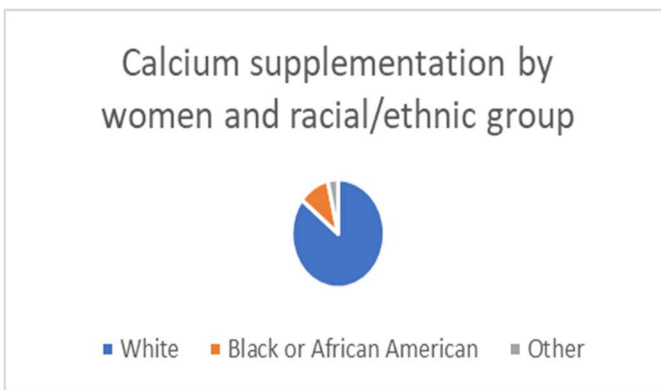


Figure 22. Women by racial/ethnic group who took a calcium supplement.

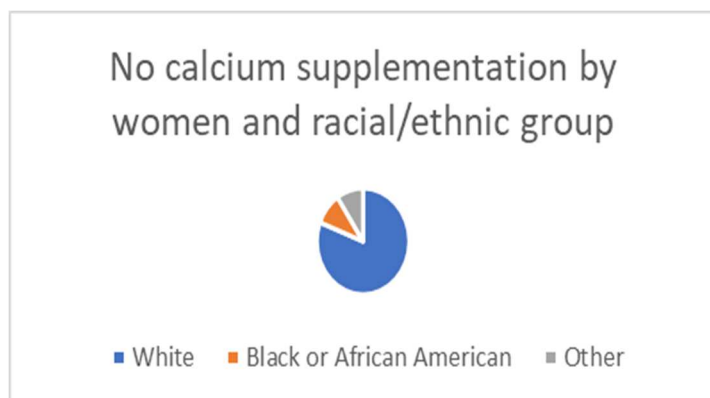


Figure 23. Women by racial/ethnic group who did not take a calcium supplement.

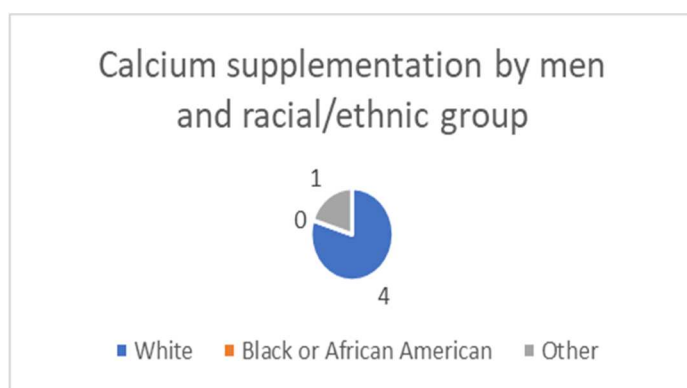


Figure 24. Men by racial/ethnic group who took a calcium supplement.

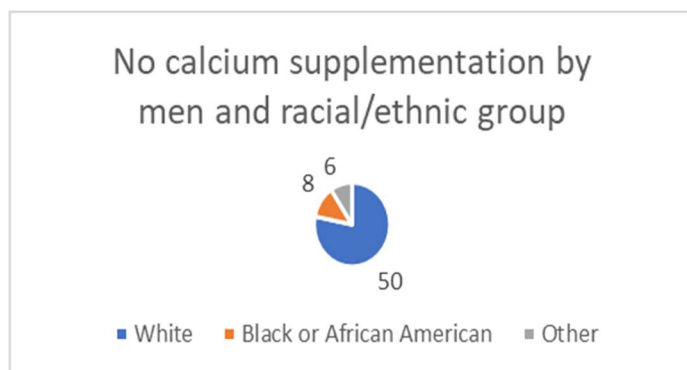


Figure 25. Men by racial/ethnic group who did not take a calcium supplement.

Physical Activity Subscale

Respondents reported levels of participation in physical activity and specific weight bearing and non-weight bearing activities. One question that asked if the respondents were

physically active in the past seven days was answered by yes or no. Therefore, the data could not be analyzed by ANOVA or independent-samples t tests.

The majority of women, 76%, and men, 79%, in all racial/ethnic groups were physically active. Figures 26, 27, 28, and 29 show the distribution of women and racial/ethnic group, men and racial/ethnic group, and sex at birth who were physically active or were not physically active.

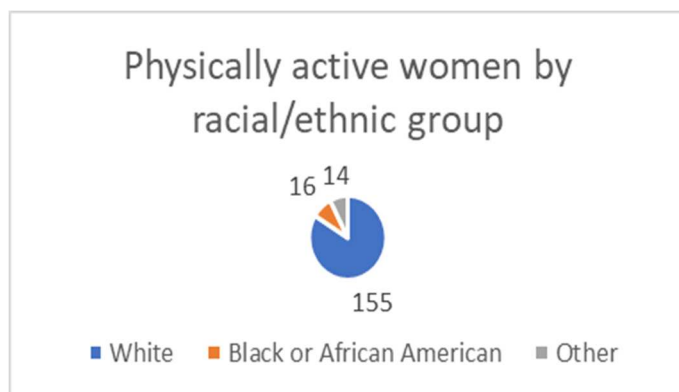


Figure 26. Women by racial/ethnic group who were physically active.

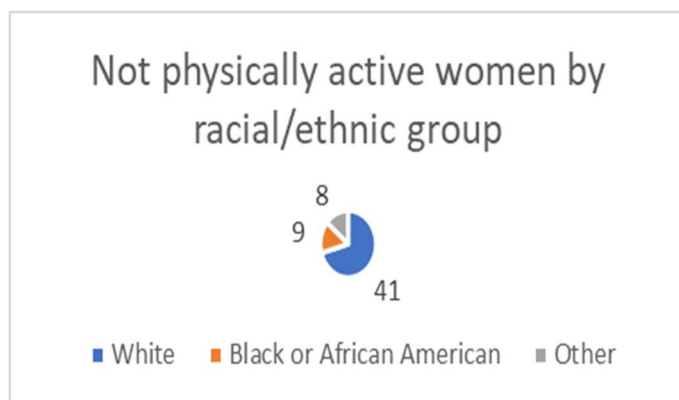


Figure 27. Women by racial/ethnic group who were not physically active.

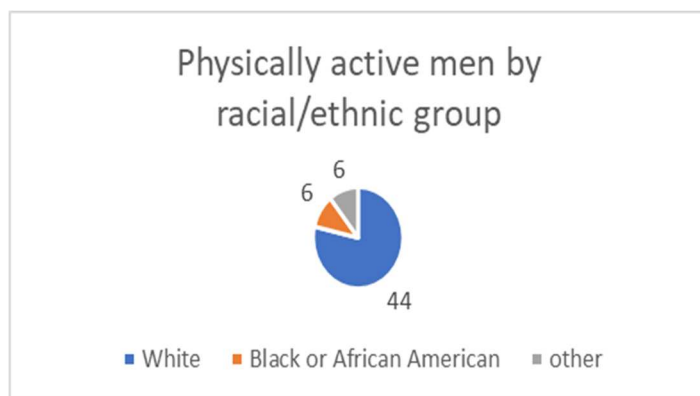


Figure 28. Men by racial/ethnic group who were physically active.

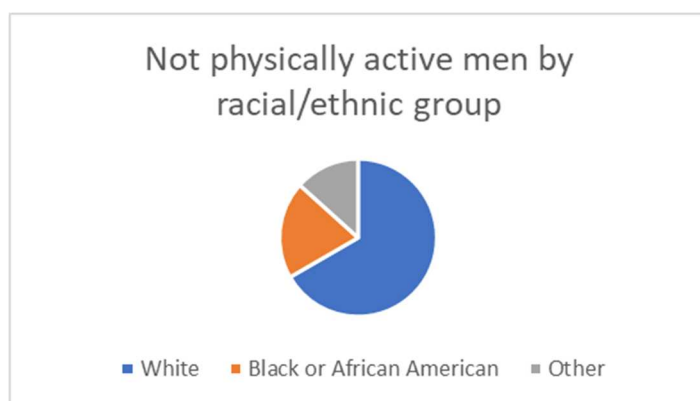


Figure 29. Men by racial/ethnic group who were not physically active.

Respondents reported the number of times per week they participated in weight bearing activities such as walking, jogging or aerobic dancing. The data could not be analyzed by ANOVA or independent-samples t tests. Table 44 shows the distribution of women and men in this study by racial/ethnic group for various activity levels. Figures 30 (women) and 31 (men) show the percent of all racial/ethnic groups that reported doing weight bearing exercises for at least 150 minutes per week. This is indicated in the tables by increments of 20–30 minutes/5–7 times per week or more than 30 minutes per day.

Table 44

Weight-Bearing Physical Activity Levels by Racial/Ethnic Group

Group	<10 min / wk	10-15 min 1-2x/wk	10-15 min 3-4x/wk	10-15 min 5-7x /wk	20-30 min 1-2x/wk	20-30 min 3-4x/wk	20-30 min 5-7x/wk	>30 min/ day
Women								
White (197)	42	29	19	10	21	31	13	32
Black or African American (25)	10	2	5	3	2	2	0	1
Other (23)	6	2	1	0	3	5	4	2
Total (245)	58	33	25	13	26	38	17	35
Men								
White (55)	12	3	7	3	3	8	4	15
Black or African American (9)	2	1	1	1	0	2	1	1
Other (9)	1	0	2	1	1	1	1	2
Total (73)	15	4	10	5	4	11	6	18

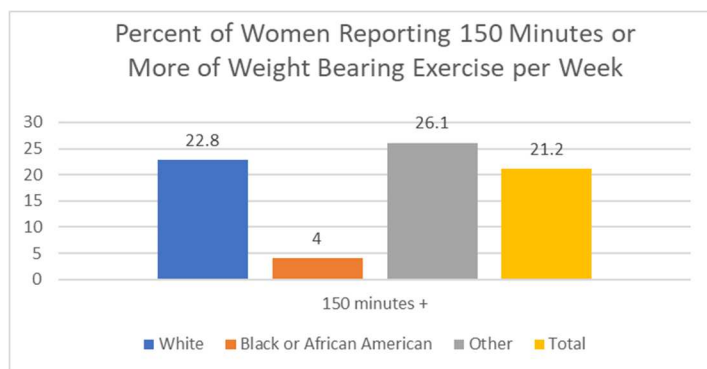


Figure 30. Percent of women reporting 150 minutes or more of weight-bearing exercise per week.

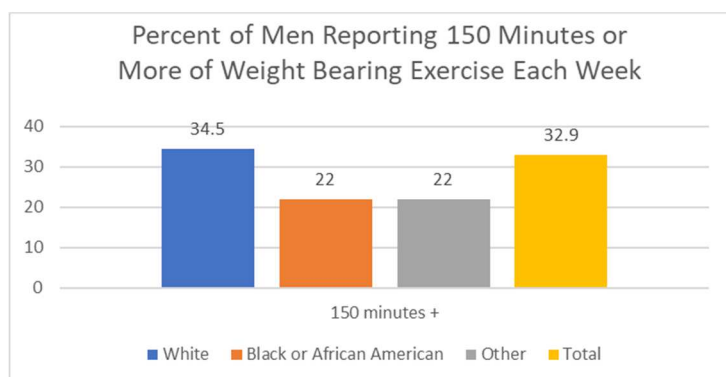


Figure 31. Percent of men reporting 150 minutes or more of weight-bearing exercise per week.

Respondents also reported the number of times per week they participated in non-weight-bearing activities such as swimming or biking. The data could not be analyzed by ANOVA or independent-samples *t* tests. Table 45 shows the distribution of women and men by racial/ethnic group for various activity levels. Figures 32 (women) and 33 (men) show the percent of all racial/ethnic groups that reported doing non-weight bearing exercises for at least 150 minutes per week. This is indicated in the tables by increments of 20–30 minutes/5–7 times per week or more than 30 minutes per day.

Table 45

Non-Weight Bearing Physical Activity Levels by Racial/Ethnic Group

Group	<10 min/ wk	10-15 min 1-2x/wk	10-15 min 3-4x/wk	10-15 min 5-7x /wk	20-30 min 1-2x/wk	20-30 min 3-4x/wk	20-30 min 5-7x/wk	>30 min/ day
Women								
White (196)	121	21	14	8	11	8	3	10
Black or African American (25)	17	2	1	0	2	2	1	0
Other (23)	12	1	3	1	3	1	1	1
Total (245)	150	24	18	9	16	11	5	11
Men								
White (55)	34	6	4	2	2	1	3	3
Black or African American (9)	5	1	1	0	1	0	1	0
Other (8)	4	0	0	0	3	0	1	0
Total (72)	43	7	5	2	6	1	5	3

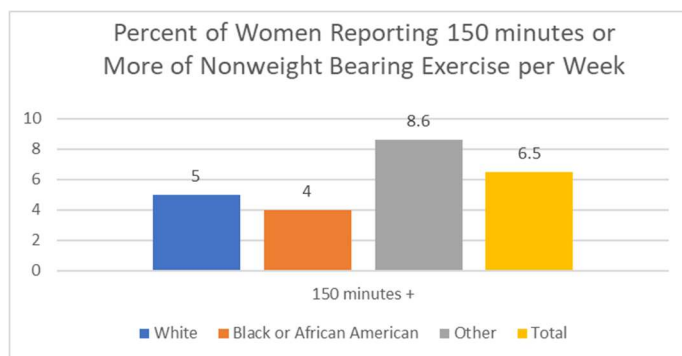


Figure 32. Percent of women reporting 150 minutes or more of weight-bearing exercise per week.

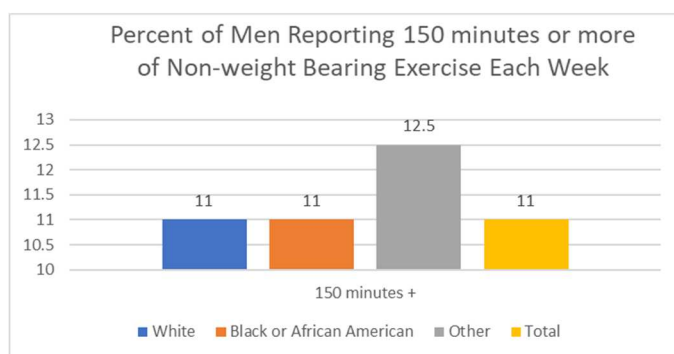


Figure 33. Percent of men reporting 150 minutes or more of weight-bearing exercise per week.

Summary

This chapter reported the results of each research question which included three hypotheses, women by racial/ethnic group, men by racial/ethnic group, and women compared to men. A general trend that appeared was that there were more significant differences found in hypothesis three, women compared to men, than there were for hypothesis one or two which compared women or men by racial/ethnic group. This was not the case every time, but did appear more often than not. Each research question is now summarized.

Research Question 1 Summary

Research Question 1 determined if significant differences existed among college students regarding osteoporosis knowledge. No significant differences were found; therefore, each

hypothesis was accepted. The levels of knowledge had a range of 4–29, with 32 being the highest score possible. The mean for hypothesis one was 16.27, hypothesis two was 16.52, and hypothesis three was 16.34.

Research Question 2 Summary

Research Question 2 determined if significant differences existed among college students regarding osteoporosis attitudes including seven subcategories of susceptibility, seriousness, benefits of exercise, benefits of calcium intake, barriers to exercise, barriers to calcium intake and health motivation. Overall health belief was analyzed by including all answers in this section of the survey. No significant differences were found in Hypothesis 1, women by racial/ethnic group; therefore, it was accepted. Significant differences were found in Hypothesis 2, men by racial/ethnic group and Hypothesis 3, women compared to men; therefore, these were not accepted. Scores ranged from 1.1–4, with 5 being the highest score possible. This mean score for Hypothesis 1 was 3.07, Hypothesis 2 was 2.96, and Hypothesis 3 was 3.04.

The subscale of susceptibility revealed significant differences in Hypothesis 1 and Hypothesis 3; therefore, these were not accepted. There were no significant differences in Hypothesis 2; therefore, it was accepted. Scores ranged from 1.0–5.0. The mean score for Hypothesis 1 was 2.67, Hypothesis 2 was 2.58, and Hypothesis 3 was 2.93.

The subscale of seriousness revealed no significant differences; therefore, each hypothesis was accepted. Scores ranged from 1–5. The mean score for Hypothesis 1 was 2.93, Hypothesis 2 was 2.91, and Hypothesis 3 was 2.93.

The subscale of benefits of exercise revealed no significant differences for Hypothesis 1 and Hypothesis 3; therefore, these were accepted. Significant differences were found in

Hypothesis 2; therefore, it was not accepted. Scores ranged from 1–5. The mean score for Hypothesis 1 was 4.03, Hypothesis 2 was 4.10, and Hypothesis 3 was 4.04.

The subscale of benefits of calcium intake revealed no significant differences for Hypothesis 1 and Hypothesis 3; therefore, these were accepted. Significant differences were found in Hypothesis 2; therefore, it was not accepted. Scores ranged from 1–5. The mean score for Hypothesis 1 was 3.74, Hypothesis 2 was 3.77, and Hypothesis 3 was 3.75.

The subscale of barriers to exercise revealed no significant differences for Hypothesis 1 and Hypothesis 2; therefore, these were accepted. Significant differences were found in Hypothesis 3; therefore, it was not accepted. Scores ranged from 1–5. The mean score for Hypothesis 1 was 2.17, Hypothesis 2 was 1.92, and Hypothesis 3 was 2.11.

The subscale of barriers to calcium intake revealed no significant differences for Hypothesis 1 and Hypothesis 2; therefore, these were accepted. Significant differences were found in Hypothesis 3; therefore, it was not accepted. Scores ranged from 1–4.8. The mean score for Hypothesis 1 was 2.32, Hypothesis 2 was 2.10, and Hypothesis 3 was 2.27.

The subscale of health motivation revealed no significant differences; therefore, each hypothesis was accepted. Scores ranged from 1–5. The mean score for Hypothesis 1 was 3.63, Hypothesis 2 was 3.64, and Hypothesis 3 was 3.63.

Research Question 3 Summary

Research Question 3 determined if significant differences existed among college students regarding osteoporosis self-efficacy including subcategories exercise and calcium intake. Overall self-efficacy was analyzed by including all answers in this section of the survey. No significant differences were found in Hypothesis 1 or Hypothesis 2; therefore, these were accepted. Significant differences were found in Hypothesis 3; therefore, it was not accepted.

Available option for confidence levels ranged from 1, not at all confident to 10, very confident. Confidence levels for overall self-efficacy ranged 0.45–10. The mean score for Hypothesis 1 was 6.13, Hypothesis 2 was 7.08, and Hypothesis 3 was 6.33.

The subscales of self-efficacy for exercise and self-efficacy for calcium intake revealed no significant differences in Hypothesis 1 or Hypothesis 2; therefore, these were accepted. Significant differences were found in Hypothesis 3; therefore, it was not accepted. Confidence levels for self-efficacy for exercise ranged from 0.63–10. The mean score for Hypothesis 1 was 6.16, Hypothesis 2 was 7.32, and Hypothesis 3 was 6.42. Confidence levels for self-efficacy for calcium intake ranged from 0.27–10. The mean score for Hypothesis 1 was 6.14, Hypothesis 2 was 6.83, and Hypothesis 3 was 6.29.

Research Question 4 Summary

Research Question 4 determined if significant differences existed among college students regarding actual osteoporosis behaviors including subscales of exercise and calcium intake. The Likert scale for calcium intake offered an equal distribution of possible answers from 1, none per week to 10, three per day; therefore, it was able to be analyzed using one-way ANOVA or independent-samples *t* test. The subscales of actual calcium intake revealed no significant differences in hypothesis one or hypothesis two; therefore, these were accepted. Significant differences were found in hypothesis three; therefore, it was not accepted. The mean score for hypothesis one was 3.11, hypothesis two was 3.87, and hypothesis three was 3.29. Option three was two servings per week and option 4 was three servings per week; therefore, these mean scores indicate servings consumed at two to three per week. Based on the calcium intake guidelines (Edmonds, 2012) and results from this survey, 76.7% of women and 53.7% of men recorded inadequate levels, 14.7% of women and 24.4% of had moderate levels and 8.6% of

women and 21.9% of men had adequate levels. The majority of women, 88%, and men, 93%, in all racial/ethnic groups did not take a calcium supplement.

The subscale of actual physical activity performance offered a range of time in each category; therefore, could not be analyzed by one-way ANOVA or independent-scales *t* test. Most respondents, 76% of women and 79% of men, reported that they were physically active within the past seven days of taking the survey. Respondents were asked to report the number of times they participated in weight bearing and non-weight bearing exercise.

Based on the physical activity guidelines (Garber et al., 2011; IOF, 2015; PCFSN, 2017) of a minimum of 150 minutes of activity per week, 22.8% of White women, 4% of Black or African American women, 26.1% of Other women, and 21.2% of all women reported 20–30 minutes of weight bearing physical activity 5–7 times per week (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week). Based on the physical activity guidelines (Garber, et al., 2011; IOF, 2015; PCFSN, 2017) of a minimum of 150 minutes of activity per week, 34.5% of White men, 22% of Black or African American men, 22% of Other men, and 32.9% of all men reported 20–30 minutes of weight bearing physical activity 5–7 times per week, (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week). Based on the physical activity guidelines (Garber, et al., 2011; IOF, 2015; PCFSN, 2017) of a minimum of 150 minutes of activity per week, 5% of White women, 4% of Black or African American women, 8.6% of Other women, and 6.5% of all women reported 20–30 minutes of non-weight bearing physical activity 5–7 times per week (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week). Based on the physical activity guidelines (Garber, et al., 2011; IOF, 2015, PCPFN, 2017) of a minimum of 150 minutes of activity per week, 11% of

White men, 11% of Black or African American men, 12.52% of Other men, and 11% of all men reported 20–30 minutes of non-weight bearing physical activity 5–7 times per week (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week).

Each of four research questions included three hypotheses. With the three racial/ethnic groups, a total of 39 hypotheses were analyzed. There were significant differences found in 12 of the 39 hypotheses. Chapter 5 will discuss the implications of the research, suggestions of related future research, and conclusions.

CHAPTER 5

DISCUSSION, CONCLUSIONS, RECOMMENDATIONS

Osteoporosis is a debilitating bone disease with physical, emotional, and financial consequences of which many individuals are not aware and for which they are not taking preventive measures. This is in part due to the focus of research being primarily on older white women (Clark & Lavielle, 2015; Edmonds, 2009; Ford et al., 2011; Geller & Derman, 2001). Preventative health behaviors should begin in one's youth when peak bone mass and bone mineral density are developed (Campbell, 2012; Cannada, 2016; Edmonds et al.; Evenson & Sanders, 2016; Ford et al., 2011; Gammage et al., 2009; Gammage et al., 2012). Osteoporosis has been called a pediatric disease with geriatric consequences (Cannada, 2016). In the United States alone, more than 53 million people have osteoporosis or are at risk of developing it (NIHSH, 2015). There are also some misconceptions that people in racial/ethnic groups other than White are not at risk (Cauley, 2011; Nam et al., 2013; NIAMSD, 2015). The loss of independence as well as complications from fractures, the presence of more than one disease or condition, and disparities in health care insurance and access make osteoporosis a public health threat (Cauley, 2011; Gillespie & Morin, 2016).

The evidence shows that osteoporosis is a preventable disease if youth build their peak bone masses throughout childhood, adolescence, and into their young adult lives, or by about age 30. It is important for all individuals to understand their personal risk factors in order to prevent

osteoporosis or minimize the debilitating effects. While some risk factors are modifiable or controllable, such as nutrition, physical activity, smoking, and the use of alcohol, other risk factors are non-modifiable and cannot be controlled or changed, such as genetics, family history, sex at birth, race/ethnicity, ages, and frame size. Individuals must be aware of the risk factors, the negative impact of osteoporosis, and have the confidence and desire to make healthy behavior choices.

This study was based on the framework that suggests that although some college-age students have knowledge of osteoporosis preventing health behaviors, they do not believe they are at risk; and therefore, do not engage in the good health behaviors that could have preventative benefits in their future. These attitudes, beliefs, knowledge, and behaviors were identified through a survey that combined four surveys that are based on the HBM. By analyzing the data through specific demographic criteria, specifically racial/ethnic group and sex at birth, it was my hope that the study results would confirm the need for college students of various racial/ethnic groups to be aware of the importance of taking proper steps to maintain or promote the health of their bones so that they can prevent osteoporosis. Moreover, specificity could be applied to educational approaches for this segment of the population.

Discussion and Recommendations

Of the approximate 7415 students enrolled at Eastern Illinois University to which the survey was distributed by the university email system, 511 survey responses were recorded. It was my hope that the demographic distribution of respondents would be similar to the demographic distribution of the EIU student population. In general, this was true. The survey distribution of women was slightly higher and men was slightly lower than the EIU population. The majority of respondents selected 18–20 or 21–24 years for age range. The categories of age

for the EIU student population included a smaller range of years than my survey, but 86% fell within the combined categories of 18–29. For this survey distribution, 87% fell within the combined categories of 18–30 years old. The distribution of students by racial/ethnic group also followed similar patterns as that of the EIU population. More Asians and Whites but fewer Black or African Americans, Hispanic or Latinos, and International or Non-Resident Aliens participated. Similar numbers of American Indian or Alaska Natives, Multiple/Two or More, and Native Hawaiian or Pacific Islanders participated. Because the sample sizes of several racial/ethnic groups including American Indian or Alaska Native, Asian, Hispanic or Latino, International or Non-Resident Alien, Multiple/Two or More, Native Hawaiian or Pacific Islander and Unknown/Not Reported were very low, they were combined with the Other group in the data analysis. Therefore, there were three racial/ethnic groups analyzed including Black or African American, Other, and White. The distribution of students by majors within academic units was overall consistent with that of the university student distribution, but some majors had more while others had fewer. This could be due to the locations in which I recruited students to participate. As mentioned in chapter 4, this variation in distribution could also be because the EIU student data (fall 2016 Databook) was from the previous school year and the current year enrollment numbers had changed. The fall 2017 Databook was not available at the time of this writing. While the demographic question about family history was not in the research questions, the responses could be considered part of college students' knowledge or awareness of osteoporosis. Most students reported that they did not have family members who were diagnosed with osteoporosis. The number of students who answered that they did have family members who had been diagnosed with osteoporosis or did not know was similar.

Not all 511 respondents completed all parts of the survey, so the sample size in each part

varied. The data was extracted from Qualtrics, organized using Excel, then analyzed using IBM SPSS Statistics software. Within each of the four original surveys, there were multiple questions that addressed similar topics, such as exercise or calcium intake and each of the health belief subscales. Therefore, if a respondent completed 2/3 of the questions for each section, they were included in the analysis of that section. Only those responses that answered the demographic criteria of racial/ethnic group and sex at birth were included in the analysis.

Research Question 1

Research Question 1 determined if significant differences existed among college students regarding osteoporosis knowledge. The survey included the 32 questions from the Revised OKT. The highest number of possible correct answers was 32. The range of correct answers was 4–29, with the average being 16.38. This indicated that the average score was only about 51% correct. Mean scores were compared for each hypothesis and it was found that there were no significant differences in any hypothesis.

Clark and Lavielle (2015), Edmonds (2009), Evenson and Sanders (2016), Ford et al. (2011), Gammage et al. (2009), and Gammage et al. (2012) discussed the importance of having knowledge in order to minimize the risk of developing osteoporosis. According to the U.S. Department of Education, International Affairs Office (2008),

Criterion-referenced grading systems are based on a fixed numeric scale, usually equated to a letter mark, from which the faculty assign grades based on the individual performance of each student. The scale does not change regardless of the quality, or lack thereof, of the students. (para. 5.)

The criterion-referenced grading systems suggest an excellent score is 90% to 100%, good score is 80% to 90%, fair score is 70% to 80%, poor score is 60% to 70%, and failure is less than 60%.

With the average knowledge score of this survey being 51% correct, it is clear that the level of knowledge of this survey's respondents is considered failing. The results of this research question indicate a need for more osteoporosis knowledge education for college students of all racial/ethnic groups. Efforts at EIU could be initiated by the Health Education Resource Center in cooperation with the Total EIU Wellness Initiative to provide educational information to students across campus. This effort could also be promoted in the Department of Health Promotion courses such as Program Planning, Applied Health Communication, or student Independent Studies.

Research Question 2

Research Question 2 determined if significant differences existed among college students regarding osteoporosis attitudes (health beliefs) including seven subcategories of susceptibility, seriousness, benefits of exercise, benefits of calcium intake, barriers to exercise, barriers to calcium intake and health motivation. The survey included 42 items from the OHBS. The OHBS tailored the concepts of the HBM to osteoporosis by including calcium intake and exercise. After reading statements regarding their beliefs of osteoporosis, respondents selected a score that ranged from the lowest possible 1 = *strongly disagree*, 2 = *somewhat disagree*, 3 = *neither agree nor disagree*, 4 = *somewhat agree*, and the highest score possible 5 = *strongly agree*. Results of overall health belief and each subscale are now discussed.

Overall health belief. Mean scores of overall health belief were compared for each hypothesis. The average score of all responses in this section was 3.02, neither agreed or disagreed with the 42 statements about their osteoporosis beliefs. There was no significant difference in the mean score for women by racial/ethnic groups. Significant differences were found for men by racial/ethnic group, specifically between men in the Other and White

racial/ethnic groups and the for sex at birth. This may indicate that tailored health promotion and education information regarding health beliefs would better serve men in the Other and White racial/ethnic groups. It would also indicate that materials targeting women or men specifically would be more effective, but that women of all racial/ethnic groups could find similar materials useful.

Susceptibility subscale. Mean scores of susceptibility were compared for each hypothesis. The average score of all responses in this section was 2.61. This was between somewhat disagree and neither agree or disagree with the six statements about their susceptibility to develop osteoporosis. There were significant differences for women by racial/ethnic group, specifically Black or African American and White, and for women compared to men, sex at birth. There was no significant difference in the mean score for men by racial/ethnic group. This suggested that Black or African American and White women feel they are more susceptible to developing osteoporosis because of body build or family history than women in the Other racial/ethnic group. It also indicated that women in general feel they are more susceptible to developing osteoporosis than men. It would also indicate that materials targeting women of specific racial/ethnic groups or men specifically would be more effective.

Seriousness subscale. Mean scores of seriousness were compared for each hypothesis. The average score of all responses in this section was 2.92, close to neither agree nor disagree with the six statements about the seriousness of osteoporosis. There were no significant differences for women or men by racial/ethnic group or women compared to men. These findings suggest that respondents somewhat disagreed to neither agreed or disagreed with the attitudes of seriousness of osteoporosis. Edmonds (2012), Ford et al. (2011), Gammage et al. (2009), and Geller and Derman (2001) suggested that the perceived severity of developing

osteoporosis was low in college-aged women of all racial/ethnic groups. These findings are similar to the literature, but also indicate that college-aged men do not feel they are likely to develop osteoporosis. It would also indicate that materials targeting women or men specifically would be more effective.

Benefits of exercise subscale. Mean scores of benefits of exercise were compared for each hypothesis. The average score of all responses in this section was 4.06, somewhat agree with the six statements regarding the benefits of exercise. There were significant differences for men in the Other and White racial/ethnic groups. There were no significant differences for women by racial/ethnic group or for women compared to men, sex at birth. These findings indicate that women of all racial/ethnic groups and more women than men somewhat agreed with the perception that exercise was beneficial in preventing the development of osteoporosis. This also holds true when men were compared by racial/ethnic groups, as there were differences between the Other and White racial/ethnic groups.

Benefits of calcium intake subscale. Mean scores of benefits of calcium intake were compared for each hypothesis. The average score of all responses in this section was 3.75, between neither agree or disagree and somewhat agree with the six statements regarding the benefits of calcium intake. There were significant differences for men in the Other and White racial/ethnic groups. There were no significant differences for women by racial/ethnic group, for women compared to men, sex at birth. These findings indicate that women of all racial/ethnic groups and more women than men somewhat agreed with the perception that calcium intake was beneficial in preventing the development of osteoporosis. This also holds true when men were compared by racial/ethnic groups, as there were differences between the Other and White racial/ethnic groups. It would also indicate that materials targeting women or men specifically

would be more effective, but that women of all racial/ethnic groups could find similar materials useful.

Barriers to exercise subscale. Mean scores of barriers to exercise were compared for each hypothesis. The average score of all responses in this section was 2.06, somewhat disagree with the six statements regarding the barriers to exercise. There were significant differences in the mean for women compared to men, sex at birth. There were no significant differences for women or men by racial/ethnic group. These findings indicate that more women than men somewhat disagreed with the perception that there were barriers to exercise in preventing the development of osteoporosis. These findings also suggest that based on the low average score for all respondents, most believe the barriers to exercise are low. It would also indicate that materials targeting women or men specifically would be more effective, but that women and men of all racial/ethnic groups could find similar materials useful.

Barriers to calcium intake subscale. Mean scores of barriers to calcium intake were compared for each hypothesis. The average score of all responses in this section was 2.23, somewhat disagree with the six statements regarding the barriers to calcium intake. There were significant differences in the mean for women compared to men, sex at birth. There were no significant differences for women or men by racial/ethnic group. These findings indicate that more women than men somewhat disagreed with the perception that there were barriers to calcium intake in preventing the development of osteoporosis. These findings also suggest that based on the low average score for all respondents, most believe the barriers to calcium intake are low. It would also indicate that materials targeting women or men specifically would be more effective.

Health motivation subscale. Mean scores of health motivation were compared for each hypothesis. The average score of all responses in this section was 3.63, between neither agree or disagree and somewhat agree with the six statements regarding their health motivation. There were no significant differences for women or men by racial/ethnic group, or for women compared to men, sex at birth. These findings suggest that respondents somewhat agreed that health motivation could influence action for preventative osteoporosis health behaviors. It would also indicate that materials targeting a specific population may not be needed but one targeting college-age students would be effective.

Summary research question 2. These subscales make up the components of the HBM which suggests, as related to osteoporosis, that an individual's perception of risk, or susceptibility, of developing the disease as well as the perceived seriousness of the disease will influence their participation in screenings, healthy behaviors, and other preventative measures. Edmonds (2012), Ford et al. (2011), Gammage et al. (2009), and Geller and Derman (2001) suggested that individuals must also believe that the benefits are greater than the barriers to osteoporosis preventing behaviors of exercise and calcium intake. Individuals must also have a high enough level of health motivation to take action. In other words, individuals must believe that they are susceptible to developing osteoporosis and that the consequences are serious enough to take steps to prevent osteoporosis development. They must also believe that the perceived benefits are greater than the barriers, and that they are motivated to engage in osteoporosis preventing measures.

My findings suggest that college students somewhat disagreed with their susceptibility and seriousness of developing osteoporosis. However, they somewhat agreed with benefits and barriers of exercise and calcium intake. The results of this research question indicate a need for

health education and health promotion information to emphasize the susceptibility and seriousness of osteoporosis for college students of all racial/ethnic groups. This could be justified by considering college students attitudes toward the risks of substance abuse or developing sexually transmitted infections (STI). Studies have shown that college students who have a feeling of invincibility, or believe they will not become addicted to drugs or develop an STI, will not avoid the use of addictive drugs or may not practice safe sex or be unlikely to get an HIV vaccine (Lipari, & Jean-Francois, 2016; University of Missouri-Columbia, 2009). Health education and health promotion information must be prepared in such a way to connect with college students that will encourage them to take action now and engage in healthy behaviors to prevent osteoporosis.

Research Question 3

Research Question 3 determined if significant differences existed among college students regarding osteoporosis self-efficacy. The survey included 12 items from the OSES. Scores reported the level of confidence individuals felt about exercise and calcium intake from not at all confident, 0, through very confident, 10. Results of overall self-efficacy and the subscales of exercise and calcium intake are discussed following.

Overall self-efficacy. Mean scores of overall self-efficacy were compared for each hypothesis. The average score of all responses in this section was 6.51, slightly more confident. There were significant differences in the mean for women compared to men in the category of sex at birth. There were no significant differences for women or men by racial/ethnic group. These findings indicate that men had a slightly higher level of confidence than women regarding their abilities to engage in osteoporosis preventing behaviors of exercise and calcium intake. These findings also suggest that based on the above average score for all respondents, most

believe that they are able to engage in osteoporosis preventing behaviors of exercise and calcium intake.

Exercise self-efficacy subscale. Mean scores of exercise self-efficacy were compared for each hypothesis. The average score of all responses in this section was 6.63, slightly more confident. There were significant differences in the mean for women compared to men in the category of sex at birth. There were no significant differences for women or men by racial/ethnic group. These findings indicate that men had a slightly higher level of confidence than women regarding their abilities to engage in osteoporosis preventing behaviors of exercise. These findings also suggest that based on the above average score for all respondents, most believe they are able to engage in osteoporosis preventing behaviors of exercise.

Calcium intake self-efficacy subscale. Mean scores of calcium intake self-efficacy were compared for each hypothesis. The average score of all responses in this section was 6.42, slightly more confident. There were significant differences in the mean for women compared to men in the category of sex at birth. There were no significant differences for women or men by racial/ethnic group. These findings indicate that men had a slightly higher level of confidence than women regarding their abilities to engage in osteoporosis preventing behaviors of calcium intake. These findings also suggest that based on the above average score for all respondents, most believe they are able to engage in osteoporosis preventing behaviors of calcium intake.

Summary. The confidence of men was slightly higher in overall self-efficacy as well as for both exercise and calcium intake self-efficacy. Combining these results with the benefits and barriers in Research Question 2 show that not only do students believe that exercise and calcium intake are important, they also believe that they have the abilities to engage in such positive osteoporosis preventing behaviors. These results are similar to the finding by Edmonds (2012),

Ford et al. (2011), and Gammage et al. (2009). The results of this research question indicate that the confidence for college students of all racial/ethnic groups is slightly more confident than less, and if this is due to available health education and health promotion information, they are effective. Certainly, further research about current practices and sources of information would help to ascertain what is best contributing to this level of confidence and what should be refined to further promote confidence. Deshpande, Basil and Basil (2009), suggested that healthy eating campaigns that combine the components of the HBM with fear and efficacy would be effective. “Highlighting negative consequences among women and susceptibility among men” plus efficacy, goal-setting and self-monitoring “had positive impact on self-efficacy to consume and consumption” of healthy foods (Deshpande et al., 2009, p. 158). Bebeley, Yi-gang & Liu (2017) found that in order to increase the confidence in college students to participate in exercise or physical activity, efforts should “foster a sense of autonomy, competence, and relatedness” (p. 2381). College students who participated in programs that promoted learning and that were also supported by the use of apps or text message reminders increased consumption of nutritious foods and increased physical activity, and were more confident and motivated to continue with such behaviors (Abraham, Noriega, & Shin, 2018; Lein, Turner & Wilroy, 2016).

Research Question 4

Research Question 4 determined if significant differences existed among college students regarding actual osteoporosis behaviors including subscales of exercise and calcium intake. The survey included 27 items related to preventing behaviors from the OPBS. Each hypothesis for calcium intake was analyzed using one-way ANOVA and independent-samples *t* test. For all of the other questions, answers were reported as yes or no, or had a range of possible answers; therefore, they could not be analyzed using one-way ANOVA and independent-samples *t* test. I

was still able to draw conclusions for women and men of the racial/ethnic groups, but I was not able to confirm the hypotheses.

Scores reported the number of servings of calcium rich foods were consumed by individuals from no servings per week, 1, through three servings per day, 10. Based on the calcium intake guidelines, (a) inadequate intake represents zero to four servings of calcium a week, (b) moderate intake represents five servings of calcium a week to one serving of calcium a day, and (c) adequate intake represents two servings to three servings of calcium a day (Edmonds, 2012, p. 76). The results from this survey indicated that 76.7% of women and 53.7% of men recorded inadequate levels, 14.7% of women and 24.4% of had moderate levels and 8.6% of women and 21.9% of men had adequate levels. Calcium supplementation has mixed reviews as to the impact on increasing BMD. The results of this survey indicate that the majority of women and men do not take a calcium supplement. It should also be noted that, at least in the United States, the common sources of calcium rich foods and drinks are from dairy sources. It is important to emphasize the sources of calcium rich foods and drink that are not dairy sources for those who may be lactose intolerant or follow vegetarian or vegan lifestyles. The results of this research question as related to calcium intake indicated a need for health education and health promotion materials to emphasize an increased consumption of calcium-rich foods and beverages for the range of dietary options for college students of all racial/ethnic groups.

The majority of women and men of all racial/ethnic groups indicated that they had actually participated in physical activity within the previous seven days of taking the survey. Physical activity guidelines suggest that adults, ages 18–64, should participate in physical activity for a minimum of 150 minutes each week (Garber, et al., 2011; IOF, 2015; PCFSN, 2017). This recommendation includes aerobic activity of at least 30 minutes per session as well

muscle strengthening activities two or more times each week. Weight bearing exercise is generally accepted as having osteoporosis preventing benefits. This survey asked respondents how many times a week they participated in weight-bearing exercises such as walking, jogging and/or aerobic dancing. and non-weight bearing exercises such as swimming or biking.

Although respondents reported that they did participate in physical activity each week, the details suggested that they did not meet the recommended levels to achieve benefits. Only 22.8% of White women, 4% of Black or African American women, 26.1% of Other women, and 21.2% of all women reported 20–30 minutes of weight bearing physical activity 5 – 7 times per week (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week). Only 34.5% of White men, 22% of Black or African American men, 22% of Other men, and 32.9% of all men reported 20–30 minutes of weight bearing physical activity 5 – 7 times per week, (110–150 minutes to 140–210 minutes per week), or at least 150 minutes each day (at least 210 minutes per week). The examples of appropriate methods of weight bearing and non-weight bearing physically activity may not match what was available to student participants in this study. It may be useful to suggested that these questions be reworded to include more current types of exercise equipment that are popular, or available to the institution, in fitness facilities such as treadmills, elliptical trainers, and weight lifting. The results of this research question as related to physical activity indicate a need for health education and health promotion information to emphasize increased participation in overall physical activity for college students of all racial/ethnic groups as well as increased participation in weight bearing exercises to prevent the development of osteoporosis. Bebeley et al. (2017) suggested that health promotion efforts that encouraged physical activity for overall well-being, improved literacy and academic performance would increase student's motivation to participate

regularly. Bebeley et al. (2017) also emphasized the need for universities to promote “physical activity practice and engagement” as well as to examine the physical activity patterns and determinants among students” (p. 2377).

Summary of Discussion and Recommendations

The results of this study indicate that designing health education and health promotion information specifically for women and men may be useful. These findings did not appear to support targeting various racial/ethnic groups of college-age students, but the samples sizes were very low for many groups. With such strong evidence that preventative health behaviors should begin in one’s youth when peak bone mass and bone mineral density are developed, it is important to develop information that younger people can relate to and find encouraging enough to make positive behavior changes.

There are many factors that influence a college student’s ability to engage in osteoporosis preventing behaviors. Institutions should consider the knowledge, attitude, beliefs and actual behaviors of their student population, but also consider the facilities, services, and programs available on campus and in the surrounding community in order to guide students to actually making such positive behavior change. More affluent institutions may have a financial advantage of being able to offer more up-to-date fitness facilities or more diverse dining options. However, with dedication and creativity all institutions can create health promotion campaigns to encourage their students to be more physically active and make nutritious food and beverage choices.

Suggestions for Future Research

With the amount of research that exists to suggest that populations other than White women can suffer serious consequences from osteoporosis, studies that include a greater

diversity of the participants, specifically racial/ethnic groups, would be useful. The results of this study suggested that college-aged students of various racial/ethnic groups do not feel they are very susceptible to developing osteoporosis. This combined with the low average score in knowledge, and the less than beneficial levels of calcium rich food or drink intake and weight bearing physical activity may suggest that the rates of osteoporosis will continue to rise. This is similar to findings by Burge (2007), Cannada (2016), Clark and Lavielle (2015), Edmonds et al. (2012), Ford et al. (2007), Hovell et al. (2009), Looker et al. (2017), Nguyen and Wang (2012), and NIAMSD (2015).

An interesting study may be to conduct a social marketing health campaign that emphasizes the importance of engaging in osteoporosis preventing behaviors of calcium intake and physical activity, as well as efforts to increase osteoporosis knowledge. If the principles of social marketing work correctly, the results should be that participants voluntarily make behavior changes which would be evident by increased calcium intake and increased physical activity. If participants do make voluntary behavior changes, it would be an indication that they are more confident; and therefore, they have higher self-efficacy to prevent osteoporosis. Having participants complete the survey before and after the campaign would give an indication if the social marketing campaign was effective or not. Lein, Turner, and Wilroy (2016) conducted a study that evaluated three versions of an osteoporosis prevention program designed for young women and found that providing informational brochures, a computer-tailored program or a computer-tailored program with verbal feedback were all effective at increasing osteoporosis preventing behaviors. The study also found that perceived barriers were decreased and perceived susceptibility and seriousness increased.

Evenson and Sanders (2016) indicated that individuals with high health motivation and

higher self-efficacy are more likely to engage in health-related activities; therefore, influence the results because they are already taking preventative measures and participating in healthful activities. Students who are in health-related majors may have a higher awareness or understanding of osteoporosis; and therefore, they may have a higher health motivation and self-efficacy to prevent it. Another interesting study would be to compare students of various majors, such as health-related, business, and education, to see if this premise holds true. Moreover, should any of the recommendations in this study be employed, it would be interesting to learn if such affected the population as a whole or specific majors individually.

Summary

The population of this study followed the general demographic trends of the student population at EIU in terms of age, sex at birth, racial/ethnic, and major. Significant differences were found in twelve of the thirty-nine hypotheses. Overall, the results suggested that differences existed more often between women and men than among the racial/ethnic groups of White, Black or African American, or Other (which combined several groups with small sample sizes). Overall osteoporosis knowledge was very low. Overall health belief was neutral with respondents neither agreeing or disagreeing with statements about osteoporosis. They disagreed with the statements related to their susceptibility, or perceived risk, of developing osteoporosis as well as the seriousness of the disease. They somewhat agreed with the benefits of exercise and calcium intake and somewhat disagreed with the barriers of exercise and calcium intake. This would indicate that they believed that they could engage in physical activity and consume calcium rich foods, and that the barriers to this would not prevent them from doing so.

Future research that recruits larger sample sizes of all racial/ethnic groups will be useful to advance the understanding of the need to target individual groups. Students who are in health-

related majors may have higher levels of knowledge, attitudes, beliefs and behaviors as related to osteoporosis because of courses they have taken or an overall higher awareness of health issues. Studies comparing various groups of majors may clarify this assumption.

There is still a great need to increase the number of college-aged students of all racial/ethnic groups engaging in osteoporosis preventing behaviors. In order to accomplish this, overall osteoporosis knowledge must be improved. College-aged students must believe that they are susceptible and believe this disease is serious. They must also believe that the benefits outweigh the barriers to exercise and calcium intake, and have high self-efficacy and health motivation. Osteoporosis is a preventable disease, but the education and awareness must reach younger people who still have time to engage in these positive behaviors. To accomplish this need, health education and health promotion information must be developed specifically for college-age students as well as by targeting women and men. The opportunities for educational programs is great not only for college students, but all young people during the growth phases that support the development of peak bone mass and bone mineral density. This is also the time that lifetime health habits and behaviors can be established, all of which may help turn the tide and reduce the rates of osteoporosis. In addition to health education and health promotion information targeting this age group, information targeting parents and guardians as well as health care providers could support the overall impact.

Osteoporosis is a preventable disease. Individuals of all racial/ethnic groups as well as women and men can be impacted. By encouraging young people to know their risks, understand the causes and consequences of negative behaviors, then to develop positive behaviors for bone health, the soaring rates can be slowed.

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APPENDIX A: LETTER OF EXPLANATION AND CONSENT FORM

Dear Students:

You are invited to participate in a research study on osteoporosis being conducted by Ms. Lauri DeRuiter-Willems, Dr. Kathy Phillips, Dr. Nikki Hillier, Dr. Sheila Simons, Dr. Misty Rhoads, and Dr. Julie Dietz from the Department of Health Promotion at Eastern Illinois University. Your participation in this study is entirely voluntary. You have been asked to participate in this study because you are a student at EIU.

The purpose of this survey is explore the knowledge of osteoporosis, health beliefs regarding osteoporosis, self-efficacy to perform osteoporosis-preventing activities, and actual performance of osteoporosis-preventing activities among college students. The results of this research may contribute to generalizable knowledge with regard to knowledge, attitudes, and behaviors relative to osteoporosis. It will take less than 30 minutes to complete the questionnaire.

Your participation in this study is voluntary. There are no foreseeable risks associated with this project, nor will you benefit directly from your participation in this study. However, if you feel uncomfortable answering any questions, you can withdraw from the survey at any point.

Your survey responses will be strictly confidential and data from this research will be reported only in the aggregate. Your information will be coded and will remain confidential. All survey findings will be reported in aggregate. Once the data is collected, only the primary investigator will have access to the data, which will be stored on a password-protected computer in the primary investigator's office and will be destroyed within three years of the completion of this study.

Again, participation in this study is voluntary and not a requirement for being a recipient of benefits or services from Eastern Illinois University. If you volunteer to be in this study, you may withdraw at any time without consequences of any kind or loss of benefits or services to which you are

otherwise entitles. If you have questions at any time about the survey or the procedures, you may contact Kathy Phillips at 217/581-6315 or by email at kphillips2@eiu.edu.

If you have any questions or concerns about the treatment of human participants in this study, you may call or write the Institutional Review Board:

Institutional Review Board

Eastern Illinois University

600 Lincoln Avenue

Charleston, IL 61920

Telephone: (217) 581-8576

E-mail: eiuirb@www.eiu.edu

You will be given the opportunity to discuss any questions about your rights as a research subject with a member of the IRB. The IRB is an independent committee composed of member of the University community, as well as lay members of the community not connected with EIU. The IRB has reviewed and approved this study.

If possible, could you please respond to the survey by October 15, 2017.

Thank you very much for your time and support.

By clicking on the continue button below, I voluntarily agree to participate in this study. I understand that I am free to withdraw my consent and discontinue my participation at any given time. I also can print out a copy of this informed consent letter should I wish to do so.

APPENDIX B: SURVEY

Osteoporosis

Demographics

Thank you for taking our survey. Remember, your participation is voluntary. No identifying data can be linked to you and data will only be reported in aggregate form, so please answer as honestly as you can. Please answer all questions, but if you do not want to finish, you can stop at any time without any penalty, just close the survey.

DEMOGRAPHIC INFORMATION:

Please answer the following about yourself:

D1 What is your age range?

- ☐ Under 18 (1)
- ☐ 18 - 20 (2)
- ☐ 21-24 (3)
- ☐ 25-30 (4)
- ☐ 31 or older (5)

Skip To: End of Survey If D1 = Under 18 (1)

D2 What is your birth sex?

☐ Female (1)

☐ Male (2)

D3 What is your ethnicity/race?

☐ American Indian or Alaska Native (3)

☐ Asian (4)

☐ Black or African American (2)

☐ Hispanic or Latino (8)

☐ International/non-resident alien (9)

☐ Multiple/2 or more races (6)

☐ Native Hawaiian or Pacific Islander (5)

☐ Unknown/Not reported (7)

☐ White (1)

D4 Has anyone in your family ever been diagnosed as having osteoporosis?

☐ Yes (1)

☐ No (2)

☐ If yes, please state relation to you (3)

☐ Unknown (4)

D5 In which department or school is your major or program?

☐ Art (2)

☐ Biological Sciences (3)

☐ Business (4)

☐ Chemistry (5)

☐ Communication Disorders and Sciences (6)

☐ Communication Studies (7)

☐ Early Childhood, Elementary, Middle level Education (8)

☐ Economics (9)

☐ Educational Leadership (10)

☐ English (11)

- ☐ Family and Consumer Sciences (12)
- ☐ Foreign Languages (13)
- ☐ Geology/Geography (14)
- ☐ Health Promotion (15)
- ☐ History (31)
- ☐ Journalism (16)
- ☐ Kinesiology and Sports Studies (17)
- ☐ Mathematics and Computer Science (18)
- ☐ Music (20)
- ☐ Nursing (21)
- ☐ Philosophy (22)
- ☐ Physics (32)
- ☐ Political Science (33)
- ☐ Psychology (34)
- ☐ Recreation Administration (23)

- ☐ Social Science Teaching (25)
- ☐ Sociology/Anthropology (26)
- ☐ Special Education (27)
- ☐ Technology (28)
- ☐ Theatre Arts (29)
- ☐ Undecided/Undeclared (24)
- ☐ Other, not listed (1)

End of Block

Knowledge

K6 Osteoporosis (os-te-o-po-ro-sis) is a condition in which the bones become very brittle and weak so that they break easily.

Below is a list of things which may or may not affect a person's chance of getting osteoporosis.

After you read each statement, think about if the person is:

MORE LIKELY TO GET OSTEOPOROSIS, or
LESS LIKELY TO GET OSTEOPOROSIS, or

NEUTRAL, IT HAS NOTHING TO DO WITH GETTING OSTEOPOROSIS, or
DON'T KNOW, I DON'T KNOW THE ANSWER

	More Likely (1)	Neutral (2)	Less Likely (3)	Don't Know (4)
Eating a diet <u>LOW</u> in dairy products (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being menopausal: "change of life" (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having a parent or grandparent who has osteoporosis (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being a White or Asian woman (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being an elderly man (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having ovaries surgically removed (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Taking cortisone (steroids e.g. Prednisone) for long time (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Being overweight (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Having an eating disorder (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Consuming more than 2 alcoholic drinks per day (10)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Smoking on a daily basis (11)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

For the next group of questions, select one answer from the 4 choices. Be sure to mark **ONLY ONE** answer.

If you think there is more than one correct answer, choose the **BEST** answer.

If you are not sure, select D. Don't know.

K7 To strengthen bones, it is recommended that a person exercise at a moderately intense level for 30 minutes a day at least

☐ 3 days a week (1)

☐ 4 days a week (2)

☐ 5 days a week (3)

☐ Don't know (4)

K8 Exercise makes bones strong, but it must be hard enough to make breathing:

☐ Just a little faster (1)

☐ Much faster, but talking is possible (2)

☐ So fast that talking is not possible (3)

☐ Don't know (4)

K9

Which of the following activities one is the best way to reduce a person's chances of getting

osteoporosis?

- ☐ Swimming (1)
 - ☐ Walking briskly (2)
 - ☐ Stretching (3)
 - ☐ Don't know (4)
-

K10 Which of the following activities is the best way to reduce a person's chances of getting osteoporosis?

- ☐ Bicycling (1)
 - ☐ Yoga (2)
 - ☐ Lifting weights (3)
 - ☐ Don't know (4)
-

K11 Which of the following activities is the best way to reduce a person's chances of getting osteoporosis?

- ☐ Jogging or running (1)
 - ☐ Golfing using golf cart (2)
 - ☐ Gardening (3)
 - ☐ Don't know (4)
-

K12 Which of the following activities is the best way to reduce a person's chances of getting osteoporosis?

- ☐ Bowling (1)
 - ☐ Doing laundry (2)
 - ☐ Aerobic dancing (3)
 - ☐ Don't know (4)
-

For the next group of questions, circle one answer from the 4 choices. Be sure to select ONLY ONE answer. If you think there is more than one correct answer, choose the BEST answer. If you are not sure, select D. Don't know.

K13 Which of these is the best source of calcium?

- ☐ Apple (1)
 - ☐ Cheese (2)
 - ☐ Cucumber (3)
 - ☐ Don't know (4)
-

K14 Which of these is the best source of calcium?

- ☐ Peanut butter (1)
 - ☐ Turkey (2)
 - ☐ Canned sardines (3)
 - ☐ Don't know (4)
-

K15 Which of these is the best source of calcium?

- ☐ Chicken (1)
 - ☐ Broccoli (2)
 - ☐ Grapes (3)
 - ☐ Don't know (4)
-

K16 Which of these is the best source of calcium?

- ☐ Yogurt (1)
 - ☐ Strawberries (2)
 - ☐ Cabbage (3)
 - ☐ Don't know (4)
-

K17

Which of these is the best source of calcium?

- ☐ Ice Cream (1)
 - ☐ Grapefruit (2)
 - ☐ Radishes (3)
 - ☐ Don't know (4)
-

K18 Which of the following is the recommended amount of calcium intake for an adult?

- ☐ 600 mg - 800 mg daily (1)
 - ☐ 1000 mg - 1200 mg daily (2)
 - ☐ 1400 mg - 1600 mg daily (3)
 - ☐ Don't know (4)
-

K19 How much milk must an adult drink to meet the recommended amount of calcium?

- ☐ 1 glass daily (1)
 - ☐ 2 glasses daily (2)
 - ☐ 3 or more glasses daily (3)
 - ☐ Don't know (4)
-

K20 Which of the following is the best reason for taking a calcium supplement?

- ☐ If a person skips breakfast (1)
 - ☐ If a person does not get enough calcium from their diet (2)
 - ☐ If a person is over 45 years old (3)
 - ☐ Don't know (4)
-

K21 Which vitamin is required for the absorption of calcium?

- ☐ Vitamin A (1)
 - ☐ Vitamin B (2)
 - ☐ Vitamin D (3)
 - ☐ Don't know (4)
-

For the next group of questions, circle one answer from the 4 choices. Be sure to circle ONLY ONE answer. If you think there is more than one correct answer, choose the BEST answer. If you are not sure, circle D. Don't know.

K22 Which is the best source of the vitamin required for the absorption of calcium?

- ☐ Carrots (1)
 - ☐ Oranges (2)
 - ☐ Sunlight (3)
 - ☐ Don't know (4)
 - ☐ I don't know what the vitamin is. (5)
-

K23 Which is the best food source of the vitamin required for the absorption of calcium?

- ☐ Spinach (1)
 - ☐ Cheese (2)
 - ☐ Salmon (3)
 - ☐ Don't know (4)
 - ☐ I don't know what the vitamin is. (5)
-

K24 Which of the following is the recommended amount of the vitamin required for the absorption of calcium for an adult, 50 years old and older?

- ☐ 800-1000 IU daily (1)
 - ☐ 1200-1400 IU daily (2)
 - ☐ 1600-1800 IU daily (3)
 - ☐ Don't know (4)
-

K25 When is the best time to build strong bones?

- ☐ Childhood (1)
 - ☐ Adolescence (2)
 - ☐ Young adulthood (3)
 - ☐ Don't know (4)
-

K28 Osteoporosis can be diagnosed by

- ☐ Blood test (1)
 - ☐ DXA scan (2)
 - ☐ Symptoms (3)
 - ☐ Don't know (4)
-

K29 Once you have osteoporosis

- ☐ There is nothing you can do about it (1)
- ☐ You can take medication to treat it (2)
- ☐ You must be careful lifting objects (3)
- ☐ Don't know (4)

Developed by Katherine Kim PhD, Mary Horan PhD, and Phyllis Gendler PhD (1991). Grand Valley State University, with support from Grand Valley State University Research Grant-in-Aid. Revised by Phyllis Gendler PhD, Cynthia Coviak PhD, Jean Martin PhD, and Katherine Kim PhD (2011, 2012). Question 26 was developed as an addition to the Osteoporosis Knowledge Test by Pamela von Hurst (2006).

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End of Block

Health Belief Scale

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, select if you STRONGLY DISAGREE, DISAGREE, are NEUTRAL, AGREE, or STRONGLY AGREE with the statement. It is important that you answer according to your actual belief 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.

HB30 Read each statement. Select one best option that explains what you believe.

	Strongly disagree (1)	Somewhat disagree (2)	Neither agree nor disagree (3)	Somewhat agree (4)	Strongly agree (5)
Your chances of getting osteoporosis are high. (1)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Because of your body build, you are more likely to develop osteoporosis. (2)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
It is extremely likely that you will get osteoporosis. (3)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
There is a good chance that you will get osteoporosis. (4)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
You are more likely than the average person to get osteoporosis. (5)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your family history makes it more likely that you will get osteoporosis. (6)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
The thought of having osteoporosis scares you. (7)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
If you had osteoporosis you would be crippled. (8)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Your feelings about yourself would change if you got osteoporosis. (9)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

It would be very
costly if you got
osteoporosis.
(10)

☐☐☐☐☐

When you think
about
osteoporosis you
get depressed.
(11)

☐☐☐☐☐

It would be very
serious if you got
osteoporosis.
(12)

☐☐☐☐☐

Regular exercise
prevents
problems that
would happen
from
osteoporosis.
(13)

☐☐☐☐☐

You feel better
when you
exercise to
prevent
osteoporosis.
(14)

☐☐☐☐☐

Regular exercise
helps to build
strong bones.
(15)

☐☐☐☐☐

Exercising to
prevent
osteoporosis also
improves the way
your body looks.
(16)

☐☐☐☐☐

Regular exercise
cuts down the
chances of
broken bones.
(17)

☐☐☐☐☐

You feel good
about yourself
when you
exercise to
prevent
osteoporosis.
(18)

☐☐☐☐☐

Taking in enough
calcium prevents
problems from
osteoporosis.
(19)

☐☐☐☐☐

You have lots to
gain from taking
in enough
calcium to
prevent
osteoporosis.
(20)

☐☐☐☐☐

Taking in enough
calcium prevents
painful
osteoporosis.
(21)

☐☐☐☐☐

You would not
worry as much
about
osteoporosis if
you took in
enough calcium.
(22)

☐☐☐☐☐

Taking in enough
calcium cuts
down on your
chances of
broken bones.
(23)

☐☐☐☐☐

You feel good
about yourself
when you take in
enough calcium
to prevent
osteoporosis.
(24)

☐☐☐☐☐

You feel like you are not strong enough to exercise regularly. (25)

☐☐☐☐☐

You have no place where you can exercise. (26)

☐☐☐☐☐

Your spouse or family discourages you from exercising. (27)

☐☐☐☐☐

Exercising regularly would mean starting a new habit which is hard for you to do. (28)

☐☐☐☐☐

Exercising regularly makes you uncomfortable. (29)

☐☐☐☐☐

Exercising regularly upsets your every day routine. (30)

☐☐☐☐☐

Calcium rich foods cost too much. (31)

☐☐☐☐☐

Calcium rich foods do not agree with you. (32)

☐☐☐☐☐

You do not like calcium rich foods. (33)

☐☐☐☐☐

Eating calcium rich foods means changing your diet which is hard to do. (34)

☐☐☐☐☐

In order to eat more calcium rich foods you have to give up other foods that you like. (35)

☐☐☐☐☐

Calcium rich foods have too much cholesterol. (36)

☐☐☐☐☐

You eat a well-balanced diet. (37)

☐☐☐☐☐

You look for new information related to health. (38)

☐☐☐☐☐

Keeping healthy is very important to you. (39)

☐☐☐☐☐

You try to discover health problems early. (40)

☐☐☐☐☐

You have a regular health check-up even when you are not sick. (41)

☐☐☐☐☐

You follow recommendations to keep yourself healthy. (42)

☐☐☐☐☐

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End of Block













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. There are no right or wrong answers. It is your opinion that is important. In this questionnaire, EXERCISE means activities such as walking, golfing, biking, aerobic dancing.

After reading each statement, **move the slider on the bar to the place that best describes your confidence level.**

SE31

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

begin a new or different exercise program (1)	
change your exercise habits (2)	
put forth the effort required to exercise (3)	
do exercises even if they are difficult (4)	
exercise for the appropriate length of time (5)	
do the type of exercises that you are supposed to do (6)	
increase your calcium intake (7)	
change your diet to include more calcium rich foods (8)	
eat calcium rich foods as often as you are supposed to do (9)	
select appropriate foods to increase your calcium intake (10)	
stick to a diet which gives an adequate amount of calcium (11)	
obtain foods that give an adequate amount of calcium even when they are not readily available (12)	

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Behaviors Survey

Select the answer that most applies to you.

BS32 How many glasses (8 ounces) of milk do you drink during an average week?

☐ None per week (1)

☐ One per week (2)

☐ Two per week (3)

☐ Three per week (4)

☐ Four per week (5)

☐ Five per week (6)

☐ Six per week (7)

☐ One per day (8)

☐ Two per day (9)

☐ Three per day (10)

☐ Other, please specify (11) _____

BS33 How many eight-ounce servings of yogurt do you eat during an average week?

☐ None per week (1)

☐ One per week (2)

☐ Two per week (3)

☐ Three per week (4)

☐ Four per week (5)

☐ Five per week (6)

☐ Six per week (7)

☐ One per day (8)

☐ Two per day (9)

☐ Three per day (10)

☐ Other, please specify (11) _____

BS34 How many (1) ounce servings of cheese do you eat during an average week?

☐ None per week (1)

☐ One per week (2)

☐ Two per week (3)

☐ Three per week (4)

☐ Four per week (5)

☐ Five per week (6)

☐ Six per week (7)

☐ One per day (8)

☐ Two per day (9)

☐ Three per day (10)

☐ Other, please specify (11) _____

BS35 Do you take a calcium supplement?

- ☐ No (1)
- ☐ Yes, what is the name of the product? (2)
-

BS36 How many times a week do you participate in weight-bearing exercise such as a walking program, jogging and/or aerobic dancing?

- ☐ Less than 10 minutes per week (1)
- ☐ 10 to 15 minutes, 1 to 2 times per week (2)
- ☐ 10 to 15 minutes, 3 to 4 times per week (3)
- ☐ 10 to 15 minutes, 5 to 7 times per week (4)
- ☐ 20 to 30 minutes, 1 to 2 times per week (5)
- ☐ 20 to 30 minutes, 3 to 4 times per week (6)
- ☐ 20 to 30 minutes, 5 to 7 times per week (7)
- ☐ More than 30 minutes per day (8)
-

BS37 How many times a week do you participate in non-weight bearing exercises such as swimming or biking?

- ☐ Less than 10 times per week (1)
 - ☐ 10 to 15 minutes, 1 to 2 times per week (2)
 - ☐ 10 to 15 minutes, 3 to 4 times per week (3)
 - ☐ 10 to 15 minutes, 5 to 7 times per week (4)
 - ☐ 20 to 30 minutes, 1 to 2 times per week (5)
 - ☐ 20 to 30 minutes, 3 to 4 times per week (6)
 - ☐ 20 to 30 minutes, 5 to 7 times per week (7)
 - ☐ More than 30 minutes per day (8)
-

BS38 Were you physically active in the past seven (7) days?

- ☐ Yes (1)
- ☐ No (2)

Skip To: End of Block If BS38 = No (2)

BS39

Please record how much physical activity you did in the last SEVEN DAYS. Please place your physical activity into one of the two categories: Moderate Physical Activity or Vigorous Physical

Activity. Record only the time you were active. Do not count breaks or rest periods.

You can record more than one activity. If you do, please write the minutes you were active for each activity separately. List the activity that you did when you were active.

Moderate Activity

Types of moderate activities include walking briskly, mowing the lawn with a non-motorized push mower, dancing, swimming at a leisurely pace, partaking in water aerobics, or bicycling on level terrain for at least 30 minutes.

Vigorous Activity

Types of vigorous activities include jogging, high-impact aerobic dancing, swimming continuous

laps at a moderate pace, bicycling uphill, high energy sports (e.g., basketball, soccer, running, singles tennis, fast dancing, or similar activities) for 20 or more minutes per occasion.

	Moderate Activity Name	Minutes Moderate Activity	Vigorous Activity Name	Minutes Vigorous Activity
	Answer 1 (1)	Answer 1 (1)	Answer 1 (1)	Answer 1 (1)
Sunday (1)				
Monday (2)				
Tuesday (3)				
Wednesday (4)				
Thursday (5)				
Friday (6)				
Saturday (7)				

BS40

Compared to your physical activity over the past 3 months, was last week's physical activity more, less, or about the same?

☐ More (1)

☐ Less (2)

☐ About the same (3)

End of Block

APPENDIX C: RECRUITMENT MESSAGES

Email message

Subject:

Hello, my name is Lauri DeRuiter-Willems, a graduate student at Indiana State University in the Department Teaching and Learning. I am conducting research on osteoporosis and college students and as an EIU student, I am inviting you to participate in this study.

Your participation in this research would be taking a survey on your knowledge, beliefs, attitudes and behaviors about osteoporosis and osteoporosis prevention. The survey will take about 15 minutes to complete. Your participation is completely voluntary and your answers will be kept confidential and anonymous.

If you would take a few minutes, I would appreciate your support by taking the survey. It's easy to do on a computer or a mobile device. Just click on the link you will find in your Panthermail email with the subject line: "Osteoporosis – Students knowledge, beliefs, attitudes and behaviors".

I know you are busy, and I really appreciate the time you take to answer the survey as completely and to the best of your abilities.

If you have any questions, I can be reached at <ljderuiterwillems@eiu.edu>.

Lauri DeRuiter-Willems

Twitter message (137 characters)

What do EIU college students know about good bones? Please check your Panthermail for the Osteoporosis – Students knowledge, beliefs, attitudes and behaviors"!

Facebook message/LinkedIn message/Pinterest message/ DEN ad

What do college students know about good bones? Osteoporosis can affect all of us. If you are an EIU students, please take the survey on knowledge, beliefs, attitudes and behaviors of osteoporosis. Check your Panthermail email for "Osteoporosis – Students knowledge, beliefs, attitudes and behaviors".

APPENDIX D: PERMISSIONS

From: **Edmonds, Ellen** <etedmonds@bsu.edu>
 Date: Tue, Apr 18, 2017 at 1:06 PM
 Subject: RE: Osteoporosis survey
 To: Kathy Phillips <kphillips2@eiu.edu>

Hi Kathy,
 Yes ma'am, you are more than welcome to use it. If you need anything from me, please feel free to contact me.

Respectfully,

Ellen Edmonds, PhD, MCHES
 Assistant Professor
 Department of Nutrition & Health Science
 Ball State University
 Muncie, IN 47306

From: Kathy Phillips [mailto:kphillips2@eiu.edu]
Sent: Monday, April 17, 2017 1:19 PM
To: Edmonds, Ellen <etedmonds@bsu.edu>
Subject: Osteoporosis survey

I am a professor at Eastern Illinois University (EIU) in the Department of Health Promotion. Several colleagues and I are interested in exploring osteoporosis attitudes, knowledge and behavior among our students at EIU. We specifically want to look at differences between minorities and Caucasians concerning osteoporosis.

We came across your dissertation and would like to ask permission to use your modified version of the Osteoporosis Preventing Behaviors Survey (OPBS) in our study.

Thank you for your consideration.

Kathy
 Dr. Kathleen Phillips
 Professor and Intern Coordinator
 Dept. of Health Promotion
 Eastern Illinois University
 Charleston, IL 61920
217-581-6315