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Osteoporosis Prevention is Linked to Education, Childhood Meals and Milk Consumption in Young Adult Females

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Osteoporosis Prevention is Linked to Education, Childhood Meals and Milk Consumption in
Young Adult Females

By

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DCN DISSERTATION

Submitted in Partial Fulfillment of the Requirements of

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Osteoporosis Prevention is
Linked to Education,
Childhood Meals and Milk
Consumption in Young Adult
Females

Karen E. From

Acknowledgments: My strength and belief in the Lord to see me through, my supporting husband, family, work peers and dissertation committee members.

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Abstract

The three aims of the study investigated the females' age 18-25 perception, knowledge, and health beliefs, barriers and strategies to overcoming barriers to prevent osteoporosis. The mixed method explanatory design of research was implemented. Phase one used a survey to gather demographic data, past and current behaviors, the completion of the Osteoporosis Health Behavior Scale (OHBS) questionnaire, and Short Calcium Intake List (SCaIL). Four hundred forty-nine quality survey responses were obtained. The second phase, the focus group ($n=23$), discussed questions designed to answer the three aims of the study.

Results- Our analysis showed 90% of our 447 survey participants did not ingest the RDA of 1000mg of calcium. Those that drank milk growing up and ate four or more family meals were more likely to consume the RDA of calcium as a young adult. Also those consuming two or more glasses of milk per day as a young adult were more likely to meet calcium RDA. As participants were more health motivated they saw fewer barriers to exercise and calcium intake. There was a positive relationship between if participants believed they were more susceptible to and viewed osteoporosis as serious they were more likely to believe there were more barriers to helping themselves.

Conclusion- These results suggest a need for nutrition education using hands-on teaching methods, and a national marketing/social media platform focused towards the young adult female pertaining to dietary consumption of calcium, vitamin D and physical activity as it relates to bone health/prevention of osteoporosis. This age group are the future parents and leaders of the next generation and current and past research indicates education of healthy meals, childhood milk consumption and family meals equate to healthier future outcomes of the next generation.

Introduction

Osteoporosis is often thought of as a disease of the elderly, but what is not understood by the general population is its formation can start as early as adolescence. Osteoporosis is defined “as a systematic skeletal disorder characterized by low bone mass and micro-architectural deterioration of bone tissue. It consequently increases the fragility of bone and hence susceptibility to fracture. The public health burden of the disease is likely to rise in the new millennium, due in part to an increase in life expectancy with a growing elderly population. Understanding the epidemiology of the disease is crucial in trying to develop strategies to help reduce this load.”¹

Another way of stating this is “osteoporosis is a disease of the geriatric group that has an adolescent onset.”² While bone mass is reaching its peak between the ages of 18-21 for women and 19-24 for men, lifestyle factors are impacting the attainment of a person’s quality peak bone mass.³ Even the exercise habits back to when one was an adolescent could impact peak bone mass. Other lifestyle factors linked with the attainment of peak bone mass are dietary factors, daily consumption of required calcium and vitamin D, and daily weight bearing physical activity.³ Additionally, life choices that can contribute to the loss of bone mass are smoking, alcohol use, and diminishing levels of estrogen either through menopause, eating disorders, or the athlete triad.³

Current studies have demonstrated the use of the Health Belief Model (HBM) when educating this age group on bone health/osteoporosis can produce a significant positive change in both their

beliefs and knowledge concerning osteoporosis.^(9,43,57) Other studies repeatedly state that the education of this age group and gender (most at risk) of bone health/osteoporosis at a time where they can make lifestyle changes to lessen their chance for the development of osteoporosis is a public health concern.^{4,5} Repeatedly, the research noted the need to educate this age group to lead to behavior change. Unfortunately, researchers have not put themselves in the position of the 18-25 year-old female to ask how to influence the needed changes. This paper chooses to focus and better understand the perceptions of young adult women who are reaching their peak bone mass. It seeks to determine their beliefs, barriers to lifestyle modification and self-efficacy concerning the development of osteoporosis. The study further delineates efficacy measure assessment, calcium and vitamin D intake and physical activity, and choices concerning calcium sources.

In summary, the age when people develop peak bone mass correlates to an age when the consumption of enough calcium and vitamin D, two key nutrients to bone health, are not sufficient in the diet. Osteoporosis disease is in an upward trend and can increase morbidity, mortality and decrease quality of life. 18-25 year-old females must be made aware of their perceived risk of developing osteoporosis and their ability to lessen their chances of developing of this debilitating disease. Education is also needed to facilitate lifestyle behavior changes, but first we must identify the barriers to those changes, while also developing strategies to mitigate the barriers.

Chapter 1: Review of the Literature

Osteoporosis Defined, Physical and Economic Impacts

“Osteoporosis is a common disease that is characterized by low bone mass, deterioration of bone tissue, and disruption of bone microarchitecture resulting in an increased risk of fracture.”⁶

Public health defines bone health as a health issue with an emphasis on prevention and early intervention to promote strong bones and prevent fractures and their consequences.⁶ The consequences of osteoporosis are both personal and societal and thought of as devastating.⁶ Consequences of osteoporosis can include pain, decreased quality of life, increased disability-adjusted life span, loss of independence, financial burden, and even death.⁷ The prevalence of low bone mass, at the time of the last US census in 2010, was 45 million adults and higher in women (52.6%) versus men (35.6%).⁶ The prevalence of osteoporosis in the United States is estimated to increase from approximately 10 million to over 14 million people in 2020. Sources stipulate this is due to an aging population.⁸ Both osteoporosis and low bone mass is expected to increase to 121.3 million by 2025.⁶ “Societal costs of osteoporosis in 2008 was \$22 billion, affects over 10 million adults and is currently being underdiagnosed and undertreated.”⁹ With the baby boomers aging and anticipated population growth, annual bone fractures are projected to increase from 1.9 million to 3.2 million (68%) from 2018 to 2040. The related annual costs rising from \$57 billion to over \$95 billion.⁹ The National Osteoporosis Foundation fast facts states one in two women and up to one in four men will break a bone in their lifetime due to osteoporosis. And for women, the incidence of bone fractures is greater than heart attack, stroke and breast

cancer combined.¹⁰ Currently, information on the burden of osteoporosis across race/ethnicity, age groups, gender and fracture sites is lacking.⁸

The country is aging with the baby boomers aging and the anticipated population growth. Just this fact supports the statement above annual bone fractures could possibly increase 68% by the year 2040. One in two women and one in four men will break a bone in their life-time due to osteoporosis. For women, this chance is greater than heart attack, stroke and breast cancer combined. It is a costly disease with an annual bill of \$57 billion and over \$95 billion for future generations, but the real cost is the quality of life and life expectancy after a bone break.

Osteoporosis Current and Future Trends

A study performing a cross sectional investigation sought to examine gender differences in osteoporosis-related knowledge and beliefs and how these beliefs would predict vigorous physical activity behavior in university students. The study found both genders had relatively poor knowledge of osteoporosis and its risks. Women did have higher knowledge than men, higher perceived susceptibility, severity, calcium barriers and lower exercise self-efficacy than men.¹¹ The research showed “The confluence of increased longevity and reduced physical activity throughout the lifecycle exacerbate the problem of osteoporosis. As such, osteoporosis is a disease of contemporary human evolution and a growing public health concern in contemporary human populations.”¹² The objective of a cross sectional investigation was to examine gender differences in osteoporosis-related knowledge and beliefs and these beliefs

would predict vigorous physical activity behavior in university students.¹¹ “54 million Americans age 50 and over either already have or are at risk of osteoporosis. Osteoporosis-related bone fractures are responsible for more hospitalizations than heart attacks, strokes and breast cancer combined. As the nation ages, this problem will continue to worsen, exacting a major economic and human toll on Medicare beneficiaries, their caregivers, and taxpayers.¹³ Yet the problem is rarely a focus of public discussion or policymaker priority. Preventing secondary osteoporotic fractures may result in significant Medicare savings while at the same time, reduce suffering for older Americans.”¹³

The trend for those to suffer from the development of the disease of osteoporosis is on the rise. Osteoporosis is rarely focused on as a public discussion or a priority for policy makers. The Futurist journal published an article in 2007¹⁴ outlining future trends concerning Osteoporosis. The article referred to osteoporosis as an epidemic likely to continue to grow due to our aging population that is expected to outpace any actions, we may attempt to slow down the disease progression through lifestyle, diet changes and an increase in effective drugs. Now in the year 2020, the article above, predicted an environment much superior in fracture prevention and quality of life than in 2007.¹⁴ Yet, the year 2020 is here and the projected rates of osteoporosis and its impact on quality of life and morbidity are still very real. The most recent public initiative (June of 2020) to address osteoporosis is called Capture the Fracture and is a component of the International Osteoporosis Foundation. Capture the Fracture aims to work internationally and interagency to reduce the hip and vertebral fractures by 25% by 2025.¹⁵

Peak Bone Mass

According to research performed by RP Heaney,¹⁶ the development of osteoporosis may occur due to either a failure to reach peak bone mass (PBM) before skeletal maturity or excessive bone loss across the life span.¹⁶ Peak bone mass for females, according to Heaney,¹⁶ is age twenty. The National Osteoporosis Foundation position statement on peak bone mass development states peak bone mineral accretion rate occurs at 12.5 +/- 0.90 years in girls and 14.1 +/- 0.95 years in boys of European ancestry. During the 4 years surrounding the peak in bone accretion, 39% of total body bone mineral is acquired; by 4 years following the peak, 95% of adult bone mass has been achieved.¹⁷ In other words, peak bone accretion is achieved between the ages of 13-17 for girls and 4 years following peak adult bone mass at ages 17-21 years. Boys achieve peak bone accretion between 14-18 years of age and 4 years following peak bone accretion. Men form peak adult bone mass at 18-22 years.¹⁷ The review goes on to state that peak bone mass is also dependent on which bone is being studied, birth weight, physical activity, etc. and until this is fully understood, lifestyle factors that impact bone health should be sustained throughout the lifecycle.¹⁷

An estimated 60–80 % of the variability in bone mass and osteoporosis risk is explained by heritable factors. Bone mineral density (BMD) is lower among daughters of women with osteoporosis and in men and women with first-degree relatives who have osteoporosis.¹⁷ “Lower peak BMD in youth may be the single most important factor leading to the development of osteoporosis in the elderly.”³ Age attainment is still unclear and most studies suggest peak bone

mass at the femur bone is achieved by the age of 17-29 years.³ A study conducted by Shanshan X, et al³ sought to estimate the age of attainment of peak BMD in both sexes at the femoral neck, total hip and lumbar spine using the NHANES data of 2005-2014. The study concluded that peak femoral neck, total hip, and lumbar spine BMD were 20-24 years old in males and 19-20 years old in females. The authors also stated body mass index (BMI) and race were not associated with age of attainment of peak BMD, and encouraging the improvement of bone health among individuals before 20 years old may aid in the reduction of future risk of osteoporosis and osteoporotic fractures.³ More studies have found comorbid conditions that promote chronic inflammation induce changes in bone health, and an increase in low bone mass may be a result.^{18,19}

Peak bone mass (PBM) research is pointing a shift from the belief that PBM is reached by the age of 30 and instead is reached earlier in life. Recent research highlights that PBM is attained in one's early twenties. Research also shows physical activity and calcium and vitamin D intake in adolescences may play more of a role in peak bone mass density than once believed. All of the research demonstrated an urgency to educate adolescents through young adult age on the lifestyle factors that contribute to bone health and prevention of osteoporosis. The education should reinforce self-efficacy to reverse the impacts of the disease.

Modifiable Factors

Diet and physical activity are the primary modifiable factors associated with bone health, although other risk factors may impact bone health.¹⁷ The other risk factors include hormonal status, calcium intake, smoking, and increased caffeine intake. Inadequate calcium intake during growth periods of childhood may increase the risk of fractures and predispose this group to lower peak bone mass.²⁰ “Calcium needs are greater during adolescence (pubertal growth spurt) than in either childhood or adulthood”²⁰. Therefore, choosing to increase calcium intake is one important decision adolescents can make to improve their PBM.

Calcium and Milk/Dairy Consumption Trends

As noted, calcium is an important nutrient to maximize bone density and strength during bone growth and development and even into the fourth decade of life for certain skeletal sites. The World Health Organization has stated an understanding of modifiable lifestyle factors that affect bone development and strength in young women is critical in prevention of osteoporosis.²¹ Because calcium is the dominant mineral in the bone matrix, adequate dietary intake of calcium is necessary for bone health.²¹ The Institute of Medicine, recommends adequate intake for females aged 19-50 years is 1000 mg per day of calcium.²¹ Other important factors about calcium absorption nutrients that increase its excretion from the body include sodium, protein, caffeine and potassium (National Institutes of Health). Inadequate vitamin D also decreases the absorption of calcium and absorption decreases 15-20% in adulthood.²¹ After conducting a

systematic review of the literature, the National Osteoporosis Foundation's position statement on peak bone mass development and lifestyle factors gave the benefit of calcium on bone health a level of evidence an A.¹⁷ "A" is the approved measure of assigning a letter grade based on accuracy of research to document the claim.

Phosphorous and calcium are the main bone-forming minerals and must exist in certain ration within the adult diet for optimum bone health. Phosphorous to calcium ratio should be three to one in the adult diet. A study evaluating calcium to phosphorous ratios concluded that Western diets low calcium to phosphorous ratios are common and more attention should be focused on decreasing excessively high phosphorous intake, found in highly processed foods and increasing the consumption of raw and unprocessed foods.²² A Finnish study looked at not only calcium intake, but phosphorous to calcium intake and its impact on the Parathyroid hormone and bone mineralization. A study by Kasper et al²³ found 59% of the participants that responded stated their diet was adequate in dairy products and other sources of calcium, yet their diets were classified as getting inadequate calcium intake, and only 3.8% were getting an adequate amount of dietary calcium and adequate exercise for bone health.²³ The study went on to clarify the relationship between being able to correctly identify the lack of calcium as a risk factor and getting an adequate amount of calcium was not significant.²³

A study published in 2001 showed that even though 68% of the women participants identified milk as a source of calcium, the mean calcium intake for this group was 533mg/d; well below the 1000mg/d recommended. Additionally, the participants that did not identify milk as a calcium

source had an intake of 506 mg/d.²⁴ The mean calcium intake by source as reported “milk” was not statistically significant ($p = .819$).²⁴ Also, those reporting sources as “milk” compared to those who did not, having low, medium or high calcium intakes were also not found to be statistically significant.²⁴ The study found subjects between the ages of 13-14 mean calcium intake was 639 mg/d and older participants 25-49 years of age was lower at an average of 463 mg/d.²⁴ Respondents were asked what was the barrier or factors that prevents them from eating more products containing calcium such as milk, yogurt and cheese. Over a third of the 89 respondents reported a belief they had already consumed enough calcium for the day.²⁴ Eighteen percent of the respondents stated they had digestive problems such as lactose intolerance and this group had an average calcium intake of 355 mg/d.²⁴ Although 66% and 42% respectively identified milk and cheese as sources of calcium many participants incorrectly stated fruits, bread, grains, meat and poultry as sources. Studies done by Chapman et al²⁵ and Zablah²⁶, found similar answers to foods that contain calcium in their studies.

Rouf et al²⁷ concluded from their study of calcium intakes among Australian adolescents and young adults, that calcium intake among both groups remains below recommended levels, especially in females. It also concurred that higher intake of calcium was associated with a better dietary overall pattern.²⁸

A 2019 meta-analysis of the effects of milk and dairy products on the prevention of osteoporosis and osteoporotic fractures concluded bone mineral density (BMD) of selected studies described a 1.7-3% lower hip BMD in young and postmenopausal women with poor intake of milk in their

youth. The meta-analysis revealed a positive relationship between baseline milk ingestion and percentage of trochanter BMD change in elderly people and a positive correlation between milk consumption and BMD change at the radius in women age >65 y. They went on to conclude that the studied population with the highest consumption of dairy products did not show a clear association with the total osteoporotic fracture or hip fracture risks. A diminished risk of vertebral fracture could be described. The authors stated the results regarding BMD change were heterogeneous and did not allow for a definitive conclusion.²⁹ Other studies reiterate the calcium intake is just part of the complex etiology of osteoporosis, genetics, environmental, hormonal, behavioral and nutritional factors all play a role.^{30,31} Quann et al³² found in their diet modeling study based on the NHANES 2007-2010 67-88% of children over the age of 4 and nearly all adults (99.0-99.6%) dietary intake of calcium fell below the recommended amounts 2.5-3 daily servings of dairy products.³² Rouf et al³³ after completing a study exploring barriers and enablers to calcium intake, stated “a combination of positive parental influence and development of habits from early childhood are likely to result in a positive impact and a continuation of dietary habits in young adulthood.”²⁷

| Institute of Medicine recommended daily adult intake 1000 mg/d | | |
|---|--------------------------|-----------------------|
| Participants | Ca Intake | Authors |
| Women | 533/mg/d | Dore S. & Yarbrough D |
| Women 13-14 | 639 mg/d | Dore S. & Yarbrough D |
| Women 25-49 | 463 mg/d | Dore S. & Yarbrough D |
| 67-88% of children over 4 y/o and nearly all adults ~99% | Below recommended levels | Quann et al |

Table 1 - Summary of Research Study Calcium intakes

Overall, studies depict a trend per capita in decreased consumption of milk in childhood, adolescents, and adulthood in developed countries.²⁷ The factors that may play a role in this downward trend may be the diagnosis or belief of lactose intolerance, competition for plant-based milk alternatives and/or a trend in veganism.²⁷ A Consumer's Perception on Dairy Milk and Plant-based Milk Alternatives, published by the National Dairy Council in October of 2018,³⁴ 78% of consumers perceived almond, soy and coconut milks as having the same or more protein and key nutrients as dairy milk. Interestingly, the report stated exclusive dairy milk buyers' associate nutrition and health overwhelmingly with dairy milk, exclusive plant-based milk buyers associated their choice to being more strongly linked to nutrition, health, vitamins, minerals and protein. Dual buyers of both dairy milk and plant-based milks do not see a difference between the products overall nutrition or protein, but do perceive dairy milk as more strongly linked to vitamins and minerals.²⁷

Young adults believe they are taking in the required daily needs of calcium, but in fact are not.²⁵ They are confused on quality sources of dietary calcium and how many servings of these sources are needed on a daily basis to meet adequate calcium for bone health and prevention of future development of osteoporosis.²⁶

Vitamin D and Physical Activity

Vitamin D insufficiency has reached epidemic proportions.³⁵ The Healthy Lifestyle in Europe by Nutrition in Adolescents (HELENA) study, a cross-sectional multi-center study examined

adolescents aged 12.5 to 17.5 years and from Ten European Cities. It found that although Vitamin D had no significant correlation between 25-hydroxyvitamin D concentrations and bone mineral concentration (BMC), their results indicated that adolescents with low 25-hydroxyvitamin D presented a tendency of having lower BMC to those with high 25-hydroxyvitamin D.³⁵ Two studies by Outila²² and Lehtonen-Veromaa³⁶ found a significant relationship between vitamin D status and bone mass in healthy adolescents.^{22,36} The National Osteoporosis Foundation's position statement on peak bone mass development and lifestyle factors systematic review gave vitamin D a level of evidence a grade of B for the benefit of Vitamin D on bone. The reason for the B grade reflected the lack of generalizability across RCT's, which included primarily female subjects with little diversity in population ancestry.¹⁷ Kasper et al²³ study that assessed participants exercise habits as it pertains to bone health found 44% of the 277 respondents to get inadequate exercise for bone health and 25% of respondents (70 out of 275) stated they were physically active, but fell into the inadequate exercise group.²³

The Childhood Health Activity and Motor Performance Study (CHAMPS)-Study³⁷ looked at bone mass development in childhood and its association with physical activity and vitamin D levels. It was a longitudinal study that examined the association of bone mass with physical activity and vitamin D levels over 6 years through puberty of the study subjects. The CHAMPS study concluded that the positive association with vigorous physical activity and total body mineral content increased with maturation development which is interpreted to mean that

physical activity may have a greater influence on bone mass in more mature participants. The vitamin D levels were also positively associated with bone mass.³⁷

A study done by Correa-Rodriguez et al³⁸ analyzed lifestyle and bone mineralization in a population of Spanish young adults between the ages of 18-25 with a mean age of 20.4. The study population consisted of 117 women and 83 men. The participants' nutrition habits were estimated with a 72-hour diet recall. Their level of activity was assessed using the International Physical Activity Questionnaire (IPAQ) and bone mass was measured by ultrasonography at the calcaneus. The results of the study showed that BMI and level of physical activity were significantly associated with bone health in the population of young adults studied. Higher bone mass was associated with an increase in weight category with significant differences in women. Higher bone mass values were also shown as the level of physical activity increased showing significant differences in males.³⁸ This study supports the risk factors of Osteoporosis – people with smaller weight and BMI have a greater propensity to develop Osteoporosis or Osteopenia. Conversely, those people with a larger weight and BMI tend to have higher bone mass.

The National Osteoporosis Foundation fast facts state that diet, exercise and healthy lifestyle are key to prevention and managing osteoporosis.¹⁰ Vitamin D intake is seen as a modifiable dietary factor to influence bone mineral density. A study conducted by Heller et al³⁹ assessing vitamin D status and body composition in collegiate athletes found that obesity negatively impacted vitamin D status of the athletes. The National Health and Nutrition Examination Survey (NHANES) statistics showed approximately 40% of adult Americans are obese and 71.6% are both

overweight and obese. Nutrient intake of females approaching peak bone mass should be researched further, suggests a study done by Beiseige⁴⁰ and Nickols-Richardson.⁴⁰ The study after analyzing diets of participants age 18 to 25 years of age, but the findings were inconsistent regarding dietary intake and BMD.⁴⁰

There are multiple factors influencing the lack of vitamin D intake and physical activity among our young adults. Food sources of vitamin D are limited and not always choices the young adult would make. The reality is 5 months out of the year many areas of the United States cannot receive adequate vitamin D from sun exposure and dietary sources are limited.⁴¹ The geographical area where the proposed research study is to take place does not receive adequate sunlight for vitamin D production from November through March. Additionally, there is a misunderstanding of the importance of lifelong physical activity and its impact on bone health.³⁸ Research also shows that 71.6% of all Americans are overweight or obese and this impacts the ability of the body to adequately pull vitamin D from stored sites within the body.³⁹ The growing numbers of overweight and obese Americans is exacerbated by the limited physical activity among this group.

Barriers to Meeting Daily Calcium and Vitamin D Requirements

Physical activity and calcium intake, referred to as lifestyle factors, account for approximately 20% of variance in peak bone mass and therefore encouraging healthy behaviors may maximize peak bone mass and slow bone loss.⁴² Since medical treatment interventions are unable to

completely reverse osteoporosis, strategies must be designed to maximize peak bone mass and reduce bone loss through health education and health promotion.⁴³ A study completed by Turner et al⁴² found barriers to attending osteoporosis prevention programs by young adult females included the availability of childcare, convenient locations and a variety of times courses were offered. The research also noted that strategies were needed to recruit underserved populations and provide an avenue for social support among the program participants to enhance the effectiveness of osteoporosis education programs.

Nutrition education efficiency using the Health Belief Model for the development of the information, attitude, and practice corresponding to the intake of calcium among women was found supportive according to research conducted by Shobeire et al.⁴⁴ Holland⁵ highlighted young adults are not concerned with future disease risk, and relatable messaging must intersect with their current interests in appearance and physical fitness. The study participants also noted a need to focus on small dietary and physical activity behavior changes that can be incorporated into their daily routines. A quarter of the research participants used by Holland A study suggested incentives or positive messages would be more effective than fear based messages for change.⁵ The participants also believed one of the barriers to health change they faced was the large amount of health information available to young adults that made filtering the information difficult and messages targeting them should be placed in sources where they routinely and already access.

Vitamin D intake is often influenced by dietary intake, as there are limited sources for Vitamin D. Sun exposure is one source, but the amount is limited by geographical location during the months of November through March and body mass index (BMI). Vitamin D status is directly associated with bone health. Research focusing on Vitamin D status in young adults has found a high prevalence of deficiency.^{45,46} Often the deficiency is multifaceted (e.g., diet, lack of sun exposure, elevated BMI).

Barriers to Meeting Physical Activity Requirements

Commonly cited barriers to young adult physical activity (PA) participation include work commitments, lack of motivation, and time expenditure.⁴⁷ Time expenditure has been reported as the highest perceived barrier to PA in adult female populations age 28-35 and women 20-27 years of age physical exertion was the leading barrier.⁴⁷ The Brown et al⁴⁷ study went on to further state the women at 28-35 had significantly higher perception of these barriers to PA compared to the 20-27 year olds, and this should be considered when designing strategies to encourage PA participation. Other suggestions when focusing on barriers to PA in this population is to explore what motivates this age group to be physically active. A study completed by Kilpatrick and Bartholomew⁴⁸ reported college students were more intrinsically motivated to participate in sports compared to exercise in which they were more extrinsically motivated. Females also stated weight management as a motivator to PA more than males.⁴⁸

The barriers to osteoporosis prevention and bone health awareness among young adult females are many. They include environmental and personal factors such as the inability to attend prevention programs, competing time commitments, difficulty filtering daily health information from the masses of social media, a general lack of concern about a future health risk and its prevention, and a number of PA barriers. The PA barriers include lack of motivation, time commitment and time expenditure involved in PA. The strategies to overcome these barriers must be evoked from the age group that identified the barriers.

Perception of Calcium, Vitamin D and Osteoporosis in Young Adults and Educational Interventions

Even though genetics is reported as 60% and 80% responsible for variance in peak bone mass (PBM),⁴⁹ peak bone mass risk can be modified by factors such as adequate intake of vitamin D, dietary calcium and weight-bearing physical activity which can play a part to maximize PBM.⁴⁹ An understanding of modifiable lifestyle factors for young women and the effects on bone development and strength is critical in prevention of osteoporosis and should be the focus of public health initiatives.²¹ Research performed by Bohaty et al²¹ studied a group of university women 18-30 years of age and evaluated the effectiveness of an educational session to increase dietary intake of calcium and vitamin D. The participants completed a pre-osteoporosis 20 question knowledge quiz, a three-day food diary, and attended one of ten 45-minute slide show presentations on various osteoporosis prevention strategies including: fueling with vitamin D and calcium, strategies for the vegan and lactose intolerant, and others. These were followed by a

discussion with the group. Eight weeks after the educational intervention, each participant completed a second three-day dietary recall and post-test on the knowledge of osteoporosis. The results showed a significant increase in knowledge scores from pretest to posttest. However, dietary intake of calcium remained below the required RDA, vitamin D intake also remained below RDA, and pre and post intervention failed to increase dairy products in the study participants. The study reaffirmed that this age group of women continues to take in less than the RDA of calcium, vitamin D and servings of dairy, yet they perceive they are doing what is needed to maintain their bone health.^{2,21} Dietary deficiencies remain and should be addressed within this age group.

A Canadian study evaluated the perceived intake of calcium and vitamin D in young Canadian adults versus actual intakes.⁵⁰ This age group continues to be under-represented in osteoporosis literature.⁵¹ “Tailored prevention education is needed for young adults, as their priorities and perceptions of their own risk for developing osteoporosis differ significantly from those of older age groups.”^{52,53} The Canadian young adults, age 17-30, responded they ate fruits, vegetables, low fat, got enough sun and not too much fat; these choices equate to meeting their Ca and vitamin D daily needs.⁵⁰ When in fact the mean calcium intake for females was 716 mg/d and 787 mg/d for males. The mean intake for vitamin D was just below the Estimated Average Requirement (EAR) for males and mean intake of vitamin D for females was above the EAR. The study noted that these values were influenced by extremely high values due to supplementation and a number of very low values. Overall, the study showed very few

participants had vitamin D values that met the EAR without supplementation.⁵⁰ A general theme of the adults interviewed was a desire to meet their Ca and vitamin D daily requirements through eating enough of what they deemed correct foods and this determination came from their “feeling” that the amount they consumed was satisfactory to a reliance on practiced behaviors.⁵⁰ Other themes centered on their belief that they had an adequate diet containing vitamin D and Ca, besides their “feeling” their food consumption was adequate. The belief was based on their absence of illness and their confusion of sources of vitamin D and Ca.⁵⁰ The study concluded there was a disconnect between the actual Ca and vitamin D intakes and individual perception of these intakes. A correlated theme for this age group portrays that they are under-consuming vitamin D and Ca and therefore increasing their potential future risk for osteoporosis. As such, education for this age group should be distanced from education focused on elderly, and instead, address the prevalence of inadequacy in younger life factors such as vitamin D and Ca intake and the consequences of inadequacy. The education should highlight the criticality of the 17-30 age group understanding the ramifications of their own intake of vitamin D and Ca and the link to lifelong bone health.⁵⁰ This age group continue to be under-represented in osteoporosis literature.⁵¹ “Tailored prevention education is needed for young adults, as their priorities and perceptions of their own risk for developing osteoporosis differ significantly from those of older age groups.”^{52,53}

According to Tussing and Chapman-Novakofski,⁵¹ the need for osteoporosis prevention programs has been demonstrated by cross-sectional surveys of knowledge and behavior.^{23,44}

Tussing and Chapman-Novakofski⁵¹ researched to determine whether a theory-based osteoporosis prevention program designed for community delivery or a group outpatient setting would be associated with improved calcium intake. The main outcome of the project was dietary calcium intake and the calcium increase of participants was statistically significant post intervention. Participants noted that the “hands on” aspects of the program was the key factor that influenced their calcium intake the most. Each of the eight group lessons provided a short lecture, hands-on activities to increase self-efficacy and pertinent handouts to reinforce behaviors learned.⁵¹

Two separate research efforts utilized a short educational program on young women’s knowledge and beliefs about osteoporosis. The program included a short one session osteoporosis educational program using professionally developed publicly available material and it was found to be effective in improving young women’s ability to correctly identify osteoporosis risk factors. The knowledge of osteoporosis factors at baseline were determined to be at a low level. Unfortunately, the women’s belief that osteoporosis development was under their control was not changed and they considered it a disease that was the consequence of the aging process rather than a result of lifestyle behaviors.^{54,55} In a study conducted by Kasper et al²³ also found women believed that a person is less responsible for acquiring osteoporosis than for getting heart disease.

Women’s health motivation is a factor that should be addressed and the motivation is an individual’s readiness to form health behaviors.⁵⁶ The literature returns to the theme of forming

health behaviors and health behavior change as it applies to adopting new health behaviors protective to bone health. A study conducted by Babatunde et al⁵⁷ showed that self-efficacy perception is the best indicator in the formation of osteoporosis preventive behaviors.⁵⁷ A study conducted by Jung et al⁵⁸ states the common practice of providing information on calcium content may increase calcium foods in older women's diets but is ineffective to increase calcium intake in younger women. Younger women's dietary intake is influenced by weight control, energy content, hunger, food cravings, time considerations and convenience factors.⁵⁸

The literature reviewed over young adults' perceptions of calcium and vitamin D intake and their control over developing osteoporosis reflected most young adults believed they were taking enough daily calcium and vitamin D when the research shows their intake is deficient. The research also showed young adult participants believed osteoporosis was a process of aging and they did not believe they were responsible for their development of the disease. This population did improve their knowledge of lifestyle factors after a pre and post Osteoporosis Knowledge quiz, but it did not change their protective lifestyle factor behaviors against the development of osteoporosis statistically.²³

Young women and adults believed their diets included sufficient vitamin D and calcium intake. They also believed osteoporosis was just a part of the natural aging process and they had no control over their development of the disease. Many of the educational sessions using the HBM showed increased knowledge and beliefs concerning osteoporosis, but not self-efficacy or behavior change towards preventative measures.

Gaps in Knowledge

After conducting a thorough literature review on the subject of osteoporosis perception, beliefs, knowledge and self-efficacy of young females, there is inadequate knowledge and understanding of this age group's osteoporosis health risk. This proposed research addresses the osteoporosis health risks and young women's perception, beliefs, knowledge and self-efficacy related to the health risks. Further, there is a gap in research to understand the barriers and the strategies that will lead to behavior change in young adulthood to positively influence bone health in later years. Research utilizing Health Belief Model as the framework concluded after young women were educated concerning osteoporosis their knowledge and beliefs increased, but not self-efficacy. Previous research further highlighted that young adult female's need osteoporosis education which can effectively increase their self-efficacy, help them select calcium rich foods and participate in weight bearing exercise. The proposed study will explore the barriers of meeting the daily requirements of calcium, vitamin D and physical activity in young female adults to prevent osteoporosis later in life.

Chapter 2: Theoretical Framework

Critique of Theoretical Models/Frameworks

Three theories are discussed as possible theoretical models/frameworks that may relate to this research. They are Phenomenological Study, Social Cognitive Theory and The Health Belief Model. The research will gain knowledge of study participants' perceptions of their bone

health/osteoporosis risks, approximate daily consumption of total calcium and vitamin D, physical activity patterns, perceived risk of developing osteoporosis, perceived barriers and strategies to meet daily calcium, vitamin D intakes and physical activity requirements.

A phenomenological study uses a combination of methods, such as conducting interviews, reading documents, watching videos, or visiting places and events, to understand the meaning participants place on whatever's being examined. The study relies on the participants' own perspectives to provide insight into their motivations.⁵⁹ The objective to phenomenology research is to understand human experience.⁵⁹ When using phenomenology, there is a main theme - meaning is embedded in human experience.⁵⁹ "Descriptive and interpretive phenomenology are the most representative approaches of phenomenology as a research method."⁶⁰ Traditional qualitative methods are focused on the subjective content of a given experience. Researchers are interested in exploring the subjective experience at a psychological level of representations, meanings, values, judgements, beliefs, etc.⁶⁰ Dr. Michael Worthington, PhD, quotes Michael Patton's (1990) explanation of the aim of phenomenological research as: the assumption that there is an essence or essences to shared experience. These essences are the core meanings mutually understood through a phenomenon commonly experienced. The experiences of different people are bracketed, analyzed, and compared to the identity of the essences of phenomenon; for example, the essence of loneliness, the essence of being a mother, the essence of being a participant in a particular program. The assumption of essence becomes the defining characteristic of a purely phenomenological study.⁶¹

If this method is chosen for the qualitative or interviewing session of a randomized selection of the research population, the focus would be to ascertain the knowledge, beliefs, values and judgements of the lived life of a young adult and their perception of diet related to health, osteoporosis, productive education behavior change strategies.

Social Cognitive Theory

Social Cognitive Theory (SCT) posits that learning occurs in a social context with a dynamic and reciprocal interaction of the person, environment, and behavior. The unique feature of SCT is the emphasis on social influence and its emphasis on external and internal social reinforcement.⁶² SCT considers the unique way in which individuals acquire and maintain behavior, while also considering the social environment in which individuals perform the behavior. The theory takes into account a person's past experiences, which factor into whether behavioral action will occur.⁶²

Often, theories of behavior used in health promotion do not consider maintenance of behavior, but rather focus on initiating behavior. This is unfortunate as maintenance of behavior, and not just initiation of behavior, should be the true goal in public health. The goal of SCT is to explain how people regulate their behavior through control and reinforcement to achieve goal-directed behavior that can be maintained over time.”⁶³ The six constructs of Social Cognitive theory; 1) Reciprocal determinism 2) Behavioral capability 3) Observational learning 4) Reinforcements 5) Expectations 6) Self-efficacy.⁶² A study conducted by Strong et al⁶⁴ using the SCT model for

health behavior change sought to identify health behavior change targets related to weight management in college students. The research investigated the health-related lifestyle behaviors and physiological characteristics of this population.⁶⁵ The research was able to assess self-regulatory habits of physical activity behaviors, dietary behaviors and environmental factors, social support, and confidence level of students in these areas.

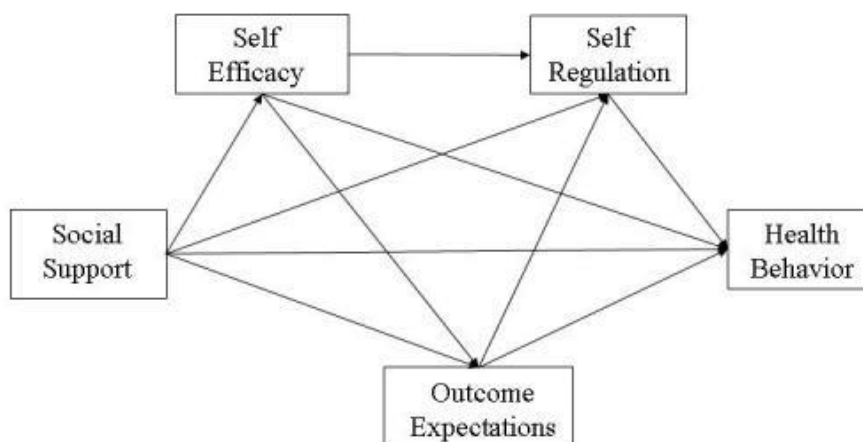


Figure 1-Social Cognitive Theory Determinants

Figure 1, is from research conducted by Anderson-Bill et al⁶⁶ depicts the interactions between the SCT evaluated social cognitive determinants. Research participants utilized Web-health, an online health education series, and exhibited comparatively high levels of self-efficacy for making changes and of expectations that changes would have health benefits.⁶⁶ Bandura, the author of SCT, suggested that self-efficacy for behavior change can be unrealistically high among individuals who lack experience in the desired, healthier behavior.⁶⁶

The Web-health users were also found to have lower confidence in managing social aspects of becoming more active, lower levels of perceived social support for behavior change, more neutral social outcome expectations, and virtual lack of self-regulatory behaviors related to making healthy changes and are more consistent with the inactivity and unhealthful diets observed in the sample. This suggests that for Web-health users who may typically have low levels of health-promoting behaviors, SCT-based interventions may temper users' pre-intervention self-efficacy levels.⁶⁶ Consistent with other research, perceived social support and engaging in self-regulatory behaviors exerted strong influences on physical activity and nutrition behavior. "Improved social support and subsequent increases in self-efficacy could lead directly to improvements in physical activity and nutrition behavior but would also be effective pathways for increasing the use of self-regulatory strategies essential to healthy levels of activity and food choices. Providing a platform for setting behavioral goals, planning, tracking, and providing feedback would be a considerable strength of automated, self-administered Internet-based health promotion programs."⁶⁶ Working with the targeted young adults, future research should assist them in establishing behavioral goals, planning, tracking and a method for them to receive positive constructive feedback to lead to sustained behavior change.

Health Belief Model

The Health Belief Model (HBM) has been used in various osteoporosis prevention, education, and assessment research.^{12,53,67} The constructs to the health beliefs model include: 1) perceived susceptibility to a disease or condition (osteoporosis); 2) perceived severity of the disease or

condition (osteoporosis or osteopenia); 3) perceived benefits of activity or behavior related to disease or condition (calcium, vitamin D and physical activity); 4) perceived barriers to performing activity or behavior related to disease or condition (knowledge or skills to increase dietary calcium, vitamin D and physical activity); and 5) self-efficacy - the belief in one's ability to perform activity or behavior (applying newly acquired knowledge to change ones behavior to choose calcium and vitamin D rich foods and daily weight bearing exercise).⁵¹

Neito-Vazquez et al⁶⁸ conducted an osteoporosis educational intervention randomized trial study of Puerto Rican women using the Health Belief Model (HBM) theoretical framework. The goal was to have 51 participants in the experimental group that would receive osteoporosis education and 54 participants in the control group that would not receive the education. Each group would complete the osteoporosis knowledge questionnaire, the osteoporosis health beliefs scale and the osteoporosis self-efficacy scale. The experimental group was educated on materials from the National Osteoporosis Foundation and criteria for education were defined. The results showed an increase of knowledge in the experimental group and increased positive beliefs, but the educational session did not significantly impact the self-efficacy of the control versus the experimental group.⁶⁸ This research was able to positively impact the knowledge and beliefs of their participants, but self-efficacy was not obtained.⁶⁸ Self-efficacy, as defined previously, is the belief in one's ability to perform an activity or behavior, applying newly acquired knowledge to change one's behavior to choose calcium and vitamin D rich foods or increase weight bearing exercise.

Evenson and Sanders⁶⁷ conducted an educational intervention to impact osteoporosis knowledge, health beliefs, self-efficacy, dietary calcium and vitamin D intakes in young adults.⁶⁷ A pre/post-test design was used to determine osteoporosis knowledge, health beliefs, and self-efficacy of a convenience sample. The participants completed pre and post questionnaires that included osteoporosis knowledge test, health beliefs scale, self-efficacy scale and a three-day food record. The students were divided into a control group and interventions or treatment groups. Treatment one group received lecture education and treatment 2 group received hands on/small group educational intervention. Both intervention groups' health beliefs and osteoporosis knowledge findings were similar to other studies' results. The educational interventions did not produce preventive behavior changes towards increasing calcium or vitamin D. The authors did point out that participants, at the time of the study, were meeting their daily calcium requirement and believed meeting vitamin D requirements is a challenge since few foods naturally contain vitamin D. The self-efficacy piece of the research was a predictor of vitamin D intake and supports other studies that report self-efficacy as an important aspect of predicting dietary vitamin D intake.⁶⁷ The authors reported a list of limitations of the study and one important one was the students used were enrolled in a nutrition course.⁶⁷ They also believed the self-efficacy may have improved if the post testing was done at a later time, allowing time for the students to hone their newly gained label reading skills and choosing vitamin D rich foods.

Gammage and Klentrou⁶⁹ set out to predict osteoporosis prevention behaviors, health beliefs and knowledge.⁶⁹ The objective of their study was to investigate if the expanded health beliefs model (EHBM) could predict calcium intake and physical activity in adolescent girls. They concluded

that EHBM appeared to be useful in predicting osteoporosis prevention behaviors in adolescent girls. Future interventions for adolescent girls should focus on identifying barriers to calcium consumption and physical activity and increasing beliefs in the ability to overcome them or self-efficacy.⁶⁹

**Phenomenological study, Social Cognitive Theory and Health Belief Model Mix of
Constructs Proposed Study**

The proposed study will integrate the knowledge, beliefs and self-efficacy constructs of the HBM, the social support and self-efficacy constructs of the SCT and the qualitative aspect of the study will be considered a phenomenological study. The proposed study will gather the perceptions of Osteoporosis Health Beliefs and knowledge of the research subjects, perceptions of participants meeting daily calcium and vitamin D intake and physical activity, and the self-efficacy/barriers to attainment. Each focus group will be asked a series of questions pertaining to knowledge and beliefs about prevention of osteoporosis and weekly physical activity, as well as, questions concerning daily calcium and vitamin D intake. Questions concerning barriers to meeting daily calcium, vitamin D and PA requirements and strategies to overcoming these barriers will be addressed as well. The research will gather data to learn more about this age group's life in a university setting as it pertains to osteoporosis prevention and barriers.

Chapter 3: Methodology

Study Purpose

The purpose of the study was to investigate young adult females' perceptions, knowledge and health beliefs of osteoporosis. The study sought to determine the barriers to meeting the Recommended Dietary Allowances (RDA) of 1000 mg of calcium and 600 IU of vitamin D and recommended daily physical activity, as well as, the strategies to overcome the barriers identified in reaching the RDA of calcium and vitamin D and recommended daily physical activity.

Aims

1. Investigated the young adult females' collective perceptions, knowledge, and health beliefs concerning osteoporosis and its prevention;
2. Determine the barriers young adult females face to meet the daily RDA for calcium, vitamin D and PA requirements;
3. Describe the young adult females' strategies to overcoming the barriers they face to meet daily calcium, vitamin D and PA requirements.

Study Design

The study design follows previous research related to chronic illnesses such as osteoporosis and employs both qualitative and quantitative methods to examine the complex underpinnings of the disease.⁷⁰ The explanatory design is a two-phased mixed method design. The researcher first collected the quantitative data through a survey sent out through MTurk to young adult females

age 18-25, the first two week of February 2021. The survey was used to assess osteoporosis perception, knowledge, health beliefs and assess current Calcium and vitamin D status of research participants. The survey was also sent out via email to 2900 female students of Northwest Missouri State University 18-25 years of age, and a survey link was also sent out via Facebook to randomly selected females that met the participant inclusion criteria. The survey data was analyzed and used to facilitate discussions and generate questions during the second phase of the explanatory design. The second phase utilized a qualitative method of 3 focus groups of 7-9 participants per focus group that took place the third week of March 2021.

The quantitative portion of the study included a survey comprised of the Osteoporosis Health Belief Scale (OHBS) (42 questions). The survey included three questions to ascertain approximate daily calcium intake, questions on vitamin D supplementation and group demographics. The four focus groups (one pilot group) of the qualitative portion included 7-9 young adult females, aged 18-25 and were asked a structured set of 14 questions. In addition to the structured questions, the sessions were also free-flowing to draw out as much qualitative data as possible. The researcher also collected data from the focus group discussions and questions via recordings and transcribed for analysis. The transcribed narratives were analyzed to capture and document research themes.

Study Participants

The participants were young adult females age 18-25. The exclusion criteria are women outside the age group of interest and adult males. MTurk study respondents were paid for their survey

responses. The researcher entered into a contract with Amazon Mechanical Turk to pay a set fee of .20 cents to each respondent and then to Amazon .50 cents for females and another .50 cents for the group age 18-25. There was no extra fee charged to stipulate that each respondent must have a 98% satisfaction rate, positive history of 50 or more completed surveys and from the United States. The response rate was less than 20 the first week the survey was put out for response on MTurk and the researcher changed the fee paid to respondents to \$1.00. The total respondents from MTurk was 68 in the over two-week period of February 2021. Why females only? The need for comprehensive education of young females and their susceptibility to the development of osteoporosis begins now in their late teens and early twenties.²³ Prevention is key to the control and development of osteoporosis and successful prevention strategies depend on patient's knowledge, self-efficacy which work together to assist this age group to make behavior modifications during this stage of life building peak bone mass.⁷¹ "Young adults are consistently low in the bone-related nutrients calcium and vitamin D, which raises their future risk of osteoporosis and other bone problems."⁷² Only 38% of women in the United States aged 19 to 30 years met recommended daily allowances for calcium (1000 mg/day) and approximately 41% of women in the same age group met vitamin D intake guidelines set by the Institute of Medicine."⁷³ Females in the 18-25 age group embody current lifestyle behaviors that may lead to low bone mass development; this is a time when behavior change can lead to lifestyle modifications that could lead to the prevention of the debilitating disease of osteoporosis. Further and as stated previously, females in the 18-25 age group are in the active process of bone density accretion.

Study Participants Sample Size

The sample size of the focus group included 8 participants in the first and second group and seven in the third group. Guest et al⁷⁴ stated the majority of all themes within the data set, could be identified within 3 focus groups and the use of three focus groups would identify the most prevalent themes. The female population age 15-29 in the United States in 2019 was approximately 31 million.⁷⁵ Using the Research Advisors sample data collection tool,⁷⁶ if the size of the population of interest is approximately 31 million females age 15-29, a sample of 384 would be necessary to answer the questions of interest, at 95% confidence margin of error and 80% power. This statistically significant number was surpassed. The survey responses, within Qualtrics, was set up that respondents cannot take the survey more than once and they would need to complete each question before moving on to the next and could not submit the survey until all questions were answered. The MTurk respondents were also assigned a random number generated after completion of the Qualtrics survey that they entered into MTurk before they were paid for their survey responses.

Study Participant Recruitment

The materials and methods used both in the survey and the focus groups were approved by the Northwest Missouri State University Institutional Review Board (IRB). The IRB approval number 2021-027. The survey described above was sent out via Mechanical Turk Marketplace (MTurk)⁷⁷ to gather responses from 400 females age 18-25 living in the United States during the month of February. MTurk is a service on a website run by Amazon. It is a readily available

marketplace to match “workers” with available work from various “requesters.” MTurk gives businesses and researchers access to a diverse, on-demand, scalable work force. The workers are able to select from thousands of tasks to complete for pay when it is convenient for them.⁷⁸

MTurk allowed the researcher to filter participants and only query those that meet the study needs (i.e., females living in the United States, age 18-25 years). Due to low survey responses from MTurk the researcher sent the link to the Northwest Data Analysis Team and they sent out the survey link to the Northwest Missouri State University female student age 18-25.

Recruitment to support the qualitative analysis was supported by an approved poster of recruitment displayed throughout the campus stating the NW IRB approval number, the age and gender needed for the focus group, the theme to be discussed, the main researcher and student research assistants contact information and a signup genius link. A second plea for Focus Group recruitment was sent out via the Northwest Data Analysis Team inviting participation to all Northwest female students between the ages of 18-25, in all majors, and requesting they respond to participate in a research focus group. The campus email reached approximately 2,900 university females age 18-25 with the same information that embodied the campus focus group recruitment flyers. Both forms of recruitment stated participants would each be paid \$10 cash for their one hour of time and also be entered into a final drawing of all focus group participants for \$50. The SignUpGenius app was used for students to sign to participate as a focus group participant and it listed the three possible days/nights during the week of March 14th 2021. Each day/night session allowed eleven participants to sign up per session. They signed up using their

email address and their first name. All three sessions were full within four hours of when the recruitment email was sent out. The plan to identify participants followed approval from the Northwest Institutional Review Board. Other recruit methods included: personal appeals at women's university clubs; and sorority meetings and professors of the university offering extra credit points to their students whom participated. Additionally, dietetic/nutrition students were asked to actively recruit study participants that met the recruitment criteria. All recruitment activities stated the contact of the researcher, the research key information, focus group activities, the time commitment of approximately 1 hour and all participants would be given an incentive in the form of \$10 cash. There was also a drawing from all the focus group participant's first name and emails for an incentive of \$50 cash. All of the incentives were paid upon successful completion of the focus group participation and the winner of the \$50 cash was notified and the funds picked up from the lead researcher the last week of March 2021.

Data Collection

Quantitative- Osteoporosis Health Belief Scale Questionnaire

Survey data in the form of a questionnaire was collected during the second and third week of February 2021. The questionnaire was comprised of three components. The first component consisted of demographic questions. The second component included the Osteoporosis Health Belief Scale questionnaire, using a Likert scale (strongly disagree, disagree, neutral, agree or strongly agree). This questionnaire included: "42 items in the scale as susceptibility (items 1–6), seriousness (items 7–12), benefits of exercises (items 13–18), benefits of calcium intake (items

19–24), barriers to exercise (items 25–30), barriers to calcium intake (items 31–36), and health motivation (items 37–42). Each item was rated using a 5-point Likert scale as 1 (strongly disagree), 2 (disagree), 3 (neutral), 4 (agree), and 5 (strongly agree). Test-retest reliability for the whole scale has been shown to be 0.90.⁷⁹ Higher scores indicate perceptions of a greater likelihood of developing osteoporosis, greater fear of living with osteoporosis, more perceived barriers to calcium consumption. Kim et al⁸⁰ reported that the use of the OHBS had good test-retest reliability. Wallace,⁸¹ found the OHBS had good internal consistency with college-age women.⁸¹ This previous research information validates data collection and ranking of results. The questionnaire’s third component is the Calcium and Vitamin D assessment. The calcium assessment consisted of three questions and were added to the composed survey sent out to the survey respondents. The three questions were derived from a study by Rasch et al⁸² and during that research, were deemed valid to assess group daily calcium intake.

| Short Calcium Intake List (SCaIL) Questionnaire | | |
|--|--|------------------------|
| Question: How many servings of the following products do you consume on a regular day? | | |
| Servings | Calcium Source | Calcium/Serving/Totals |
| | Glasses of milk and other dairy drinks (8 oz.) | x 300 mg = (____) mg |
| | Bowls of yogurt/custard/pudding (5-6 oz.) | x 150mg = (____) mg |
| | Servings of cheese (1 oz.) | x 300mg = (____) mg |
| | Daily calcium intake from other products. | = 350 mg |
| | Total | = (____) mg |

Table 2 - Modified Short Calcium Intake List (SCaIL) Rasch L,et al⁸²

The group calcium mean was calculated using this validated tool. The vitamin D intakes were assessed by a Registered Dietitian based on data gathered from the survey question responses relevant to vitamin D supplementation. The group data was used to calculate mean daily calcium and vitamin D consumption for the research participants. These data were compared to the Recommended Dietary Allowance (RDA) for calcium of 1000 mg/day and Vitamin D RDA of 600 IU's per day.

See Appendix A for a copy and link used to access the Qualtrics survey

Qualitative-Focus Group Questions and Guide

The last outcome to be assessed and investigated was the perceptions of the research participants based on the themes and data saturation collected during the three focus group meetings. Focus group questions drew out themes the study participants provided while answering questions concerning their perception of the disease osteoporosis, barriers to calcium and vitamin D intake, perceived barriers to daily weight bearing physical activity, and strategies to overcoming the identified barrier's. All focus group research participants were asked to complete a sociodemographic questionnaire upon arrival using a QR scanned by their phone. The demographics questionnaire was taken from the survey sent out in the quantitative part of the research. Their permission to collect and use the data they provide was also obtained. All names and identities were kept confidential. The sociodemographic questionnaire was used to facilitate data collection related to focus group participants' age, social and living arrangements that

impact dietary consumption. Further information on the questionnaire is located at appendix C. The focus group questions were developed, reviewed and pilot-tested with a focus group of five young adult females aged 18-25. An informed consent was collected at the time of arrival to the focus group. The focus group questions were designed from knowledge gained from the literature review, the theoretical framework constructs and outcome questions to be answered. The final focus group questions were updated based on anomalies or statistically significant findings from the analysis of the survey respondents' data, and information gathered from the pilot focus group.

The venue for the focus group meetings was a large classroom on the third floor of the NWMSU Administration Building room 306. The chairs were placed in a circle with 6 foot spacing between each chair, and face masks were worn to meet the university Covid mitigation policies. The room was bright with large windows providing natural light, excellent ventilation and newly updated chairs and color scheme. The focus group sessions were audiotaped using VidGrid recording on Canvas and mechanically transcribed. This process was tested during the pilot focus group for accuracy of mechanical transcription. It was found to be accurate, but the wearing of facemasks by participants made the audiotaping not 100% audible. The focus group questions were also placed in a word document and the student research assistant captured each respondent's words and name during the hour-long sessions. The responses of the group, for each question, were also captured on a large poster size post it note pad. Each sheet was pre-numbered to align with the focus group sequenced question. The questions were also projected up on two projector screens via Power point. At the wrap up of each focus group the session

notes taken on the pad were reviewed for accuracy and any additional information offered by the group was added. For each subsequent focus group, during the wrap up, themes from previous focus groups were shared and the group was asked if they believed the statements were accurate and if they wanted to add more. Focus group audio tape transcriptions, post it note pad theme notes were supplemented by detailed note taking by assistant researcher about groups interactions, mood of the group, etc. Appendix B contains the focus group questions and format that were used for introduction and wrap up of for the sessions. The questions were designed based on the constructs of the Health Belief Model knowledge and belief and the Social Cognitive Theory constructs social support, and confidence level (self-efficacy).⁸³

Statistical Methods

Descriptive statistics were first ran on participant responses to survey questions about their demographics, and past and present behaviors that may impact osteoporosis. Demographics included age and race. These were calculated with frequency analyses, producing percentages. Age was categorized as 18-20, 21-23 or 24-25 years old. Race was categorized as Asian, Black/African American, Caucasian and Other. Regarding past experiences, this included how often participants ate with family members growing up and how often participants drank milk. Current behavior included living arrangements, daily consumption of milk, cheese, yogurt, total calcium and the use of a vitamin D supplement.

Descriptive statistics was also ran on the Osteoporosis Health Belief Scale scores of each participant. Means and standard deviations were calculated for all scale scores using version 25-SPSS statistical analysis software.^{84,85}

This included the scores for susceptibility, seriousness, benefits of exercise, benefits of calcium intake, barriers to exercise, barriers to calcium intake and health motivation. The Osteoporosis Health Belief Scale responses to the 42 questions are set in a Likert-scale. Seven constructs were measured with the OHBS; susceptibility, seriousness, calcium benefits calcium barriers, exercise benefits, exercise barriers and health motivation.⁸⁰ The five-point Likert-scale answers are strongly disagree, disagree, neutral, agree or strongly agree. An excerpt below:

| | Strongly Disagree | Disagree | Neutral | Agree | Strongly Agree |
|--|-------------------|----------|---------|-------|----------------|
| 15. Regular exercise helps to build strong bones | | | | | |
| 16. Exercising to prevent osteoporosis also improves the way your body | | | | | |
| 17. Regular exercise cuts down the chances of broken bones | | | | | |
| 18. You feel good about yourself when you exercise to prevent osteoporosis | | | | | |

Excerpt from Osteoporosis Health Belief Scale Questionnaire

See Appendix A for complete questionnaire

Table 3-Excerpt from OHBS Questionnaire

There was an examination of data to determine if there were relationships between any of the Osteoporosis Health Belief Scale scores. This included the use of Pearson correlation (Field, 2013)⁹⁵. Each Pearson correlation that was calculated produced an r value to show strength and direction of correlation. Finally, a p value was calculated to compare with an alpha value of .05. This was calculated in the form of a correlation matrix.

Next data was analyzed to determine if differences existed in any of the Osteoporosis Health Belief Scale Scores based on participant demographics or past behavior. Depending on whether the independent variable had two or more categories of values, independent t-tests or ANOVA were used to seek differences between the scale scores based on these variables.

Lastly to identify if differences exist in participants current behavior based on Osteoporosis Belief Scale Scores. Again, depending on how many categories of values each independent variable had, either independent t-tests or ANOVA were used. The 227 in the 18-20 year old group were compared to the 222 participants in the 21-25 year old group to see if there were any differences based on OHBS scores. This was done using an independent t-test.

The data was then analyzed looking at current milk consumption among participants related to milk consumption growing up or age. Due to the categorical nature of all variables, Chi-Square

tests were used. Finally were any differences in participant consumption of the calcium RDA based on the other variables included in the study. The independent variables included: how often participants drank milk growing up; how often participants ate meals with family growing up; current milk consumption; current living arrangement, use of a vitamin D supplement; OHBS score for serious scale; and OHBS score for barriers to calcium scale. These independent variables were chosen because they appeared to be related to total calcium consumption in other parts of the study. These analyses were conducted with Chi-Square and logistic regression.

The statistical analysis of the focus group interview questions followed this format. The researcher coded the qualitative data collected. Each identified segment was labeled with a word or phrase also known as a code. An inductive coding method was used. The main researcher developed the codes and these were based on the research questions to be answered. The codes were then condensed into themes and used to construct relationships and patterns seen throughout the data. The researcher analyzed the data within and between codes to determine how the codes related to each other, or if they did at all. Analysis of the codes revealed themes – that showed up most frequently, were exceptionally interesting, or were an expected find in the study. The themes identified from the research were compared to similar, existing research/literature. This process lead to noting of important reoccurring themes. Secondly, the researcher eliminated, combined, and subdivided themes and placed them into categories. The researcher then focused attention to the recurring ideas and the wider themes connecting the codes. Non-sampling coding errors were limited by pretesting the questions with a pilot focus

group and peer review of transcripts was implemented to check possible alternate themes or findings by Dr. Alice Foose, PhD, an experience qualitative researcher and two dietetics senior students’ research assistants. Having four reviewers should mitigate the chance for coding differences or errors. As stated by Zade et al⁸⁶ differences between coding may include unclear code definitions or particular data points that researchers need to negotiate or clarify.

Disagreements amongst qualitative data are often due to the fact each may draw from their diverse experiences, priorities, and ways of communicating. The analysis of these disagreements often yield unanticipated insights from the data. Data saturation was noted after the third and final focus group when themes were reoccurring and no new ideas or thoughts were being presented.

Ethnographic analysis can also be applied to focus group discussions when the researcher interprets social communication and actions within the focus group.⁸⁷ Constant comparison was used to analyze transcripts and different analysis. Lastly, the researcher was aware of her own experience and background as this may lend to possible bias, values and ideals that could affect data and data reporting.

Table 4-Data Collection Summary

| Study Questions | Theoretical Construct | Data to be obtained to answer question | Data to be analyzed how |
|---|---|--|--|
| What are the young adult females’ perceptions of osteoporosis and its associated risks? | HBM- perceived susceptibility to osteoporosis or osteopenia, benefits of behavior change in diet or PA, Perceived barriers, skills needed to increase dietary Ca, vit D and PA, belief in | OHBS survey, Focus group questions (what do you know about your bone health and osteoporosis, how important is nutrition bone health to your daily life? | OHBS questionnaire uses a Likert Scale data will analyze the seven constructs measured with the OHBS; susceptibility, seriousness, calcium benefits calcium barriers, exercise benefits, exercise barriers and |

| | | | |
|---|---|--|--|
| | <p>ones' ability to perform such activities SCT- self-efficacy making changes in barriers towards Ca, vitamin D intake and PA requirements</p> | | <p>health motivation - group mean. Focus Group-themes as related to the study population questions What do you know about your bone health and osteoporosis, how important is nutrition bone health to your daily life?</p> |
| <p>What are the young adult females perceptions' associated with the barriers to meeting daily calcium, vitamin D and physical activity requirements related to osteoporosis?</p> | <p>HBM- Barriers to calcium, vitamin D and PA to lessen risk of development of osteoporosis HBM and SCT-Self-efficacy of behavior change to lessen said barriers SCT- social interactions and influence</p> | <p>OHBS survey questions, three Calcium questions concerning calcium intake (daily servings of dairy milk, yogurt and cheese) Vitamin D supplementation and IU taken daily. Focus Group Questions (What do you see as barriers to daily consuming calcium rich foods. Do you know how to get your daily vitamin D? What are vitamin D rich foods? What are the barriers to meeting your daily vitamin D needs? What is a weight bearing exercise? How important is regular weight bearing exercise to you? What are the barriers for you to engaging in daily weight bearing exercise? SCT question- How does your current living arrangements, work, social life impact your daily food intake?</p> | <p>Seven constructs are measured with the OHBS; susceptibility, seriousness, calcium benefits calcium barriers, exercise benefits, exercise barriers and health motivation group means will be assessed for each question. Three questions concerning calcium intake will be assessed and vitamin D supplementation will give us a survey group mean and SD compared to RDA. Focus group questions will supply themes associated to barriers to Calcium, Vitamin D intake and PA, group dynamics and living arrangements influences on food choices and PA</p> |
| <p>What are the young adult females' identified strategies to overcoming noted barriers to meeting daily</p> | <p>SCT- learning occurs in social context with a dynamic and reciprocal interactions of the person, environment and behavior. Setting behavioral goals,</p> | <p>Focus Group Questions; What are some strategies you could employ to overcoming the barriers to consuming enough</p> | <p>Reoccurring themes and saturation of data</p> |

| | | | |
|--|--|--|--|
| calcium, vitamin D and physical activity requirements related to osteoporosis? | planning, tracking and positive reinforcement important to behavior change/education | calcium daily? Vitamin D daily? Weight bearing exercise daily? Describe the impact setting behavior goals, planning and tracking these goals and receiving positive reinforcement might play in overcoming these barriers? | |
|--|--|--|--|

Chapter 4 - Results

The purpose of the study was to investigate the young adult females collective perceptions, knowledge, and health beliefs concerning osteoporosis and its prevention, determine the barriers those same young adult females face to meet the daily RDA for calcium, vitamin D and PA requirements, and then describe their strategies to overcome the barriers. The investigation utilized surveys and focus groups to critically examine the relationship of the Osteoporosis Health Belief Scale Scores based on participant demographics and past and current behaviors related to osteoporosis. The mixed method of research was implemented using a survey that was sent out to young adult females age 18-25, and the qualitative data gathered, used the same gender and age for the focus groups. The survey was used to gather data concerning demographics and past and current behaviors and the completion of the OHBS questionnaire. The focus group questions were used to identify knowledge of osteoporosis, barriers, and strategies to consuming calcium and vitamin D and physical activity. The quantitative data

gathered drove the decision to divide group into two age group and revamping of focus group questions.

The study survey participants included 68 young adult females' ages 18-25 solicited through MTurk and 439 attending Northwest Missouri State University located in Maryville, Missouri. The study sample size for the quantitative portion of the research include approximately 498 young adult females age 18-25. Of the 498 responses 49 were deleted due to lack of completion of the survey or many missing data. This left a total of 449 quality responses to the survey quantitative analysis on all survey items including descriptive statistics and inferential analyses was conducted. The focus group research participants included young adult females age 18-25 from a division II university, located in a rural farming community in Northwest Missouri. In total, 23 young adult females participated in 3 focus groups.

Demographics and behaviors of both survey respondents and focus group participants

The age group 18-25, for our survey respondents, was broken into three sub groups 18-20, 21-23 and 24-25. Due to the small sample sizes of the 21-23 and 24-25 age groups, they were combined for the sake of the study. Descriptive statistics for the survey participants can be found in table 5.

Table 5 - Survey Participants Descriptive Statistics (n=447)

| Descriptive Statistics | Frequency | Percent of Total |
|---|-----------|------------------|
| Age | | |
| 18-20 | 227 | 50.56 |
| 21-23 | 155 | 34.52 |
| 24-25 | 67 | 14.92 |
| Race | | |
| African American/Black | 17 | 3.79 |
| Asian | 30 | 6.68 |
| Caucasian | 377 | 83.96 |
| Other | 25 | 5.57 |
| Ate Meals with Family Growing Up | | |
| Did not eat family meals together | 13 | 2.90 |
| 2x/week or less | 42 | 9.35 |
| 3x/week | 93 | 20.71 |
| 4x/week or more | 301 | 67.04 |
| Living Arrangement | | |
| Family | 111 | 24.72 |
| Roommate/s | 264 | 58.80 |
| Self | 74 | 16.48 |

The vast majority of both survey and focus group participants were Caucasian, with the remaining 16% of participants identifying their race as African American or Black, Asian or Other.

The qualitative data showed a significant difference in responses between two age groups; 18-20 and 21-25. Therefore, each focus group was further differentiated into these two age groups. Forty-eight percent of the participants were in the 18-20 year old group and 52% were in the 21-25 age group. The majority of the participants were Caucasian 78% and 22 % identified as either African American or Asian. The research demographic information for the focus group participants is summarized in Table 6.

Table 6 - Focus Group Demographics

| Demographics Descriptive Table for Focus Group Participants - N=23 | | | |
|--|-------|-------|-------------|
| Survey Questions | 18-20 | 21-25 | Group Total |
| Age | 48% | 52% | |
| Race | | | |
| Caucasian | | | 78% |
| African American | | | |
| Asian | | | |
| Other | | | |
| Live With | | | |
| Roommates | | | 65% |
| Family | | | 4% |
| Self | | | 30% |
| Ate Meals Growing up | | | |
| None | | | 0% |
| 2 times | | | 22% |
| 3 times | | | 4% |
| 4 times | | | 74% |
| Growing up 8 oz. milk/day | | | |
| None | | | 4% |
| One time | | | 39% |
| Two times | | | 17% |

| | |
|---------------------------------|-----|
| Three times | 30% |
| More than 4 times | 10% |
| Drink milk Daily | |
| Yes | 30% |
| No | 67% |
| Drink Plant-based daily | |
| Yes | 13% |
| No | 87% |
| Vitamin D Supplements daily | |
| Yes | 13% |
| No | 87% |
| 8 oz. milk or kefir per day | |
| None | 52% |
| Once | 22% |
| Twice | 17% |
| Three or more | 13% |
| 1 oz. of cheese per day | |
| None | 30% |
| Once | 48% |
| Twice | 17% |
| Three | 4% |
| 6 oz. yogurt or pudding per day | |
| None | 74% |
| Once | 17% |
| Twice | 4% |
| Three | 4% |
| Total Calcium | |
| 1000 mg/day (RDA) | 22% |
| Less than 1000 mg/day | 78% |
| Total Calcium Breakdown | |
| Less than 500 mg/day | 47% |
| 501-999 mg/day | 30% |
| 1000 mg/day or more | 23% |

The First Aim of Research - Perception, knowledge and Health Beliefs Concerning

Osteoporosis and its Prevention

The first of the three aims of the study included investigation of the study participant’s perception, knowledge, and health beliefs as it relates to osteoporosis and its prevention. The data from the survey participants OHBS responses and their relationships to other questions will

be addressed.

The calculated means and standard deviations on the OHBS scores are noted in table 7. Higher scores indicate perceptions of a greater likelihood of developing osteoporosis, greater fear of living with osteoporosis, more perceived barriers to calcium consumption. Scores can range between 6 and 30.

Table 7 - Osteoporosis Health Belief Scale Scores

| <u>Osteoporosis Health Belief Scale Scores</u> | <u>n</u> | <u>Mean</u> | <u>SD</u> |
|--|----------|-------------|-----------|
| Susceptibility | 449 | 15.04 | 4.73 |
| Seriousness | 449 | 19.41 | 3.98 |
| Benefits of Exercise | 449 | 23.12 | 3.19 |
| Benefits of Calcium | 449 | 22.03 | 3.24 |
| Barriers to Exercise | 449 | 13.53 | 4.86 |
| Barriers to Calcium | 449 | 15.08 | 4.29 |
| <u>Health Motivation</u> | 449 | 21.13 | 3.99 |

Table 8 contains correlation matrix mix. The seriousness scale was positively correlated with the perceived susceptibility scale, indicating as someone took osteoporosis more seriously, the more likely they were to feel susceptible to the disease, and vice-versa. In contrast, health motivation was negatively associated with barriers to exercise and barriers to calcium indicating that as someone became more motivated to improve their health, they saw fewer barriers towards these healthy activities. The reverse was also true, in that participants with less motivation to be healthy were more likely to see barriers to exercise and calcium.

An interesting positive correlation occurred with the susceptibility and seriousness scales. These were both positively correlated with the two barriers scales, suggesting that participants who perceived themselves as more susceptible were more likely to perceive barriers to activities that could help them. Also, those that perceived osteoporosis as a serious disease were more likely to perceive there were barriers to helping themselves.

Table 8 - Correlations for Osteoporosis Health Belief Scale Scores

| OHBS Correlation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------------------|--------|--------|---------|---------|---------|---------|---|
| 1. Suscep. | - | | | | | | |
| 2. Serious. | 0.18** | - | | | | | |
| 3. Ben. Ex. | 0 | 0.14** | - | | | | |
| 4. Ben. Calc. | -0.02 | 0.16** | 0.42** | - | | | |
| 5. Bar. Ex. | 0.27** | 0.15** | -0.39** | -0.19** | - | | |
| 6. Bar. Calc. | 0.14** | 0.13** | -0.27** | -0.23** | 0.48** | - | |
| 7. Hth. Mot. | -0.09 | 0.08 | 0.4** | 0.24** | -0.44** | -0.38** | - |

* $p < .05$. ** $p < .01$

Table 9 - Means of Osteoporosis Health Belief Scale Scores by Age Group

| Scale Scores | 18-20 | | 21-25 | | <i>t</i> (447) | <i>p</i> | η^2 |
|--------------|-------|------|-------|------|----------------|----------|----------|
| | M | SD | M | SD | | | |
| Suscep. | 14.53 | 4.43 | 15.57 | 4.97 | 2.33 | 0.02 | 0.01 |
| Serious. | 18.96 | 3.94 | 19.86 | 3.99 | 2.39 | 0.02 | 0.01 |
| Ben. Ex. | 23.14 | 3.36 | 23.10 | 3.01 | 0.14 | 0.89 | 0.00 |
| Ben. Calc. | 22.00 | 2.96 | 22.05 | 3.50 | 0.15 | 0.88 | 0.00 |
| Bar. Ex. | 13.52 | 4.88 | 13.54 | 4.85 | 0.04 | 0.96 | 0.00 |
| Bar. Calc. | 15.70 | 4.03 | 14.45 | 4.46 | 3.09 | 0.00 | 0.02 |
| Hth. Mot. | 20.64 | 4.29 | 21.63 | 3.59 | 2.64 | 0.01 | 0.02 |

Table 9 shows the means of OHBS by age group. Regarding susceptibility, there was a statistically significant difference between the younger group (M = 14.53, SD = 4.43) and the older (M = 15.57, SD = 4.97), $t(447) = 2.33, p < .05$. Also, on the seriousness scale, there was a statistically significant difference in the younger group (M = 18.96, SD = 3.94), than the older group (M = 19.86, SD = 3.99), $t(447) = 2.39, p < .05$. There were no statistically significant differences in the three middle scales, benefits of exercise, benefits of calcium and barriers to exercise, based on age.

However, there were differences based on age for the final two scales, barrier to calcium and health motivation. The younger group was more likely to find barriers to calcium (M = 15.70, SD = 4.03) versus the older group (M = 14.45, SD = 4.46), $t(447) = 3.09, p < .01$. In addition, the younger group was less likely to be motivated to be healthy (M = 20.64, SD = 4.29) than the

older group (M = 21.63, SD = 3.59), $t(447) = 2.64, p < .05$.

Table 9 shows a significant difference in susceptibility, seriousness, barriers to calcium and health motivation scales based on the age of the participant. However, the calculated effect size for these comparisons indicates that no more than 1-2% of the differences in these scales can be attributed to the age variable.

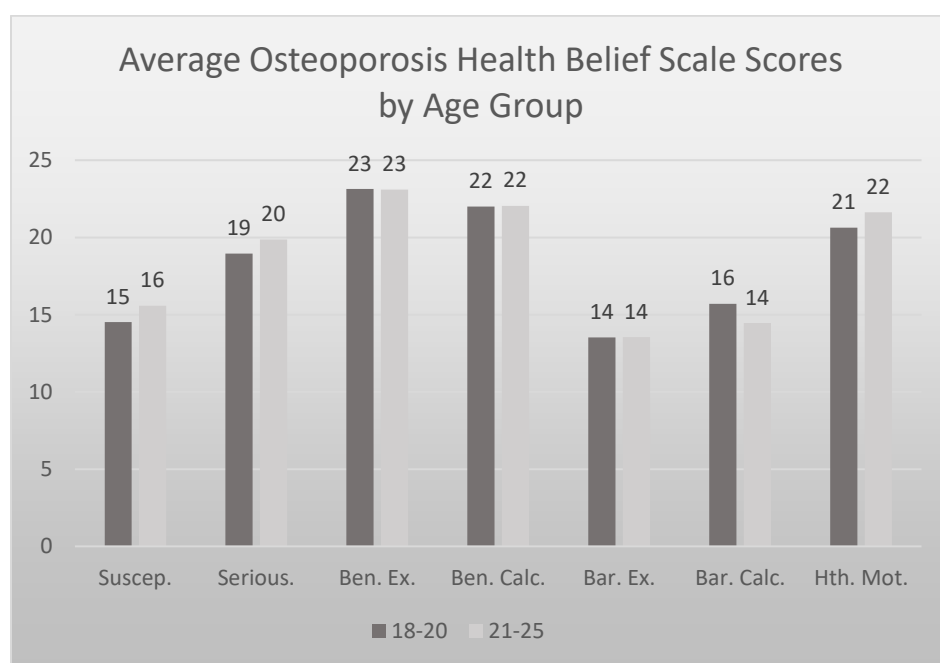


Figure 2 - Average Osteoporosis Health Belief Scale Scores by Age Group

Another ANOVA was performed to determine if there were differences in OHBS scores based on how often participants ate meals with family growing up.

Table 10 - ANOVA of Osteoporosis Health Belief Scale Scores by Frequency Ate Meals with Family Weekly

| Scale Scores | 2x. | | 3x. | | 4x/more | | Did Not | | $F(3, 445) \eta^2$ | |
|--------------|-------|------|-------|------|---------|------|---------|------|--------------------|------|
| | M | SD | M | SD | M | SD | M | SD | | |
| Suscep. | 15.38 | 4.01 | 16.28 | 4.83 | 14.64 | 4.77 | 14.46 | 4.01 | 3.02* | 0.02 |
| Serious. | 19.98 | 3.86 | 19.37 | 3.64 | 19.38 | 4.12 | 18.54 | 3.69 | 0.50 | 0.00 |
| Ben. Ex. | 22.29 | 2.88 | 22.42 | 2.97 | 23.43 | 3.26 | 23.69 | 2.78 | 3.60* | 0.02 |
| Ben. Calc. | 22.19 | 3.37 | 21.63 | 2.95 | 22.16 | 3.33 | 21.23 | 2.45 | 0.92 | 0.01 |
| Bar. Ex. | 13.95 | 4.52 | 14.49 | 5.02 | 13.12 | 4.77 | 14.69 | 6.02 | 2.32 | 0.02 |
| Bar. Calc. | 16.31 | 4.02 | 15.99 | 4.31 | 14.63 | 4.27 | 15.15 | 4.28 | 3.72* | 0.02 |
| Hth. Mot. | 19.50 | 3.83 | 20.68 | 3.47 | 21.53 | 4.06 | 20.31 | 4.82 | 4.00* | 0.03 |

* $p < .05$. ** $p < .01$

Table 10, depicts the results of ANOVA of Osteoporosis Health Belief Scores by frequency ate meals with family growing up. There were significant differences at $p < .05$ on the scales for susceptibility ($F(3, 445) = 3.02, p < .05$), benefit of exercise ($F(3, 445) = 3.60, p < .05$), barriers to calcium ($F(3, 445) = 3.72, p < .05$), and health motivation ($F(3, 445) = 4.00, p < .05$).

Using post hoc analyses of Tukey HSD, there was a difference in susceptibility between the participants that ate three times per week with family ($M = 16.28, SD = 4.83$) and those that ate four times or more with family weekly ($M = 14.64, SD = 4.77$). Therefore, participants who ate three times a week with family believed they were more susceptible to osteoporosis than those that ate four or more times.

Regarding benefit of exercise, the difference again was between those that ate three times per

week with family ($M = 16.28$, $SD = 4.83$) and those that ate four times or more with family weekly ($M = 14.64$, $SD = 4.77$). This time, those that ate three time per week with family were more likely to perceive benefits of exercise than those that ate four times or more per week with family.

Tukey HSD also indicated that the difference in barriers to calcium was between those that ate three times per week with family ($M = 15.99$, $SD = 4.31$) and those that ate four times or more with family weekly ($M = 14.63$, $SD = 4.27$).

Finally, Tukey HSD found that the difference in health motivation was between those that ate two times per week ($M = 19.50$, $SD = 3.83$) and those that ate four times or more with family weekly ($M = 21.53$, $SD = 4.06$). So, those that ate four times or more weekly with family were more likely to be motivated to be healthy.

These findings suggest an overall difference between those participants that ate 4x or more per week with family and all other participants. In susceptibility, they had the second lowest scores except for those that did not eat at all with family. Figure 3 illustrates the OHBS scores associated with how often the study participants reported eating meals with family per week.

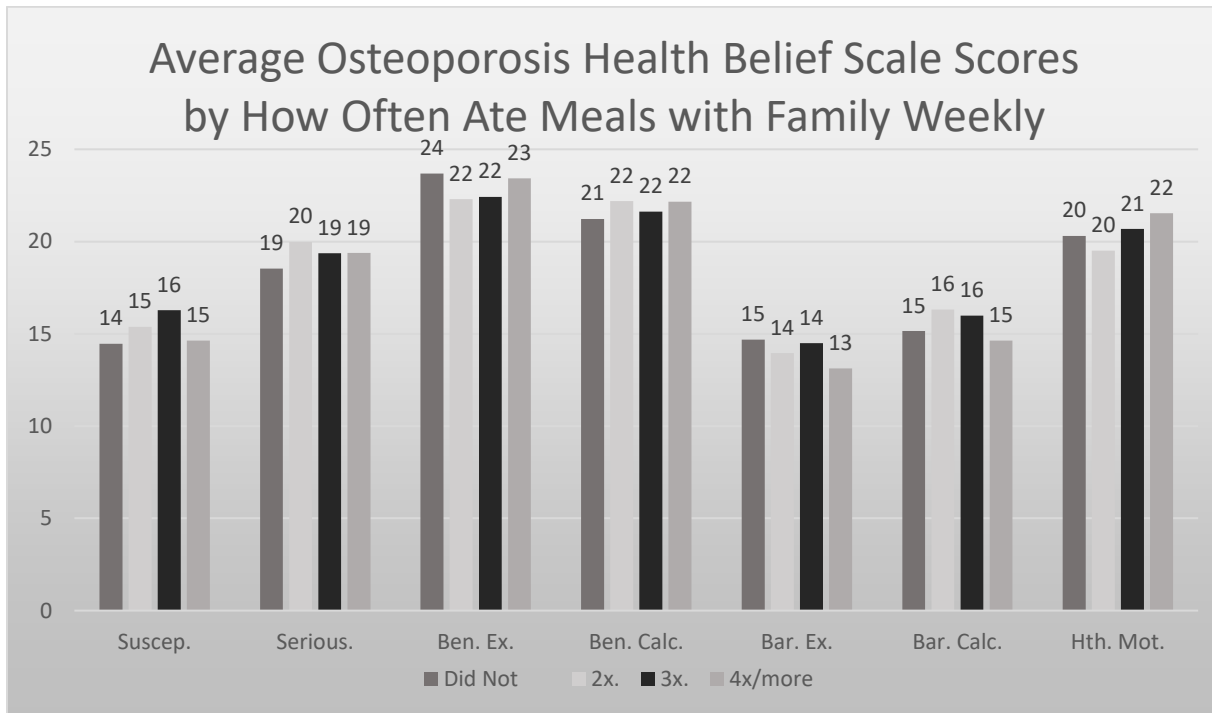


Figure 3 - Average Osteoporosis Health Belief Scale Scores - Meals with Family

An ANOVA was performed to see if there were any differences in OHBS scores based on participant living arrangement and race and no statistically significant results were found for either.

Table 11 illustrates the results of the T-tests performed to identify differences in OHBS scores based on whether participants consumed the RDA of calcium.

Table 11 - *t*-test of Osteoporosis Health Belief Scale Scores by Total Calcium RDA

| | <u>Below RDA</u> | | <u>At/Above RDA</u> | | <i>t</i> (447) | <i>p</i> | η^2 |
|------------|------------------|------|---------------------|------|----------------|----------|----------|
| | M | SD | M | SD | | | |
| Suscep. | 15.03 | 4.64 | 15.16 | 5.67 | -0.15 | 0.88 | 0.00 |
| Serious. | 19.53 | 3.93 | 18.08 | 4.33 | 2.16 | 0.03 | 0.01 |
| Ben. Ex. | 23.05 | 3.18 | 23.89 | 3.19 | -1.57 | 0.12 | 0.01 |
| Ben. Calc. | 21.99 | 3.25 | 22.45 | 3.09 | -0.84 | 0.40 | 0.00 |
| Bar. Ex. | 13.54 | 4.81 | 13.39 | 5.42 | 0.17 | 0.86 | 0.00 |
| Bar. Calc. | 15.22 | 4.10 | 13.58 | 5.88 | 2.27 | 0.02 | 0.01 |
| Hth. Mot. | 21.12 | 3.97 | 21.18 | 4.29 | -0.09 | 0.93 | 0.00 |

Those who did not consume the RDA believed osteoporosis was more serious (M = 19.53, SD = 3.93) than those who did consume the RDA (M = 18.08, SD = 4.33), $t(447) = 2.16, p < .05$. In addition, those who did not consume the RDA were more likely to perceive barriers to calcium (M = 15.22, SD = 4.10) than those who did consume the RDA (M = 13.58, SD = 5.88), $t(447) = 2.27, p < .05$.

Table 12 illustrates findings of the T-tests performed to identify differences in OHBS scores based on whether participants took a vitamin D supplement.

Table 12 - *t*-test of Osteoporosis Health Belief Scale Scores by Vitamin D Supplement Usage

| Scale Scores | Do Not Use | | Use Vitamin D | | <i>t</i> (444) | <i>p</i> | η^2 |
|--------------|------------|------|---------------|------|----------------|----------|----------|
| | M | SD | M | SD | | | |
| Suscep. | 14.86 | 4.54 | 15.57 | 5.24 | -1.38 | 0.17 | 0.00 |
| Serious. | 19.25 | 4.00 | 19.87 | 3.95 | -1.44 | 0.15 | 0.00 |
| Ben. Ex. | 22.94 | 3.15 | 23.63 | 3.31 | -1.98 | 0.05 | 0.01 |
| Ben. Calc. | 21.97 | 3.07 | 22.21 | 3.72 | -0.68 | 0.50 | 0.00 |
| Bar. Ex. | 13.78 | 4.77 | 12.71 | 5.05 | 2.03 | 0.04 | 0.01 |
| Bar. Calc. | 15.15 | 4.25 | 14.86 | 4.46 | 0.63 | 0.53 | 0.00 |
| Hth. Mot. | 20.62 | 4.02 | 22.64 | 3.49 | -4.80 | 0.01 | 0.05 |

There were three significant differences in OHBS scores. Those who did consume a supplement were more likely to believe in benefits of exercise (M = 23.63, SD = 3.31) than those who did not take a supplement (M = 22.94, SD = 3.15), $t(444) = -1.98, p < .05$. Also, those that did not take a vitamin D supplement were more likely to perceive barriers to exercise (M = 13.78, SD = 4.77) than those who did take a supplement (M = 12.71, SD = 5.05), $t(444) = 2.03, p < .05$. Finally, those that did take a vitamin D supplement were more likely to be motivated to be healthy (M = 22.64, SD = 3.49) than those that did not take a supplement (M = 20.62, SD = 4.02), $t(444) = -4.03, p < .01$.

Focus group themes and subthemes can be found in table 13. The first theme associated with this study aim centers on lack of knowledge and education. The focus group participants

reported, when asked about their knowledge of bone health/osteoporosis, the following: (a) 35% of participants stated they knew little or nothing about the subject; (b) 22% of participants related osteoporosis to age and arthritis; and (c) 22% related bone health/osteoporosis to being female or genetics. Participants stated that osteoporosis is not a factor at their age. Some direct participants quotes were: “Doesn’t affect you so you don’t hear about it”; “women are more at risk, but I do not know why.” When asked if the participants based their food choices on how the food supports bone health, 65% of the participants responded “no.” The 18-20 year-old group was more likely to state they eat what they want, and the 21-25 age group indicated that they attempt to be aware of what they choose to eat. Sixty-five percent of focus group participants responded they did not associate food choices with their bone health.

Table 13 – Identified Themes, Sub-Themes, Quotes Related to Research Aims, Osteoporosis Perceptions, Knowledge, Health Beliefs, Barriers and Strategies for Behavior Change (n=23)

| Themes | Sub Themes | Participant Quotes |
|-----------------------------|---|---|
| Lack of Knowledge/education | <ul style="list-style-type: none"> Limited knowledge of calcium, Vitamin D sources and bone health | <p>“I think at this age we are focused on trying to not get acne and dairy causes it and water makes it go away”</p> <p>“ I don’t really think about what I eat”</p> <p>“I don’t know what has calcium and there is not the best options for vegans at NW and Maryville”</p> <p>“We don’t have the information about what foods to eat in place of the supplements we take. You have to google it, moms or grandmas”</p> <p>“Actually learn what has vitamin D, because I have no clue. Social media”</p> |
| | <ul style="list-style-type: none"> Meal prep skills/recipes | <p>“I am not familiar with foods that are calcium rich besides milk and cheese.”</p> <p>“A lot of stuff with cheese you cook and we don’t have time to plan and make meals”</p> |
| | <ul style="list-style-type: none"> National Marketing/social Media | <p>“A radio commercial with random facts campaign, and instagram.”</p> <p>“I feel like education, accessibility, simplicity is good but promote more on social media because we are always on social media.”</p> |
| Money/budget | <ul style="list-style-type: none"> Limited Funds | <p>“Being a college student for fruits we buy cheap-non-perishable food items that are often not calcium rich and I don’t drink milk anymore”</p> <p>“My money is budgeted towards rent. Dinner is the best meal and it’s always cheap.”</p> |

| Themes | Sub Themes | Participant Quotes |
|-----------------|---|--|
| Time management | <ul style="list-style-type: none"> • Food choices due to university dining Or small town food availability • Busy schedule • Peer/roommate/work/ social life influence choices | <p>“I am paying for food on campus so I have to eat my money’s worth. My living situation causes me to overeat.”</p> <p>“I live in dorms so eat at the Union and I do a pretty good job getting a fruit with every meal, but at work I just eat the snacks the kids do not consume or if I am at a friends I eat whatever they order”</p> <p>“I eat at the Union for all meals and when I eat with friends at a restaurant we eat the cheap stuff.”</p> <p>“In general it’s hard for us to find school-life balance.”</p> <p>“I’m busy all the time always doing school. It is difficult to take time to cook and eat something healthy. Busy is the worst.”</p> <p>“Not eating three meals a day because school and hanging out with people comes first and I try to make food stretch. Sometimes I do not eat all day then just eat a sandwich and snack foods.”</p> <p>“When your roommate asks you to go out to eat, even though you may not be hungry, you go.”</p> <p>“Adding exercise goals to your schedule may overcome barriers to PA”</p> |

Second Aim of Research – Barriers to Consuming the RDA for Calcium, Vitamin D and Physical Activity

The second aim of the research focused on determining the barriers young adult females face meeting the daily RDA for calcium, vitamin D and physical activity requirements. The data collected from the survey respondents addressed OHBS responses can be found in figure 4.

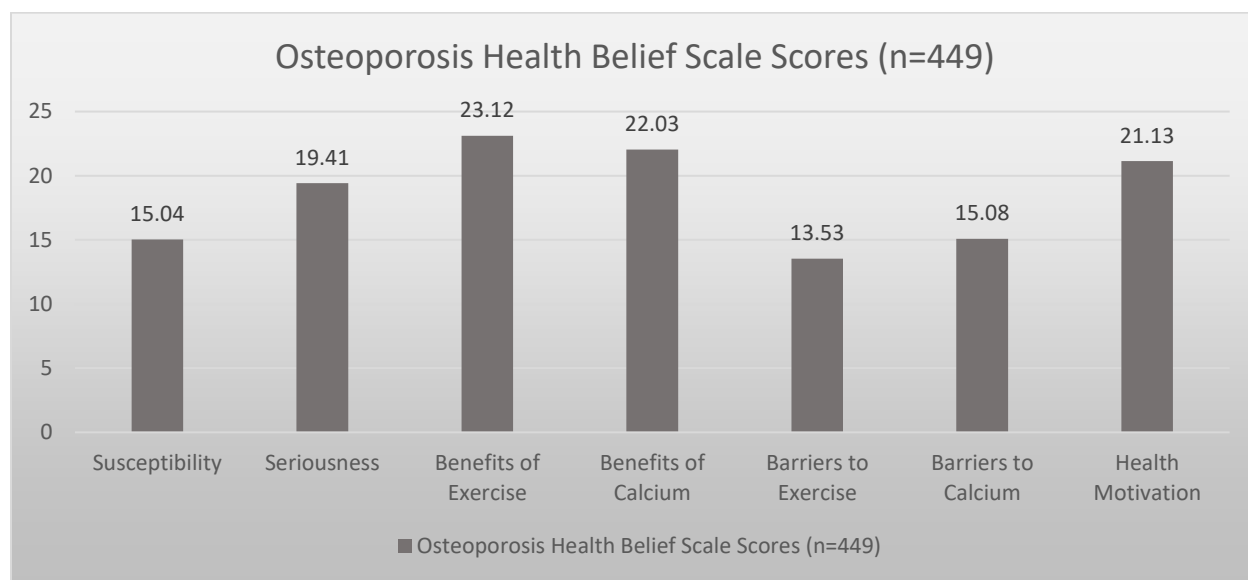


Figure 4 - Osteoporosis Health Belief Scale Scores

Barriers to exercise was the lowest scoring scale (13.53) and benefits of exercise was the highest scoring scale (23.12). This means that participants were more likely to recognize the benefits of exercise and less likely to perceive barriers to exercise.

Table 14 - Correlations for Osteoporosis Health Belief Scale Scores

| OHBS Correlation | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|------------------|--------|--------|---------|---------|---------|---------|---|
| 1. Suscep. | - | | | | | | |
| 2. Serious. | 0.18** | - | | | | | |
| 3. Ben. Ex. | 0 | 0.14** | - | | | | |
| 4. Ben. Calc. | -0.02 | 0.16** | 0.42** | - | | | |
| 5. Bar. Ex. | 0.27** | 0.15** | -0.39** | -0.19** | - | | |
| 6. Bar. Calc. | 0.14** | 0.13** | -0.27** | -0.23** | 0.48** | - | |
| 7. Hth. Mot. | -0.09 | 0.08 | 0.4** | 0.24** | -0.44** | -0.38** | - |

* $p < .05$. ** $p < .01$

Relationships between OHBS scores are found in table 14. It was noted that the majority of scales are correlated positively to each other. The barriers scales, Barriers to Calcium and Barriers to Exercise, were correlated to all other scales.

Focus group themes and sub-themes related to barriers continued to demonstrate a lack of knowledge and education in calcium and vitamin D sources and factors that contribute to overall bone health. Of the focus group participants, 39% reported barriers to daily consumption of calcium rich foods were due to; (a) the lack of knowledge; (b) limited knowledge of calcium rich foods or (c) incorrect knowledge of foods that are calcium rich. Other themes related to calcium rich food consumption barriers were revealed in the focus groups: (a) limited cost/budget due to college finances 17%; (b) busy lifestyle 13%; (c) limited choice or availability of variety of

choices of milk at the Union and in Maryville 22%. Aside from milk or cheese, the majority of focus group participants, 91%, did not mention other foods as sources for calcium and its consumption as barriers to implementing calcium into their daily diet.

The barriers identified by focus group participants to meeting their vitamin D requirements were; (a) 39% of participants stated a lack of knowledge/education; (b) 28% stated food and supplement costs; and (c) 28% stated lack of sunshine. Other comments concerning the barriers to consuming vitamin D included: “I don’t know why I need or what this is” and “Vitamins are encouraged instead of food sources of vitamin D”.

The themes to barriers to getting daily exercise were: (a) 31% stated time and schedule; (b)18% stated self-conscience; (c) 18% stated Covid and face masks; (d)10% stated they do not know how to use the gym equipment; and (e) 28% stated availability of facilities and weather.

Participants also associated exercise to the use of a gym and did not recognize other daily activities as exercise.

Third Aim of Research – Strategies to Overcome the Barriers

The third and final aim of the study was describing strategies to overcoming barriers study participants face to meeting daily calcium, vitamin D and PA requirements to prevent osteoporosis. No quantitative data directly correlate to the strategies for overcoming the barriers, but focus groups provided responses to address this aim and are reported below.

Focus group themes and sub-themes continued to center on lack of knowledge, education, financial/budgets and time management. Focus group discussions relevant to the participants' barriers to calcium consumption lead to examining strategies to overcome these barriers. Ninety one (91) percent of the participants stated the feasible strategies included: the need for education through sampling stations at the university union; required nutrition/health classes during high school or university; and education in the form of fliers and posters hung throughout the Union or at various locations throughout the university campus. A small group of 17% of participants stated there needs to be an effective national marketing campaign for the young adult, similar to the "got milk" mustache campaign, or the use of an effective trending social marketing campaign. Finally, 13% asked for meal prep information using calcium rich foods and recipes that can be made easily and in a convenient manner.

Strategies offered to overcome their barriers to consuming daily vitamin D from 50% of participants was a resounding "knowledge/education." The education strategies highlighted by the participants included food samplings of vitamin D and calcium rich foods at the grocery store and Union, recipes to promote calcium and vitamin D, fliers and posters, and residence halls tastings and education. Thirty percent of participants suggested the initiation of social media campaigns targeted at their 18-25 age group. Lastly, 20% of participants agreed free or promotional items and incentives to consume vitamin D rich foods would be effective for their age group. During focus group two, one participant suggested the use of scare tactics concerning the health consequences of not consuming enough vitamin D as a strategy; other participants within the group shook their head in agreement.

The participants provided a number of suggestions to overcome barriers to exercise: 45% stated establishing goals and adding it to your schedule; (b) 35% stated free gym classes and free beginners instructions on how to use the gym equipment; and (c) 20% stated the creation of women's workout clubs/workout buddy, and incorporating movement (e.g., walking) into their daily busy schedules.

Challenges

The challenges faced during the designing, implementing and reporting of the research included:

1) Recruitment of participants during ongoing Covid 19; 2) resource constraints to conduct and implement the research; 3) time management to perform analysis and conduct quality research.

University administration approval was requested to hold the focus group meetings in advance of the February/March timeline, submitted Covid mitigation plan for focus group meetings, reserved the meeting rooms for the focus groups before the end of the Fall 2020 semester, and prepared recruitment materials by January 2021. In addition, two senior dietetic students who volunteered as research assistants were recruited and trained.

Strengths and Limitations of the Study

The mixed method research, using both quantitative and qualitative research methods to gather data is a strength of the study. Additionally, the research included a pilot focus group, here questions prior to the use with the three research focus groups were practiced. This facilitated refining the focus group questions to ensure data gathered was valid. The OHBS has been used in previous research and was tested as both valid and reliable for gathering osteoporosis health

beliefs knowledge and beliefs, this is a strength. The diet analysis tool used to assess calcium intake, has been proven as valid when used with group population assessment for calcium.⁸² The data gathered is generalizable to the general university population but the focus groups responses may not be; this is a limitation. However, the study fills the gap in research and provides data on this population to mitigate the risks of osteoporosis in young adult females. Another limitation is the lack of diversity for both the MTurk survey respondents and the focus groups. The MTurk survey workers are 77% white, non-Hispanic, 6% black, non-Hispanic, 6% Hispanic and 11% other.⁸⁸ The student population at Northwest Missouri State University is 77.5% Caucasian, 5% African American, 3.68% Hispanic or Latino, 3.06% two or more races, .836 % Asian, .284% American Indian or Alaskan Native and 0.158% Native Hawaiian or other pacific Islander (Data USA). In other words, the lack of diversity could result in a limitation in its generalization, but osteoporosis is more prevalent in white females. Lastly a limitation on the focus group responses concerning calcium rich food intake could have been influenced by the previous two questions focused on milk intake and milk intake growing up.

Chapter 5 - Discussion and Conclusion

The purpose of this research was to investigate if young females, age 18-25, believe they are susceptible to the disease of osteoporosis, if they understand its seriousness, the barriers and strategies to meeting the RDA of calcium and vitamin D and daily physical activity. The research included quantitative data from 449 survey responses obtained from 18-25 year old females living within the United States, as well as qualitative data from four focus groups. The focus

groups consisted of one pilot group and three study groups, which included 23 young females age 18-25. The focus group participants answered demographic data and 15 questions on their perception of bone health/osteoporosis, barriers to achieving bone health (i.e., consuming calcium and vitamin D foods and daily physical activity) and strategies for overcoming the barriers. Focus group questions can be found in Appendix B.

The results of this study also provided insights into participants' approximate daily calcium consumption based on servings of milk, cheese, yogurt/pudding and their perception of how roommates', work and social life impacted their food choices. See Table 15 for survey participants' calcium and vitamin D intake statistics.

Table 15 - Descriptive Calcium and Vitamin D Intake Statistics (n=449)

| Descriptive Statistics | Frequency | Percent of Total |
|--|-----------|------------------|
| Daily Milk Consumption Growing up | | |
| Did not drink milk daily growing up | 105 | 23.39 |
| 1 time | 163 | 36.30 |
| 2 times | 123 | 27.39 |
| 3 times | 28 | 6.24 |
| More than 3 times | 30 | 6.68 |
| Milk Consumption | | |
| 0mg | 268 | 59.69 |
| 300mg | 119 | 26.50 |
| 600mg | 41 | 9.13 |
| 900mg | 16 | 3.56 |
| 1200mg | 5 | 1.11 |
| Cheese Consumption | | |
| 0mg | 145 | 32.29 |
| 150mg | 165 | 36.75 |
| 300mg | 100 | 22.27 |
| 450mg | 25 | 5.57 |
| 600mg | 14 | 3.12 |
| Yogurt Consumption | | |
| 0mg | 312 | 69.49 |
| 200mg | 110 | 24.50 |
| 400mg | 24 | 5.35 |
| 600mg | 3 | 0.67 |
| Daily Calcium Consumption | | |
| 0-500mg | 313 | 69.71 |
| 501-799mg | 65 | 14.48 |
| 800+mg | 71 | 15.81 |
| Daily Vitamin D | | |
| Do not take vitamin D supplement | 331 | 74.22 |
| 400 IU | 48 | 10.76 |
| 1000 IU | 41 | 9.19 |
| More than 1000 IU | 26 | 5.83 |

This study was an inclusive study, looking at three of the modifiable lifestyle behaviors (daily calcium intake, vitamin D intake, and daily physical activity) known to positively or negatively

impact bone health and the future development of osteoporosis. The study also gathered data on calcium intake of research participants and compared it to the RDA of 1000mg of calcium. Our research collected data on and examined number of meals shared with family and, daily servings of milk growing up, and the focus group participant's perception of how well setting and tracking goals, receiving reinforcements and incentives work for their age group. To the researcher's knowledge, there has not been any research of this magnitude, designed and implemented thus far, to include the many facets that impact current and future bone health and future osteoporosis risk. The three aims the study set out to investigate were: (1) Young adult females' perceptions of osteoporosis and its associated risks; (2) Young adult females' perceptions associated with the barriers to meeting calcium, vitamin D and physical activity requirements related to osteoporosis; and (3) Young adult females' identified strategies to overcoming the noted barriers to meeting daily calcium, vitamin D and physical activity requirements related to osteoporosis. The following paragraphs discuss the data collected to answer the research aims while also linking the findings to support previous research and adding to the depth of knowledge concerning osteoporosis prevention.

Research Aim One- Perceived Susceptibility Severity to the Disease of Osteoporosis

The young females surveyed and interviewed during the focus groups did not perceive a susceptibility or understand the severity to the disease of osteoporosis. The Osteoporosis Health Belief Scale (OHBS) portrayed the seriousness scale was positively correlated with the perceived susceptibility scale. As a participant perceived osteoporosis more seriously, the more likely they

were to feel susceptible to the disease and visa-versa. Also, those that perceived osteoporosis as a serious disease were more likely to perceive there were barriers to helping themselves. The focus group participants did not perceive osteoporosis as a disease that impacts their age group or did not believe they had any control over its development. This correlated to their perception of susceptibility or severity to osteoporosis in the survey responses associated with the OHBS. The research participants also believed the disease only impacted older adults and had no current impact on them during focus group discussions. Similar findings^{26,59,60,89,90} were reported assessing osteoporosis perceived susceptibility or severity in this young adult female age group. The researcher also noted negative correlations in the OHBS responses. Those with a high score on the health motivation scale would score low in the barriers to exercise and low barriers to calcium scales. In other words, as someone was more health motivated, they saw fewer barriers towards these healthy activities. A study conducted with Australian young adults also found a better dietary overall pattern was associated with higher intake of calcium.³³

The research found, like many studies conducted in the past ten years, this age group of females perceived their susceptibility and the seriousness of osteoporosis as low. The study went further to ask women of this age group if they understood the disease and the significance of bone health. There was a resounding “no.” They do not perceive a susceptibility or seriousness to developing osteoporosis.

Research Aim 2- Barriers

The results from the OHBS survey of research participants showed a positive correlation with the susceptibility and seriousness scales to both calcium and physical activity barriers scale. The participants who perceived themselves as more susceptible were more likely to perceive barriers to consuming calcium, vitamin D and physical activity that could aid them in preventing osteoporosis. The barriers identified during the focus groups to consuming calcium rich foods included a singular focus on milk consumption as a source for calcium; a lack of milk consumption; a general lack of knowledge of foods containing calcium; and limited knowledge of calcium's importance in their diets. Focus group participants also expressed limited knowledge of alternate sources of calcium rich foods, other than milk or dairy products, even when prompted. Studies conducted by both Chapman et al²⁵ and Zablah²⁶ found similar lack of knowledge on identifying calcium rich food sources and calcium intakes among study participants were below the recommended amount of 1000mg per day. The researcher found two statistically significant factors associated with the participants' total daily calcium consumption. Those participants that drank milk as a child were more likely to consume the RDA total calcium of 1000mg per day, and those participants that consumed more than 600mg of milk per day as a young adult were also more likely to consume RDA total calcium of 1000mg per day. Rouf et al²⁷ also completed a study exploring barriers and enablers to calcium intake. The results noted a combination of positive parental influences and development of habits from early childhood are likely to result in a positive impact and continuation of dietary habits in young

adulthood. This study also found those participants who ate four or more meals with family per week believed they had lower susceptibility to osteoporosis, lower barriers to daily calcium and exercise and higher health motivation.

There was a positive correlation between family meals consumed growing up and the participants' daily RDA consumption of total calcium - as the number of family meals consumed together increased, so too did the percent of participants' daily consumption of total calcium. The focus group participants noted milk consumption while growing up, primarily due to enforced consumption in school breakfast and lunch programs. A caveat however was expressed by focus group participants; those early habits of milk consumption did not continue while attending university. Seventy percent of the study participants reported consuming less than half the RDA of total calcium per day (500mg). This outcome (less than the RDA intake of calcium) is not dissimilar from other studies' evaluations of calcium intake of young adults.^(23,24,25,26)

Participants noted multiple reasons for not consuming more milk daily - tired of the taste; wanted more variety of flavors; the campus dining facility did not have or had run out of the "type of milk" they preferred.

Barriers to Consuming Vitamin D Rich Foods

Vitamin D plays a supportive and important role in the absorption of calcium, bone metabolism and mineralization.⁹¹ The foods that contain vitamin D are limited to oily fish, egg yolk, dairy milk, butter and mushrooms. These are often not the foods of choice for the research participants. The other source for vitamin D from sun exposure. Fifteen (15) minutes of sun

exposure on your skin is required to produce a body's required vitamin D. Often however, the sun is not available daily or depending on the geographic location, the sun does not have the right intensity during certain times of the year. The lack of knowledge of foods that contain vitamin D, the reason to incorporate vitamin D foods into one's diet, the limited food sources of vitamin D and geographic location are barriers to the research participants' ability to obtain their vitamin D needs. These barriers (or similar) were also noted in other studies conducted with young adults.^{21,27,92} Seventy-five percent of the surveyed participants did not take a vitamin D supplement and also lived in a geographical location where they could not obtain adequate vitamin D from sun exposure for five months out of the year.

Barriers to Daily Physical Activity

As with both vitamin D and calcium intake barriers, the barriers to being physically active for this 18-25 year old age group were available time and knowledge. Knowledge expressly pertained to the use of gym equipment. The focus group participants vocalized a list of barriers to daily physical activity: the need for a buddy to workout with; Covid social distancing and face masks; and not being held accountable. Kasper et al²³ and Correa-Rodriguez et al³⁸ studies found a relationship between physical activity and bone health. Their study also noted the young adult participants lead physically inactive lifestyles. Brown et al⁴⁷ study participants also cited work commitments, time, and lack of motivation as barriers to physical activity similar to our research participants. The current research found a correlation between survey participants' low health motivation score and a higher score in perceived barriers to exercise.

The research data giving insight into the barriers this age group faces in obtaining the RDA and needed daily calcium, vitamin D and physical activity, lead to the participants expressing a lack of knowledge on calcium and vitamin D rich food choices. There was also noted lack of time, and skill to meal plan and prep to include calcium and vitamin D rich foods. Time, knowledge and accountability/a buddy were identified as reasons why they did not participate in regular physical activity. All of the above pointed to strategies to overcoming these barriers and the focus group participants repeatedly pointed to a need for education/knowledge in all three areas.

Research Aim 3- Strategies to Overcoming the Expressed Barriers to Calcium and Vitamin D Intake, and Daily Physical Activity

The resounding strategy for overcoming each of the three barriers (calcium and vitamin D intake and daily physical activity) was education - a gained knowledge and skill in prevention of the disease of osteoporosis. Previous research in a myriad of studies^{50,51,52,53} discussed the need for osteoporosis education for the young adult female age 18-25. The World Health Organization stated an understanding of modifiable lifestyle factors that affect bone development and strength in young women is critical in the prevention of osteoporosis.²¹ Health Belief Model education models were effective in improving osteoporosis perceived susceptibility and knowledge. The previous studies also showed a hands-on model of teaching was effective in increasing self-efficacy in the young adult population.⁵¹ Corroborating previous research results, participants of this study suggested hands-on methods such as sharing calcium and vitamin D nutrient dense recipes, meal planning and taste testing stations as potentially effective models of education. The

past research studies stated osteoporosis education was an important and timely public health concern for the young adult.^{52,53} Those studies also reported the young adults of their research believed osteoporosis disease was something you acquired as you became elderly and was not a concern for their age group.

Social Impacts on Lifestyle Choices of Participants

The social cognitive theory model of behavior change states that social interactions such as roommates, work and social circles of friends have an impact on a person's personal lifestyle choices. The participants of this study were no different. Focus group participants stated work peers, friends and roommates all impacted their food and dining location choices and their motivation for daily physical activity. Research by Turner L et al⁷ noted a need for social support among research participants to enhance effectiveness of osteoporosis education program. Even though the current research did not find a significant correlation between living with roommate, family or alone on HBMS responses, the focus group participants voiced they did have an influence. Focus group participants also believed goal setting, tracking of physical activity and reinforcements would be positive motivators towards behavior change.

Until this age group and the topic of osteoporosis prevention and bone health becomes a public health priority, this researcher does not foresee wide-spread behavior change for the young adult female. This age group voiced a need for education, skill development and support for them to make needed behavior changes. Two of the focus groups made the distinct comment that their age group is "transitioning to adulthood" and they require nutrition education, time management

skill development, meal preparation and meal planning skills. This was notable within the two sub age groups of the survey participants. As noted previously, the younger age group 18-20 vs the older age group 21-25 were less health motivated and believed there were more barriers to consuming daily calcium and physical activity. A limitation to the study responses, were the majority of the young adult females surveyed and 100% of the focus group participants were university students. Their strategy ideas were focused more in the university setting.

The research results presented reinforced the desire from this age group to be educated and also taught hands on how to overcome the barriers to calcium and vitamin D intake and daily physical activity. The new terms uncovered during research and adding to the body of research is the term and belief “transitioning to adulthood”, and the need for important life skills that should be taught either during high school or the university setting (nutrition, meal planning, meal prep, quality snacking, physical activity).

Interdisciplinary efforts between public health, community based Registered Dietitian Nutritionists, K-12 and higher educators and RD’s, and Extension need to work together to address the lack of knowledge the young female 18-25 has concerning the development and prevention of osteoporosis. Studies have shown self-efficacy acquired through hands on learning of new skills is most effective in long term behavior change. The Health Belief Model addresses when a person is ready to change it is often associated with the level of perceived susceptibility or seriousness of the disease. Even though young adults may have been educated on nutrition and bone health earlier in their lives, it may not be considered important until age. The research

revealed a difference between the 18-20 year old group and the 21-25 group's perceived susceptibility and seriousness; the OHBS scores were higher in the older group and the older group participants tended to be more health-motivated. The correlation between the age groups and their OHBS scores was found to be statistically significant, even though there was only one OHBS point difference between the groups. The FG participants reinforced this correlation through their responses, substantiated their beliefs changing between ages 18-20 to 21-25. FG participants referred to this period of growth as "transitioning to adulthood."

The data gathered reinforces past research pointing to a need for more research to identify an effective social marketing campaigns to draw attention to the body's need for calcium and the importance of dairy intake targeted to and during high school and young adults. (as this is being written the researcher noted a social media post on Tik Tok under Got Milk with a new slogan "you're gonna need milk for that"). This age group are the future parents of the next generation and current and past research indicates education of healthy meals, milk consumption and family meals while growing up equate to healthier future outcomes of the next generation!

Doctoral Candidate

Osteoporosis Prevention is
Linked to Education,
Childhood Meals and Milk
Consumption in Young Adult
Females

Karen E. From

Appendices

Appendix A: OHBS Survey developed in Qualtrics

Qualtrics link: http://unf.co1.qualtrics.com/jfe/form/SV_3RkrRrRxz0VGLUF

OHBS

Start of Block: Block 7

TITLE OF STUDY

Young Adult Females' Perceptions of Bone Health Barriers: Osteoporosis Prevention and Lifestyle

Contributing Factors Strategies

PRINCIPAL INVESTIGATOR

Karen E. From, MS, RDN, LD

University of North Florida, Doctoral Candidate

Redacted

Maryville, MO

Redacted

PURPOSE OF STUDY

You are being asked to take part in research study survey or focus group. Before you decide to

participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The purpose of this study is to inform the body of knowledge related to female bone health and related factors to positively influence strategies to overcoming barriers to bone health to prevent osteoporosis.

STUDY PROCEDURES

The purpose of this study is to examine the perceptions of young adult females' age 18-25 perceived risk of developing osteoporosis, barriers to meeting lifestyle modifications and strategies to overcoming these barriers in prevention of osteoporosis. The proposed research will conduct both a research survey and three focus groups each with 7-9 female research participants. To examine the study populations insights concerning their perceived risk of developing osteoporosis, the barriers to meeting modifiable lifestyle factors and strategies to overcome these barriers in prevention of osteoporosis. The research proposed will use both quantitative and qualitative methods, referred to as the mixed method approach. The quantitative portion of the study will include a survey that includes the Osteoporosis health beliefs scale (OHBS), diet analysis of calcium and vitamin D intake and demographic data collection. The focus groups are structured around set questions to answer the research questions, but the sessions will be free-flowing to draw out as much qualitative data as possible. Analysis of the OHBS will examine the beliefs, knowledge and self-efficacy of osteoporosis and barriers to calcium intake and physical activity of survey respondents. The diet analysis questions will give a mean and SD of the total survey respondents approximate intake of calcium and vitamin D. Those data will be compared to the recommended dietary allowances for both Calcium and vitamin D. The qualitative method of research

will collect data from the discussions and questions from the focus group participants. These are captured via recordings and transcribed for analysis. The transcribed narratives will be analyzed to capture and document research themes.

If you are participating in completion of the survey it should take you no more than 15 minutes.

If you are agree to participate in the focus group it is expected to require 60 minutes.

The focus groups will employ audio taping of the discussions.

RISKS

There are no significant risks associated with this study.

You may decline to answer any or all questions and you may terminate your involvement at any time if you choose.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may help future generations of women and prevent osteoporosis.

CONFIDENTIALITY

For the purposes of this research study, survey respondents' answers will remain anonymous. Focus group participants' comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following: Assigning code names/numbers for participants

that will be used on all research notes and documents. Keeping notes, interview transcriptions, and any other identifying participant information in a locked file cabinet in the personal possession of the researcher. Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk.

COMPENSATION

Each survey participant through Mturk, upon successful completion of the survey, will be compensated as offered in the Mturk assignment of work.

Each participant in the focus group will receive a \$10 gift card and all participants are eligible for an end of study drawing award of \$50 per focus group. In the event of early withdrawal, no compensation will be provided.

CONTACT INFORMATION

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the Primary Investigator, please contact the Institutional Review Board at IRBNWMS@nwmissouri.edu

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

I have read and I understand the consent information provided. I understand that my participation is voluntary and I am free to withdraw at any time, without giving a reason and without cost. I voluntarily agree to take part in this survey.

Yes, I have read the informed consent. (1)

Doctoral Candidate

Osteoporosis Prevention is
Linked to Education,
Childhood Meals and Milk
Consumption in Young Adult
Females

Karen E. From

Page Break

End of Block: Block 7

Start of Block: Demographics

Age

18-20 (1)

21-23 (2)

24-25 (3)

Race/Ethnicity

African American/Black (1)

Asian (2)

Caucasian (3)

Other (4)

Live with;

- Self (1)
 - Roommate/s (2)
 - Family (3)
-

Growing up ate family meals at home;

- 2x/week or less (1)
 - 3x/week (2)
 - 4x/week or more (3)
 - I did not eat meals with my family growing up
-

Growing up I drank 8 ounces of dairy milk how many times a day?

- 1 time (1)
 - 2 times (2)
 - 3 times (3)
 - more than 3 times (4)
 - I did not drink dairy milk daily growing up
-

Do you drink dairy milk daily?

- Yes (1)
- No (2)

Do you drink plant based milk daily?

Yes (1)

No (2)

Do you take a vitamin D supplement daily?

Yes (1)

No (2)

If you do take a vitamin D supplement daily what are the International Units of your vitamin D? (Choose the best answer for you please)

- 400 IU (1)
 - 1000 IU (2)
 - More than 1000 IU (3)
 - I do not take a vitamin D supplement daily (4)
-

Do you currently work in or do you have a background in the nutrition field?

- Yes (1)
- No (2)

End of Block: Demographics

Start of Block: Read each statement and check the one best option that explains what you believe

Your chances of getting osteoporosis are high

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Because of your body build, you are more likely to develop osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

It is extremely likely that you will get osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

There is a good chance that you will get osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You are more likely than the average person to get osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Your family history makes it more likely that you will get osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



The thought of having osteoporosis scares you

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



If you had osteoporosis you would be crippled

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Your feelings about yourself would change if you got osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



It would be very costly if you got osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



When you think about Osteoporosis you get depressed

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly Agree (5)



It would be very serious if you got osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Regular exercise prevents problems that would happen from osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You feel better when you exercise to prevent osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

End of Block: Read each statement and check the one best option that explains what you believe

Start of Block: Exercise

Regular exercise helps to build strong bones

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Exercising to prevent osteoporosis also improves the way your body looks

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Regular exercise cuts down the chances of broken bones

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You feel good about yourself when you exercise to prevent osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

End of Block: Exercise

Start of Block: Questions 19-24, Calcium

Taking in enough calcium prevents problems from osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You have lots to gain from taking in enough calcium to prevent osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Taking in enough calcium prevents painful osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You would not worry much about osteoporosis if you took enough calcium

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Taking in enough calcium cuts down on your chances of broken bones

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You feel good about yourself when you take in enough calcium to prevent osteoporosis

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

End of Block: Questions 19-24, Calcium

Start of Block: Exercise

You feel like you are not strong enough to exercise regularly

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You have no place where you can exercise

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Your spouse or family discourages you from exercising

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Exercising regularly would mean starting a new habit which is hard for you to do

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Exercising regularly makes you uncomfortable

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

End of Block: Exercise

Start of Block: Summation

Exercising regularly upsets your every day routine

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Calcium rich foods cost too much

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Calcium rich food do not agree with you

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You do not like calcium rich foods

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Eating calcium rich foods means changing your diet which is hard to do

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



In order to eat more calcium rich foods you have to give up other foods that you like

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

Calcium rich foods have too much cholesterol

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You eat a well balanced diet

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You look for new information related to health

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



Keeping healthy is very important for you

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You try to discover health problems early

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)



You have a regular health check-up even when you are not sick

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

You follow recommendations to keep you healthy

Strongly Disagree (1)

Disagree (2)

Neutral (3)

Agree (4)

Strongly agree (5)

End of Block: Summation

Start of Block: Calcium Intake

How many (8 ounce) servings of dairy milk (kefir, buttermilk, etc.) do you consume a day?

- One (1)
 - Two (2)
 - Three (3)
 - More than three (4)
 - I do not consume dairy milk daily (5)
-

How many (1 ounce) servings of cheese do you consume a day?

- One (1)
 - Two (2)
 - Three (3)
 - More than three (4)
 - I do not consume cheese daily (5)
-

How many (5-6 ounce) servings of yogurt or pudding do you consume a day?

- One (1)
- Two (2)
- Three (3)
- More than three (4)
- I do not consume yogurt daily (5)

End of Block: Calcium Intake

Start of Block: Block 9

Please share any comments you might have regarding this survey (if you had any difficulty understanding the questions, any issues related to the content or the format of the study, etc.)

End of Block: Block 9

Start of Block: Block 8

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Thank you for your participation. Your validation code for MTurk is

`{e://Field/random}`

Please press "Next" button in order to receive your payment.

End of Block: Block 8

Appendix B: Focus Group Questionnaire

Welcome- Good evening and welcome to our focus group gathering. First of all, thank you for taking the time out of your busy schedules to discuss our topic of Bone Health. My name is Karen From and assisting me is Goldie Barnes, senior Dietetics student. The purpose of our time together is to gain insight in to how you young adult females view bone health/osteoporosis, calcium and vitamin D, physical activity, behavior change methods. We will be holding three focus groups hoping to gain insight into how and what your age group think.

You were invited to be a part of this focus group because you met the participant criteria.

(Assistant will ask participants to sign in upon arrival, with email and each will be assigned a number and name tag for their name and number. (The assigned number will be placed on the participants OHBS forms (both pre and post), dietary questionnaire.)

There are no wrong answers but rather differing points of view. Please feel free to share your point of view even if it is different from what others have stated. Keep in mind we are interested in all comments positive or perceived negative. Are you all comfortable?

If you have not noticed we are taping the audio part of each session. We cannot capture all the meaningful things you will share, fast enough typing, so we will listen to the audiotapes for clarity. We will be on a first name basis and we will not use any names in our reports. Please be assured of complete confidentiality.

As we begin, may I please ask you all to silence and put away your cell phones so we are not distracted? Thank you

You have all been given an Osteoporosis Health Beliefs Scale of 42 questions to fill out and a Food Frequency questionnaire concerning Calcium and Vitamin D intake. Please remember there are no wrong or right answers, but if you will complete these first then we will begin our group conversation. If you would like the results of your Calcium and Vitamin D intake, please place your e-mail on your form for us to send the results to you.

You have all been given name tags to wear to aid us in remembering names. Let us go around the table and learn more about each other. Tell us your name and your home town. Goldie and I will start.

Questions

1. What do you know about your bone health/Osteoporosis?

2. Would you say you base your food choices on how they support your bone health?
3. How often did you drink cow's milk per day when you were growing up?
4. What do you see as your barriers to daily consumption of calcium rich foods?
5. What are some strategies you could employ to overcome these barriers to your calcium intake?
6. How do you get your daily vitamin D?
7. What foods are rich in Vitamin D?
8. What are the barriers to meeting your daily vitamin D needs?
9. What are some strategies you could employ to overcome these barriers to your vitamin D intake?
10. How does your current living arrangement, work and/or social life impact your daily food intake?
11. How would you define weight bearing exercises?
12. What barriers do you face getting your daily exercise?
13. What are some *strategies* you could employ to overcome the barriers to daily exercise?
14. Describe the impact *setting behaviors goals, *planning and tracking these goals and *receiving positive reinforcement might play in overcoming these barriers?
15. If you drink cow's milk or plant-based milks, why do you choose either product?

As we wrap up the session is there anything more on any of the questions that you would like to share?

Thank you first and secondly, we would appreciate you taking the OHBS one more time. (Assistant and moderator will hand out with assigned number to each coordinating number on their name tag)
 After you hand this form in to Goldie or myself you will be given your incentive and we will let the winner of the \$50 incentive know via e-mail and where they can pick up their gift card.

Appendix C: Demographic Questionnaire

Included in Qualtrics survey, but will be asked of focus group as well.

Demographic

1. Age _____
2. Race/ethnicity _____
3. Live with; Self _____ Roommate/s _____ Family _____
4. Growing up ate family meals at home;
 2x a week or less _____ 3x week _____ 4x week or more _____ Did not eat meals
 with family growing up _____
5. Growing up I drank (8 ounce) servings of dairy milk how many times a day? 1 _____
 2 _____ 3 _____ > 3 _____ none _____
6. Do you drink dairy milk daily now? _____ Do you drink plant based milk daily now?

7. Do you take a Vitamin D supplement? Yes _____ No _____
8. If you answered Yes to Vitamin D Supplementation, how often?

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Daily___ 3xweek_____ Weekly_____

9. What are the International Units (IU) of your Vitamin D supplement? _____IU

Appendix D: Informed Consent

TITLE OF STUDY

Young Adult Females' Perceptions of Bone Health Barriers: Osteoporosis Prevention and Lifestyle Contributing Factors Strategies

PRINCIPAL INVESTIGATOR

Karen E. From, MS, RDN, LD

University of North Florida, Doctoral Candidate

Redacted

fromkar@nwmissouri.edu

PURPOSE OF STUDY

You are being asked to take part in research study survey or focus group. Before you decide to participate in this study, it is important that you understand why the research is being done and what it will involve. Please read the following information carefully. Please ask the researcher if there is anything that is not clear or if you need more information.

The purpose of this study is to inform the body of knowledge related to female bone health and related factors to positively influence strategies to overcoming barriers to bone health to prevent osteoporosis.

STUDY PROCEDURES

The purpose of this study is to examine the perceptions of young adult females' age 18-25 perceived risk of developing osteoporosis, barriers to meeting lifestyle modifications and strategies to overcoming these barriers in prevention of osteoporosis. The proposed research will conduct both a research survey and three focus groups each with 7-9 female research participants. To examine the study populations insights concerning their perceived risk of developing osteoporosis, the barriers to meeting modifiable lifestyle factors and strategies to overcome these barriers in prevention of osteoporosis. The research proposed will use both

quantitative and qualitative methods, referred to as the mixed method approach. The quantitative portion of the study will include a survey that includes the Osteoporosis health beliefs scale (OHBS), diet analysis of calcium and vitamin D intake and demographic data collection. The focus groups are structured around set questions to answer the research questions, but the sessions will be free-flowing to draw out as much qualitative data as possible. Analysis of the OHBS will examine the beliefs, knowledge and self-efficacy of osteoporosis and barriers to calcium intake and physical activity of survey respondents. The diet analysis questions will give a mean and SD of the total survey respondents approximate intake of calcium and vitamin D. Those data will be compared to the recommended dietary allowances for both Calcium and vitamin D. The qualitative method of research will collect data from the discussions and questions from the focus group participants. These are captured via recordings and transcribed for analysis. The transcribed narratives will be analyzed to capture and document research themes.

If you are participating in completion of the survey it should take you no more than 15 minutes.

If you are agree to participate in the focus group it is expected to require 60 minutes.

The focus groups will employ audio taping of the discussions.

RISKS

There are no significant risks associated with this study.

You may decline to answer any or all questions and you may terminate your involvement at any time if you choose.

BENEFITS

There will be no direct benefit to you for your participation in this study. However, we hope that the information obtained from this study may help future generations of women and prevent osteoporosis.

CONFIDENTIALITY

For the purposes of this research study, survey respondents' answers will remain anonymous. Focus group participants' comments will not be anonymous. Every effort will be made by the researcher to preserve your confidentiality including the following:

- Assigning code names/numbers for participants that will be used on all research notes and documents
- Keeping notes, interview transcriptions, and any other identifying participant information in a locked file cabinet in the personal possession of the researcher.

Participant data will be kept confidential except in cases where the researcher is legally obligated to report specific incidents. These incidents include, but may not be limited to, incidents of abuse and suicide risk.

COMPENSATION

Each survey participant through Mturk, upon successful completion of the survey, will be compensated as offered in the Mturk assignment of work.

Each participant in the focus group will receive a \$10 gift card and all participants are eligible for an end of study drawing award of \$50 per focus group. In the event of early withdrawal, no compensation will be provided.

CONTACT INFORMATION

If you have questions at any time about this study, or you experience adverse effects as the result of participating in this study, you may contact the researcher whose contact information is provided on the first page. If you have questions regarding your rights as a research participant, or if problems arise which you do not feel you can discuss with the Primary Investigator, please contact the Institutional Review Board at IRBNWMS@nwmissouri.edu

VOLUNTARY PARTICIPATION

Your participation in this study is voluntary. It is up to you to decide whether or not to take part in this study. If you decide to take part in this study, you will be asked to sign a consent form. After you sign the consent form, you are still free to withdraw at any time and without giving a reason. Withdrawing from this study will not affect the relationship you have, if any, with the researcher. If you withdraw from the study before data collection is completed, your data will be returned to you or destroyed.

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CONSENT

I have read and I understand the provided information and have had the opportunity to ask questions. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving a reason and without cost. I understand that I will be given a copy of this consent form. I voluntarily agree to take part in this study.

Participant's signature _____ Date _____

Investigator's signature _____ Date _____

Appendix E- IRB Approval Document and Link

<https://documentcloud.adobe.com/link/review?uri=urn:aaid:scds:US:2e08f38d-b4b6-473b-b73f-3e041e71819a>

Date: 20 January 2021

IRB Approval Code: 2021-027

Primary Investigator: Karen From

Project Title: Young Adult Females' Perceptions of Bone Health Barriers: Osteoporosis Prevention and Lifestyle Contributing Factors Strategies

Dear Ms. From,

The Northwest Missouri State University Institutional Review Board (IRB) has approved your application as exempt from further IRB review. You may proceed with your project and with data collection using the procedures, materials, and documents as outlined in your application. Because your project is considered exempt from further review, you do not need to submit a status report once your project is complete. However, if you make any changes to the research protocols outlined in your application, you must submit a Protocol Change Form to the IRB for approval. This form must be submitted prior to implementing any changes to your design or data collection. Common examples of protocol changes you may need to submit for approval include (but are not limited to):

- • Adding new principal investigators, faculty advisors, or other researchers who will have access to participants and data.
- • Adding new survey questions/questionnaires, or changing the wording or presentation of existing survey questions/questionnaires.
- • Changing the location where an in-person study will be conducted, or changing aspects of the location (e.g., allowing larger groups to participate than was originally planned).
- • Changing the modality by which the project is conducted (e.g., an in-person study which needs to shift to online data collection procedures).
- • Changes to procedures or materials due to unforeseen circumstances that have arisen during data collection (e.g., adding a procedure requiring subjects to turn their phones off prior to participation).
- • Collecting additional subjects significantly beyond that planned in the original IRB application.

If a protocol change is required, you can download the Protocol Change form from the Northwest IRB website and submit the form (and any supplementary documents) to the Northwest IRB email (IRBNWMS@nwmissouri.edu). You may also contact us at this email address with any other questions or concerns you have regarding the project.

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Karen E. From

Thank you for your interest in research at Northwest Missouri State University. We wish you the best with your important research.

Regards,

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Doctoral Candidate

Osteoporosis Prevention is
Linked to Education,
Childhood Meals and Milk
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Females

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