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The Association Between Osteoporosis and Early Menopause Following Hysterectomy

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This is to certify that the doctoral dissertation by

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Abstract

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MPH, Walden University, 2012

MS, California State University, Fullerton, 2000

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Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Osteoporosis is the most adverse public health disease associated with substantial mortality among postmenopausal women. Hysterectomy, a surgically-induced menopause, contributes to the early onset of menopause. However, there was no evidence of an association between early menopause following hysterectomy and osteoporosis among postmenopausal women. The purpose of this quantitative study was to examine the association between demographic and behavioral factors and the prevalence of osteoporosis among hysterectomized postmenopausal women. The integrated theory of health behavior change theoretical framework guided study. Cross-sectional secondary data from the 2009-2010 National Health and Nutrition Examination Survey were used. Multiple logistic regression models were used to examine the associations between demographic and behavioral factors and the prevalence of osteoporosis among the study population. The results of this study indicate that the prevalence of osteoporosis was inversely associated with age, education, and annual family income. Non-Hispanic Whites with age of hysterectomy 36-45 were significantly associated with the prevalence of osteoporosis. Moderate recreational activity and calcium/vitamin D intake were associated with decreased prevalence of osteoporosis. Demographic and behavioral factors play substantial roles in the prevalence of osteoporosis. The study results may be used to facilitate risk-prevention strategies to reduce the incidence of osteoporosis. This study may drive positive social change by facilitating public health to promote and implement effective behavioral interventions to prevent osteoporosis in the potential hysterectomized postmenopausal women.

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Dedication

I dedicate this dissertation to my spouse, Al Botkin, my biological mother, Duk Hee Jang, my mother-in-law Carolyn Garcia, and my family members. Having a doctoral degree has been my lifelong goal, challenge, and ambition. During my educational journey, my dear, loving, and gifted husband has positively motivated and persistently encouraged me to pursue my degree despite his health problem caused by experiences during his military duty. My special loving elderly mother has supported me spiritually and encouraged me with her endless prayers. My caring mother-in-law has also countlessly supported and encouraged me every moment. My lovely younger sister and her family members have supported and cared for me during my journey. My brothers and their family members in South Korea have constantly encouraged me to pursue my goal.

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Chapter 1: Introduction to the Study

Osteoporosis is a bone disease that commonly occurs in postmenopausal women (CDC, 2012a). Menopause in women is associated with the prevalence of osteoporosis later in life (Kim, Lee, Chung, & Park, 2011; Shuster, Rhodes, Gostout, Grossardt, & Rocca, 2010). Natural menopause is defined as the absence of menstrual bleeding at least for 12 months (Wu et al., 2014). In the United States, the average age of natural menopause is 51 years (Shuster et al., 2010). Surgically-induced menopause, or hysterectomy prior to the onset of menopause, is one of the major gynecological procedures in reproductive-age women (Fredericks, 2013: Siegel, Devesa, Cokkinides, Ma, & Jemal, 2013; Wright et al., 2013). The hysterectomy rate increases as women get older and peaks between 40 and 50 years (Hammer et al., 2015). The purpose of this study is to promote prevention of osteoporosis and enhance bone health in the postmenopausal women who have undergone early menopause following hysterectomy.

It is important to investigate the association between demographic factors (age, race/ethnicity, education, annual family income, and age of hysterectomy) and behavioral factors (moderate recreational activity and calcium/vitamin intake) when examining the prevalence of osteoporosis among postmenopausal women age 50 and older who have undergone hysterectomy prior to reaching natural menopause.

The potential positive social change implication of the study is that bone health is critical for postmenopausal women who have undergone hysterectomy prior to menopause to improve the quality of life. Addressing osteoporosis prevention, changing individual health behaviors by increasing knowledge and health belief, engaging in self-regulation and self-management, facilitating positive social interaction at a community level and influencing policymakers are needed to reduce the disease in women. Understanding the factors associated with women's bone health would aid in maintaining, managing, and treating the malady among hysterectomized postmenopausal women (Ryan, 2009).

In this chapter, I describe osteoporosis, hysterectomy, and risk factors associated with demographic and behavioral characteristics. I also present the research problem statement and purpose of the study. I explore include the research questions and hypotheses to be tested. Finally, I present the conceptual framework, nature of the study, definition of key concepts, assumptions, scope and delimitations, limitations, and significance of the study.

Background

Osteoporosis

Osteoporosis is a preventable and manageable disease (Orimo et al., 2012). This preventable chronic disease occurs frequently among postmenopausal women and is considered to be a substantial burden on public health in the Unites States (Blume & Curtis, 2011; Cauley, 2013; Centers for Disease Control and Prevention [CDC], 2013; Hamidi, Tarasuk, Corey, & Cheung, 2011). Deaths related to osteoporosis also have increased over the past 10 years (CDC, 2013a). More than 54 million individuals are affected by osteoporosis or are at risk for bone fractures due to low bone mass (osteopenia). By 2030, individuals over 50 years of age with osteoporotic or low bone mass will be estimated to be 64.4 million (National Osteoporosis Foundation [NOF], n.

d.). Approximately 44 million individuals age 50 and older are at high risk of osteoporosis and bone fracture due to low bone mass (International Osteoporosis Foundation [IOF], 2014). More than 10 million individuals are affected with osteoporosis at the hip or lower back area (IOF, 2014; National Institutes of Health [NIH], 2014). An estimated 8.2 million women are affected with osteoporosis, and 27.3 million women are affected with low bone mass (IOF, 2014). More than 90% of individuals diagnosed with osteoporosis are 50 years and older and 70% of postmenopausal women are 80 years and older (Aggarwal et al., 2011).

Notably, postmenopausal women who have menopause before age 47 years are at higher risk for osteoporosis, fracture, and mortality compared with women who have menopause at 47 years or later (Svejme, Ahlborg, Nilsson, & Karlsson, 2012). Earlier menopause results in higher prevalence of osteoporosis and fractures among postmenopausal women (Svejme et al., 2012). These hip fractures affect morbidity and mortality due to existing fractures causing additional fractures (Blume & Curtis, 2011; Cauley, 2013).

The 1-year osteoporosis fatality rate was estimated at 20%, and annual deaths related to osteoporosis among Medicare patients over 64 years of age are approximately 5%. Osteoporosis is related to prolonged physical limitations due to fractures related disability or impairment, which affect on decreasing a quality of social or interpersonal relationships (Blume & Curtis, 2011).

In the United States, the total cost related to the prevalence of bone fractures in the population was more than $19 billion (Cauley, 2013, p. 1243). Vertebral fractures are the most common (27%), wrist fractures are the second (19%), hip fractures are the third (14%), and the bone with lowest fractures is the pelvis (7%) (Cauley, 2013, p. 1243). Fracture rates among older women account for 71% of the entire group, and 75% of medical expenses are associated with bone fractures (Cauley, 2013, p. 1243). In 2005, direct medical costs related to osteoporosis ranged from $13.7 billion to $20.3 billion (Dempster, 2011). The range is related to only osteoporosis and does not include indirect costs from reductions in productivity, survival, and quality of life (Blume & Curtis, 2011, p.1835; Cauley, 2013). It is estimated that over 3 million individuals will suffer fractures by 2025, and costs related to fractures will be more than $25 billion per year (Dempster, 2011). Annually, approximately 2 million individuals are affected by osteoporotic fractures (Dempster, 2011). The cost related to osteoporosis imposes a heavy burden on public health (Dempster, 2011).

Hysterectomy Prior to Menopause

Hysterectomy in reproductive-age women relates to surgically induced menopause due to a reproductive surgical procedure involving the removal of uterus. Hysterectomy is one of the most common reproductive surgical procedures that lead to medical complications in the Western world (Fredericks, 2013; Pandey et al., 2014; Taran, Stewart, & Brucker, 2013). It is estimated that one in nine reproductive-age women undergoes a hysterectomy during her lifetime, or nearly 600,000 women annually (Khan, Shehmar, & Gupta, 2014; Siegel et al., 2013; Wright et al., 2013). The incidence of hysterectomy is approximately 7.35 per 1,000 women (Fredericks, 2013; Qi et al., 2013). One in three women have undergone hysterectomy by age 60 (Tishler, Raven, Lu, Altshuler, & Bartzokis, 2012). The incidence of hysterectomy typically peaks (68%) at ages 35-50 (Hammer et al., 2015; Siegel et al., 2013). The mean age of hysterectomized women is 42.7 years, and the median age is 40.9 years with a range of 15-80 years (Fredericks, 2013). Almost 90% of hysterectomy procedures are due to personal elective reasons (Fredericks, 2013; Pandey et al., 2014; Taran et al., 2013). Even though the ovaries are attached, hysterectomized women reach menopause on average 3.7 years earlier than those experiencing normal menopause (Shinde, Upadhyaya, & Jadhav, 2012).

Hysterectomy prior to the onset of menopause is widely considered the primary therapeutic option for uterine problems in women of reproductive age, such as abnormal uterine bleeding due to fibroids, menorrhagia, heavy pelvic pain, and menstrual cramps (Fredericks, 2013; Pandey et al., 2014; Taran et al., 2013). Annually, 200,000 U.S. women undergo hysterectomies (Bulun, 2013). Among those, 78% were associated with the indication of uterine fibroids (leiomyoma), which are due to abnormal formation of the extracellular matrix of the uterus. This health problem commonly develops due to the increase of female hormones in reproductive-age women. As women reach 50 years old, approximately 70% have experienced at least one fibroid. Approximately 35-50% of women of reproductive age (younger than 50 years) are affected by fibroids (Bulun, 2013). The warnings signs of hysterectomy include various benign and malignant conditions of women's reproductive tract (Fredericks, 2013). The symptoms of uterine fibroids include abnormal uterine bleeding, pelvic pain, and infertility (Fredericks, 2013; Corona et al., 2014; Hammer et al., 2015; Leppert, Fouany, & Segars, 2013; Pandey et al., 2014). The consequence results of uterine fibroids include miscarriage, endometriosis, and pregnancy complications (Fredericks, 2013; Corona et al., 2014; Hammer et al., 2015; Leppert, et al., 2013; Pandey et al., 2014).

Menorrhagia is caused by abnormal heavy and prolonged menstrual bleeding that requires changing menstrual pads every 1-2 hours (CDC, 2014a; Sweet, Schmidt-Dalton, Weiss, & Madsen, 2012). Menorrhagia affects more than 10 million U.S. women each year (Sweet et al., 2012). This problem leads to nearly 33% of the hysterectomies every year in the United States (Ashraf & Gamal, 2012). Approximately 9-14% of reproductive-age women between menarche and menopause have experienced abnormal uterine bleeding (Sweet et al., 2012).

The Southern U.S. regions with higher population density have the highest hysterectomy rates, and the Northeastern regions have lower population density have it lower rates (Fredericks, 2013; Qi et al., 2013). African American women undergo hysterectomy at higher rates than European American women (Fredericks, 2013). Hispanics and women of other ethnicities undergo hysterectomy less often than White and African American women (Rivera Drew, 2013). When comparing ethnicities, Whites account for 89%, followed by African American and Hispanic women who account for 4% each, and other ethnicities account for about 3% (Cauley, 2013, p. 1243). When comparing hysterectomy rates according to income level, women with lower levels of family income or lower socioeconomic status experience hysterectomy at higher rates than those with higher levels of income and socioeconomic status. Women with higher education levels are also less likely to undergo hysterectomy procedures than women with lower levels of education (Rivera Drew, 2013).

Osteoporosis is considered a silent disease that commonly affects individuals before they are aware of it and does not become apparent until their bone fracture events occur (Cosman et al., 2015). The continual increase of osteoporotic fractures in growing aging population leads to a rise in bone health problem in older women (Cauley, 2013). Morbidity and mortality related osteoporosis substantially influence on an increase in burden on public health (Cauley, 2013). It is crucial to examine the association between behavioral and demographic factors and the prevalence of osteoporosis among women age 50 and older who have undergone hysterectomy prior to reaching natural menopause. Despite previous studies that have supported menopause is associated with osteoporosis in postmenopausal women (Kim, Lee, Chung, & Park, 2011; Shuster et al., 2010), the initial literature review revealed no evidence of an association between hysterectomy prior to natural menopause and osteoporosis in later life. The current study fills a gap in understanding the association between behavioral and demographic factors and osteoporosis among women age 50 and older who have undergone hysterectomy prior to the onset of natural menopause.

The change of health behaviors in hysterectomized postmenopausal women would prevent osteoporosis and make the community and nation healthier. This study is essential for individuals and communities in promoting public awareness of osteoporosis in the U.S. adult women population. The findings may promote bone health in postmenopausal women, and the consistency in the processes and procedures may be replicable for future study investigation in the women's osteoporosis research community.

Problem Statement

Despite the available information regarding osteoporosis among postmenopausal women, osteoporosis is still a public health concern in the United States. Osteoporosis is a bone or skeletal disorder caused by low bone mineral density (BMD), which increases the risk of bone fractures (Aggrawal et al., 2011). Osteoporosis is closely associated with substantial morbidity, mortality, health-related quality of life, and socioeconomic burden (Bleibler, Rapp, Jaensch, Becker, & König, 2014). Today, an osteoporotic fracture is considered to be the most adverse health event in older adult women and is strongly associated with age and a previous bone fracture (Bleibler et al., 2014). In women, the loss of BMD accelerates perimenopause or menopause transition, leads a condition of menopause, and ultimately develops postmenopause (Aggarwal et al., 2011).

Several previous studies have reported that the prevalence of osteoporosis is associated with menopause with the aging process (Gambacciani, 2012; Hamidi et al., 2011; Sajjan et al., 2012; Snyman, 2014). Premature menopause prior to the age of 40 or early menopause prior to the age of 40-47 is correlated with an amplified risk of bone osteoporosis in later life and premature death (Svejme et al., 2012). The earlier the age when menopause occurs, the greater the adverse effect on bone health (Shuster et al., 2010). Hysterectomy among reproductive-aged women is one of the factors that contributes to the early onset of menopause (Hunter et al., 2012). It was necessary to investigate the association between demographic and behavioral factors and the prevalence of osteoporosis among women age 50 and older who had undergone hysterectomy prior to reaching natural menopause.

Examining the association between demographic and behavioral risk factors and osteoporosis would provide valuable information to reduce the incidence of the disease and improve the quality of a life among hysterectomized postmenopausal women. Also, an understanding of appropriate health-related demographic and behavioral factors might provide direction in promoting healthy risk behaviors and preserving hysterectomized postmenopausal women's bone health.

Purpose of the Study

The purpose of this quantitative study was to examine the association between demographic factors (age, race/ethnicity, education level, annual family income level, and age of hysterectomy) and behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis in women of age 50 and older who had undergone hysterectomy prior to reaching natural menopause. This study's ultimate goal was to understand and foster knowledge and behavior change, self-regulation, self-management, and community facilitation in hysterectomized older population with osteoporosis. To conduct this cross-sectional study, I used the 2009-2010 National Health and Nutrition Examination Survey (NHANES) data from the CDC (2015). These study findings may have the potential for generalization to the U.S. adult women population (CDC, 2014).

Research Questions and Hypotheses

The purpose of this study was to examine the association between demographic and behavioral factors (independent variables) and osteoporosis prevalence (dichotomous dependent variable) in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause. The demographic factors included race/ethnicity, education level, and annual family income level. The behavioral factors included moderate recreational activity and calcium/vitamin D intake. Covariates of interest included age and age of hysterectomy as the demographic factors.

Research Question 1

Is there an association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause?

Hypothesis 1

Null hypothesis (*H*1o): There is no association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause.

Alternative hypothesis (*H*1a): There is an association between demographic factors (age, race/ethnicity, education level, and annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause.

Research Question 2

Is there an association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause?

Hypothesis 2

Null hypothesis (*H*2o): There is no association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause.

Alternative hypothesis (*H*2a): There is an association between behavioral factors (moderate recreational activities and calcium/vitamin D intake) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to reaching natural menopause.

Theoretical Framework for the Study

The theory used to frame the study was the Integrated Theory of Health Behavior Change (ITHBC). Ryan (University of Wisconsin-Milwaukee, 2014) developed the ITHBC. The ITHBC descriptive theory whole comprises integrated concepts that have been appropriately adopted into health-related interventions or programs for public health. These properly blended concepts originated from multiple theories and various empirical studies that developed health behavior changes, self-regulation theories, a social support theory, and a study of self-management of chronic illness. Moreover, the ITHBC reflects various existing theories. Its concepts were customized to encourage health behavior change in chronic disease patients to improve their health status by increasing their knowledge and beliefs, self-regulation skills and abilities, and enhancement of community facilitation (Ryan, 2009). The ITHBC was developed through an intervention related to the prevention or attenuation of osteoporosis.

Particularly, the intervention was aimed at enhancing health-related behavior changes to prevent osteoporosis (Ryan, 2009).

The ITHBC was a suitable theory for assessing the association between demographic factors (age, race/ethnicity, education level, and annual family income level, and age of hysterectomy) and behavioral factors (moderate recreational activity and calcium /vitamin D intake) and osteoporosis prevalence women age 50 and older who had undergone a hysterectomy prior to reaching the onset of menopauses. I explained ITHBC in detail in Chapter 2.

The ultimate goal of this study is to prevent osteoporosis in hysterectomized postmenopausal women identifying closely associated risk factors of the disease to improve their bone health through changing of heath behaviors. Osteoporosis is a preventable disease. However, knowledge alone does not influence health behavior changes. When knowledge and health beliefs are coupled with self-regulation engagement, individuals are able to enhance self-management behaviors, which can affect positive community facilitation. The community facilitation, in turn, encourages knowledge and health beliefs that can provide a positive directional effect on individual health behavior changes, communities, and decision making of policymakers (Ryan, 2009).

Nature of the Study

I explored the multiple dimensional demographic and behavioral approaches associated the prevalence of osteoporosis in this quantitative cross-sectional study. A rationale for this design used a secondary data obtained from the NHANES 2009-2010 data set allowed for quick and easy data collection. The NHANES data provide the largest and higher quality of national source objectively measured health and nutritional status (Barrett-Connor et al., 2011). Results of this study may be generalized to and across populations or other settings (Public Health Action Support Team [PHAST], 2011).

The NHANES is a cross-sectional survey study conducted by the National Center for Health Statistics (NCHS) and sponsored by the CDC (2014b). The NHANES survey includes a stratified multistage probability sample of the noninstitutionalized U. S. population (CDC, 2013). The NHANES 2009-2010 is the latest data set in which both variables of osteoporosis and hysterectomy are accessible in the public domain. The study population is hysterectomized postmenopausal women respondents from the NHANES 2009-2010. The study variables from the NHANES data set were collected according to the NCHS Research Ethics Review Board (ERB) approval (protocol # 2005-06) (CDC, 2012b).

In the NHANES 2009-2010 data set, variables were selected from survey participants, family, and Mobile Examination Center (MEC) questionnaires. The variables of age, race/ethnicity, education level, and annual family income level were selected from the demographics data (DEMO_F) file. The variables of calcium and vitamin D were selected from the Dietary Supplement use 30-day-Total Dietary supplements Data Documentation (DSQTOT_F) file. Under the questionnaire survey, the variables of moderate recreational activity, osteoporosis, hysterectomy, and age of hysterectomy were selected. The variable of moderate recreational activity was selected from the physical activity (PAQ_F) file. The variable of osteoporosis among women age ≥ 50 years was selected from the osteoporosis (OSQ_F) file. The variables of age of hysterectomy ≤ 50 years were selected from the Reproductive Health (RHQ_G) in the MEC questionnaire data file (CDC, 2015).

The dichotomous dependent variable in the study was osteoporosis. The independent variables included demographic factors (race/ethnicity, education level, and annual family income level) and behavioral factors (moderate recreational activity and calcium & vitamin D intake). Covariates included age and age of hysterectomy as the demographic factors. Women's age of hysterectomy and osteoporosis were controlled to meet the statement for that postmenopausal women age 50 and older who had undergone hysterectomy prior to menopause. The hysterectomy age of 50 was maximized in this study since natural menopause occurs an average age at 51 (Li et al., 2013; NIH, n. d.; Shuster et al., 2010). Accordingly, ages of osteoporosis 50 and less were discounted from the osteoporosis group, and ages of hysterectomy 50 and older were excluded from the hysterectomized population.

After collecting data from the NHANES, I merged the variables using (Statistical Package for the Social Sciences (SPSS) analysis software program. Then, I selected the study cases based on the respondent sequence number arranged on the NHANES data set and recorded into same variables with dummy codes. I examined and treated for any missing values in the chosen study data. I used descriptive statistics to characterize the study sample, NHANES sample, and total study population of each study variable. I used a multiple logistic regression (MLR) analyses were used to analyze crude odds ratios (crude ORs) and adjusted odds ratios (adjusted ORs) controlling reference groups in each variable. The MLR analysis determines whether osteoporosis were significantly associated with demographic factors and behavioral factors.

The data collection methods and analysis plan are discussed detail in Chapter 3.

Definitions

In this section, I provide concise definitions of the concepts used throughout the study. In Chapter 3, I specified specific operational definitions for the key variables measured.

Annual family income: This is a total family income variable indicating income range value. The Current Population Survey (CPS) criterion in NHANES indicates that a family is a group of two people or more residing together related by marriage, birth, and/or adoption. Members of one family include those individuals who are concerned, and subfamily members defined by the NCHS. The annual family income includes income from the survey respondents and their family members (CDC, 2015).

Age: This term refers to “age in years of the household reference person at the time of the household screening” (CDC, 2015, p. 22).

Age of hysterectomy: The age when the uterus was removed (CDC, 2015).

Calcium plus vitamin D intake: Estimated daily intake of calcium (mg) and vitamin D (D2+D3) (mcg) supplements (CDC, 2015).

Education level: Education level refers to the highest grade/level of school completed or the highest degree earned (CDC, 2015).

Hysterectomy: Surgical removal of the uterus (CDC, 2015). This reproductive surgical procedure involves the removal of partial or whole structures of the uterus, cervix, fallopian tubes, or ovaries. The removal of the uterus is one of the most common women's reproductive surgery procedures in the United States (Fredericks, 2013; Pandey et al., 2014; Taran et al., 2013).

Natural menopause: Natural menopause refers to the absence of menstrual bleeding for at least 12 months (Wu et al., 2014), which occurs at an average age of 51 in the United States (Shuster et al., 2010). This type of menopause is influenced by the rate of the number of ovarian follicles that can be lost across the lifespan (Sievert, Murphy, Morrison, Reza, & Brown, 2013).

Osteoporosis: This bone disease is caused by a loss of bone mineral density and is associated with fractures at the hip, wrist, spine, and other bones (CDC, 2015; NOF, n. d.).

Moderate recreational activity: This term refers to daily leisure time and sedentary activities (CDC, 2015). Regular exercise has been associated with benefits in bone health. At least 30 minutes of moderate weight-bearing exercise daily is crucial to improving the bone health in postmenopausal women (U.S. HHS, 2015).

Race/ethnicity: Race/ethnicity is defined based on self-identified responses by survey participants, which include Mexican American, other Hispanic, non-Hispanic White, non-Hispanic Black, and other race, including multi-racial (CDC, 2015).

Assumptions

Menopause that occurs at an earlier age is associated with a greater adverse effect on bone health, including osteoporosis (Shuster et al., 2010). Hysterectomy is a significant factor for the early onset of surgically induced menopause among reproductive age women (Hunter et al., 2012). I assumed that age, race/ethnicity, education, annual family income, age of hysterectomy, daily intake of calcium/vitamin D, and moderate recreational activity (or moderate physical activity) might be associated with osteoporosis later in life among women who had undergone hysterectomy prior to the onset of natural menopause. Furthermore, the NHANES 2009-2010 survey data would be appropriately valid and reliable because the survey is conducted periodically on the national health and nutritional status of American individuals. The secondary survey data would provide a source to collect the variables of interest for this study (CDC, 2014b).

Scope and Delimitations

Despite evidence supporting an association between menopause and prevalence of osteoporosis in postmenopausal women (Kim, Lee, Chung, & Park, 2011; Shuster et al., 2010), there is no evidence of an association between hysterectomy prior to the onset of natural menopause and osteoporosis occurrence later in life due to risk factors within the hysterectomized postmenopausal women. In addition, there is no evidence of an association between demographic and behavioral risk factors and the osteoporosis prevalence in the study group.

I focused to examine the association between demographic and behavioral factors and osteoporosis in women age 50 or older who had undergone hysterectomy prior to the onset of natural menopause. The availability of the hysterectomized and osteoporotic population in the NHANES 2009-2010 was crucial to analyze the bone health of hysterectomized postmenopausal women. In the NHANES data, women aged 50-80 years who had undergone hysterectomy prior to the age of 51 years was considered to be the age group for the study subjects in this study. I excluded women age less than 50 years for the analyzing the prevalence of osteoporosis. The age of osteoporosis distribution was as follows: 50-59 years, 60-69 years, 70-79 years, and 80 and older. I also excluded women age older than 50 years for the hysterectomy population. The limited hysterectomy age allowed to control hysterectomized age prior to the onset of natural menopause, reaching average age at 51 (Shuster et al., 2010). The age of hysterectomy distribution was as follows: 19-25 years, 26-35 years, 36-45 years, and 46-50 years. Age of osteoporosis and hysterectomy were used to control for the potential confounding effects on ages of osteoporosis occurrence and menopause.

Limitations

There were several limitations in the study. First, although the study sample was representative of the U.S. adult women population, the cross-sectional design of the NHANES database may not have allowed for inferences about temporal sequences of the association between the hysterectomized women prior to menopause and osteoporosis. Second, the present study data applied only to noninstitutionalized U.S populations. Institutionalized patients may have shown higher rates of osteoporosis prevalence due to their condition, especially if those women were immobilized. Third, self-report survey methods may provide poor estimates of the absolute amount of data, which may also be affected by recall bias lack of reported or inaccurate reports (CDC, 2014c). Despite the limitations, the NHANES study design may be useful to generate hypotheses that require further investigation regarding the association between risk factors and osteoporosis among hysterectomized postmenopausal women.

Significance of the Study

Osteoporosis is a preventable chronic disease and a major public health problem in older adult women (Tan, LaMontagne, Sarmugam, & Howard, 2013). The potential contribution of the study was to promote understanding of the epidemiological bone disease resulting from demographic and behavioral factors among hysterectomized postmenopausal population prior to the onset of natural menopause. Further understanding of the bone disease may increase individuals' awareness and changes of health-related behaviors.

Potential contributions of the study include promotion of public health practices in preventing osteoporosis and improving quality of life through engaging in individuals' self-regulation, self-management, and management abilities. The study may also promote policy to reduce unhealthy risk behaviors and improve the health of U.S. hysterectomized older adult women (Ryan, 2009).

This study may contribute to positive social change in the hysterectomized older U.S. population. Applying individual and community based-osteoporosis prevention interventions, the practical bone health promotion may result in preventing the disease in our communities through either the delay of bone degradation or the management of bone health in a cost-effective way. For positive social change, osteoporosis interventions should be used to increase knowledge and beliefs, promote self-regulation and social support, and provide community facilitation by delivering information through community health education, social media, and mass media. Engaging in regular bone density screening, weight-bearing moderate recreational activity, and calcium and/or vitamin D intake would delay the onset of osteoporosis (Ryan, 2009).

Summary and Transition

In Chapter 1, I explored the potential association between hysterectomized women prior to menopause and osteoporosis occurrence later in life. I presented the research questions and hypotheses for the study. I also included the ITHBC theoretical framework and defined key terms. The study assumptions, scope and delimitations, limitations, and significance were also described.

In Chapter 2, I explain the literature review search strategy and summarize key themes in the literature. I indicate how the study fills gaps in the literature and explain the theoretical framework in detail. I address the concepts of hysterectomy, menopause, and osteoporosis and explore their relationships. The influence of osteoporosis on public health problem is also considered.

Chapter 2: Literature Review

Osteoporosis is one of most common diseases among adults and affects long-term morbidity and mortality (Shuster et al., 2010). Previous studies indicated that pre- or earlier menopause lead to osteoporosis in later life and premature death (Shuster et al., 2010; Svejme et al., 2012). In the United States, hysterectomy (removal of the uterus) is one of the most common surgical procedures in reproductive women (Doll, Milad, & Gossett, 2013; Ramos, Fader, & Roche, 2015; Wright et al., 2013). However, the relationship between osteoporosis and demographic and behavioral factors in postmenopausal women who had undergone hysterectomy prior to reaching menopause is not understood.

The purpose of this study was to examine the association between the demographic and behavioral factors among hysterectomized women prior to reaching menopause affecting osteoporosis in women age 50 and older using the NHANES 2009-2010. The demographic factors included age, race/ethnicity, education level, annual family income and the age of hysterectomy. The behavioral factors included moderate recreational activity and calcium/vitamin D intake.

Recent studies indicated that menopause leads to osteoporosis, and hysterectomy is a surgical menopause (Fu et al., 2011; Fletcher et al., 2013). In the United States, approximately 600,000 hysterectomy surgeries are performed every year (Wright et al., 2013). That is, one in nine women undergoes removal of the uterus each year (Wright et al., 2013). Researchers investigating the relationship between hysterectomy and osteoporosis in postmenopausal women who had hysterectomy reported that there was an increase in the risk of osteoporosis (Fletcher et al., 2013). Hysterectomy is significantly associated with low bone mineral density, which contributes to osteoporosis (Fletcher et al., 2013).

In Chapter 2, I describe the literature search strategy including a description of key search terms; databases used, and search engines. I also review the ITHBC theoretical foundation, key variables, and concepts of this study.

Literature Search Strategy

I conducted a literature search on osteoporosis and hysterectomy prior to menopause using the following search engines and databases: Google Scholar, ProQuest, PubMed, Medline, CINAHL, PsyclNFO, EBSCOhost, Academic Search Complete, Science Direct, Europe PubMed Central, Cochrane Library, Morbidity and Mortality Weekly Report on the CDC. I focused on articles published in the last 5 years. Search results included 2,970 studies containing the terms of *hysterectomy* and *osteoporosis*. Under the concept of hysterectomy, *surgical removal of the uterus*, *premature menopause*, *early menopause*, *perimenopause*, *menopause*, *postmenopause*, and *surgical menopause* were searched. Under the osteoporosis, *adult women*, *public health, prevalence*, *bone fractures*, *bone disease*, *skeletal disease*, *porous bone*, *brittle bone*, *bone density*, *bone mineral density*, *bone heath*, *physical function*, *behavior changes*, *prevention and treatment*, *osteoporosis risk behavior factors*, *osteoporosis screening*, *prevalence of osteoporosis*, *epidemiology*, *treatment*, *management*, *health promotion*, *education*, *income status*, *beliefs*, and *osteoporosis management* were sought. The resulting number of articles was narrowed to 1,360. I removed duplicated articles and screened for articles relevant to the dissertation topic. Those search terms included *premenopause, menopause, age 50 and older women, bone density, management, beliefs, education, calcium, vitamin D, moderate recreational activity, fractures,* and *income level*.

The search results yielded of 125 journal articles and books. I used combinations of search terms to represent the primary concepts of osteoporosis among women age 50 and older who had undergone hysterectomy prior to reaching menopause. I also examined reference lists of articles retrieved using the key search terms. I excluded studies that did not meet the dissertation study criteria, such as male subjects, animal subjects, and literature not written in English.

This literature review covered osteoporosis and risk factors for osteoporosis associated with hysterectomy. This literature review search targeted current peer-reviewed journal articles, primary research papers, information from government and organization websites, books related to epidemiology disciplines, and English-translated literature.

Theoretical Foundation

The theory I used when studying osteoporosis development among hysterectomized women prior to menopause was the Integrated Theory of Health Behavior Change (ITHBC), which is also referred as a descriptive midrange theory. Ryan (2009) noted that the concepts used for interventions of health behavior changes in the ITHBC came from various previous theories including theories of health behavior changes, self-regulation, social support, and studies associated with self-management of chronic illness.

Assumptions of the ITHBC are that behavior changes are dynamic and iterative processes. Behavior changes require desire and motivation. Once desire and motivation are engaged, self-reflection should be involved to facilitate the process. Positive community interaction improves a person's interest and willingness to support and sustain behavior changes. Individual-centered interventions are more likely to be effective than group interventions when facilitating changes of health-related behaviors. Involvement of health-related behavior changes would be a short-term outcome. The influences of the health-related behavior changes improve an individual's health status, which extends to long-term positive health outcomes over the period (Ryan, 2009). The ITHBC is associated with health-related behavior changes disseminating individual-centered interventions using concepts of knowledge and beliefs, improving self-regulation skills and abilities, and enhancing community facilitation. This theory emphasizes an individual's tendency to adopt recommended behaviors if the individual has information about health beliefs that can be embraced and are consistent with his or her health-related behaviors. Self-regulation skills and abilities are engaged in changing health-related behaviors. Individuals who have positive experiences with community facilitation can enhance health-related behaviors (Ryan, 2009).

The theory emphasizes knowledge and beliefs as condition-specific actual information. Beliefs signify an individual's perceptions about a particular health condition or behaviors. Both knowledge and beliefs can improve self-efficacy regarding specific health-related behaviors. The ability to change behaviors in an effective manner during a normal or stressful situations leads to desired results. According to Ryan (2009), goal congruence is an integrated concept from the studies of Bandura (1986) and Carver and Sheier (1998). Goal congruence with a resolution of anxiety and confusion issues is needed when health goals are contradictory and conflicting. Stress, anxiety, and confusion issues come from competing life situations (Bandura, 1986; Ryan, 2009). The necessity of personal amelioration of the stress using secondary cognitive approaches defines a hierarchical goal that ranges from general values of goals to tangible behaviors (Carver & Scheier, 1998; Ryan, 2009).

The theory stresses that self-regulation skills and abilities are a process that is used to change health-related behaviors and activities on a daily basis. Those that are linked to health-related behavior changes and activities include "goal settings, self-monitoring, reflective thinking, decision making planning for and engaging in specific behaviors, and self-evaluating, self-managing physical, emotional, and cognitive responses" (Ryan, 2009, p. 166). The theory also emphasizes community facilitation, which refers to community influences, community support, and negotiated partnership between individuals/families and public health care professionals in the community. Engagement of community facilitation influences through community leaders' motivation, which the participation ultimately leads to behavior changes (Ryan, 2009). Various resources influence the health of the community. Collaboration through family, neighbors, coworkers, and public health care providers would be primary to facilitate community engagement. Community actions through social media (E-mail, Facebook, Twitter, Instagram, YouTube, and LinkedIn) and mass media (television, radio, magazines, and newspapers) aid in the motivation of health-related behavior promotion. Emotional, instrumental, and informative public health educational support along with the collaboration and community engagement can facilitate health behavior changes (Ryan, 2014).

The theory's goal is to enhance both proximal and distal health-related outcomes. The proximal or short-term outcomes are the individual's self-management behavior involvements, which eventually improve his or her distal or long-term outcomes for health behaviors in public (Ryan, 2009). The ITHBC is intended to facilitate health-related behavior changes, which are linked to management of chronic diseases to promote health (Ryan, 2009). Although the ITHBC theory was established in 2009, the theory has been used in numerous articles in a short period to address interventions with a person-centered chronic health care approach and self-management for health promotion and disease prevention. Several researchers have used the ITHBC theory to examine health interventions. Cosio and Lin (2013) studied effects of pain education for veterans to adopt self-management of noncancer pain. The ITHBC was applied in studies that addressed healthy weight management during the postpartum period. Precise definitions and frameworks of the ITHBC to guide healthy weight self-management during the postpartum period were descriptive and situation specific. The theory frameworks were developed for postpartum women to promote their healthy weight management. Weight management allowed them to take charge of their health and the health of their family members (Ohlendorf, Weiss, & Ryan, 2012; Ryan, Weiss, Traxel, & Brondino, 2011). Happell, Stanton, Hoey, and Scott (2014) and Happell, Stanton, Platania-Phung, McKenna, and Scott (2014) also studied health behaviors related to knowledge and health outcomes targeting chronic mental illness by applying the ITHBC. Happell, Stanton, Hoey, et al. (2014) examined the association between health-related knowledge and self-reported health-related behavior among individuals who had a mental health problem assessing their health-related knowledge, physical activity level, intake of fruits and vegetables, and attitudes toward saturated fat intake (p. 198). Happell Stanton, Platania-Phung, et al. (2014) examined the relationship between a cardiometabolic health nurse and behaviors, knowledge, and attitudes of health, and offered recommendations regarding future health behavior directions in mental health individuals (p. 768). Ryan, Maierle, Csuka, Thomson, and Szabo (2013) applied a computer-based intervention designed to improve self-health management of women's calcium and vitamin D consumptions by strengthening beliefs and self-regulation skills of women. An interaction effect was examined for self-efficacy predicting calcium intake and approach significance for goal congruence (Ryan et al., 2013).

The rationale for the choice of ITHBC theory was that this theory was originally developed as an intervention that was designed to promote health behavior changes associated with the prevention or decrease of osteoporosis. Interestingly, this theory-based intervention was intended to foster osteoporosis-related behavior changes. Osteoporosis prevention was increased by knowledge and beliefs, self-regulation skills and abilities, and the community's active support (Ryan, 2009).

Based on the concepts of the theory, osteoporosis and bone fractures are prevented by engaging various health behaviors such as appropriate consumption of calcium and vitamin D, weight-bearing exercises, balancing to prevent falls related to fragile fractures, regular bone density scans, and taking prescribed medication (Ryan, 2009). The concepts of the ITHBC are well suited to the intervention related to women's osteoporosis prevention among postmenopausal women who had undergone hysterectomy (Ryan, 2009). Hysterectomized women may prevent osteoporosis when attaining and increasing knowledge and beliefs and enhancing their self-regulation skills and abilities while increasing intake of calcium/vitamin D supplements and engaging in weight bearing physical exercises (Ryan, 2009).

The ITHBC theory is applicable to promote osteoporosis prevention in hysterectomized postmenopausal women. The theory concepts can be applied to the present study to improve a hysterectomized woman's ability to adopt health-related behavior changes through self-management behaviors. The theory is appropriate to this study investigating epidemiological osteoporosis in women age 50 and older who had undergone hysterectomy prior to natural menopause. The ultimate goal of this study was to investigate the prevalence of osteoporosis in the hysterectomized postmenopausal women and understand the epidemiology of osteoporosis by examining demographic and behavioral factors of the hysterectomized postmenopausal women.

The concepts of knowledge and beliefs, self-regulation management, and community facilitation may provide a positive health directional effect on hysterectomized postmenopausal women's behaviors to prevent osteoporosis. The research questions address the association between demographic factors (age, race/ethnicity, annual family income, and education level) and behavioral factors (physical exercise, calcium/vitamin D intake, and age of hysterectomy) and the prevalence of osteoporosis within the selected population.

Literature Review Related to Key Variables and Concepts

Epidemiology of Hysterectomy

One common factor leading to hysterectomy is uterine leiomyoma, commonly called fibroids. Fibroids are benign tumors developing in reproductive women aged 30-40 years predominantly driven by a reproductive hormone (American Congress of Obstetricians and Gynecologists [ACOG], n. d.). In the United State, the prevalence of fibroids is considered to be 36-50%, but it is more likely much greater the percentage (Lepper, Fouany, & Segars, 2013). The cumulative incidence rate of fibroids in reproductive women age by 50 in African American is nearly 80%, and Caucasian women by age 50 is 70% (Lepper et al., 2013, p. 1). Recently, one in every two reproductive women is affected by fibroids. Fibroids are considered the most common disease causing hysterectomy in the reproductive age women, followed by myomectomy, endometrial ablation, and uterine artery embolization (Lepper et al., 2013; Pandey et al., 2014). Approximately, 588,000 U.S. reproductive age women seek treatment for uterine fibroids annually. Of those, 200,000 are undergone hysterectomy (Lepper et al., 2013). The higher prevalence of uterine fibroids is the leading causes of hysterectomy (Khan et al., 2014). The cycle of a woman's typical menstruation is between 21 and 35 days, with bleeding period lasting two to six days. The typical volume of blood loss is ranged between 26 to 60 milliliters. Fibroids show symptoms of longer, frequent, and heavy uterine bleeding between periods, excessive vaginal bleeding, and pelvic pain (ACOG, n.

d.). The abnormal uterine bleeding to be out of the range of the menstrual cycle is treated as women's illness (Pandey et al., 2014). Taveira -DaSilva, Rabel, Gochuico, Avila, and Moss (2011) evaluated the prevalence of uterine leiomyomas and hysterectomy at the National Institutes of Health (NIH) reviewing of 174 fibroids patients' medical records detected by computed tomography published a retrospective study. In the result of the study, forty-two patients underwent hysterectomy as the common treatment of fibroids. The prevalence of fibroids and hysterectomy was greater in African American women followed by Caucasian reproductive women. Women's age 40-44 years was vulnerable to a significantly higher rate of hysterectomy than ones with younger age were. Women 40 years of age and younger undergo 14.2% hysterectomy, which the rate was lower than the one in the U.S. general population. One of the study limitations was that computed tomography used to analyze the prevalence of uterine fibroids may not be relatively sensitive than ultrasound detection. Typically, ultrasonography detection is considered the first line imaging study, and magnetic reassurance imaging is the next line imaging study. The computed tomography could result in less quality of image detection (Taveiraddd-DaSilva et al., 2011).

Menorrhagia is considered a bleeding disorder because it causes abnormally heavy prolonged menstrual bleeding (Ray &Ray, 2014). Menorrhagia affects 30% of reproductive women and is a risky factor for women to undergo hysterectomy procedure (Shivhare, Bulmer, Innes, Hapangama, & Lash, 2014). Ashraf and Gamal (2012) conducted a randomized clinical prospective comparative quantitative study the 3-year 2010-2012 to compare efficacy and safety of uterine thermal balloon ablation with hysteroscopic endometrial resection in the treatment of menorrhagia. The uterine thermal balloon ablation is an alternative technique to hysterectomy for menorrhagia treatment. In the study, 75 premenopausal menorrhagia patients were selected and randomly divided into two groups, consisting of 35 individuals each. One group was treated with uterine thermal balloon system, and the other group was treated with hysteroscopic endometrial resection. Pre- and post-procedures with menstrual bleeding were defined by self-reports, and the number of pads counted with the twelve-month-follow-up procedure were compared. The study reported that there were 91% patients of the hysteroscopic endometrial resection, and 82.3% of the thermal balloon patients were successfully returned the normal menstrual flow levels. However, 8.5% of intra-operative complications were occurred in the hysteroscopic endometrial resection group compared to the thermal balloon group that has no complications. The study concluded that hysteroscopic endometrial resection is less likely effective than uterine thermal therapy for the menorrhagia treatment (Ashraf & Gamal, 2012).

Adenomyosis is an abnormally growing benign tumor in the uterus. Adenomyosis is one of the common risk factors that can lead hysterectomy. Symptoms of Adenomyosis include menorrhagia and pain along with dysmenorrhea. The prevalence of adenomyosis varies from 5-7%. Mean frequency of adenomyosis at hysterectomy is average 25%. Nearly 70% of adenomyosis diagnosis was premenopausal women. The frequent coexistence of adenomyosis and leiomyomas in the same uterus provides problematic distinguishing symptoms of each pathological process (Taran et al., 2013). Taran et al. (2013) study focused on summarizing the epidemiology and risk factors of adenomyosis and evaluates surgical and interventional methods alternative to hysterectomy. The study discussed that hysterectomy regularly performed in premenopausal and perimenopausal women. Approximately 20% were diagnosed as the coexistence of adenomyosis and leiomyomas, and 70% of adenomyosis were premenopausal. Chronic pelvic pain and dysmenorrhea developing among adolescent and younger women of reproductive age were indications of developing risk factors of a hysterectomy. Pregnancy with the myometrial fibers might allow adenomyotic foci to develop adenomyosis, which increases in performing hysterectomy. The study finding was that women with adenomyosis and leiomyomas generally undergo hysterectomy (Taran et al., 2013).

Sreekantha et al. (2011) study discussed the level of magnesium and calcium in the early hysterectomized women (34 participants), the late hysterectomized women (32 participants), and healthy women controls (28 participants). An ANOVA statistical analysis was used and Pearson's correlation coefficient for a correlation analysis. The researchers found that the levels of magnesium and calcium were more likely to be decreased in the early-hysterectomized women compared to late-hysterectomized women. The study reported that hysterectomy was associated with osteoporosis development due to an imbalance of hormone level after the surgery (Sreekantha et al., 2011).

Siegel et al. (2013) conducted a quantitative study collecting hysterectomy data from the Behavioral Risk Factor Surveillance System (BRFSS) and population data from U. S. Census Bureau. This study compared the state-level uterine cancer incidence rates between the corrected and uncorrected hysterectomy incidences related to age and race/ethnicity. The survey years were 2004, 2006, and 2008. This study resulted that the uncorrected hysterectomy incidence rate was ranged from 17.1 in Louisiana to 32.1 in New Jersey. On the other hand, the corrected hysterectomy incidence rate was greater by 30% in District of Columbia to more than 100% in Mississippi, Louisiana, Alabama, and Oklahoma. No detectable geographic patterns were found. The hysterectomy prevalence differed by ethnicity/race that African American women undergone a hysterectomy procedure three times greater than that of Caucasian women do due to the cancer-related uterus (Siegel et al., 2013). The study results supported other studies' findings that there were differences of the hysterectomy prevalence among ethnicities/races (Fredericks, 2013; Qi et al., 2013). In 2000-2004, 90% of hysterectomy performance was due to benign uterine disease. Among them, 10% was due to cancer-related uterine, such as cervical cancer, uterine cancer, and ovarian cancer. Approximately 37% of women aged between 15 and 44 years, and 78% of women with aged 50-54 years had a hysterectomy (Frederick, 2013; Qi et al., 2013). Siegel et al. (2013) and Hammer et al. (2015) reported that, overall, there was 510/100,000 incidence rate in 2004, which was the highest hysterectomy rate report. In the Northeast, the rate of hysterectomy was 430/100,000, In the South; its rate was 630/100,000. The reports indicate that south has much greater hysterectomy rate than Northeast (Siegel et al., 2013; Hammer et al., 2015).

Epidemiology of Osteoporosis

Osteoporosis and a major public health burden. Recently, due to the average number of adult population group has been unprecedented and rapidly growing in the nation, frequencies of osteoporosis and bone fractures among older individuals have been rapidly increasing. Osteoporosis is a considerable magnitude of the public health problem (Cauley, 2013; Cooper et al., 2011).

Cooper et al. (2011) study examined temporal trends in the prevalence of age-adjusted osteoporotic fracture incidence to predict future public health burden among North America, Europe, Oceania, and Asia. U.S. population was selected to examine the prevalence of the osteoporotic fractures of North America. In the study, potential risk factors of osteoporosis contributed to the changes in the age-adjusted incidence of osteoporotic fractures. A change in physical activity level and vitamin D intake were significant contributions to the age-adjusted incidence of osteoporotic fractures. The researchers concluded that overall temporal trends with the age-specific rates of osteoporosis substantially increased in hip fractures during recent decades, particularly noticeable in women. The increase of osteoporosis and bone fractures was correlated with the public health burden (Cooper et al., 2011).

Cauley (2013) study supported the study of Cooper et al. (2011)'s result indicated that modern demographic trends of an increased number of older adult populations may be associated with growing number of osteoporotic fractures and rising rate of mortality for osteoporosis. The study reported that hip-related fractures are the most highly involved in mortality risk among the osteoporotic fractures. The mortality risk can be greater when individuals become 75 years old and older with major or minor fractures of the hip and vertebral bones. The bone fractures noticeably affect reducing those bone functions to decrease in quality of life. The economic impact related to osteoporosis is substantially growing that osteoporosis may lead to increased financial burden on public health field. It is critical to assess and reduce risks to individuals in the aging population and to reduce the impact of osteoporosis on public health (Cauley, 2013).

Blume and Curtis (2011) conducted a cross-sectional population-based sample study. The purpose of the study was to examine the prevalence and medical cost related osteoporosis in older adults using 2002 data from Medical Current Beneficiary Survey (MCBS) consisting of health survey interviews of Medicare recipients. The MCBS is an ongoing multipurpose study for Medicare participants and represents the national Medicare population. The prevalence of osteoporosis accordance and osteoporosis-related medical costs was estimated with randomly selected Medicare participants, including elderly who live in either institutions or communities in the United States. For the study statistical analysis, a multiple regression analysis was used to compute the data. The study found that 1.6 million (5%) and 7.2 million (24%) among 30.2 million Medicare recipients were treated for fractures and osteoporosis with no bone fractures. The medical costs for osteoporosis were an average $500 per drug treatment and $2 billion for the nationwide treatment. The estimated annual mean medical cost for the fractures was $14 billion for the U.S. costs (Blume & Curtis, 2011). For the prevalence of osteoporosis and fractures in women, women's age group between 65 and 74 was estimated four times greater than that of the same men's age group. Women's age group between 75 and 84 was estimated five times greater than that of the same men's age group, and fractures were about double in women than men. For women's age group 85 and older, the women's age group was almost three times greater than that of the same men age group and fractures was nearly double on women than men (Blume & Curtis, 2011, p. 1839).

Calcium/vitamin D intake and osteoporosis. Numerous studies noted about prevention of osteoporosis and bone fractures associated with intake of calcium/vitamin D (Avenell, Mak, & O'Connell, 2014; Mangano, Walsh, Insogna, Kenny, & Kerstetter, 2011; Prentice et al., 2013; Reymondier et al., 2013).

Prentice et al. (2013) observational prospective cohort study found that postmenopausal women with intake of calcium plus vitamin D supplements reduced osteoporosis and hip fractures significantly. The study data was collected from the Women's Health Initiative (WHI). The study participants of 32,282 women aged 50-79 years were randomly selected at 40 medical clinic sites in the United States. Double-blind and placebo-controlled clinical trials were randomly assigned to those women had either daily supply of 1,000 mg calcium plus 400 IU vitamin D3 or its placebo for average seven years of the intervention period. Medical records of semiannually self-reported clinical outcomes were analyzed using Cox regression model. The study stressed that long-term intake of calcium/vitamin D supplements was beneficial to reduce a critical risk factor for osteoporosis among women (Prentice et al., 2013).

Reymondier et al. (2013) conducted a retrospective descriptive cohort study. The study explored co-prescription rates of the supplementation among women over 50 years old who were an osteoporosis treatment. The study data were obtained from the French Insurance Healthcare system between May 1 and August 1 in 2010. Among 4,415 participated women initiating osteoporosis treatment, 77.0% of women were participated for combined osteoporosis treatment combined and calcium/vitamin D intake, and more than 75% of the women were participated for only calcium and/or vitamin D supplementation. The study concluded that intake of calcium and vitamin D supplementation plus osteoporosis treatment greatly improved osteoporosis than only osteoporosis treatment in the study population (Reymondier et al., 2013).

In an intervention review study conducted by Avenell, Mak, and O'Connell (2014), the authors analyzed vitamin D with or without calcium for preventing bone fractures among postmenopausal women. The authors conducted random or quasi-randomized trials reviewing medical literature to compare intervention of vitamin D with or without calcium supplements impacts positively on outcomes of bone fractures in older women age 65 years and older from communities, nursing homes, or hospital inpatients. The authors found that vitamin D supplement alone was no effective in preventing bone fractures in older women. However, a combination of calcium and vitamin D supplements intake was significantly associated with the reduction in dangers of any types of fractures and incidence of new non-vertebral fractures. The authors stressed that combination of vitamin D and calcium supplementation were drastically effects on preventing osteoporosis based on the reliable study evidence. Although vitamin D and calcium supplement intake was associated with the reduction of the bone fracture, adverse effects were found gastrointestinal and renal health. The authors demonstrated that there was no association between vitamin D and calcium supplementation and risk of death (Avenell et al., 2014).

Physical activities engagement and osteoporosis. Kim, Shin, Lee, Myung, & Kim (2012) conducted a cross-sectional study in Korea. The study participants (n =

6,477) were collected data from May 2001 to April 2007 of the National Cancer Center in Korea. The leisure-time physical activity was examined using a questionnaire asking the type of activities, frequency per week, and duration in minutes. Measurement of bone mineral activity at the lumbar (L1 - L4) and femur neck region was measured using dual-energy X-ray absorptiometry (DXA) every month. Student *t*-test statistical analysis was performed to compare the age, height, weight, BMI, and lumbar and femoral bone mineral density based on menstrual status. X^2 tests were conducted to examine the distribution of duration and intensity of the physical activity by menstrual status. The association between the BMD and physical activity was evaluated using a generalized linear regression statistical analysis. The authors indicated that physical activity was positively associated with BMD at the lumbar and femoral regions in postmenopausal women (p<0.001). Increases in physical activity levels were also positively associated both pre- and postmenopausal women groups. The study had some limitations, such as a lack of generalization of the population because the study participants in the cancer center were patients and those patients had higher monthly income level compared to the patients among the basic population. Another weakness of the study was that the researchers used various DXA imaging sites and different manufacturers of DXA imaging operation. The various types of instruments used in the study provided a lack of stability of the study measures. Despite the weaknesses, this cross-sectional study provided an increased level of physical activity, such as more than moderate level, significant effects on maintaining BMD in both pre- and postmenopausal women. In the study results, leisure-time physical activities were positively effect on bone mineral density in pre - and postmenopausal women. Particularly, the levels of duration and intensity of physical activities were associated with a benefit in bone mineral density and prevention of bone loss (Kim, Shin, Lee, Myung, & Kim, 2012).

One of the similar studies to the Kim et al. (2012) was conducted in the United States. Polidoulis, Beyene, and Cheung (2012) conducted a systemic meta-analysis study with randomized, controlled clinical trials in the United States. The authors aimed to identify the effect of physical activity on BMD in postmenopausal women using peripheral quantitative computed tomography (pQCT parameters) and magnetic resonance imaging. Healthy postmenopausal women age ranged between 50 and 85 years were randomly selected for the quantitative study searching MEDLINE, PubMed, and EMBASE from 1950 to 2009. The authors resulted that women with the longer duration of exercise involvement in earlier postmenopausal status enhanced statistically significant changes in bone mineral density on the tibia. The authors concluded that an increase in physical activity in postmenopausal women is more likely prevent a decrease in bone mineral density (Polidoulis et al., 2012).

Muir, Ye, Bhandari, Adachi, and Thabane (2013) conducted a retrospective cohort study analyzing data from the Multicentre Osteoporosis Study (CaMos) in Canada. The study focused on the incidence and prevalence of osteoporosis determining the association between regular daily physical exercise and bone mineral density in postmenopausal women aged 75 years and older on an at-risk demographic. In the study, physical activity level, BMD, health habits, and drug treatments through self-reporting on the CaMos were assessed. The physical activity level was categorized by type of exercise, intensity of exercise, and duration to prevent bone loss. The detail categories include moderate exercise as housework, brisk, walking, bicycling, golfing, and bowling and strenuous exercise as jogging, tennis, racquetball, and swimming laps that the study participants could spend performing the physical activity level. The duration included never, ½ hour - 1 hour, 2 hours - 3 hours, 4 hours - 6 hours, 7 hours - 10 hours, 11 hours - 20 hours, and 31 hours and longer. The BMD was calculated using X-ray absorptiometry measurement. To evaluate the relationship between the physical activity and BMD, a linear regression analysis was used. Multiple regression analysis was used to determine the intensity level of physical activity and BMD. SPSS was used for the statistical analyses. The authors found that the greater increase in the physical activities, the greater increase in the positive effect on BMD. However, the aging process negatively affected BMD. The study suggested that an increase for level is related to a reduction in BMD, which adequate physical activity prevents osteoporosis in postmenopausal women (Muir et al., 2013).

Educational level and osteoporosis. Education should be considered as an important factor for osteoporosis. Numerous worldwide-published articles reported the relationship between the osteoporosis and level of education (Laslett, Lynch, Sullivan, & McNEIL, 2011; Maddah, Sharami, & Karandish, 2011; Wastesson, Weitoft, Parker, & Johnell, 2013). The lower in BMD was linked with the lower educational level (Wastesson et al., 2013). A cross-sectional study in Turkish females resulted that lower educated women were older, rural residents, and higher prevalence of osteoporosis with vitamin D deficiency (Maddah et al., 2011). On the other hand, higher educated women were younger, urban residents, and lower prevalence of osteoporosis with an adequate level of vitamin D. Low family income areas have significantly higher rate of osteoporotic fractures than that of higher family income areas, which was linked with the low education level. The prevalence of osteoporosis among pre- and -postmenopausal women was highly associated with the low level of education (Maddah et al., 2011).

Laslett et al. (2011) conducted a nonrandomized prospective study with single-blinded allocation aimed to examine if osteoporosis education can change knowledge and health behaviors, such as dietary calcium. Over three months of follow-up, the authors examine if different osteoporosis education courses influence the change of these outcomes. Adult participants age 50 years and older with emergency mild fracture trauma were subjected to be eligible to complete questionnaires. Overall, the study resulted that osteoporosis education enhanced osteoporosis knowledge and calcium intake. Osteoporosis medication management increased in the education duration. However, the duration between 1-week and 4-weeks education did not affect change in physical activity. The outcome of the result may be due to the education duration was not sufficient (Laslett et al., 2011).

A similar research to the Laslett et al. (2011) study was conducted by Okumus, Ceceli, Tasbas, Kocaoglu, Akdogan, and Borman (2013). The authors targeted pre- and postmenopausal women to determine osteoporosis awareness and knowledge levels. The authors reported that postmenopausal women had the higher level of awareness (51%) than premenopausal women had (32%), whereas a knowledge level between the two groups was not different. A higher level of education in pre- and postmenopause women demonstrated better knowledge and awareness of risk factors associated with osteoporosis. The author suggested that better understanding of health beliefs of osteoporosis at risk play critical roles in determining health-related behaviors among pre- and postmenopausal women (Okumus et al., 2013).

A Swedish nationwide register-based population study conducted by Wastesson et al. (2013) examined educational disparities in the osteoporosis drug use the study subjects age 75-89 years old. The authors used a multivariate logistic regression analysis. The result of the study showed that the level of the education was correlated with the use of osteoporosis drug treatment in both older men and women. However, there was a gender difference for seeking osteoporosis drug therapy when sustaining an osteoporotic fracture and after osteoporotic fractures. The both results showed that women were more involved in the osteoporosis drug therapy than men in the cases were. Educational level among women was positively corrected with osteoporosis treatment whereas, men's inconsistent received treatment in the elderly population (Wastesson et al., 2013).

A cohort study conducted by Crandall et al. (2014) assessed the association between education level and osteoporotic fracture incidence in women ages 42-52 years at baseline over nine years of follow-up from 2,234 participants collected from the study of women's health across the nation. The study participants were premenopausal or early premenopausal women with a uterus intact. The premenopausal condition was defined as "menstruated in the past 3 months with no changes in the menstrual regularity in the past year." The early premenopausal status was described as "menstruated in the past 3 months with decreased [menstrual] regularly in the past year" (p. 1380). At baseline, no participants were taking osteoporosis medications. In the study result, there was the relationship between higher educational level and time delay of first osteoporotic fracture incidence in non-Caucasian women. However, there was no relationship between education and the delay bone fractures among Caucasian women. Among non-Caucasian women who had, postgraduate educational level had 23% of traumatic fracture incidence, which was the relatively lower rate of non-traumatic fractures than Caucasian women were. Each additional educational level was linked with 16% lower odds of non-traumatic fractures (Crandall et al., 2014).

Socioeconomic factors and osteoporosis. Shi, Yin, Shi, & Hoover (2012) study had proven that there was an association between the lower socioeconomic status and disparity in osteoporosis testing in the participated elderly white women. In addition, high and persistent socioeconomic disparities were positively associated with less education and lower bone mineral density testing (Shi et al., 2012).

At a risk of osteoporosis in women with effective treatment to improve bone health outcomes could be associated with socioeconomic factors (Meadows, Mitchell, Bolge, Johnston, & Col, 2012). Meadows et al. (2012) conducted a retrospective self-reported study of the United States 2007 National Health and Wellness Survey. The study was targeted in women aged 40 and older years that were diagnosed with osteoporosis or osteopenia with or without taking osteoporosis medication. Annual U.S. 2006 family income was characterized and treated as an ordinal variable. A logistic regression analysis was used to assess factors that are associated with osteoporosis treatment. According to the study results, the socioeconomic factor was correlated with the higher ratio of monthly medication expenditure, and higher income was significantly associated with medical treatment (Meadows et al., 2012).

Fu, Ma, Lu, He, Wang, and Zhu (2011) was conducted the association of mass and distribution of fat with BMD in 260 pre- and 267 postmenopausal Chinese women age ranges of 18 to 79 using multiple regression statistical analysis. The study found that premenopausal women are more likely associated with greater fat mass and lower BMD than postmenopausal women. In addition, fat deposition during menopause increases menopause-related osteoporosis. The study suggested that greater fat mass causes greater mechanical stress on bones (Fu et al., 2011).

Brennan et al. (2013) conducted a population-based adult cohort study to assess the association among extreme social disadvantage, BMD, and vertebral deformity prevalence in older women. The authors assessed a socioeconomic status obtaining Socioeconomic Indexes derived from Australian Bureau of Statistics 2001 Census Data. The association between the extreme social advantage and bone mineral density was compared with the rest of the general population for women. In the study results, women participants of the extreme social disadvantage showed a strong association with greater BMD loss. The positive association was observed between the greater loss of BMD and older-aged women. However, the study stressed that there was no relationship between the extreme social disadvantage and vertebral deformity prevalence in the study participants (Brennan et al., 2013).

Devold et al. (2013) study was to determine the association between osteoporosis and incident osteoporosis treatment in Norway women aged 50 and older during the year of 2005. The data was obtained from the Norwegian Prescription Database, the Norwegian Epidemiologic Osteoporosis Studies Hip Fracture Database, the National Population Register and Statistics Norway. Devold et al (2013) disagreed to Meadows et al. (2012) study result regarding that there was the positive association between the socioeconomic factor and medical treatment expenses. The greater the income clues, the greater in medical treatment. Instead, Devold et al. (2013) study resulted that there was no association between the socioeconomic factor and incident osteoporosis treatment (Devold et al., 2013).

In the cohort study from Crandall et al. (2014) study, the authors investigated the association between socioeconomic status (income and education) and risks of fracture incidence in the study of women's health across in the United States. The study data was analyzed using Cox proportional hazards regression models. The study showed that higher education level was negatively associated with fractures among non-White women but not among White women. Income level was not associated with low fracture rates in non-White women, whereas, income level was associated with low fracture rates in White women. The authors implied that there might have a lack of health information among minority group in the United States and that it was necessary to design appropriate preventive strategy in menopause women (Crandall et al., 2014).

Early menopause and osteoporosis

Premature menopause defines menopause occurs prior to the age of 40 years (Okeke, Anyaehie, & Ezenyeaku, 2013; Rocca et al., 2012). Early menopause commonly defines as menopause occurs age ranged between age 40 and 45years (Okeke et al., 2013;

Rocca et al., 2012). According to Rocca et al. (2012), both premature and early menopause falls below the average of natural menopause due to reproductive health consequences. Premature menopause can be marked by amenorrhea and experience female hormone (estrogen) deficiency, which can cause health problem. Premature menopause negatively influences to one percentage of women under the age of 40 years. Premature menopause is correlated with a risk of premature death and osteoporosis (Okeke et al., 2013).

Li, Liu, and Guo (2014)'s large prospective cohort study investigated the relationship between the early age at natural menopause and an increase in "all-cause and cause-specific mortality" among African-American women in the United States. The study data were collected from Black Women's Health Study, a follow-up study of African-American women enrolled in 1995 (Li et al., 2014, p. 246). The women participants (11,212) who were naturally undergoing menopause were entered as an entry to the study and a follow-up study. The authors collected menopause data from a participant's medical and reproductive histories through self-reports and mortality data from the National Death Index. To get the mortality rate ratios, multivariable Cox proportional hazard models and 95% confidence intervals were used for categories of age at natural menopause. Among 734 study participants who had a hysterectomy for adenomyosis, 580 (96.7%) of participants were premature menopausal. Their premature menopausal age range was 21-55 years with the median age of 45 years. Among the premature menopausal women, 35.9% of participants had dysmenorrhea. Approximately, 1.8% of participants had menorrhagia or metrorrhagia alone. The menopausal age range was 49-75 years, and the median age was 52 years, which age was associated with the risk of menorrhagia. Natural menopause was associated with age of 50-54 years. Natural menopause before age 40 was linked to the greater rate of all-cause mortality relative to the natural menopause. Among 91,829 of individuals with years of follow-up study, 692 deaths associated with heart disease (n =199) and other diseases (n =232) were identified. The study concluded that natural menopause prior to age 40 was associated with an increase in both all-cause and cause-specific mortality rates, which would be a marker of quickened physical aging process (Li et al., 2014).

Pearce, Thøgersen-Ntoumani, Duda, and McKenna (2014) study explored the changing body images with women who surgically reduced menopause because of undergoing menopause. The study was a qualitative interview design and used Interpretative Phenomenological Analysis (IPA). The study participants were seven women who had undergone a surgical menopause or hysterectomy due to consequence of uterus medical conditions and premenopausal prior to the operation. At the time of the interview, the participants' ages were from 36 to 54 years with post-hysterectomy time ranged between 6 months and 19 years. The uterus-related medical conditions prior to the hysterectomy operation were endometriosis (one participant) and fibroids or endometriosis (six participants). Among those participants, three participants did not go through menopausal symptoms those who had hormone replacement therapy immediately after the hysterectomy operation. Two participants experienced menopausal symptoms immediate after their operations and one participant experienced the symptoms six months after the operation. The interview procedure was semi-structured, comprising open-ended questions emphasizing on the study participants' each unique lifestyle before and after a hysterectomy operation. The study was engaged in-depth examination using comprehensive transcripts using IPA. The interview answers were analyzed using both appraised meaning provided by each participant's response and the researchers' appropriate understanding of each participant's account throughout the interview process. To strengthen the validity of the study, the interview responded texts and their emerging themes were further analyzed by all authors. The study reported that a surgically induced menopause lead serious body changes, which was necessary to improve health-related behaviors that were associated with self-presentation concerns and coping with changes of body images. Adaptation to changing body to maintain health behaviors in women over the menopausal transition was critical. One of the study limitations was that the retrospective data collection could lead a participants' memory limitation. Despite the limitation, the study finding was significant that the changing of body image was associated with experiences of women in the meaning of the body, perception of attractiveness, appearance investment, and consideration of self-presentation (Pearce et al., 2014, p. 746). The change influenced to adapt to and cope with changing body image. Engagement of self-management and well-being, such as optimizing health behaviors, affected positively on awareness of menopausal women's improvement of health-related behavior change (Pearce et al., 2014).

Shuster et al. (2010) studied evidence related to long-term health concerns following premature menopause and early menopause collecting data from existing literature and Mayo Clinic cohort study of oophorectomy and aging. The authors defined premature menopause as the menstrual bleeding stop before age 40 years, and early menopause as menstrual bleeding stop before age 45 years. The authors defined that both types of menopause were more likely to be below the median age of natural menopause that occurred at age of 51 years. Based on the study, premature and early menopauses were associated with a greater risk increase of health problems such as osteoporosis, premature mortality, heart disease, neurological disease, mental health issues, and other medical complications. The risks of adverse health outcomes were greater with earlier age at the time of menopause. According to the study conclusions, the earlier age of the onset of estrogen insufficiency was more likely to be linked with premature menopause and earlier menopause. The premature and earlier menopauses were substantial determinants of the greater risks of osteoporosis. Intake of estrogen was recommended in women with premature or early menopause until at least age of natural menopause, which was an average age of 51 years old (Shuster et al., 2010).

Several studies have confirmed that significant bone loss was evidenced among premature menopausal women. Seifert-Klauss et al. (2012) conducted a prospective observational study to assess rates of bone density loss in pre-, peri-, and postmenopausal women over 9 years. The author reported that this study followed 50 healthy Caucasian women participants who were either hospital employees or outpatient clinic for counseling connected with perimenopause through their menopausal transition. Premenopause refers to regular menstrual cycles occurring between 26 and 32 days in length. Perimenopause refers to menstrual period cycles lasting longer than 35 days, having menstrual cyclic irregularities of more than 5 days between subsequence menstrual cycle, and hot flushes occurring more than 5 days per menstrual cycle. Postmenopause refers to no menstrual period had been experienced in the past one year or more before the clinic visit for the study. Quantitative computed tomography (QCT) was used to analyze Bone Mineral Density (BMD). The study participants with a very low BMD had higher bone density loss over the time. The study result reported that women with the menopausal transition were observed the greater amount of BMD loss. The study concluded that loss of BMD is highly associated with menopausal transition than both premenopause and postmenopause (Seifert-Klauss et al., 2012).

Another prospective population-based observational study was conducted by Svejme et al. (2012) hypothesized that the long-term effect of early menopause is associated with the risk factors for mortality, the risk of fragility fracture, and development of osteoporosis. In the study, the term of menopausal status was attained from World Health Organization classified as at least one year of continuous absence of menstrual bleeding abnormally. At baseline, BMD was measured forearm by single-photon absorptiometry (SPA) to identify menopausal status. Early menopausal status was determined by menopause occurring before the age of 47 years. Late menopausal status was determined by menopause occurring at the age of 47 years or later. At the age of 77, SPA was reused to measure BMD of the forearm. Dual-energy X-ray absorptiometry (DXA) was used to collect data of osteoporosis in the lower back and hip areas. The incidence of fragility fractures, mortality, and prevalence of osteoporosis were measured. The study result reported that women with early menopause before the age of 47 significantly increased the risk of fractures, mortality risk, and osteoporosis risk increased at the age of 77 (Svejme et al., 2012).

Sievert et al. (2013) study investigated the age at menopause in the diverse ethnic community of Hilo and assessed determinants age of hysterectomy and natural menopause. The study samples were randomly selected through postal survey and a follow-up clinical study of menopause symptoms, including hot flashes and blood pressure was conducted. The target population in the study was selected from women's age between 40 and 60 years from the larger Hilo women's health study in the multiple ethnic communities in Hawaii. Probit analysis was to compute median age at natural menopause. A logistic regression analysis was applied to hysterectomy determinants. Cox regression analysis was used to determine risk factors for an earlier age at menopause. The study resulted that the rate of hysterectomy operation was 19%. The mean age hysterectomy occurrence was 40.5 years with a range of the ages of 22.7-58.4 years. The mean age of natural menopause occurrence was 49.9 years. The median age at natural menopause was 53.0 years. On the other hand, average natural menopause is considered to be at age of 51 years (NIH, n. d. Shuster et al., 2010). Ninety-four percentages of the participated women were menstruating at the time of undergoing hysterectomy procedure. The determinant of hysterectomy in the diverse ethnicity was 60% who were considered Hawaiians. The frequency of an increase in hysterectomy was positively associated with an increase in aging process (Sievert et al., 2013).

Summary and Transition

The literature introduced the prevalence of osteoporosis and the overall role of demographic factors including socioeconomic status (age, race/ethnicity, education level, and annual family income, and age of hysterectomy) and behavioral factors (moderate recreational activity and calcium/vitamin D intake) among hysterectomized postmenopausal women. I described theoretical foundation and literature search methods. I explored the multiple dimensional demographic and behavioral approach associated osteoporosis. I also provided prevalence and description of hysterectomy, menopause, and osteoporosis were provided. Variables of osteoporosis were explored.

Hysterectomy is a one of the factors that contributes to the early onset of menopause (Hunter et al., 2012). The literature review studies explained the association between hysterectomy and menopause, as well as the association between menopause and the prevalence of osteoporosis in women’s life. However, the literature review studies have provided no evidence of the association hysterectomy prior to natural menopause and the prevalence of osteoporosis in the postmenopausal women, which might be a major burden on public health. The present study was extend the knowledge to fill in the public health-related bone health, which I concentrated on the association between demographic and behavioral factors in hysterectomy prior to natural menopause and osteoporosis in women of age 50 and older while premenopausal is associated with a risk of osteoporosis. To assess the relationship between demographic and behavioral factors and osteoporosis in hysterectomized postmenopausal women prior to reaching menopause, I used the NHANES as a secondary data in chapter 3.

Chapter 3: Research Method

The purpose of the study was to investigate an association between demographic and behavioral factors and the prevalence of osteoporosis in women age 50 and older who had undergone a hysterectomy prior to reaching natural menopause. Investigating osteoporosis in hysterectomized postmenopausal women prior to reaching natural menopause would promote osteoporosis awareness, prevention, detection, and treatment. The understanding of osteoporosis would encourage possible changes in lifestyle of the target individuals who have risk factors affecting bone health.

This study included a quantitative cross-sectional design using secondary data obtained from the NHANES 2009-2010 data set. In Chapter 3, I describe the detailed research design and methodology. Regarding the study target population, I present the sample size operational definitions for each variable. I also describe the NHANES data used for the study and address threats to validity and reliability of the NHANES survey instrument. Finally, I describe applicable ethical procedures including Institutional Review Board (IRB) approval.

Research Design and Rationale

The study was a quantitative cross-sectional study using survey questionnaires obtained from the NHANES 2009-2010 data set to examine the association between demographic and behavioral factors and evidence of the prevalence of osteoporosis among postmenopausal women who had undergone the surgical procedure prior to natural menopause. The data for both reproductive health and osteoporosis were collected from the 2009-2010 National Health and Nutrition Examination Survey (NHANES). The categorical or continuous independent variables of the study were demographic and behavioral factors.

The research design was chosen to test the association between demographic and behavioral factors and osteoporosis within the target population. The demographic factors included race/ethnicity, education level, annual family income level, and age of hysterectomy. The behavioral factors were calcium/vitamin D intake and moderate recreational activity. The dichotomous dependent variable in the study was osteoporosis. Data on covariates of interest in this study were obtained from NHANES demographic files and self-reported questionnaire interview information from participants, which included demographic age and age of hysterectomy (CDC, 2015).

The study's findings would be generalizable to a larger population or other settings. The cross-sectional design is widely used in the public health field because allows for reasonably quick and easy data collection and does not require a long follow-up period (PHAST, 2011). The cross-sectional design includes descriptive and analytical techniques. A descriptive design would involve descriptive means of (a) assessing the frequency and distribution of women who had undergone hysterectomy prior to reaching menopause and (b) assessing the frequency and distribution of osteoporosis in the defined population in the same year. An analytical design would involve investigation of the association between the recognized demographic and behavioral risk factors in the study population. The limitation of the cross-sectional design was that it does not allow the researcher to alter the independent variables and make before-and-after comparisons due to the variables being investigated at one point in time. Therefore, it was challenging to incorporate controls necessary to establish causality (Frankfort-Nachmias & Nachmias, 2008).

Using secondary data from the NHANES 2009-2010 with a cross-sectional design would be a distinct advantage over using primary data for the study. An advantage of using secondary data was accessing a large sample of the target group, representing a noninstitutionalzed population. Another advantage was that the NHANES 2009-2010 data set is the most recent publically available information for both hysterectomy and osteoporosis variables (Vartanian, 2011). The secondary data were appropriate for the research question that is associated with addressing a policy-relevant research outcome.

Methodology

Population

The study population was 113,441,131 civilian noninstitutionalized U.S women aged 19 and older in the NHANES 2009-2010 data set. The age of postmenopausal women was 50 and older who had undergone hysterectomy prior to natural menopause. The hysterectomy age range was between 19 and 50 years prior to natural menopause. From 2004 to 2011, approximately 11% reproductive women had undergone a hysterectomy prior to natural menopause. Over 43% of U.S., women had undergone natural menopause between 48 and 52 years (Morris et al., 2012). The average age at natural menopause in the United States is at 51 years (Li et al., 2013; NIH, n. d.; Shuster et al., 2010).

The NHANES 2009-2010 data set improved reliability and precision of the data allowing for oversampling of a larger number of African-American and Hispanic women age 60 and older. The oversampling would allow for an unbiased national estimate for the subgroups to improve statistical analysis with an increase of the samples (CDC, 2015). Excluded individuals included pregnant women, children <19 years, men, institutionalized women, and women on active duty in the Armed Forces (CDC, 2015; Johnson et al., 2013).

Sampling and Sampling Procedures

Sampling strategy. The NHANES 2009-2010 data set was the most recent data containing both the independent and dependent variables published in the public domain (CDC, 2015). The study population was postmenopausal women age 50 and older. Individuals younger than 50 years were excluded. The total hysterectomized postmenopausal population of women age 50 and older was 10,537. Among the population, the NHANES sample number was determined as 3,212. From the NHANES data set, the women age 50 and older who had hysterectomy prior to menopause with the upper limit of the age of hysterectomy being 50 years was analyzed (CDC, 2013). Due to number of missing values in the study variables, the variables were examined with the missing value analysis method in SPSS. After treating for the missing values, the study sample was determined as $N = 361$.

Sampling procedures. I used NHANES data set conducted a stratified multistage probability design, which allowed for the sampling of households (CDC, 2015). NHANES sampling involves complex multistage probability sampling procedures to select a sample representative of the U.S. civilian noninstitutionalized population. NHANES contains a four-stage sampling drawing strategy. The first stage of the sampling selection is the primary-sampling units (PSU) including data from individual counties. The second stage of the sampling selection is segments of the counties. The third stage is units of households with the segments. The fourth stage is individuals within households. Questionnaire surveys are conducted within households and at a mobile examination center (MEC) in each local area by trained interviewers (CDC, 2013).

Sampling frame. The NHANES includes a nationally representative sample of approximately 5,000 individuals annually. The individuals are from 15 different county locations that MECs visit each year (CDC, 2013). In the present study, postmenopausal women's age less than 50 years were excluded to minimize potential bias attributed to the age (CDC, 2015; Johnson et al., 2013).

Power analysis. When there is insufficient sample size, a type II error typically occurs. Power analysis is conducted to measure a type II error. A type II error occurs when the null hypothesis is not rejected although it is false (Anderson-Cook & Dorai-Raj, 2003).

For this study, I used G*Power 3.1.9.2 to establish an appropriate sample size to minimize the chances of making a type II error. G*Power 3.1.9.2 is a free power analysis program for Mac OS X platforms that use many types of statistical tests (Faul, Erdfelder, Buchner, & Lang, 2009). When determining the study sample size, effect size, alpha, and statistical power level were considered. Using a MLR statistical analysis, a statistical power of 95% with an alpha level of 0.05 was used to improve the chance arriving at the right conclusion (Wuensch, 2009). The odds ratio was used to compute an effect size

(Cho et al., 2012). An effect size provides the level of a strong relationship from key outcomes in a quantitative study. As an effect size is decreased, the number of participants needs to increase, which would improve detection effect and relationship (Sullivan & Feinn, 2012).

To determine the total sample size of the current study, *Z* tests with a logistic regression statistical test were used. The type of power analysis was selected as a priori: compute required sample size - givenα, power, and effect size. Two-tails measure was selected for input parameters. Odds Ratio of 2.33 was used based as the default values of Pr (Y=1/X=1). H1 was 0.5; Pr (Y=1/X=1) H0 was 0.2 as effect size input mode; α err prob was selected as 0.05; Power (1-β err prob) was 0.95 as defaulted; R2 other X was 0; X distribution was normal; X parm μ was 0; and X parm σ was 1. The output parameters of the results revealed that the sample size was 104; critical *z* was 1.96, and actual power was 0.95 (Faul et al., 2009).

Procedures for Recruitment, Participation, and Data Collection

According to NHANES, health interviews were conducted in homes, and health measurements were conducted in the specially equipped mobile centers traveling through counties. Advanced computers were used for the data collection process. The survey participation was facilitated and encouraged with participants' transportation and compensation. Medical findings for each participant were reported. Collected survey information was confidential and protected by public law. If needed, federal, government, research, educational institutions, and medical and private organizations were allowed to access the survey data (CDC, 2015). The NHANES data are reliable and valid and all instruments are tested for accuracy, calibration, and adherence to protocol. Public users are allowed to access the full scope of the data (CDC, 2012c). Participation selection was a complex statistical process. Based on the most current census data, neighborhoods were randomly selected from communities, and selected households were eligible for the study. There were two surveys: the in-home interview and health examination at the MEC containing high-tech medical equipment (CDC, 2013).

NHANES is a major survey data collection program that is the most in-depth and logistically complex survey to examine health and nutritional status of individuals in the United States. Data collection is conducted by a combination of MECs traveling randomly through selected counties and randomly identified household interviews. When NHANES selected MEC training interview and the training program are completed, the equipped NHANES field office is located in the PSU to support activities and MEC data collection. Household personal interviews are conducted through randomly identification of households. All eligible screener members were adults and at least one household was given the relationship questionnaires. A home interview consent form was completed prior to conducting the sample adult participant or family questionnaires. A trained interviewer collected sensitive information, including the participant's demographic, socioeconomic, and dietary data. MEC conducted a wide range of evaluation, including standard physical examinations using dual-energy X-ray absorptiometry, diagnostic process, laboratory tests, and interviews in the MEC. The interview includes dietary and private health information. The collected data are reliable, accurate, calibrated, and adhere to protocol. The data are protected with a security system of data collection information (Zipf et al., 2013).

Instrumentation and Materials

NHANES is a major program of the NCHS, is sponsored by the CDC, and is accountable for vital health statistics for the United States. The NHANES program began in the early of 1960s as a series of interviews and examinations. The survey interview consists of demographic, socioeconomic, dietary, and health-related questionnaires. NHANES sample represents United States civilians (CDC, 2015). NHANES is a unique survey that combines interviews with physical examinations related to health, nutritional health, and health behaviors of the U.S. individuals. The survey includes prevalence data and trends in selected diseases, environmental exposures, and risk factors for U.S. individuals (Zipf et al., 2013).

The study data were collected via the NHANES 2009-2010 data set. Age, race/ethnicity, education level, and annual family income data were collected via the screening survey from the demographic variable list data file. Calcium/vitamin D intake data were collected from dietary variable list. Hysterectomy data and age of hysterectomy data were obtained from reproductive health data, and osteoporosis data was obtained from the osteoporosis survey file of the questionnaire variable list data file during the personal interviews (CDC, 2013).

Operationalization: Independent and Dependent Variables and Covariates

The independent variable, dependent variables, and covariates were directly obtained from the questionnaires of 2009-2010 NHANES (CDC, 2015).

Dependent variable. Osteoporosis was used as a binary dependent variable

(Yes/No).

Osteoporosis

This interview was conducted from household participant questionnaires.

- Ever told had osteoporosis/brittle bone. Has a doctor ever told {you/SP} that {you/s/he} had osteoporosis, sometimes called thin or brittle bones? [This question is required Yes or No answer] (CDC, 2015).

Independent variables. The independent variables consisted of demographic factors (race/ethnicity, education level, and annual family income level) and behavioral factors consisted of (calcium/vitamin D and physical activity).

Race/Ethnicity

The race/ethnicity was derived from responses to the self-identified survey questions in the Demographic file. The race/ethnicity was categorized as Mexican American, other Hispanic, non-Hispanic White, non-Hispanic Black, and other race - including multi-racial (CDC, 2015).

- Recode of reported race and ethnicity information (CDC, 2015)

Annual Family Income

The annual family income was obtained from the variable named INDFMIN2 in the demographic variable and sample weights (DEMO_F) of the NHANES data file. The family defined as a group of one or more families associated with "birth, marriage, or adoption and residing together" including related subfamily members (CDC, 2015, p 5). The family income was obtained from total family income in dollars (CDC, 2015). In this study, the annual family income was categorized in NHANES data set as 1 = $0-$4,999, 2 = $5,000-$9,999, 3 = $10,000-$14,999, 4 = $15,000-$19,999, 5 = $20,000-$34,999, 6 = $35,000-$44,999, 7 = $45,000-$54,000, 8 = $55,000-$64,999, 9 = $65,000-$74,999, 10 = Over $20,000, 11 = Under $20,000, 12 = $75,000-$99,999, and 13 = $100,000 and over (CDC, 2015). The annual family income was recoded into the following categorical variables: 1 = $0-$44,999, 2 = $45,000-$64,999, 3 = $65,000 to $99,999, and 4 = $100,000 and over (CDC, 2015).

- Income from wages/salaries. Did {you/you an OTHER NAMES FAMILY MEMBERS 16+} receive income in {LAST CALENDAR YEAR} from wages and salaries? [Did {you/you or OTHER FAMILY MEMBERS 16+} get paid for work in {LAST CALENDAR YEAR}]? (CDC, 2015)

Education Level

The education level was defined as the level of highest degree of participants in the NHANES. The education level was characterized as 1= High school dropout; 2 = High school or Grad/GED or equivalent; 3 = Some college or AA degree; and 4 = College graduate or above (CDC, 2015).

- What is the highest grade or level of school {you have/SP has} completed or the highest degree {you have/s/he has} received? (CDC, 2015)

Calcium/vitamin D Intake

Calcium/vitamin D intake data were obtained from the dietary supplement use 30-Day–Total Dietary Supplements Data Documentation (DSQTOT_F) file. This dietary supplement data was provided by personal interview based on the participants' use of the supplement during a 30-day period prior to the survey interview date. The data included detailed individual supplements, such as types and amounts, and reported participated individuals. The participants were asked interview questionnaires using a computer-assisted personal interview in the MEC (CDC, 2015).

The level of daily calcium intake is different depending on women's age. Women age 19-50 years is recommended to take 1,000 mg. The age 51 and older is for 1,200 mg. The upper limit of calcium intake recommendation is 3,000 mg (Institute of Medicine, 2011a; NOF, n. d.; NIH, 2013). Intake of calcium supplement in the diet provides health of bones to prevent osteoporosis.

Vitamin D enhances healthy bone development assisting calcium absorption (U.S. Department of Health and Human Services [HHS], 2015a). Intake of an average 600 international units (IU) (or 0.025 mcg) vitamin D intake level is recommended for the most individuals (NIH, 2013). However, women aged 50 and older are recommended to take 800-1,000 IU (or 20 mcg-25 mcg) and not to limit 4,000 IU (or 100 mcg) (NIH, n. d.; NOF, n. d.).

Physical Activity (Moderate Recreational Activity)

According to NHANES data file, physical activity included questions about daily, leisure time, and sedentary activities. The physical activity survey questionnaire was based on the global physical activity questionnaire from the World Health Organization (WHO) website (CDC, 2015).

- {Do you/Dos SP} do any moderate-intensity sports, fitness, or recreational activities that cause a small increase in breathing or heart rate such as brisk walking, bicycling, swimming, or golf for at least 10 minutes continuously?

(CDC, 2015)

Covariates. Confounding variables for the study included age and age of hysterectomy.

Age

The age was a demographic factor. It was the age in years at the time of the screening interview for the survey participants' age 50 and older. The survey participants who responded were 80 and older are coded as the age 80. The age was the actual or imputed date of birth by each participant. For this study, the age was categorically recoded as the age range of 1 = age 50-59, 2 = age 60-69, 3 = age 70-79, and 4 = age 80 and older (CDC, 2015).

- Best age in years of the sample person at the time of household (HH) screening. Individuals 80 and over are top coded at 80 (CDC, 2015)

Age of Hysterectomy

The target ages of women when had hysterectomy was at 50 years and younger (CDC, 2015). For this study, the age was categorically recoded as the age range of 1 = age 25 and younger, 2 = age 26-35, 3 = age 36-45, and 4 = age 46-50.

- Age when had hysterectomy. How old {were you/was SP} when {you/she} had {your/her} (hysterectomy/uterus removed/womb removed)? (CDC, 2015)

Control variable. In this study, hysterectomized individuals were selected to examine their demographic factors and behavioral and osteoporosis.

Hysterectomy

Hysterectomy defined as surgically induced menopause. Hysterectomy age ranged based on an adult women, and the study participant's upper age limitation was 50 years (CDC, 2015).

- Had a hysterectomy. {Have you/Has SP} had a hysterectomy, including a partial hysterectomy, that is, surgery to remove {yours/her} uterus or womb? (CDC, 2015)

Study variables and covariates. A list of the study variables and covariates are provided in Table 1.

Table 1

Dependent and Independent Variables Used in This Study

Variable Type	Variable Name	Variable Source	Level of Measurement
Dependent	Osteoporosis (OSQ060)	Osteoporosis (OSQ_F) in the questionnaire data file	Categorical
	Race/Ethnicity (RIDRETH1)	Demographic data file (DEMO_F)	Categorical
	Education Level (DMDEDUC2)	Demographic data file (DEMO_F)	Continuous
Independent	Annual Family Income (INDFMIN2)	Demographic data file (DEMO_F)	Continuous
	Physical Activity (Moderate recreational activities (PAQ665)	Physical Activity (PAQ_F) in the questionnaire data file	Categorical
	Calcium (DSQICALC) /Vitamin D (D2 + D3) intake (DSQIVD)	Dietary Supplement Use 30- day – Total Dietary Supplements Data Documentation file (DSQTOT_F)	Categorical
Covariate	Age (RIDAGEYR)	Demographic data file (DEMO_F)	Continuous
Covariate	Age when had Hysterectomy (= Age of hysterectomy) (RHQ291)	Reproductive Health (RHQ_F) in the questionnaire file	Continuous
Control	Hysterectomy (RHD280)	Reproductive Health data file (RHQ_F)	Categorical

Note: Dependent variable (= osteoporosis), Independent variables: Demographic factors (= race/ethnicity, education level, and annual family income), behavioral factors (moderate recreational activity and calcium/vitamin D), covariate factor (age and age of hysterectomy), and control variable (hysterectomy)

Data Analysis Plan

Both hysterectomy diagnosis data from the reproductive health module and osteoporosis diagnosis data from osteoporosis module of the NHANES 1999-2010 was used to test the study hypotheses. International Business Machines Corp.(IBM) SPSS Statistics version 21 was used to conduct a multiple regression analysis for all data analyses. SPSS provides suitable data management, such as coding, recoding, transformation, and missing value of analysis of variables to analyze survey data set. Collected data files was organized and recorded prior to appending the data sets based on the method. The data files were merged using the unique identifier according to the sequence number. The merged files were sorted for the study variables. Missing data were reviewed and conducted missing value analysis to preserve the resulting integrity. The response,“ don’t know”, was treated as missing data in the analysis (CDC, 2013),

This study was provided with descriptive statistics for demographic factors (race/ethnicity, education level, and annual family income) and behavioral factors (moderate recreational activity and calcium/vitamin D) associated with the prevalence of osteoporosis among the hysterectomized postmenopausal population. Covariates were age and age of hysterectomy. Means and standard deviations of the descriptive statistics were provided. The correction matrix was provided to predict the association between the independent variables of demographic and behavioral factors and binary dependent variable of the prevalence of osteoporosis. The results of these data were estimated with statistical reliability.

Research Question 1. Is there an association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and the prevalence of osteoporosis (yes/no) in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Null hypothesis (*H1o*): There is no association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and the prevalence of osteoporosis (yes/no) in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Alternative hypothesis (*H1a*): There is an association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and the prevalence of osteoporosis (yes/no) in the U.S. women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

For the independent variables of the study, age (1 = age 50-59, 2 = age 60-69, 3 = age 70-79, and 4 = age 80 and older) and race/ethnicity (Mexican American, other Hispanic, non-Hispanic White, non-Hispanic Black, and other race) were categorical nominal variables. Osteoporosis was a binary dependent variable. Race/ethnicity was a non-parametric test. Logistic regression analyzes were used to observe the association between race/ethnicity and dichotomous osteoporosis (CDC, 2014b). The education and annual family income levels were treated as ordinal variables, such as 1= Less than 9th grade; 2 = 9th-11th grade; 3 = High school or Grad/GED or equivalent; and 4 = Some college or AA degree; and 5 = College graduate or above, and the annual family income level, such as 1 = $0-$44,999; 2 = $45,000-$64,999; 3 = $65,000-$99,999; 4 = $100,000 and over.

For the statistical test, multiple logistic regressions were used to predict the association between demographic factors (race/ethnicity, education level, annual family income, and age of hysterectomy) and osteoporosis in postmenopausal women who had undergone hysterectomy prior to natural menopause. A *p*-value <0.05 was statistically significant. The model determined R^2 value ranged, “0” as none of variance fit to “1” as 100% of fits in the dependent variable, for how the model fits the data. These analyses were parametric tests, and the continuous variables expected to have normal distributions (ChangingMinds, 2002-2015), Confidence intervals 95% was used. Coefficients was estimated the magnitudes of the association between each independent variables and dependent variable adjusting other predictors in the model. Odds ratio was estimated to analyze the strength of the association between each independent variable and dependent variable (StatisticsSolutions, 2014; Tsai, Lo, Yang, Keller, & Lyu, 2015).

Research Question 2. Is there an association between behavior factors (calcium /vitamin D intake and moderate recreational activity and the prevalence of osteoporosis (yes/no) in women age 50 and older who had undergone a hysterectomy prior to the onset of natural menopause?

Null hypothesis (*H2o*): Is there no association between behavior factors (calcium /vitamin D intake and moderate recreational activity) and the prevalence of osteoporosis (yes/no) in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Alternative hypothesis (*H2a*): There is association between behavioral factors (calcium /vitamin D intake and moderate recreational activity) and the prevalence of osteoporosis (yes/no) in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

The study independent variables (calcium/vitamin D intake and moderate recreational activity; yes/no) were discrete binominal, and the study dependent was a dichotomous variable (osteoporosis; yes/no). Age of the hysterectomized postmenopausal women age 50 and older who had a hysterectomy at age 50 and younger was analyzed. MLR statistical analyses were appropriately applied for the relationships between the study variables (CDC, 2014b; Sprague, Trentham-Dietz, & Cronin, 2012). The *p*-value of 0.05 was treated as a “cut off error level.” Coefficient, confidence level 95%, and the odds ratio were evaluated (Parab & Bhalerao, 2010).

Overall, The observation of this study was that there were a dichotomous dependent variable and categorical or continuous independent variables. In this study, there were a few assumptions for the use of a MLR statistical analysis. The presence or absence of osteoporosis disease was considered. Another assumption was that the regression does not assume the measurement variables are normally distributed (McDonald, 2014).

Threats to Validity

External Validity

External validity is considered to be critically assessing the quality and accuracy. The NHANES data set was generated from the national population-based sample that provided a large sample size and an appropriate response rate. In this study, the NHANES data set was involved in investigating the association between demographic and behaviors factors and osteoporosis among women who had undergone hysterectomy prior to reaching natural menopause. These study findings from the NHANES would be representative and generalized to postmenopausal women of the Untied States. The NHANES data set has been conducted since in the early of 1660s targeting on different population and the survey is continuously focusing on a variety of health and nutrition measurement for necessary needs. The data set would provide an excellent external validity (Kurt-Sirin et al., 2014).

Internal Validity

Internal validity was considered to be critically assessing the quality and accuracy. The NHANES data provided internal consistency as well. However, in this present study, historical variables, such as genetic factors, ethnicity/race, and pathogenesis might be associated with involving of threats to internal validity. For instance, osteoporosis may be resulted by the consequences of collagen genes that subtly mature due to aging process (Kurt-Sirin et al., 2014). Race/ethnicity may differently affect bone fractures (Cauley, 2011). Pathogenesis features and influence of bone health condition also impacts on bone fractures (Hudec & Camacho, 2013).

Construct Validity

In this study, threats to validity for statistical conclusion may occur if an incorrect conclusion about the association between demographic and behavioral factors within the hysterectomized postmenopausal group and the prevalence of osteoporosis. There are two types of errors. The first error would be that there is no relationship in the study's conclusion when, in fact, there is, which lead to low statistical power. The second error would be that there is a relationship in the study's conclusion when, in fact, there is not, which needs to adjust an error rate when conducting multiple analyses (Trochim, 2006).

Ethical Procedures

The NHANES protocol complied with the U.S. Department of Health & Human Services (HHS) policy for human research subjects or participants (45 CFR part 46), which were approved by the NCHS Research Ethics Review Board (ERB) and underwent the annual review. There are three federal laws protections for all data: Privacy Act of 1974 (5 U.S.C.552a), Section 308(d) of the Public Health Service Act (42 U.S.C.242m), and Confidential Information Protection and Statistical Efficiency Act (CIPSEA) (PL107-347). As gaining access to participants or data, it is responsible for a researcher to be aware of the rights to protect all NHANES participants and data. The NCHS research Ethics Review Board (ERB), former name was NHANES Institutional Review Board (IRB) protects the right and welfare of study participants in the NHANES (45 CFR 46.111). Review and approval processes of ongoing changes to the protocol of the NHANES by the ERB ensure the ethical treatments of the vulnerable study participants.

The NHANES 2009-2010 survey was reviewed and approved by the NCHS IRB/ ERB (Continuation of Protocol # 2005-06) (Zipf et al., 2013). The NHANES data are allowed for public and approval of the data for access is not warranted. However, the Institutional Review Board for Ethical Standards in Research from Walden University requires IRB's approval prior to any data collection or analysis of data (Walden University, 2015). Before analyzing the NHANES data, IRB approval was requested and obtained (09-09-15-0197012)

Summary and Transition

In Chapter 3, I discussed a description of the research methods including study population, samples, instrumentation, materials, operational definitions of variables, study questions, and hypotheses using the selected independent and dependent variables. For the independent variables, demographic and behavioral factors, as well as covariates were used. Osteoporosis was a dichotomous dependent variable. This study data were obtained from the NHANES 2009-2010 dataset. This data was the latest published data that contains both the hysterectomy and osteoporosis variables, which this study was focused on. I used SPSS 21 for Mac platform and MLR analyses to determine the association between demographic and behavior factors and osteoporosis among women who have undergone hysterectomy prior to menopause.

Chapter 4: Results

The purpose of the study was to examine the relationship between the demographic and behavioral factors and osteoporosis in U.S. women age 50 and older who had undergone hysterectomy prior to natural menopause. The research questions and related null and alternative hypotheses for this study were as follows:

Research Question 1

Is there an association between demographic factors (age, race/ethnicity, education, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Null hypothesis (*H*1o): There is no association between demographic factors (age, race/ethnicity, education, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Alternative hypothesis (*H*1a): There is an association between demographic factors (age, race/ethnicity, education, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Research Question 2

Is there an association between behavioral factors (moderate recreational activity and calcium /vitamin D intake) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Null hypothesis (*H*2o): There is no association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Alternative hypothesis (*H*2a): There is an association between behavioral factors (moderate recreational activity and calcium /vitamin D intake) and osteoporosis prevalence in women age 50 and older who have undergone hysterectomy prior to the onset of natural menopause.

To test these hypotheses, cross-sectional secondary data was obtained from the NHANES 2009-2010 dataset, which included the civilian, noninstitutionalized U.S. population. Chapter 4 presents the results of the study based on the statistical analyses, descriptive overview, demographic data characteristics, and basic univariate analyses. In addition, this chapter presents results of the MLR analyses to answer to the research questions.

Data Collection

The data source for the present study was the 2009-2010 NHANES, which included nationally collected data representative of the U.S. population. The NHANES 2009-2010 survey included a stratified, multistage probability sample of the target population. The procedure of the multistage probability sample selections included 15 primary sampling units (PSUs) procedure during a 12-month period. The PSUs consisted of most counties, segments within the PSUs, households within the segments, and participants within the households. The NHANES 2009-2010 survey consisted of an interview in homes as well as physical and laboratory examinations in MEC centers (CDC, 2013c).

To analyze the NHANES 2009-2010 data set statistically, I used the SPSS statistical analysis software. I collected and sorted the variables of interest from the data set based on the respondent sequence number (SEQN). The independent variables included demographic and behavioral factors. The demographic variables included age, race/ethnicity, education, and annual family income from the demographic variable list. The behavioral factors included calcium and vitamin D intake from the dietary variable list data file, moderate recreational activity, and age of hysterectomy from the questionnaire variable list data file. For the dichotomized dependent variable, osteoporosis, data was collected from the questionnaire variable list data file. The data contained missing values in the variables were treated with a missing value analysis quantitatively and categorically. Then, the analyzed data were selected and no missing data were generated. The data with no missing values were merged, and the merged cases were filtered based on satisfaction of the study condition. In the merged data set, postmenopausal women’s age 50 and older who had hysterectomy prior to menopause at the age of 51 years or maximum hysterectomized at 50 years. As a result, the final study participants in this study were 361 individuals. The sample size was appropriate for this study because $N = 361$ exceeded the minimum study sample size ($N = 104$) generated by power analysis described in the methodology section in Chapter 3.

Regarding the demographic factors, race/ethnicity was determined by self-report from the survey questions. Education level was categorized for adults 20 and older. The annual family income was also included. Family was considered as a group of one or more individuals residing together through marriage, birth, or adoption (CDC, 2015). In the NHANES dataset, Hispanic and African American women age 60 and older and low-income individuals were oversampled to incorporate an increase in reliability and precision (CDC, 2013c). SPSS Statistics 21 was used to compute all data analyses for the study.

This chapter presents demographic characteristics and descriptive statistics for the binary categorized dependent and the continuous and categorical independent variables and covariates. The basic univariate analyses show inclusion of covariates that are associated with the dependent in the model. In addition, this chapter presents the results of inferential statistics testing the hypotheses and summaries of the statistical analyses.

Demographic Characteristics of the Sample

I used NHANES 2009-2010 data set to analyze the relationship between demographic and behavioral factors and osteoporosis prevalence among hysterectomized postmenopausal women. The study variables of age, race/ethnicity, education level, annual family income, and physical activity were obtained from the interviews. Dietary (calcium/vitamin D intake) data were obtained from dietary variable list data file, and age of hysterectomy data was obtained from the medical examination questionnaire variable list data file. Osteoporosis data were obtained from the medical examination questionnaire variable list data file. The target population was postmenopausal women who had undergone hysterectomy prior to menopause. The study sample was selected from the noninstitutionalized U.S. population. The frequency distributions were analyzed to determine responses within a possible range of values. The missing data included "refused" and "don't know" interview responses. The study sample of hysterectomized postmenopausal women resulted in 361 individuals age 50 and older who had hysterectomy prior to menopause, and this number ($N = 361$) was used as the final sample size for the study.

For the variable of the physical activity, moderate recreational activity was selected because the age range of the study target population was postmenopausal women age 50 and older. The physical activity criteria included moderate-intensity sports and fitness, which were brisk walking, bicycling, swimming, or golf for at least 10 minutes continuously to increase of breathing or heart rate. The amount of calcium (mg) was 600 mg per day, and vitamin D (D2+D3) (mcg) was 10 mcg per day. The supplements were used consistently for 30 days prior to the dietary interview. The category of hysterectomy included a partial hysterectomy, which involved removal of the uterus or womb, and total hysterectomy, which involved removal of the uterus, ovaries, and fallopian tubes. The age of hysterectomy variable was defined as the age when hysterectomy was performed to remove the uterus (CDC, 2015).

Table 2 presents the frequencies and percentage of demographic characteristics of three sample sizes. Women age 50 and older were included. The women population ($N =$ 10,537) included only women age 50 and older (25.6 %) among the noninstitutionalized U.S. population (CDC, 2015). In the study, Hispanics and African Americans age 60 and older and low-income individuals were oversampled to increase reliability and precision (CDC, 2013c). The NHANES study sample consisted of 3,312 menopausal women participants. Among the women, individuals who had hysterectomy prior to menopause age at 51 years (*N* = 361) were randomly selected for the final study sample. The final number was treated with missing data analysis for variables of age of hysterectomy, calcium intake, and vitamin D intake.

In the study sample, the age group 60-69 years showed the highest participant rate (38.0%) followed by the age group 70-79 years (25.8%), 50-59 years (24.1%), and 80 and older (12.2%). For the race/ethnicity demographic characteristics, non-Hispanic White had the highest frequency in all three samples. The demographic characteristics of the race/ethnicity in the study demonstrated that, along with the non-Hispanic White participants (55.7%), the second highest group was non-Hispanic Black (20.5%) followed by Mexican American (13.6%), Hispanic (7.5%), and other race (2.8%).

In education level, the rates of the education level in the study sample as follows: Some college or AA degree (28.8%), high school (26.3%), 9-11th grade (17.7%), college graduate or above (14.4%), and less than 9th grade (12.2%). In annual family income (AFI), the range was as follows: The highest AFI was \$0-\$44,999 (63.7%) followed by \$65,000-\$99,999 (8.9%), \$45,000-\$64,999 (8.0%), \$100,000 and over (1.4%), and missing (18.8%). Table 2 presents the demographic characteristics of the study sample, NHANES samples, and study population.

Table 2

Demographic Characteristics of the Samples: The Study Sample, NHANES Samples, and Study Population: Age and Race/Ethnicity, Education, and Annual Family Income.

Variables	*Study Sample* *N* = 361 (%)	*NHANES Sample* *N* = 3,212 (%)	*Study Population* *(N = 10,537)* (%)
Age:			
50-59	87 (24.1)	454 (14.3)	(8.0)
60-69	137 (38.0)	482 (15.0)	(7.8)
70-79	93 (25.8)	380 (11.0)	(5.8)
80 and older	44 (12.2)	223 (06.9)	(4.0)
Race/Ethnicity:			
Mexican American	49 (13.6)	589 (18.3)	(7.87)
Other Hispanic	27 (7.5)	349 (10.9)	(4.90)
Non-Hispanic White	201 (55.7)	1,520 (47.3)	(68.54)
Non-Hispanic Black	74 (20.5)	569 (17.7)	(12.12)
Other race	10 (2.8)	185 (05.8)	(6.58)
Education Level:			
Less than 9th grade	44 (12.2)	392 (12.2)	(12.4)
9th - 11th grade	64 (17.7)	515 (16.0)	(16.2)
High School graduate	95 (26.3)	701 (21.8)	(22.9)
Some college or AA degree	104 (28.8)	971 (30.2)	(28.0)
College Graduate or above	52 (14.4)	623 (19.4)	(12.0)
Annual Family Income:			
\$0 - \$44,999	230 (63.7)	1,797 (68.7)	(54.6)
\$ 45,000 - \$ 64,999	29 (8.0)	397 (12.4)	(12.8)
\$ 65,000 - \$ 99,999	32 (8.9)	357 (11.0)	(11.8)
\$ 100,000 and over	5 (1.4)	369 (11.5)	(12.7)
Missing	65 (18.0)	19 (0.6)	(4.8)

Note: The study population included women age 50 and older (25.6 %) among the noninstitutionalized U.S. population (CDC, 2015). The NHANES sample included hysterectomized postmenopausal women age 50 and older who participated the Reproductive Health (RHQ-F) survey. The study sample included hysterectomy before the onset of menopause at age 51.

Univariate Analysis

I described the descriptive statistics for continuous variables using the univariate analysis. Table 3 presents the study sample size (*N*), mean (*M*), standard deviation (*SD*), missing count and percent, and number of extremes with low and high values. The sample included women age 50 and older (*N* = 361) who had undergone hysterectomy prior to the onset of menopause, and the cutoff age was 50.

In the NHANES 2009-2010 dataset, participants who were 80 and older were coded as 80; "Refused" were coded as "7", "77", and "777"; and "Don't know" were coded as "9", "99", and "999" (CDC, 2015). In the study, "Refused" and "Don't know " were treated as missing values. The mean (*M*) age of the study sample was 66.14 years (*SD* = 9.03), with a minimum 50 years and a maximum 80 years.

The annual family income (AFI) was categorized as 1 = $0-$44,999; 2 = $45,000-$64,999; 3 = $65,000-$99,999; and 4 = $100,000 and over (CDC, 2015). The mean sample size of the annual family income (*N* = 346, *SD* = 4.13) was 7.55, which met the income range of $45,000-$54,000. The reported 15 missing values (4.2%) included "Refused" coded as "77" and "Don't know" coded as "99."

The mean of vitamin D (D2 +D3) (mcg) (*n* = 184) was 21.89 mcg (*SD* = 21.87), with a minimum 0 (zero) mcg and a maximum 138 mcg. The missing value was 177 (49%). The mean of calcium (mg) (*n* = 205) was 582.01 (*SD* = 563.33), with a minimum 5 mg and a maximum 3,220 mg. The mean of age of hysterectomy (*N* = 361) was 38.39 years (*SD* = 7.36), with a minimum 19 years and a maximum 50 years. Table 3 presents descriptive statistics for the continuous variables.

Table 3

Univariate Descriptive Statistics for Variables Using Univariate Analysis: Age, Annual Family Income (AFI), Calcium/Vitamin D, and Age of Hysterectomy

	N	*M*	*SD*	Missing		No. of Range	
				Count	Percent	Low	High
Age	361	66.14	9.026	0	0	50	80
AFI	346	7.55	4.099	15	4.2	0	0
Vitamin D	184	21.89	21.865	177	49.0	0	138
Calcium	205	582.01	563.325	156	43.2	5	3220
Age of Hysterectomy	361	38.39	7.358	0	0	19	50

Note: Sample size *(N*), Mean *(M),* and Standard Deviation *(SD*)
Units: Age (years), AFI ($), Vitamin D (mcg), Calcium (mg), and Age of Hysterectomy (years)

A missing value analysis was conducted to increase the precision of statistics so that the analysis provided more accurate results of age of hysterectomy, calcium and vitamin D variables (IBM, n. d.). The missing value analysis indicated that all variables demonstrated no missing values ($N = 361$). The values of the original variables were transformed into new values using SPSS analysis. The age range of the participants was 50 years and older. The ratio measurement level was transformed into the ordinal measurement level indicated as 1 = age 50-59, 2 = age 60-69, 3 = age 70-79, and 4 = age 80 and older.

The age of hysterectomy was transformed from the ratio measurement level to the ordinal measurement level as the following: as 1 = 25 and younger, 2 = age 26-35, 3 = age 36-45, and 4 = age 46-50 to categorize women's ages at hysterectomy prior to the onset of menopause. The ratio measurement level of the annual family income was categorized into the ordinal measurement level, 1 = $0-$44,999, 2 = $45,000-$64,999, 3

= $65,000-$99,999, and 4 = $100,000 and over.

The calcium and vitamin D intake was merged and selected to combine if the study participants were taken both supplements. Based on Recommended Dietary Allowances (RDAs), the level of intake of calcium for women age 19-50 years was 1,000 mg and age 51 and older is 1,200mg, and the upper limit of the supplement was allowed up to 3,000 mg (Institute of Medicine, 2011a; NIH, 2013; NOF, n. d.). The ratio measurement level of calcium value was transformed into the ordinal measurement level following as: 1 = less than 1,200 mg, 2 = 1200 mg-2,999 mg, and 3 = 3,000 mg and more. For vitamin D level, 1IU equals 0.025 mcg, and recommendation of vitamin D intake is ranged between 15 mcg-100 mcg according to the calculation provided by dietary supplement ingredient database (NIH, n. d.). Intake of an average 600 International Units (IU) (15 mcg) is recommended for most individuals (NIH, 2013). However, particularly women aged 50 and older are recommended of 800 (20 mcg) - 1,000 IU (25 mcg). The safe daily intake for the upper limit of the supplement is 4,000 IU (100 mcg) for most adults (NOF, n. d.). Vitamin D also was transformed from the ratio measurement level to ordinal measurement level as follows: 1 = less than 15 mcg, 2 = 15 mcg-100 mcg, and 3 = greater than 100 mcg. The transformed each calcium and vitamin D variables was combined and recorded into one variable to assess the association between the appropriate level of intake combined calcium/vitamin D daily supplement level and osteoporosis. To approach the research study question, both calcium and vitamin D variables were retransformed into a categorical value 1 = *Yes* for the appropriate level of the calcium (1,200 mg-2,999 mg)/vitamin D (15mcg-100mcg) recommendation for women aged 50 and older, and 2 = *No* for either too low or high level of the combined supplement intake.

Study Results

In this study, the variables of interest for the independent or predictors included demographic factors (age, race/ethnicity, education, annual family income and age of hysterectomy) and behavioral factors (physical activity and calcium/vitamin D intake). The variable for the independent or outcome was osteoporosis. The variables were obtained from the NHANES 2009-2010 data set. The variables of the demographic factors were from the general interview survey and of behavioral factors were from the medical exam survey questionnaires. To examine the relationship between demographic and behavioral factors among the hysterectomized postmenopausal women, MLR analyses were computed using SPSS.

The assumptions to use the logistic regression analyses were to compute a relationship between the dependent and independent variables. The independent variables require the use of categorical and continuous variables. The dependent variable requires being binary or dichotomous in nature (Field, 2013). Using SPSS, logistic coefficient (β) was expected to have the rates of changes in a dependent variable or predictor as an independent variable changes for each one unit. If the coefficient (β) is closer to zero, the less influence on predicting the logit" (Research and Statistical Support [RSS], 2015, para. 9). Wald statistics is used to evaluate if the logistic coefficient (β) is different from zero or to test whether or not the independent variables make any important contribution toward to predicting outcomes. The statistical significant values with $p<0.05$ considered to be statistically significant.

Exp(β) is odds ratio (OR), which refers how much the odds an outcome occurring increase or decrease when there is unit changes in the independent variables of interest. The OR indicates a measure of an association between an independent or exposure and a dependent or outcome. A predictor increases when OR is greater than 1.0 and does have a higher effect. A predictor has no changes when OR equals to 1, and does not have an effect. A predictor decreases when OR is less than 1.0 and has less effect. It is substantial when comparing categories with nominal and ordinal predictor variables. The 95% confidence interval (CI) is to estimate precision of the OR. A smaller CI implies a higher precision of the OR, and larger CI implies a lower precision of the OR (Szumilas, 2010).

Results for Osteoporosis Prevalence Rates

Table 4 reports osteoporosis prevalence rates of demographic and behavioral factors among women age 50 and older who had undergone hysterectomy prior to the onset of menopause in NHANES 2009-2010 data set. For the data, crosstabs analysis was used to compute osteoporosis prevalence rates of osteoporosis in the dependent variables. The osteoporosis prevalence rates for the variables of demographic factors included age, race/ethnicity, education, annual family income, and age of hysterectomy. The osteoporosis prevalence rates for the variables of behavioral factors included moderate recreational activity and calcium/vitamin D intake. The total of the study sample size was n =361.

Table 4

The Osteoporosis Prevalence Rates of Demographic and Behavioral Factors Among Hysterectomized Postmenopausal Women in NHANES 2009-2010

Variable	Total (*n* = 361)		Cases of Osteoporosis (*n* = 76)		No Osteoporosis (*n* = 285)	
	n	%	*n*	%	*n*	%
Age						
50 - 59	87	24.1	11	14.5	76	26.7
60 - 69	137	38.0	24	31.6	113	39.6
70 - 79	93	25.8	22	28.9	71	24.9
80 and older	44	12.2	19	25.0	25	8.8
Race/Ethnicity						
Mexican American	49	13.6	14	18.4	35	12.3
Other Hispanic	27	7.5	8	10.5	19	6.7
Non-Hispanic White	201	55.7	49	64.5	152	53.3
Non-Hispanic Black	74	20.5	5	6.6	69	24.2
Others	10	2.8	0	0	10	3.5
Education						
Less than 9^{th} grade	44	12.2	14	18.4	30	10.5
9^{th} - 11^{th} grade	64	17.7	21	27.6	43	15.1
High school graduate	97	26.9	17	22.4	80	28.1
Some college or AA degree	104	28.8	16	21.1	88	30.9
College Graduate or above	52	14.4	8	10.5	44	15.4
Annual Family Income						
$0 - $44,999	230	63.7	57	75.0	173	60.7
$ 45,000 - $ 64,999	33	9.1	7	9.2	26	9.1
$ 65,000 - $ 99,999	61	16.9	6	7.9	55	19.3
$ 100,000 and over	37	10.2	6	7.9	31	10.9
Physical Activity						
Yes	123	34.1	23	30.3	53	69.7
No	238	65.9	100	35.1	185	64.9
Calcium/Vitamin D						
Yes	29	8.0	9	11.8	67	88.2
No	332	92.0	20	7.0	265	93.0
Age of Hysterectomy						
≤25	18	5.0	5	6.6	13	4.6
26 - 35	104	28.8	22	28.9	82	28.8
36 - 45	172	47.6	29	38.2	143	50.2
46 - 50	67	18.6	20	26.3	47	16.5

Note: Annual Family Income ($), Physical Activity (min; moderate recreational activity for at least 10 minutes continuously), Calcium/Vitamin D (mg/mcg), and Age of Hysterectomy (year).

As Table 4 reported, overall, there was an inverse association between demographic factors and the prevalence of osteoporosis.

In the age group, the association between age and the prevalence of osteoporosis was highest among age 60-69 (31.6%), followed by age 70-79 (*2*8.9%), age 80 and older (25%), and lowest among age 50-59 (14.5%). Base on the result, age was inversely associated with the prevalence of osteoporosis among hysterectomized postmenopausal women.

In the race/ethnicity group, the association between race/ethnicity groups and the prevalence of osteoporosis was highest among Non-Hispanic Whites (64.5%), followed by Mexican American (18.4%), other Hispanic (10.5%), and lowest among non-Hispanic Blacks (6.6%), and others (0.0%). Base on the result, the prevalence of osteoporosis was strongly associated with non-Hispanic Whites, followed by Mexican American, other Hispanic, and non-Hispanic Blacks among hysterectomized postmenopausal women.

In the education level, the association between education and the prevalence of osteoporosis was highest among 9th-11th grade (27.6%), followed by high school graduate (22.4%), some college or AA degree (21.1%), less than 9th grade (18.4%), and lowest among college graduate or above (10.5%). Based on the result, education was inversely associated with the prevalence of osteoporosis; the lower the education level the higher the prevlanece of osteoporosis among hysterectomized postmenopausal women.

In the annual family income level, the association between the annual family income and the prevalence of osteoporosis was highest among annual family income level $0-$ 44,999 (75.5%), followed by annual family income levels $45,000-$64,999

(9.2%), and lowest among annual family incomes $65,000-$99,999 (7.9%) and $100,000 and over (7.9%). Based on the result, annual family income was inversely associated with the prevalence of osteoporosis; the lower the annual family income level the higher the prevalence of osteoporosis among hysterectomized postmenopausal women.

In the age of hysterectomy, the association between age of hysterectomy and the prevalence of osteoporosis was highest among age of hysterectomy 36-45 (38.2%), followed by age of hysterectomy 26-35 (28.9%), age of hysterectomy 46-50 (26.3%), and lowest among age of hysterectomy 25 and younger (6.6%). Based on the result, age of hysterectomy 36-45 was highly associated with the prevalence of osteoporosis among hysterectomized postmenopausal women.

In the physical activity group, there was an association between moderate recreational activity and the prevalence of osteoporosis among hysterectomized postmenopausal women. The prevalence of osteoporosis was lower with moderate recreational activity (30.3%) than with no moderate recreational activity (35.1%). The results indicated that moderate recreational activity was associated with decreased prevalence of osteoporosis among hysterectomized postmenopausal women.

In the calcium/vitamin D intake, there was no association between calcium/vitamin D intake and the prevalence of osteoporosis among hysterectomized postmenopausal women. The association between calcium/vitamin D intake and the prevalence of osteoporosis (11.8%) was higher than that the association between no calcium/vitamin D intake and the prevalence of osteoporosis (7.0%). In the result, the osteoporosis prevalence was higher with calcium/vitamin intake D than no calcium/vitamin intake. This reversed outcome may be due to the higher number of study participants with no calcium/vitamin D intake group (92.0%) than the lower study participants calcium/vitamin D intake (8.0%). The result caused for the higher osteoporosis prevalence with no calcium/vitamin D intake group (Table 4).

Overall, age, education, and family income were inversely associated with the osteoporosis prevalence. Non-Hispanic Whites with age of hysterectomy 36-45 were highly associated with the prevalence of osteoporosis, but calcium/vitamin D intake was not associated with the prevalence of the disease.

Results for Research Question 1

Is there an association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and osteoporosis prevalence in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Null hypothesis (H1o): There is no association between demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and osteoporosis in the women aged 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Alternative hypothesis (H1a): There is an association between demographic factors (age, race/ethnicity, education level, education level, annual family income, and age of hysterectomy) and osteoporosis prevalence in the women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause. I used multiple logistic regressions and multivariate analyses using SPSS to answer the research question1.

Table 5 reported the results of the analysis of the crude and adjusted odd ratios for osteoporosis by demographic factors including age, race/ethnicity, education, annual family income, and age of hysterectomy) and osteoporosis prevalence in hysterectomized postmenopausal women in NHANES 2009-2010. Multiple logistic regression analyses were used to compute the crudes and adjusted ORs and CIs. The crude (raw) ORs and CIs were to compare the osteoporosis prevalence between the reference group and other groups in each variable. The adjusted ORs and CIs to adjust for confounding and determine for effective modification or assess the relationships of risk factors on an outcome simultaneously (Boston University School of Public Health, 2013). The continuous variables, such as age, annual family income level, and age of hysterectomy, were adjusted to the ordinal levels of the measurement from the ratio levels of the measurements originally assigned by NHANES 2009-2010 dataset. The model included the total number of the study sample size (N =361) (Table 5).

Results for age associated with osteoporosis. The frequencies and rates for the osteoporosis prevalence for the age groups were as follows: Age 50-59 years (n = 87, 24.1%), age 60-69 (n = 137, 38.0%), age 70-79 (n = 93, 25.8%), and age 80 years and older (n = 44, 12.2%). The results reported the crude and adjusted ORs and 95% CIs for the osteoporosis at the education level. The reference group was determined as the age group 50-59 years since this youngest age group was least affected with an osteoporosis risk. The crude odds for osteoporosis prevalence in the age group 60-69 years were 5.25 times higher in osteoporosis prevalence than the reference group (crude OR = 5.25, 95%

CI [2.20, 12.53]). The results were statistically significant (p = 0.00). The crude odds for osteoporosis prevalence in the age group 70-79 years were 3.58 times higher in osteoporosis prevalence than the reference group (crude OR = 3.58, 95% CI [1.71, 7.51]). The results were statistically significant (p = 0.00). The crude odds for osteoporosis prevalence in the age group 80 and older years were 2.45 times higher in osteoporosis prevalence than the reference level (crude OR = 2.45, 95% CI [1.14, 5.25]). The results were statistically significant (p = 0.02). Overall, statistical significance in difference of the osteoporosis prevalence in the age group and reference group (Table 5).

The result reports the adjusted ORs and 95% CIs of the age for osteoporosis prevalence. The adjusted odds for osteoporosis prevalence in the age group 60-69 years was 5.23 times higher in osteoporosis prevalence than the reference level (adjusted OR = 5.23, 95% CI [2.03, 13.45]). Statistically significant association was found between the age group 60-69 and the reference age group (p = 0.00). The adjusted odds for osteoporosis prevalence in the age group 70-79 years was 3.70 times higher in osteoporosis prevalence than the reference level (crude OR = 3.70, 95% CI [1.63, 8.43]). Statistically significant association was found in the age group 70-79 and the reference group (p = 0.00). The adjusted odds for osteoporosis prevalence in the age group 80 and older years was 2.27 times higher in osteoporosis prevalence than the reference level (crude OR = 2.27, 95% CI [0.99, 5.21]) The association was statistically significant (p = 0.05). The results of the aged adjusted osteoporosis prevalence were statistically significant (Table 5).

Overall, the associations between both crude/adjusted age and osteoporosis prevalence among hysterectomized postmenopausal women were significant.

Results for race/ethnicity associated with osteoporosis. In the race/ethnicity group analysis, the frequencies and rates for the osteoporosis prevalence was as follows: Mexican American (n = 49, 13.6%), other Hispanic (n = 27, 7.5%), non-Hispanic White (n = 201, 55.7%), non-Hispanic Black (n = 74, 20.5%), and other races (n = 10, 2.8%) were analyzed. The reference group was determined as non-Hispanic White. The result reported the crude ORs and 95% CIs of the race/ethnicity for osteoporosis prevalence.

The crude odds for osteoporosis prevalence in the Mexican American was 0.81 times (19%) lower than the odds for the osteoporosis prevalence in the reference level (crude OR = 0.81, 95% CI [0.40, 1.62]). No statistically significant association of the osteoporosis prevalence was found between the Mexican American and the reference group (p = 0.55). The crude odds for the osteoporosis presence in the other Hispanic was 0.77 times (27%) lower than the osteoporosis prevalence in the reference group (crude OR = 0.77, 95% CI [0.32, 1.86]). The association was not statistically significant (p = 0.56). The osteoporosis prevalence of the non-Hispanic Black was 4.55 times (455%) higher than the reference group (crude OR = 4.45, 95% CI [1.70, 11.66]. Statistically significant association was found between the non-Hispanic Black and the reference group (p = 0.00) (Table 5). Overall, no significant associations were found between crude odds of osteoporosis prevalence of race/ethnic groups and the reference group. However, non-Hispanic Black was statistically associated with the reference group.

The result of the adjusted ORs and 95% CIs for osteoporosis prevalence were reported. The adjusted odds for the osteoporosis prevalence in the Mexican American was approximately 0.76 times (24%) lower than the odds for osteoporosis prevalence in non-Hispanic White as the reference group (adjusted OR = 0.76, 95% CI [0.33, 1.73]). The association was statistically significant (*p* = 0.51). The adjusted odds for the osteoporosis prevalence in other Hispanic was approximately 0.62 times (38%) lower than the odds for the osteoporosis prevalence in the reference group (adjusted OR = 0.62, 95% CI [0.23, 1.68]). The association was statistically significant (*p* = 0.35). On the other hand, the Non-Hispanic Black was approximately 3.84 times higher than the odds for osteoporosis prevalence in the reference group (adjusted OR = 3.84, 95% CI [1.40, 10.52]). The association was statistically significant (*p* = 0.01) (Table 5).

Based on the results of the race/ethnicity-adjusted osteoporosis prevalence, no significant associations were found between adjusted odds of osteoporosis prevalence of race/ethnic groups and the reference group. However, non-Hispanic Black was statistically associated with the reference group. Overall, the crude and adjusted association between non-Hispanic Blacks and the reference group was significant.

Results for education level associated with osteoporosis. In the education level analysis, the frequencies and rates for the osteoporosis prevalence for the education level were as follows: Less than 9^{th} grade (*n* = 44, 12.2%), 9^{th}-11^{th} grade (*n* = 64, 17.7%), high school graduate (*n* = 97, 26.9%), some college or AA degree (*n* = 104, 28.8%), and college graduate or above (*n* = 52, 14.4%). In the relationship between osteoporosis prevalence and education levels, the some college or AA degree education level was determined as the reference level because this education group had higher number of survey responses.

The result reported the crude ORs and 95% CIs of the education level for osteoporosis prevalence. The crude odds for osteoporosis prevalence in the Less than 9th grade level was 0.39 times (61%) lower in osteoporosis prevalence than the education level in the some college or AA degree education level as the reference education group (crude OR = 0.39, 95% CI [0.15, 1.04]). The association was not statistically significant (*p* = .06). The crude odds for osteoporosis prevalence in the 9th-11th grade level was 0.37 times (63%) lower in the osteoporosis prevalence than the reference level (crude OR = 0.37, 95% CI [0.15, 0.93]). The association was not statistically significant (*p* = 0.35). The crude odds for the high school grade level was 0.86 times (14%) lower in osteoporosis prevalence than the reference level (crude OR = 0.86, 95% CI [0.34, 2.14]). The association was not statistically significant (*p* = 0.74). The crude odds for osteoporosis prevalence in the college graduate or above level was 1.00 time (100%) to the reference level (crude OR = 1.00, 95% CI [0.40, 2.14]). The college graduate or above level makes no statistically significant difference than one in the reference. The association was not statistically significant (*p* = 1.00). Overall, there were no statistical difference between the education levels and the reference level (Table 5).

The results of the adjusted odds ratios and 95% CI reports that the adjusted odds for osteoporosis prevalence in the less than the 9th grade level was 0.53 times (47%) lower than the odds for osteoporosis prevalence in the reference level (adjusted OR = 0.53, 95% CI [0.17, 1.62]). The association was not statistically significant (*p* = 0.27). The adjusted odds for osteoporosis prevalence in the 9th-11th grade level was 0.34 times (66%) lower than the odds of osteoporosis for the reference level. the adjusted odds of the osteoporosis prevalence in the 9th-11th grade level was significantly associated with the osteoporosis prevalence in the reference level (adjusted OR = 0.34, 95% CI [0.13, 0.93], *p* = 0.04). The adjusted odds for osteoporosis in the high school graduate level was 0.95 times (5%) lower than the odds of osteoporosis for the reference level (adjusted OR = 0.95, 95% CI [0.36, 2.50]). The association was not statistically significant (*p* = 0.91). The adjusted odds for osteoporosis in the college graduate or above was 0.92 times (8%) lower than the odds of the reference level (adjusted OR = 0.92, 95% CI [0.35, 2.44]). The association was not statistically significant (*p* = 0.87) (Table 5).

In the results of both crude and adjusted ORs and CIs in the education level, the 9th-11th grade level was significantly associated with a high risk of osteoporosis. Therefore, there was an association between level of the education and the osteoporosis prevalence among women aged 50 and older who have under hysterectomy prior to the onset of menopause.

Results for annual family income associated with osteoporosis. In this economic status study, the frequencies and rates for the income were ranged as follows: $0-$44,999 (*n* = 230, 77.3%), $ 45,000-$64,999 (*n* = 33, 12.5%), $65,000-$99,999 (*n* = 61, 9.0%), and $100,000 and over (*n* = 37, 1.4%). The association between the osteoporosis prevalence in each annual family income (AFI) level and the osteoporosis prevalence in the reference group, AFI $65,000-$99.000 level, was analyzed. The $65,000-$99.000 level was determined as the reference level because the income level was higher than the middle income in the variable. The result reports the crude ORs and 95% CIs for the osteoporosis prevalence at the AFI level.

The crude odds for the osteoporosis prevalence was 0.59 times (41%) lower in the $0-$44,999 AFI level than at the reference group (crude OR = 0.59, 95% CI [0.23, 1.48]). The association was not statistically significant (*p* = 0.26). The crude odds for osteoporosis prevalence was 0.72 times (28%) lower in the $45,000-$64,999 AFI level than the reference group (crude OR = 0.72, 95% CI [0.22, 2.41]). The association was not statistically significant (*p* = 0.59). The crude odds for the osteoporosis prevalence was 1.77 times (77%) higher in the $100,000 and over AFI level than the reference level (crude OR = 1.77, 95% CI [0.53, 5.98]). The association was not statistically significant (*p* = 0.36) (Table 5). Overall, there was no statistical significant association of the osteoporosis prevalence at each income level than the osteoporosis prevalence at the reference level.

The results of the adjusted ORs and 95% CIs reports that the adjusted odds for osteoporosis prevalence in the $0-$44,999 AFI level was 0.76 times (24%) lower in the osteoporosis prevalence at the income level than the prevalence at the reference group (adjusted OR = 0.76, 95% CI [0.28, 2.07]). The association was not statistically significant (*p* = 0.59). The adjusted odds for osteoporosis prevalence in the $45,000-$64,999 AFI level was 0.80 times (20%) lower in the osteoporosis prevalence at the income level than the odds of the osteoporosis prevalence at the reference level (adjusted OR = 0.80, 95% CI [0.22, 2.87]). The association was not statistically significant (*p* = 0.73). The adjusted odds for the osteoporosis prevalence in the $100,000 and over level was 1.84 times (184%) higher than the odds of the osteoporosis prevalence at the reference level (adjusted OR = 1.84, 95% CI [0.51, 6.67]). The association was not statistically significant ($p = 0.33$) (Table 5). Overall, the odds of income levels were positively associated with the prevalence of osteoporosis compared to the odds of the reference income level. The association was not statistically significant.

Results for age of hysterectomy associated with osteoporosis. The result reports the crude ORs and 95% CIs of age of hysterectomy for osteoporosis prevalence. Frequencies and rates for age of hysterectomy were ranged as follows: Less than age 25 years ($n = 18$, 5.0%), age 26-35 ($n = 104$, 28.8%), age 36-45 years ($n = 172$, 47.6%), and age 46-50 years ($n = 67$, 18.6%). The highest frequency of age of hysterectomy was 35-45 years, which determined as the reference group.

The crude odds for the osteoporosis prevalence in age of hysterectomy 25 years and younger was 0.53 times (47%) lower the osteoporosis prevalence in age of hysterectomy 35-45 years in the reference level (crude OR = 0.53, 95% CI [0.17, 1.59]). The association was not statistically significant ($p = 0.26$). The crude odd for the osteoporosis prevalence in age of hysterectomy 26-35 years was 0.76 (34%) times lower than the osteoporosis prevalence in the reference level (crude OR = 0.76, 95% [0.41, 1.40]). The association was not statistically significant ($p = 0.37$). The crude odds for the osteoporosis prevalence in age of hysterectomy 46-50 years was 0.48 times (52%) lower than the osteoporosis prevalence in the reference level (crude OR = 0.48, 95% CI [0.25, 0.92]) (Table 5). The association between age of hysterectomy and the prevalence of osteoporosis was statistically significant ($p = 0.03$). Overall, the odds of age of hysterectomy were negatively associated with the prevalence of osteoporosis compared to the odds of the reference. The association was significant in age of hysterectomy 36-45 and the prevalence of osteoporosis among hysterectomized postmenopausal women.

The results of the adjusted ORs and 95% CIs reports that the adjusted odds for the osteoporosis prevalence in age of hysterectomy 25 and younger years was 0.36 times (64%) lower than the odds for the osteoporosis prevalence in the reference level (adjusted OR = 0.36, 95% CI [0.11, 1.24]). The association was not statistically significant (*p* = 0.11). The adjusted odds for the osteoporosis prevalence in age of hysterectomy 26-35 years was 0.73 times (27%) less than the odds of the osteoporosis prevalence for the reference level (adjusted OR = 0.73, 95% CI [0.37, 1.43]). The association was not statistically significant (*p* = 0.35). The adjusted odds for osteoporosis in age of hysterectomy 46-50 years was 0.48 times lower than the odds of the osteoporosis prevalence for the reference level (adjusted OR = 0.48, 95% CI [0.23, 1.01]). The age adjusted association was statistically significant (*p* = 0.05) (Table 5). Overall, the association of crude and adjusted odd ratios for age of hysterectomy was not significant. However, there was a significant association between age of hysterectomy 46-50 and the prevalence of osteoporosis.

I examined the research question if there were significant association between demographic factors and the prevalence of osteoporosis. The study results were reported that there were association between the age, race/ethnicity, and age of hysterectomy and the prevalence of the disease. Based on the results, I rejected the null hypothesis. Education level and annual family income were not associated with the prevalence of osteoporosis that I failed to reject the null hypothesis.

Table 5

The Crude/Adjusted ORs and CIs for Osteoporosis by Demographic Factors Among Hysterectomized Postmenopausal Women Prior to the Onset of Menopause in NHANES 2009-2010

	Osteoporosis Crude Odds Ratio (95% CI)	Osteoporosis Adjusted* Odds Ratio (95% CI)
Age		
50-59	Reference	Reference
60-69	5.25 (2.20, 12.53)	5.23 (2.03, 13.45)
70-79	3.58 (1.71, 7.51)	3.70 (1.63, 8.43)
80 and older	2.45 (1.14, 5.27)	2.27 (0.99, 5.21)
Race/Ethnicity		
Mexican American	0.81 (0.40, 1.62)	0.76 (0.33, 1.73)
Other Hispanic	0.77 (0.32, 1.86)	0.62 (0.23, 1.68)
Non-Hispanic White	Reference	Reference
Non-Hispanic Black	4.45 (1.70, 11.66)	3.84 (1.4, 10.52)
Education		
Less than 9th grade	0.39 (0.15, 1.04)	0.53 (0.17, 1.62)
9th-11th grade	0.37 (0.15, 0.93)	0.34 (0.13, 0.93)
High school graduate	0.86 (0.34, 2.14)	0.95 (0.36, 2.50)
Some college or AA degree	Reference	Reference
College Graduate or above	1.00 (0.40, 2.52)	0.92 (0.35, 2.44)
AFI		
$0-$44,999	0.59 (0.23, 1.48)	0.76 (0.28, 2.07)
$45,000-$64,999	0.72 (0.22, 2.41)	0.80 (0.22, 2.87)
$65,000-$99,999	Reference	Reference
$100,000 and over	1.77 (0.53, 5.98)	1.84 (0.51, 6.69)
Age of Hysterectomy		
≤ 25	0.53 (0.17, 1.59)	0.36 (0.11, 1.24)
26-35	0.76 (0.41, 1.40)	0.73 (0.37, 1.43)
36-45	Reference	Reference
46-50	0.48 (0.25, 0.92)	0.48 (0.23, 1.01)

Note: AFI = Annual Family Income, CI = Confidence Intervals
* The adjusted variables: age, race/ethnicity, education level, and annual family income, and age of Hysterectomy.

Results for Research Question 2

Is there an association between behavioral factors (moderate recreational activity and calcium/vitamin D intake and the prevalence of osteoporosis in the women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Null hypothesis (H2o): There is no association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis in the women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Alternative hypothesis (H2a): There is an association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and osteoporosis in the women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Results for moderate recreational activity associated with osteoporosis. Table 6 reported that the results for the association between physical activity and osteoporosis.

The osteoporosis crude odds ratio and 95% CI was computed to assess the association between the group of moderate recreational activity for at least 10 minutes continuously and osteoporosis prevalence among women aged 50 and older who have undergone hysterectomy prior to the onset of menopause. The osteoporosis was dichotomous dependent (yes, no) variable and “Yes’ was determined as the reference level. The result reports that the crude odds for the osteoporosis prevalence in the group of no moderate recreational activity were 0.80 times lower than the osteoporosis prevalence in the reference level. The odds of the group with no moderate recreational activity were 20% lower in the osteoporosis prevalence than the osteoporosis prevalence in the reference level. The result was not statistically significant (crude OR = 0.80, 95% CI [0.47, 1.39]) (Table 6).

The results of the adjusted odds ratios and 95% CI reported that the adjusted odds for the osteoporosis prevalence with no moderate recreational activity for at least 10 minutes continuously was 26 times higher than the adjusted odds for osteoporosis prevalence in the reference level. The result indicates that the odds of the osteoporosis prevalence were 126 % higher with no moderate recreational activity than the osteoporosis prevalence in the reference level. The adjusted odds for osteoporosis prevalence among no moderate recreational activity was statistically significant (adjusted OR = 0.77, 95% CIs [0.44, 1.34]) (Table 6). Overall, the no physical activity was associated with the prevalence of the disease.

Results for calcium/vitamin D associated with osteoporosis. The osteoporosis crude odds ratio and 95% CI was computed to assess the association of the osteoporosis prevalence between the calcium/vitamin D level and the osteoporosis prevalence in the reference group among women age 50 and older who had undergone hysterectomy prior to the onset of menopause. The osteoporosis was a dichotomous dependent (yes, no) variable, and "Yes' was determined as the reference level.

The result reported that the crude odds for the osteoporosis prevalence in the group of no calcium/vitamin D intake were 78 times (178%) higher than the prevalence in the reference level. There was a statistical significant difference between the two groups (crude OR = 1.78, 95% CI [0.78, 4.09]) (Table 6).

The results of the adjusted odds ratios and 95% CI reports that the adjusted odds for the osteoporosis prevalence in the group of no calcium/vitamin D intake was 66 % (166%) higher than the odds for osteoporosis prevalence in the reference level (adjusted OR = 1.52). The association was statistically significant when compared to the reference (95% CIs [0.78, 4.09]) (Table 6). Overall, no calcium/vitamin D intake was significantly associated with the prevalence of osteoporosis.

Based on the results of the study, I found that there was an association between behavioral factors (moderate recreational activity and calcium/vitamin D intake) and the osteoporosis prevalence. Therefore, I rejected the null hypothesis. Physical activity and adequate level of calcium/vitamin D intake positively affect osteoporosis among the hysterectomized postmenopausal women.

Table 6

The Crude and Adjusted ORs and CIs by Behavioral Factors Among Hysterectomized Women Prior to the Onset of Menopause in NHANES 2009-2010

		Osteoporosis Crude Odds ratio (95% CI)	Osteoporosis Adjusted* Odds ratio (95% CI)
Physical Activity			
	Yes	Reference	Reference
	No	0.80 (0.47, 1.39)	1.26 (0.66, 2.39)
Cal/vit D			
	Yes	Reference	Reference
	No	1.78 (0.78, 4.09)	1.66 (0.66, 4.18)

Note: CI = Confidence Intervals
* The adjusted variables: Physical Activity (= moderate recreational activity for at least 10 minutes continuously) and Cal/Vit D (= Calcium/vitamin D).

Summary and Transition

In summary, NHANES 2009-2010 survey data were used to examine whether demographic factors and behavioral factors associated with osteoporosis among postmenopausal women who had undergone hysterectomy prior to the onset of natural menopause. The demographic factors included age, race/ethnicity, education, annual family income, and age of hysterectomy. The behavioral factors included physical activity and calcium/vitamin D intake.

Chapter 4 presented the data collection and results of the research study. In the data collection, I reported the results of the univariate descriptive statistical and MLR analyses. In the study results, the highest osteoporosis prevalence occurred in some college or AA, degree (28.8%) educated non-Hispanic women (55.7%) age group between 60 and 69 years (38.0%) with their annual family income level range was between $0-$44,999 (63.7%) (Table 4). For the univariate descriptive statistical analysis, the continuous variables (age, annual family income, calcium, vitamin D, and age of hysterectomy) were included. Because of the high percentage of the missing values of calcium (43.4%) and vitamin D (48.8%), the missing value analysis was conducted. The final study sample was determined with $N = 361$. The maximized age of hysterectomy was determined as women age 50 years and younger. The determination of the age was based on the Shuster et al. (2010) study that the average age of natural menopause among US women is 51 years (p.165). Hysterectomy leads surgically induced premature or early menopause (Shuster et al., 2010). The age was also determined in accordance to the study target women's age group consisted of 50 and older who had undergone hysterectomy prior to the onset of menopause. In the MLR analyses to compute the crude and adjusted ORs, age was statistically significantly associated with the prevalence of osteoporosis. In In the races/ethnicities there was significantly association between the adjusted OR for the prevalence of osteoporosis and non-Hispanic Black and not the crude OR. Other races/ethnicities were not significant for both crude and adjusted osteoporosis prevalence. The education level of 9th-11th grade was significant for adjusted osteoporosis prevalence compared to other education levels. Annual family income was not significant for both crude and adjusted ORs. Age of hysterectomy 46-50 was significant for both crude and adjusted ORs. Based on the results of the demographic factors influencing osteoporosis among hysterectomized postmenopausal women, age, education, and age of hysterectomy were associated with osteoporosis, but annual family income was not. In the results of the behavioral factors, physical activity was significantly associated with adjusted OR for decreasing the prevalence of osteoporosis. Calcium/vitamin D intake was statistically significant with both crude and adjusted ORs. Based on the results, both moderate recreational activities and calcium/vitamin D intake are associated with osteoporosis.

Chapter 5 presents the interpretation of the findings, limitations and strength of the study, and conclusions, as well as recommendations for further study. In addition, this chapter discusses the implications of the findings and its potential impact on positive social change.

Chapter 5: Discussion, Conclusions, and Recommendations

The purpose of this study was to examine the prevalence of osteoporosis among hysterectomized postmenopausal women. This study addressed a critical research gap concerning the association between demographic and behavioral factors and osteoporosis among women age 50 and older who had undergone hysterectomy prior to menopause.

This cross-sectional quantitative study included a nationally representative sample of the U.S. population to determine whether demographic and behavioral factors were associated with osteoporosis outcome among hysterectomized postmenopausal women. The demographic factors included race/ethnicity, education, and annual family income. The behavioral factors included physical activity and calcium/vitamin D. Covariates were demographic age and age of hysterectomy.

No published research studies had been found addressing the association between demographic and behavioral factors and osteoporosis among hysterectomized postmenopausal women who had undergone hysterectomy prior to the onset of menopause. This quantitative cross-sectional study included the NHANES 2009-2010 data set to answer the research study questions. I reported overall demographic characteristics of the study sample, NHANES sample, and total women population. I conducted univariate statistical analysis to determine the descriptive statistics of variables. Finally, I conducted MLR analyses to examine the association between demographic and behavioral factors and osteoporosis using SPSS statistical analysis.

Interpretation of Findings

Osteoporotic risk among postmenopausal women is a substantial health problem.

This study focused on women age 50 and older who had been diagnosed with osteoporosis and had a hysterectomy, including a partial hysterectomy, prior to natural menopause at age 51 (CDC, 2015; NIH, n. d.; Shuster et al., 2010). In this study, the natural menopausal age was determined at age 51 years. Although a false-positive or -negative menopause condition was found in non-menopausal women (Mosch, Jaschinski, and Eikermann (2014), the clear concept of natural menopause defined as the absence of menstrual bleeding at least for 12 months (Wu et al., 2014). Based on the concept defined by the studies of Shuster et al. (2010) and Wu et al. (2014), the natural menopause was determined at average age of 51 years, and the hysterectomized women's age was maximized at age of 50 (CDC, 2015).

I discussed that Fu et al. (2011) and Fletcher et al. (2013) reported the bone health risk that were associated between hysterectomy (or surgically induced menopause) and osteoporosis in the literature review. I revealed that demographic factors (age, race/ethnicity, education, and age of hysterectomy) and behavioral factors (physical activity and calcium/vitamin D) were associated with the bone health risks among women age 50 and older that had undergone hysterectomy prior to the onset of menopause.

Overall, the findings of this study indicate that behavioral factors including moderate recreational activity and calcium/vitamin D intake play a substantial role as risk factors of osteoporosis in hysterectomized postmenopausal women. Demographic factors including age, education, annual family income, non-Hispanic Whites, and age of hysterectomy 36-45 play a substantial role as risk factors of osteoporosis, but annual income family income plays a less substantial role in identifying the risk factors of osteoporosis. The MLR analysis with osteoporosis as the dichotomous dependent variable was stronger when age and hysterectomy at age covariates (R^2 = 0.23) were included as compared to the MLR models without the covariates (R^2 = 0.19) in the independent variables.

Missing values can cause potential biases or lead to inefficient data analysis (Horton & Kleinman, 2007). In this study, large percentages of missing values in variables of annual family incomes (4.1%) and calcium (43.2%) and vitamin D intake (49.0%) were observed. To reduce bias and increase efficiency, missing value analysis was conducted using SPSS.

The independent variables were measured as either continues or dichotomous. In this study, demographic factors (race/ethnicity, education, and age of hysterectomy) and behavioral factors (physical activity and calcium/vitamin D intake) significantly influenced to increase the prevalence of osteoporosis. The relationship persisted with the inclusion of age covariate in the MLR analysis. This result confirmed the studies (Fredericks, 2013; Kim et al., 2012; Maddah et al., 2011; Qi et al., 2013; Prentice et al., 2013; Reymondier et al., 2013) that were reviewed in Chapter 2. On the other hand, annual family income factor did not significantly influence risk for osteoporosis. Among hysterectomized postmenopausal women.

Research Question 1

Is there an association between demographic factors (age, race/ethnicity, education level, and annual family income) and the prevalence of osteoporosis in women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Association Between Demographic Factors and Osteoporosis

Age and osteoporosis. I found that, overall; there was a statistically significant association between age and osteoporosis among women age 50 and older who had undergone hysterectomy prior to the onset of menopause. Based on the results of the crude ORs and 95% CI analyses, there were more than 5.25 times higher risk of osteoporosis in women age 60-69, 3.58 times higher risk in women age 70-79, and 2.45 times higher risk in women age 80 and older. I concluded that there was a statistically significant association between age and osteoporosis prevalence.

For the results of the adjusted OR and 95% CI analysis, there was 523% higher risk of osteoporosis in women age 60-69 years, 370% higher risk in women age 70-79 years, and 227% higher risk in women age 80 and older. Despite the fact that osteoporosis risk was highly affected in the earlier ages, I concluded that, overall, there was an association between age and osteoporosis prevalence. This finding was consistent with the results from previous studies. The results of the cohort study conducted by Cooper et al. (2011) to examine secular trends in the incidence of osteoporosis in North America revealed that age substantially influences the incidence of osteoporotic hip fracture among postmenopausal women (Cooper et al., 2011).

In the following year, Dawson-Hughes et al. (2012) published a study that assessed the prevalence of risk factors for osteoporosis among men and women age 50 and older (N = 3,608). The study participants were candidates for hip and lower back spine fracture risk treatment. This finding supported the Cooper et al. (2011). The finding was that age was positively associated with osteoporosis risk (Dawson-Hughes et al., 2012).

Furthermore, findings from Wright et al.'s (2014) cross-sectional study were consistent with Dawson-Hughes et al.'s (2012) findings. Wright et al. used NHANES 2005-2010 data to estimate the prevalence of osteoporosis and low bone mass among adults age 50 and older in the United States. Wright et al. found that as women got older, the prevalence of osteoporosis increased as follows: age 50-59 was 6.8% (SE = .83); age 60-69 was 12.3% (SE = 1.44); age 70-79 was 25.7% (SE = 1.56); and age 80 and older was 34.9 % (SE = 2.44). Overall, the results of this study supported the conclusion that there was an association between age and increase in the prevalence of osteoporosis in the hysterectomized postmenopausal women.

Race/ethnicity and osteoporosis. The results of osteoporosis distribution for race/ethnicity indicated that non-Hispanic White (64.5%) was highly affected compared to other race/ethnicity groups. The distribution results may be due to the number of participants, as the non-Hispanic White participation was approximately 10 times greater than non-Hispanic Black (6.6%) was.

The results of the crude ORs and 95% CI analyses indicated that there was a significant association between the non-Hispanic Black and osteoporosis prevalence with non-Hispanic White as the reference group, but there was no osteoporosis prevalence association with the rest of the race/ethnicity groups. I concluded that non-Hispanic Black was associated with the prevalence of osteoporosis in the hysterectomized postmenopausal women.

The results of the adjusted ORs and 95% CI analyses also showed that the race/ethnicity groups of Mexican American and the other Hispanic were associated with a lower risk of osteoporosis. The non-Hispanic Black group was associated with a higher risk of osteoporosis. In addition, the adjusted ORs and CIs indicated that the Mexican American and the other Hispanic groups were associated with a lower osteoporosis risk. However, the non-Hispanic Black group was associated with a higher risk of osteoporosis among women age 50 and older who had under undergone hysterectomy prior to the onset of menopause.

I concluded that, overall, there were significant associations between non-Hispanic Black and osteoporosis prevalence among postmenopausal women age 50 and older who had undergone hysterectomy prior to natural menopause. This new finding indicates that non-Hispanic Blacks have significant association with the prevalence of osteoporosis among hysterectomized postmenopausal women.

Previous studies indicated an association between race/ethnicity and osteoporosis risk among postmenopausal women. Dawson-Hughes et al. (2012)'s cross-sectional study not only assessed the association between age and prevalence of risk for osteoporosis but also assessed race/ethnicity and osteoporosis in men and postmenopausal women age 50 and older. Dawson-Hughes et al. found that race/ethnicity was significantly associated with the prevalence of risk for osteoporosis. Dawson-Hughes et al. found that Mexican American women had a higher prevalence of osteoporosis (24.4%) than non-Hispanic Black women (5.3%) followed by non-Hispanic White women (10.9%). Dawson-Hughes et al. found that Mexican American women also had a higher prevalence of osteoporosis

(18.4%) than non-Hispanic Black (6.6%).

Overall, these study findings showed that non-Hispanic White women had a higher prevalence of osteoporosis (55.7%) than non-Hispanic Black women (20.5%) followed by Mexican American women (13.6%). Odds ratio analysis result from this study indicated that non-Hispanic Black were higher risk of osteoporosis compared to non-Hispanic Whites among hysterectomized postmenopausal women. Race/ethnicity was significantly associated with the prevalence of osteoporosis. This new study's finding about the association between non-Hispanic Black and the prevalence of osteoporosis would contribute to a new way of understanding of the high risk of osteoporosis among non-Hispanic White women age 50 and older who had undergone hysterectomy prior to the onset of menopause.

Education level and osteoporosis. Based on results from the distribution for osteoporosis in level of education, the level 9th-11th grade showed the greatest distribution for osteoporosis (27.6%), which was more than twice the college graduate was or above level (10.5%).

According to results from the crude ORs and 95% CIs analyses to understand the relationship between the education level and osteoporosis prevalence, there was 61% lower risk of osteoporosis than 9th grade level, 63% lower risk in the 9th-11th grade level, and 24% lower risk in the high school grade level compared to the reference of some college or above. I concluded that there was a significant association between the 9th-11th grade level and osteoporosis prevalence. However, there was no significant association between the less than 9th grade and high school grade levels, and college graduate or above and osteoporosis risk prevalence.

According to the results of the osteoporosis adjusted ORs and 95% CIs analyses related to the education level associated with osteoporosis prevalence, there was 47% lower risk of osteoporosis in the less than 9th grade level, 66% lower risk in the 9th-11th grade level, 5% lower risk in the high school grade level, and 8% lower risk in the college graduate or above level than the reference level of some college or AA degree. I concluded that there was a significant association between the 9th-11th grade and osteoporosis prevalence. The 9th-11th grade group was equivalent to the high school dropout age. This study result was consistent with Rivera Drew's (2013) finding that women with the lower education levels were more likely to undergo hysterectomy than ones with higher education levels.

Wastesson et al. (2013) examined the association between education level from 625,429 individuals aged 75-89 years and the use of osteoporosis drug treatment in Sweden. Wastesson et al. found that education level was more likely associated with the use of osteoporosis drugs in older women. When Wastesson et al. compared higher education and lower education level among women, higher education was significantly associated with the use of osteoporosis drug treatment (OR = 1.57, 95% CI, 1.52-1.61) after adjustment of age.

Etemadifar et al. (2013) conducted a cross-sectional study to investigate the association between knowledge about osteoporosis with education level and life habits in Iran. Etemadifar et al. found that education level was significantly associated with awareness of osteoporosis. In addition, risk and preventive factors were statistically significant (R = 0.83, $p = 0.00$). However, osteoporosis-related life habit was not associated with preventive behavioral factors (R = 0, $p = 0.99$). Education involves knowledge of health (Etemadifar et al., 2013). Since this present study finding that the higher education is more likely to be associated with the lower risk of osteoporosis, this present study supports the Etemadifar et al. study that women with a higher education level have better knowledge about osteoporosis than ones with a lower educational level. However, women do not use the knowledge in their life (Etemadifar et al., 2013).

Annual family income level and osteoporosis. Based on the results of the prevalence of osteoporosis in the level of the annual family income level, the annual family income level $0-$44,999 had the highest osteoporosis prevalence (63.7%). The family income level ($0-$44,999) had more than seven times of osteoporosis distribution to the income level $45,000-$64,000 (9.1%), more than three times than the income level $65,000-$99,999 (16.9%), and more than six times than the income level $100,000 and over (10.2%).

The osteoporosis crude ORs and 95% CIs analyses were used to examine the differences of odds of osteoporosis prevalence comparing the levels of the family annual income to the reference group's annual family income at $65,000-$99,999 in the hysterectomized postmenopausal women. The odds of the osteoporosis prevalence were 41% lower in the family income level at $0-$44,999 than the reference level. The odds of the disease prevalence were 28% lower in the family annual income level at $ 45,000-$64,999 than the reference level. However, the odds of the disease prevalence was 77% higher in the family annual family income at $100,000 and over than for the reference level. I conclude that the family annual income was less significantly associated with the osteoporosis prevalence among women 50 and older who have under gone hysterectomy prior to the onset of menopause.

For the results of the adjusted ORs and 95% CIs analyses, there were 24% lower osteoporosis in the postmenopausal women's annual family income level at $0-$44,999, 20% lower in the women's annual family income at $45,000 - $64,000, and 84% higher in the women's annual family income at $100,000 and over than the reference income level. According to the results, the income level overall is significantly associated with the osteoporosis prevalence among postmenopausal women who have hysterectomy prior to the onset of menopause. The outcome of the annual family income at $100,000 and over had the highest percentage difference to the reference group with both crude and adjusted ORs. One reason could be that the study participants (1.4%) in the income level were considerably less than other income levels were. These results suggested that it might need a further study. However, overall, the finding reasonably supported Brennan et al. (2012) study that the lowest income associated with osteoporosis among postmenopausal women. The Brennan et al. stressed that socially disadvantage women are more likely to be negatively associated with hip bone mineral density ($p = 0.02$), which indicated that bone mineral density impacts on an increase in greater fractures or bone deformities in postmenopausal women (Brennan et al., 2012). This study is congruent to the Brennan et al. (2012) study that the low annual family income negatively affects on osteoporosis. In this study, family income level is associated with women aged 50 and older who have undergone hysterectomy prior to the onset of menopause.

Age of hysterectomy and osteoporosis. Based on the results of the distribution frequency statistics, the highest osteoporosis prevalence in the age of hysterectomy group as follows: The age of hysterectomy 36-45 (38.2%) was 5.8 times, 26-35 (28.9%) was nearly 4.4 times, and 46-50 (26.3%) was approximately 4 times higher the osteoporosis prevalence than in the age of hysterectomy 25 and younger (6.6%) (Table 4).

The results of the crude and adjusted ORs and 95% CIs analyses, there are no significant associations between the age of hysterectomy and the osteoporosis prevalence among women age 50 and older who had undergone hysterectomy prior to the onset of menopause. Based on the National Health Service (NHS) (2014), women are more likely to be at a greater risk of developing osteoporosis if a hysterectomy was performed before the age of 45 years (NHS, 2014). Hysterectomy is more likely increase with older ages (Sievert et al., 2013).

In this study, the age range of the age of hysterectomy was selected age 50 and younger among postmenopausal women population. These study findings of the age of hysterectomy were not significant. It may be due to the age of hysterectomy 26-35 had greater missing values and “don’t know” answers in the NHANES 2009-2010 data. In the previous studies (Hammer et al. 2015 Siegel et al., 2013), the highest frequency of the age of hysterectomy was the age of 36-45 years. This study supports the Hammer et al. and Siegel et al studies that this study found that the age of hysterectomy 36-45 had the highest frequency of the osteoporosis prevalence in the study group. Age of hysterectomy 26-35 for both crude and adjusted osteoporosis ORs had the lowest difference in osteoporosis prevalence when comparing to the reference group as age of hysterectomy 36-45 among all age of hysterectomy levels. This data result would be a new study. Currently, no published studies were found to support this study result that age of hysterectomy 36-45 influences on the osteoporosis prevalence among women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause.

Research Question 2

Is there an association between behavioral factors (physical activity and calcium/vitamin D intake) and osteoporosis in the women age 50 and older who had undergone hysterectomy prior to the onset of natural menopause?

Association Between Behavioral Factors and Osteoporosis

To examine the association between behavioral factors and osteoporosis, MLR analyses were used.

Moderate recreational activity and osteoporosis. The results of the prevalence of osteoporosis in the moderate recreational activity, the moderate recreational activity reduced the prevalence of osteoporosis (30.3%) compared to the non-moderate recreational activity (35.1%). The result of the crude OR and 95% CI analysis showed that there was 20% lower risk of osteoporosis with no physical activity compared to physical activity as the reference group. However, the adjusted OR for osteoporosis resulted that there was 26% higher risk of osteoporosis with no physical activity compared to physical activity among women 50 and older who had undergone hysterectomy prior to the onset of menopause. Based on the results, I conclude that the physical activity including moderate recreational activity at least 10 minutes continuously every day would prevent osteoporosis among postmenopausal women aged 50 and older who had hysterectomy prior to the onset of menopause.

Moderate recreational activity has long been suggested to prevent osteoporosis in postmenopausal women (Polidoulis et al., 2012). Engaging physical activity positively influences on preventing bone mineral density. Furthermore, adequate physical activity is associated with osteoporosis prevention in postmenopausal women (Muir et al., 2013; Polidoulis et al., 2012). A meta-analysis study conducted by Howe et al. (2012) indicated that physical activity is potentially effective to prevent loss of bone in postmenopausal women (Howe et al., 2012). The Moreira et al. (2014) study uncovered that moderate to intensity exercise with a high speed during short intervals of time considering duration and intensity physical activities to improve muscle strength to prevent osteoporosis in later life (Moreira et al., 2014).

For the physical activity analysis, I used moderate recreational activities. The NHANES defined the physical activity as “moderated-intensity sports, fitness, or recreational activities that cause a breathing increases, heart rates, such as walking, bicycling, swimming, or golf for at least 10 minutes continuously” in NHANES 2009 - 2010 (CDC, 2015).

In the dichotomous moderate recreational activity after treating missing values (*n* = 361), the number of the physical activity participants was 123 (34.1%) and no physical activity was 238 (65.9%), which nearly twice higher numbers than the physical activity. Despite the higher number of the no physical activity participants, the adjusted odds of osteoporosis results indicated that the physical activity (or moderate recreational activity) engagement influences on the prevalence of osteoporosis among hysterectomized postmenopausal women aged 50 and older who had undergone hysterectomy prior to the onset of menopause.

Calcium/vitamin D level and osteoporosis. In the adequate calcium/vitamin D intake level, the number of no calcium/vitamin D intake participants (*n* = 332, 92%) was 11 times greater than the number of calcium/vitamin D intake participants (*n* = 29, 8%). Although the large number differences between two study groups, calcium/vitamin D intake positively influenced on osteoporosis. The result of the crude and adjusted ORs and 95% CIs analysis showed that 78% and 66% higher risk of osteoporosis with no calcium/vitamin D intake group compared to the calcium/vitamin D intake group as the reference. I concluded that there is a positive association between calcium/vitamin D intake and osteoporosis among women age 50 and older who had undergone hysterectomy prior to the onset of menopause. The study result suggested that adequate calcium/vitamin D intake among postmenopausal women is needed to reduce or prevent osteoporosis.

The retrospective descriptive cohort study of Moyer (2013) assessed an adequate level of calcium/vitamin intake to prevent bone fractures in noninstitutionalized postmenopausal women. This study was established based on the recommendation provided by U.S. Preventive Services Task Force (USPSTF). The study found that daily intakes of both 1,000 mg calcium or less and 400 IU vitamin D prevent osteoporosis among postmenopausal women (Moyer, 2013).

This study result was consistent with the Reymondier et al. (2013) study that calcium/vitamin D intake was positively associated with osteoporosis, which indicates that calcium/vitamin D intake is considered be recommended for osteoporosis prevention among menopausal women. This finding was associated with ITHBC framework that is related to knowledge and beliefs along with self-regulation skills and abilities to change health behaviors. Calcium/vitamin D supplementation intake among postmenopausal women is tied to an increase in self-management behaviors (Ryan, 2009).

Overall Findings

Overall, using ITHBC theory as the theoretical framework for this study, I identified significant new findings. In the association between demographic factors (age, race/ethnicity, education, and annual family income) and the prevalence of osteoporosis, I found that demographic factors are associated to the prevalence of osteoporosis among women age 50 and older who had undergone hysterectomy the onset of natural menopause. However, I found that age of hysterectomy group 36-45 has the highest prevalence of osteoporosis among women aged 50 and older who had undergone hysterectomy prior to the onset of menopause. In the association between behavioral factors (moderate recreational activity and calcium/vitamin D) and osteoporosis, I found that calcium/vitamin D is significantly associated with the osteoporosis prevalence and confirmed moderate recreational activity influences to the osteoporosis prevalence.

The finding of the association between physical activity and osteoporosis supported the previous study using NHANES 2007-2008 study (Vásquez, Shaw, Gensburg, Okorodudu, & Corsino, 2013) that moderate intensive physical activity was associated with osteoporosis. Overall findings of this study are considerably support

ITHBC concepts might be linked with an individual's knowledge and belief, self-regulation and management, and community facilitation to prevent osteoporosis associated with demographic and behavioral factors.

Limitations of the Study

Several limitations exist to this study. The cross-sectional study of the NHANES dataset is not designed to make inferences regarding temporal sequences of the study. Despite of the samples are demographically selected, not difficult to achieve appropriate geographical representative spread. Questionnaires in the NHANES data were based on the self-report survey. The study participants may potentially misrepresent their responses, such as recall problems, misunderstanding of the survey questions, misreporting history, and diagnosis, as well as other factors (Institute of Medicine, 2011b). Small sample size for some race/ethnic groups and a lack of physical activity participants of the study data were randomly selected from noninstitutionalized U.S. population, which the limited data selection may cause the weaken the statistical study results.

Despite the limitations, there are some strengths of the study. This study used the NHANES, which is a national representative sample data. The data questionnaires are standardized. The data contents are consistent over time, which make valid and reliable.

Although prior studies have been examined hysterectomy and osteoporosis, no published study has yet to assess the association between demographic and behavioral factors and osteoporosis among women age 50 and older who had undergone hysterectomy prior to menopause. These study findings are substantial for epidemiology of osteoporosis prevention among postmenopausal women who had hysterectomy prior to the onset of natural menopause.

Recommendations

Further recommendations include examining the association between education and age of hysterectomy among osteoporotic postmenopausal women. Determining to what extent the association between education and age of hysterectomy plays a substantial role in delaying or preventing osteoporosis among osteoporotic postmenopausal individuals. In addition, it is recommended to explore moderate intensity physical activity comparing frequency, intensity, and duration. Examining the effectiveness of osteoporosis prevention comparing the given variables among hysterectomized women age 50 and younger may aid to determine earlier osteoporosis prevention.

This study was conducted based on the concepts of the ITHBC theory. This theory posits that osteoporosis or bone fracture is preventable through engagement with several health behaviors, such as physical activity, calcium/vitamin D intake, regular check-up, and managing medications. Hysterectomized women may prevent or delay osteoporosis by achieving increased higher education levels to obtain knowledge or awareness of disease and recommended regular check up for women's reproductive health. Self-managing and belief through calcium/vitamin D supplementation and annual family income support, along with moderate intensity physical activity are recommended to develop muscle strength to stimulate bone strength. Furthermore, community facilitation or support between individuals/families and public health care would advance improvement of bone health among hysterectomized osteoporotic postmenopausal women in the United States.

Implications for Social Change

The findings of this study have potential impact on positive social change at the individual, family, and community level as well as policy to improve health of postmenopausal women 50 and older who had undergone hysterectomy prior to menopause. According to the study findings, demographic factors (age, race/ethnicity, education level, annual family income, and age of hysterectomy) and behavioral factors (physical activity and calcium/vitamin D) are significantly associated with osteoporosis in hysterectomized postmenopausal women. Particularly, age of hysterectomy between 36-45 years is associated with the highest osteoporosis prevalence in hysterectomized postmenopausal women.

Potential positive social change implications at the individual level should be designed to increase awareness of osteoporosis among hysterectomized postmenopausal individuals. Promote awareness of appropriate calcium/vitamin D intake and moderate recreational activity levels and an individual’s race/ethnicity, education, income, and age of hysterectomy affecting osteoporosis. An individual’s behavior change should lead to improvement of education level and family finance, as well as a regular women’s health checkup.

Positive social change at the family level includes family members’ awareness of bone heath in hysterectomized postmenopausal women. Public health related to health promotion through osteoporosis education should be designed to assist family members with low socioeconomic status, such as low education and annual family income levels. This assistance is designed to encourage them to participate and support them based on race/ethnicity background and resources available.

At the community level, positive social change includes appropriate modifications of community supports within race/ethnic community through private or public organizations, non- or government-organizations, and negotiated partnerships. Within the community level, increasing jobs for older women to improve their annual family income level, further promoting the potential target individuals and family members to easily access osteoporosis health education and resource availability, building sport parks with safety, and promoting weight bearing moderate recreational activity and calcium/vitamin D intake promotion would promote health of bone in hysterectomized postmenopausal women.

At the policy level, social change would include improving socioeconomic status (education and annual family income), promoting moderate recreational activity and calcium/vitamin D intake among potential hysterectomized postmenopausal women. An increase in socioeconomic status, moderate recreational activity and calcium/vitamin D supplement intake should be based on hysterectomized postmenopausal population-based approaches to promote bone health. This approach may decrease the burden of cost associated with short-term health care due to bone fractures, its related-bone health problems, and death affected by natural causes due to fractures of bones. In addition, the burden of cost associated with long-term health care cost due to consequences after bone fractures (Dempster, 2011). Therefore, these study findings may aid public health policymakers to promote and implement effective behavioral interventions to prevent osteoporosis in the potential hysterectomized postmenopausal women. The approach may contribute to meet the objectives of *Healthy People 2020* that target 5.3 percent of osteoporosis in older US population (HHS, 2015b, para, 2).

Conclusions

I explored the association between demographic and behavioral factors and osteoporosis among women 50 and older who had undergone hysterectomy prior to the onset of menopause in the US civilian, non-institutionalized population. The demographic factors include age, race/ethnicity, education level, annual family income, and age of hysterectomy. The behavioral factors include moderate recreational activity and calcium/vitamin D intake. Overall, age race/ethnicity, education level, and annual family income, and age of hysterectomy are associated with dichotomous osteoporosis prevalence. Moderate recreational activity, engaging moderate recreational activity would help to prevent risks of osteoporosis. Calcium/vitamin D intake is associated with osteoporosis. Daily Intake of the adequate recommendation for combined calcium/vitamin D supplementation would aid to improve the bone mineral density to prevent or delay osteoporosis (Prentice, et al., 2013). Continuous covariates, age and age of hysterectomy significantly influence on osteoporosis adjusted ORs.

The findings of this study support the hypothesis that there is the relationship between demographic factors (age, race/ethnicity, education, annual family income, and age of hysterectomy) and behavioral factors (physical activity and calcium/vitamin D intake) and the prevalence of osteoporosis. It is recommended to design an appropriate osteoporosis preventive strategy in hysterectomy postmenopausal women at the individual, family, and community level. The osteoporosis intervention strategy may be carefully considered promotion of osteoporosis prevention with awareness of those heath factors resulted by this epidemiologic pubic health study.

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Appendix A: Protecting Human Research Participation Certificate

Certificate of Completion

The National Institutes of Health (NIH) Office of Extramural Research certifies that **Mia Botkin** successfully completed the NIH Web-based training course “Protecting Human Research Participants”.

Date of completion: 06/18/2015

Certification Number: 1781730