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Influence of Expectations of Aging on Older Women's Use of Dietary Supplements Using the Health Promotion Theory

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INFLUENCE OF EXPECTATIONS OF AGING ON OLDER WOMEN'S USE OF DIETARY SUPPLEMENTS USING THE HEALTH PROMOTION THEORY

by

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ABSTRACT

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The use of vitamins, minerals and herbal supplements by older adults is increasing and changing. There are concerns about supplement quality, safety, and vitamin D overuse. Little is known about supplement use by nursing home residents and about factors that influence older women to use supplements. The current study describes the supplement use of 247 nursing home residents and 110 independent living women 65 years or older in the Midwestern United States. A secondary analysis of 247 medication administration records describes the prevalence of vitamin, mineral, and herbal supplement use of nursing home residents. Using the health promotion theory, the author examined factors that influence independent living older women's use of supplements. The research hypothesis for the study was: controlling for age, comorbidity and education level, expectations of aging, self-efficacy, and prior related behavior will predict vitamin, mineral and herbal supplement use. A cross-sectional descriptive survey included expectations regarding aging, general self-efficacy, the Self-Administered Comorbidity Questionnaire, a 24-hour supplement recall and an inventory of supplement use in the past month. A multiple regression model was used to determine predictors of vitamin, mineral and herbal supplement use. Education level, prior use of VMS, and expectations of aging are significant predictors of supplement use in the model and explain 27 % of the variance. Prior use

is the strongest predictor of current use followed by expectations of aging. Ninety-two percent of the independent living women and 94 % of nursing home residents are taking a vitamin, mineral or herbal supplement. Vitamin D is the most frequently reported supplement for both independent living women and nursing home residents. Independent living women report 0 to 16 supplements in a month and 31% use herbals. Seventy-five percent of the independent living women take vitamin D. Seven percent of independent living women are taking vitamin D at or above the Tolerable Upper Intake Level recommended by the Food and Nutrition Board. Health care and food and nutritional professionals should be aware of overuse and high-dose use of supplements. Findings suggest expectations of aging may be an important consideration to understand older women's health behavior.

Keywords: health promotion theory, aging, supplement, expectations of aging, vitamin D

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Dedication

To my parents, Lois and Richard Higgins who fostered the love of learning,

my husband, Christopher Hekel,

and family whose support and encouragement is invaluable.

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Chapter 1

This chapter begins with an introduction to the potential problems regarding supplement use by older adults. What is known about the prevalence of supplement use and characteristics of users is briefly described. Vitamin D is the supplement of interest in the study. Vitamin D function, controversy, measurement, and current research is provided. Definitions of supplement, supplement categories, dietary terms and terms used in the Health Promotion Model (HPM) are included. A review of older adults' expectations regarding aging and the possible influence of these expectations on health behavior is provided. Models of physiological homeostasis and aging are also described because changes associated with aging and illness also influence supplement use and make older adults more likely to be harmed by the inappropriate use of supplements. Based on the premise that factors unrelated to medical need, such as expectations regarding aging, may explain the high use of supplements in older adults, the Health Promotion Model (HPM) is introduced to elucidate factors that may influence the use of supplements. Gaps in current knowledge are outlined. Finally, the research questions and hypothesis that guide the study complete the chapter.

Introduction of Problem

Older adults are using more vitamins, minerals, and herbal supplements (VMS) than ever before. VMS are often taken for purposes that are not supported by research (Hossein-nezhad & Holick, 2013). The National Health and Nutrition Examination Survey (NHANES) does not include older adults in nursing homes (Ahluwalia, Dwyer, Terry, Moshfegh, & Johnson, 2016). In recent years, a number of geriatric health care professionals and organizations have voiced concerns regarding VMS and older adults; type and amount of VMS taken and reasons why VMS are used.

VMS have potential health benefits, health risks, drug interactions and safety concerns (Kennedy, 2005; Timbo, Ross, McCarthy, & Lin, 2006). Vitamin D is a supplement of particular interest due to increased use, dosage concerns, and current controversies (Aschemann-Witzel & Grunert, 2015; Bailey et al., 2011; Cohen, 2012; Dietary Guidelines Advisory Committee, 2015; Nutrition Business Journal, 2012). Expectations of aging has been found to influence health behaviors including physical activity and seeking health care (Sarkisian, Prohaska, Wong, Hirsch, & Mangione, 2005a; Sarkisian, Hays, & Mangione, 2002a). It is the purpose of this dissertation study to examine if expectations of aging influences supplement use. Additional information on what VMS older adults are taking and what influences older adults use of supplements is needed.

Vitamins and minerals are required for healthy functioning yet too little or too much may potentially cause deficiencies or damage respectively. Health problems from VMS have been reported from; adverse reactions to the active ingredients, improper use, drug interactions, and defects of the product (Timbo et al., 2006). Some VMS have been implicated in liver failure (Navarro et al., 2014) and the elimination of supplements may burden the kidneys. Liver injury is more severe from vitamin, mineral and herbal supplements than from medications and may result in the need for transplantation or death (Navarro et al., 2014).

It is more probable that an older adult would be on medication than a younger person (Gallagher, Barry, & O' Mahony, 2007). Polypharmacy is used to describe the use of multiple medicines and is common among older adults (Gallagher et al., 2007; Loya, González-Stuart, & Rivera, 2009). Polypharmacy, increases the risk of adverse drug interactions with VMS (Gallagher et al., 2007; Gardiner, Phillips, & Shaughnessy, 2008; Loya et al., 2009). VMS may also increase or decrease drug activity (Gardiner et al., 2008). Many older adults with chronic

medical conditions use supplements and are likely to be taking prescription medications which may lead to an increased risk of interactions (Mehta, Gardiner, Phillips, & McCarthy, 2008). Among community dwelling older adults who were on a prescription medication, 52% (95%CI, 48.8%=55.5%) concurrently used dietary supplements (Qato et al., 2008). Long term use of some medications by older adults directly affects vitamin status (Joshi, 2015). Vitamin D levels are affected by anticonvulsants, cholestyramine, rifampin, corticosteroids and levodopa (Joshi, 2015).

The potential for adverse reactions from VMS include drug interactions, interactions from the ingredients within the VMS, and other adverse effects (Geller et al., 2015; Kutz, 2010; Nahin et al., 2009; Timbo et al., 2006). VMS have also been found to be adulterated with hazardous contaminants including lead, arsenic, mercury, cadmium, and pesticides (Kutz, 2010). In 2000 the FDA reported that since 1993 there were 2,797 reports of adverse effects due to supplements which included 105 deaths (U.S. General Accounting Office, 2000). It has been estimated that over 23,000 emergency department visits each year are credited to VMS adverse events (Geller et al., 2015).

Prevalence of Supplement Use in Older Adults

Supplement use among older adults is changing. The National Health and Nutrition Examination Survey (NHANES) has shown steadily increasing use of dietary supplements over the last 40 years among older adults in the United States (Bailey et al., 2011; Gahche et al., 2011; Radimer et al., 2004). A report using NHANES data from 2003-2006 found that 70% of adults over the age of 71 years use VMS and a third of them use a multivitamin, multimineral dietary supplement (Bailey et al., 2011). Vitamin D use is increasing and the money spent on vitamin D supplements has increased sharply over the last 15 years (Nutrition Business Journal, 2015).

Older women are taking more VMS than in the past (Park, Harnack, & Jacobs, 2009; Timbo et al., 2006).

Characteristics of Supplement Users

Results from national surveys and other research reports that adults who view themselves as healthy appear to be using VMS (Bailey et al., 2011; Conner, Kirk, Cade, & Barrett, 2003). Adults who use VMS are more likely to be in good health, have health insurance, use alcohol in moderation, exercise more frequently, and do not smoke cigarettes (Bailey, Gahche, Miller, Thomas, & Dwyer, 2013). People who take VMS also tend to have higher incomes and be better educated (Dickinson & MacKay, 2014). VMS users tend to have better dietary patterns, have healthy weight or have a lower BMI than people who do not use VMS (Dickinson & Mackay, 2014). There appears to be a contradiction between need for and use of VMS in older adults (Bailey et al., 2011; Conner et al., 2003).

VMS use appears to be prevalent in adults who need supplements the least, this has been termed the 'inverse supplement hypothesis' (Conner et al., 2003). Results of studies appear to support the inverse supplement hypothesis as VMS users have been found to have higher dietary nutrient intakes than VMS non-users (Braun & Venter, 2008; Kirk, Cade, Barrett, & Conner, 1999; Kofoed, Christensen, Dragsted, Tjønneland, & Roswall, 2015; Sebastian, Cleveland, Goldman, & Moshfegh, 2007). However, one study which explored an individual nutrient, resveratrol, did not confirm the inverse supplement hypothesis (Aschemann-Witzel & Grunert, 2015). Instead a strong belief in favorable health effects and use of complementary and alternative medicine positively affect the use of resveratrol (Aschemann-Witzel & Grunert, 2015).

There are a variety of reasons for people to take dietary supplements. VMS are taken to

decrease susceptibility to chronic health problems (Mehta et al., 2008). Improved nutrition has been attributed to lengthening of the lifespan (Vaupel, 2010). VMS are used as a part of preventive health care to maintain health (U.S. General Accounting Office, 2000). One study found the three most common reasons older adults use VMS were: to preserve a healthy life, to prevent a disease, or a recommendation by a health professional (Albright et al., 2012). The most common reason to use VMS in the 2007-2010 NHANES was to "improve" or "maintain" health (Bailey et al., 2013).

Older adults were more likely to use supplements for site-specific reasons (Bailey et al., 2013). Site-specific reasons are when a supplement is taken for specific body site. Sites of the body older adults' mention include heart health, eye health, bone health, or joint health (Bailey et al., 2013). Men tend to take a supplement for "heart or to lower cholesterol" while women tend to use calcium products for "bone health" (Bailey et al., 2013). Another study, with primary care patients as the sample participants, found the top three conditions for supplement use were: heart hearth/cholesterol, cold/sinus, followed by joint pain (Gray & Rutledge, 2013).

Vitamin D: Function, Controversy, and Current Research

Vitamin D is the supplement of interest in this study due to concerns regarding use and current controversies. Vitamin D is essential for skeletal health and has a wide range of other functions. One function of vitamin D is to maintain serum calcium and phosphorus concentrations which in turn maintains bone health (Committee to Review Dietary Reference Intakes for Vitamin D and Calcium, Food and Nutrition Board, & Institute of Medicine, 2011). The vitamin D receptor is found in most tissues and cells in the body including skeletal muscle tissue (Holick et al., 2011; Holick, 2007). Vitamin D has a role in cellular death, cellular proliferation, cellular differentiation, and insulin stimulating production (Holick et al., 2011).

Vitamin D has been reported to have wide-ranging health benefits but not all the health benefits are supported by research (Hossein-nezhad & Holick, 2013). Researchers have suggested vitamin D may have a potential role in preventing cardiovascular disease, some types of cancer and other chronic disease such as diabetes (Manson, Bassuk, & Buring, 2017; Manson & Buring, 2016; Committee to Review Dietary Reference Intakes for Vitamin D and Calcium et al., 2011). Research suggests that vitamin D may influence cognitive decline, depression, autoimmunity, allergy and frailty, however the evidence is not conclusive at this time (Committee to Review Dietary Reference Intakes for Vitamin D and Calcium et al., 2011).

Current controversies include different recommendations for Tolerable Upper Intake Level, blood levels, dosage of vitamin D, and benefits of vitamin D. While current evidence suggests that adults with limited sun exposure require a vitamin D supplement, there exists controversy among organizations regarding vitamin D dosage (Holick et al., 2011; Hossein-nezhad & Holick, 2013). A recent study of frail elderly with severe vitamin D deficiency contrasted supplementation with the dosage at the Recommended Daily Allowance (RDA) and an individual loading dose regimen. The frail elderly on the RDA dose regimen took longer to reach a target level and fewer reached the target than those on an individual loading dose regimen and it is suggested that some current guidelines for supplementation doses are too low for the frail elderly with severe vitamin D deficiency (Wijnen, Salemink, Roovers, Taekema, & Boer, 2015).

Currently there are 153 studies recruiting participants in the United States under the search terms “vitamin D and seniors” on the U.S. National Institutes of Health Clinical Trials website. Topics of research include both vitamin D2 and vitamin D3, a wide variety of diseases, delivery methods, and dosage levels. The Vitamin D and Omega-3 Trial (VITAL) at Brigham

and Women's Hospital, an affiliate of Harvard Medical School is an ongoing five-year study of 25,874 people who are taking vitamin D or a placebo (Manson & Buring, 2016). The VITAL study is investigating if vitamin D or omega-3 fatty acids reduce the risk for developing heart disease, cancer and stroke (Manson & Buring, 2016). The Finnish Vitamin D Trial (FIND) is another five-year placebo-controlled study of vitamin D regarding prevention of cancer and cardiovascular disease (U.S. National Institutes of Health, 2016a). The Sunshine 2 Study for Women with Diabetes is currently recruiting participants, this is also a placebo controlled study to determine the effectiveness of vitamin D3 on self-management, blood pressure, and depressive symptoms (U.S. National Institutes of Health, 2016b).

Vitamin D: Serum Levels and Intake

Vitamin D, as measured by serum 25-hydroxyvitamin D (25[OH]D), is defined as deficiency at levels less than 12 ng/mL (NIH, Office of Dietary Supplements, 2016). Levels of vitamin D less than 12 ng/mL is associated with osteomalacia in adults and is inadequate for bone health. Levels of 25(OH)D between 12 to < 20 ng/mL are considered inadequate for overall health and bone in healthy individuals. Levels of 25(OH)D between 20 and 50 ng/mL are considered adequate for overall health and bone health for healthy individuals. Emerging evidence links low and high levels of 25(OH)D (above 50 ng/mL) to adverse effects (NIH, Office of Dietary Supplements, 2016).

Older adults frequently consume less vitamin D than recommended (Dietary Guidelines Advisory Committee, 2015). When vitamin D intake is calculated from food and beverage most adults over the age of 71 had intakes of vitamin D below the estimated average requirement; 97 percent of females and about 93 percent of males (Dietary Guidelines Advisory Committee, 2015). When vitamin D supplements are included the total intake of vitamin D increases

markedly to about 52 percent of adequate intake levels (Dietary Guidelines Advisory Committee, 2015). The Dietary Guidelines Advisory Committee named vitamin D as a nutrition of public health concern as the under-consumption of vitamin D has been linked to adverse health outcomes (2015).

There is also a health concern regarding over-consumption of vitamin D (Dietary Guidelines Advisory Committee, 2015). Vitamin D toxicity, hypervitaminosis D, occurs from excessive vitamin D intake. With hypervitaminosis D, the calcium levels can increase in the blood leading to damage to heart, kidney and blood vessels (NIH, Office of Dietary Supplements, 2016). Overconsumption of vitamin D is found especially among those who take high-dose supplements (Dietary Guidelines Advisory Committee, 2015). Vitamin D is sold over the counter and comes in a wide variety of dosages and combinations with other supplements. The amount of vitamin D taken from diet and supplements should not exceed the Tolerable Upper Intake Level (UL) unless directed by a health care professional. If the supplement dose exceeds the UL then monitoring by a health care professional is warranted (Dietary Guidelines Advisory Committee, 2015). The concern regarding deficiency, under-consumption and overconsumption of vitamin D highlights the importance of gathering information regarding vitamin D dosages in this population.

Definitions of Supplement, Supplement Categories, Dietary Terms, Independent Living Women and HPM

There is a lack of standardized categories and definitions for supplements (Comerford, 2013). Lack of clarity is one of the problems. Some definitions allow for inclusion of products that contradict the primary designated ingredient, such as a product with several B vitamins being labeled a multi-vitamin/ mineral. To provide clarity and ease of comparison to other

studies, similar language is helpful. The United States Dietary Supplement Health and Education Act of 1994 (DSHEA) definition of 'supplement' is provided as well as a classification system for dietary supplement categories (Bailey et al., 2013).

Definition of Supplement

For this dissertation study, the Dietary Supplement Health and Education Act (DSHEA) definition of dietary supplement will be used. Dietary supplements will be referred to as VMS (vitamin, mineral, or herbal supplement). Dietary supplements were defined by the DSHEA in 1994 as:

> a product (other than tobacco) that is intended to supplement the diet which bears or contains one or more of the following dietary ingredients: a) a vitamin, b) a mineral, c) an herb or other botanical, d) an amino acid, e) a dietary substance for use by man to supplement the diet by increasing the total daily intake, or f) a concentrate, metabolite, constituent, extract, or combination of any ingredient described in clause (a), (b), (c), (d), or (e) (NIH, Office of Dietary Supplements, 2015a).

Classification System for Dietary Supplement Categories

Bailey et al. (2013) examined the 2007 to 2010 NHANES data using a classification system that includes clear definitions with examples. The classification system used for this study is based the system used by Bailey et al. (2013) and is provided in Appendix A along with examples for each category.

Multi-vitamin, multi-mineral (MVMM). Contains 3 or more vitamins and contains 1 or more mineral.

Multi-vitamin (MV). Contains 2 or more vitamins, does not contain minerals and not classified a MVMM.

Multi-mineral (MM). Contains 2 or more minerals and does not contain vitamins, not classified a MVMM, and calcium was not main ingredient.

Herbals. Contains a botanical ingredient, such as melatonin, cranberry, or coenzyme Q-10.

Fatty acids. Contains omega-3 or fatty acids as primary ingredient.

Calcium-containing. The primary ingredient is calcium, and may have other minerals or vitamins; but not classified as a MVMM. This contains antacid products if calcium is the primary ingredient.

Joint supplements. Contains containing glucosamine, chondroitin, or a combination.

Protein and sports. Contains protein, amino-acids, may be intended to enhance athletic performance.

Fiber and colon health. Contains fiber as primary ingredient or laxative in name. Probiotics are classified in this category.

Single nutrient supplements. Stand alone, single nutrient supplement products not otherwise categorized.

Definitions of Dietary Terms

The Institute of Medicine (IOM) Food and Nutrition Board provides Dietary Reference Intakes (DRIs). DRIs are the set of reference values to assess nutrient intakes for healthy individuals. The DRIs for vitamin D were established to provide sufficient vitamin D to maintain bone health and calcium metabolism for healthy people. There are no differences in values for men or women for the DRIs for vitamin D. The DRIs are reported in International Units (IUs) and micrograms (mcg), for vitamin D, 1 mcg is equal to 40 IUs (Institute of Medicine Panel on Macronutrients, Dietary Fiber & Standing Committee on the Scientific

Evaluation of Dietary Reference Intakes, 2005; NIH, Office of Dietary Supplements, 2016).

Adequate Intake (AI). The AI is the level assumed to ensure nutritional adequacy when the evidence is insufficient for RDA.

Estimated Average Requirement (EAR). The EAR is the average daily intake level of the nutrient that is estimated to meet the requirements for half of the healthy individuals in a particular gender and life stage. The EAR for adults over the age of 51 years for Vitamin D is 400 IU.

Recommended Daily Allowance (RDA). The RDA is the average daily level of intake that is sufficient to meet the nutritional needs of nearly all healthy people. The RDA for adults 51-70 years for vitamin D is 600 IU and for adults over 70 years the RDA is 800 IU.

Tolerable Upper Intake Level (UL). The Tolerable Upper Intake Level is the maximum daily intake that is not likely to cause adverse health effects. The UL for vitamin D is 4,000 IU for adults over the age of 51 years.

Definition of Independent Living Women

For this dissertation study the term independent living women is used to describe women who live in the community or an independent living setting in a Continuing Care Retirement Community (CCRC). Independent living older women in a CCRC are in the independent living apartments and are not in assisted living or skilled nursing care.

Health Promotion Model Definitions

The HPM has been used to research variables influencing a given health behavior (Pender, Murdaugh, & Parsons, 2011). The definitions of the components of the HPM included in the framework (see Appendix B) for the proposed study are given below.

Individual characteristics and experiences. The individual characteristics and

experiences are experience factors and innate factors (such as gender or age) which are generally unmodifiable (Pender, Murdaugh, & Parsons, 2015; Srof & Velsor-Friedrich, 2006). These factors contain prior related behavior and personal factors (Pender, 2006; Pender et al., 2011).

Prior related behavior. The frequency of a similar or the same behavior in the past.

Personal factors. Include psychological, biological or sociocultural general characteristics of the individual that influence the health behavior.

Behavior-specific cognitions and affect. Contain the variables within the HPM that are believed to have major motivational significance. The behavior-specific cognitions and affect in the model include perceived benefits of action and self-efficacy.

Perceived benefits of action- Expectations of Aging. Contain the perceptions of the reinforcing or positive consequences or benefits of partaking in a specific health behavior. It is proposed that perceived benefits motivate the behavior. The hypothesis is that older adults with positive expectations of aging would be more likely to engage in taking VMS for perceived positive benefits.

Perceived self-efficacy. Perceived self-efficacy relates to an individual's belief or judgement of their ability to succeed in a situation or accomplish a task (Pender et al., 2015).

Behavioral outcome- health promoting behavior. This is the specific health behavior, the desired behavioral outcome of health decision-making, and preparation for action.

Expectations Regarding Aging and Influence on Health Behavior

Expectations of aging are the older adult's perceptions of aging (Sarkisian, Steers, Hays, & Mangione, 2005b). Expectations regarding aging (ERA) has been defined as the expectations of achievement and maintenance of physical, mental, and cognitive health (Sarkisian et al., 2005b). Expectations regarding aging has been used to examine relationships between health

behaviors, perceptions of aging, and outcomes (Sarkisian et al., 2005b). An individual's expectations of aging has been found to influence specific health behaviors (Goodwin, Black, & Satish, 1999; Leventhal & Prohaska, 1986; Rakowski & Hickey, 1992; Sarkisian et al., 2002a).

Perceptions and expectations of aging vary and have been examined from both a more negative and a positive perspective (Levy, Slade, Kunkel, & Kasl, 2002; Rakowski & Hickey, 1992). In one study, the older adults who attributed illness to old age reported less routine health maintenance behaviors at a 2 year follow up (Stewart, Chipperfield, Perry, & Weiner, 2012). Some of the health behaviors they were less likely to engage in included: eating a healthy nutritious diet, getting a regular check-up, making health a priority, exercise, and getting enough sleep (Stewart et al., 2012). Attributing urinary incontinence to aging was associated with self-treatment and self-management of incontinence (Locher, Burgio, Goode, Roth, & Rodriguez, 2002). Older adults are less likely to seek treatment or report to their health professional if they attribute symptoms of illness to aging (Brody & Kleban, 1981; Brody, Kleban, & Moles, 1983; Morgan, Pendleton, Clague, & Horan, 1997). Holding the expectation that health problems are an inevitable part of old age may create barriers to seeking care, delay the start of care, impact current choices for care, delay changes in health behaviors, and delay treatment (Locher et al., 2002; Stewart et al., 2012).

A negative expectation of aging may lead to a delay in: seeking care, treatment, care decisions, or practicing preventive health behaviors (Goodwin et al., 1999; Leventhal & Prohaska, 1986; Sarkisian, Lee-Henderson, & Mangione, 2003; Stewart, Chipperfield, Perry, & Hamm, 2016). The older adults who attributed illness to old age had twice the probability of death (36% vs. 14%) than those who did not (Stewart et al., 2012). There was a risk of adverse health events when the association between attributing health problems to aging and mortality

was examined (adjusted odds ratio = 1.78, CI = 1.05, 3.00, Rakowski & Hickey, 1992). Another longitudinal study found increases in mortality and disability for older adults with diabetes and lower cognitive function (McGuire, Ford, & Ajani, 2006). Attributing a specific health condition, heart attack or stroke, to old age was associated with less likely to change their lifestyle, a double probability of future hospitalization, and saw their physician more often (Stewart et al., 2016). This suggests there is a potential for adverse consequences of attributing some health problems to old age. The older adult may perpetuate the expectation that aging has a negative trajectory (Rakowski & Hickey, 1992).

Expectations of aging can also be viewed from a positive perspective. Older adults with positive self-perception of aging lived 7.5 years longer than older adults with less positive self-perceptions of aging (Levy et al., 2002). The impact of self-perceptions of aging appears to have an association with health behaviors and length of life (Levy et al., 2002). Another study found that when expectations regarding aging are high or positive the individuals were more likely to have had a health physical in the preceding two years (Meisner & Baker, 2013). Expectations towards aging has been documented to influence current health behaviors (Goodwin et al., 1999; Sarkisian et al., 2005a) and future health (Leventhal & Prohaska, 1986; Levy et al., 2002; Rakowski & Hickey, 1992). Expectations of aging has an impact on seeking health care, health behaviors, and health outcomes.

Theoretical Framework

This study is based on two central premises: 1) Older adults have a higher risk for complications from under or over consumption of VMS due to physiological changes of aging and aging's impact on physiological homeostasis; and 2) Factors unrelated to medical need may explain VMS use. Expectations regarding aging has an impact on current health behaviors,

expectations regarding aging may have an impact on older women's use of supplements. The Health Promotion Model (HPM) provides a framework to conduct research to explore what motivates older women to engage in supplement use. Covariate, independent and dependent variables are also identified.

Physiological Homeostasis

The model of physiologic homeostasis is commonly used in geriatrics and is helpful to understand the impact supplements can have on older adults. Physiologic homeostasis balances metabolic activity and regenerative responses (Wang, Karpac, & Jasper, 2014). Aging causes widespread loss of and difficulty maintaining, homeostasis (Wang et al., 2014). The physiological changes of aging have an impact on all organ systems. The kidney and liver have decreased function with aging and there is reduced regenerative capacity of the liver (Navaratnarajah & Jackson, 2013; Schmucker, 2005). Liver function may be impacted due to aging changes, polypharmacy, use of multiple supplements, or overconsumption of VMS. Age related changes alter physiology, body composition, and the pharmacokinetic and pharmacodynamics which may increase the risk of adverse events (Castelino, Hilmer, Bajorek, Nishtala, & Chen, 2010; Hamilton, Gallagher, & O'Mahony, 2009). Older adults are at higher risk from vitamin dosages above the UL in part due to decreased liver and kidney function (Dietary Guidelines Advisory Committee, 2015).

In summary, older adults have a higher risk for complications from under or over consumption of vitamin D due to the physiological changes of aging and aging's impact on physiological homeostasis. The process of aging occurs at different rates and the homeostatic reserves vary greatly between people. Older adults often have comorbid conditions which are accompanied with multiple prescription medications increasing the risk of adverse events

(Castelino et al., 2010). The potential burden of supplements on organs are not clearly understood. Specific physiological changes associated with aging and with illnesses common with aging, make it more likely that older adults may be particularly vulnerable to adverse effects from supplements.

Health Promotion Model

The HPM is an interpersonal level theory that is useful for research of health behaviors and the development of interventions (Pender et al., 2015). HPM is suitable for health behaviors where 'threat' is not the most important source of motivation (Pender, 1996). Health behavior motivation for the individual is unique and often has combinations of health promotion and health protection motives. A health protective behavior aims to decrease the likelihood of disease or to stabilize health while a health promotion behavior sustains or increases well-being (Pender, 1996). Together these health promotion and health protective behaviors are complementary parts of a healthy lifestyle (Pender, 1996). Supplements such as vitamin D are taken for a variety of health promotion and health protection reasons.

The HPM postulates that *individual characteristics and experiences* influence *behavior specific cognitions and affect* which leads to a *health promoting behavior* (Pender, 2006; Pender et al., 2011; Pender et al., 2015). The variables of interest included in the model are: individual characteristics and experiences (prior related behavior and personal factors), behavior-specific cognitions and affect (perceived benefits of action-ERA and self-efficacy) and the health promoting behavior VMS use.

Individual Characteristics and Experiences

Prior related behavior is one of the best predictors of behavior (Pender, 1996). Prior related behavior in this study is past use of VMS. The regular habit of taking a supplement in the

past influences the possibility of taking VMS.

Personal factors are predictive and determined by the target behavior of supplement use (Pender, 2006; Pender et al., 2011). Personal factors found in the literature which may be associated with and confound the relationship between ERA and supplement use include comorbidity, age, and education level (de Groot, Beckerman, Lankhorst, & Bouter, 2003; Johnson, Angela J.M. Donkin, Morgan, Neale, & Lilley, 2000; Kim, 2009; Levy et al., 2002; Meisner & Baker, 2013; Sebastian et al., 2007; Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009). Chronic diseases are lasting, non-communicable, recurrent diseases which do not have a microbial cause (Egger, 2012). As people age the chance of having multiple chronic disease increases (Egger, 2012; Marengoni et al., 2011). Comorbidity may have a confounding influence on studies (de Groot et al., 2003; Valderas et al., 2009). Supplement use has been found to increase with age (Bailey et al., 2011; Dickinson & MacKay, 2014; Gahche et al., 2011; Radimer et al., 2004). Educational level is a representation of income and may predict supplement use (Dickinson & MacKay, 2014; Johnson et al., 2000; Meisner & Baker, 2013). Personal factors will be measured and if related to outcome measure will be used as control variables.

Behavior-Specific Cognitions and Affect

The behavior-specific cognitions and affect for the current model are *perceived benefits of action-ERA* and *perceived self-efficacy* (Pender et al., 2011). *Perceived benefits of action* are the perception of the positive consequence of using supplements. The literature supports that *ERA* has been documented to influence health behaviors (Goodwin et al., 1999; Sarkisian et al., 2003; Sarkisian et al., 2005a). This study proposes that when an older adult has positive ERA those anticipated outcomes influence the current health behavior of supplement use.

Perceived self-efficacy is the perception of the personal capability to accomplish supplement use. Self-efficacy is the judgement that one is able to execute the task (Pender, 2002; Pender et al., 2011). If an individual has a higher level of self-efficacy they are more likely to engage in a health behavior (Pender et al., 2015). It is proposed that individuals with high self-efficacy are more likely to engage in supplement use.

Behavioral Outcomes

The behavioral outcome for the proposed study is supplement use. The classification system (Appendix A) assists with defining nonusers and users of dietary supplements and for measurement of the dependent variable, supplement use.

Gaps in Knowledge

New supplements are flooding the market at the same time supplement use is increasing in the elderly population. There is insufficient understanding regarding how and why supplements are used and why supplements continue to be used when there is no improvement in health. More information is needed on supplement adverse interactions and supplement and medication interactions. Currently there are concerns regarding under-consumption and overconsumption of vitamin D.

There is also debate regarding updating the Recommended Daily Allowance (RDA) for certain supplements. The RDA is the average daily level of intake that is sufficient to meet the nutritional needs of nearly all healthy people. Also, not all supplements have a Dietary Reference Intake (DRI) which specifies the amount required for optimal health. Effective and safe dosages for different ages and disease states do not exist for all supplements. An example of difficulty in determining effective and safe dosages is vitamin D. The RDA for vitamin D for adults over 70 years for male and female is 800 IU and this was determined for optimal bone

health. The Endocrine Society has provided clinical guidelines for vitamin D use with some chronic health issues and disease (Holick et al., 2011). But further research is needed to determine optimal vitamin D levels for chronic health issues and diseases for all ages including older adults.

Additional details of the physiological impact of supplement dosages used above RDA along with the prevalence of overconsumption of supplements would be beneficial. While adverse physiological interactions of supplements on the liver have been reported, it has been very difficult to identify causality due to simultaneous use of products and products with multiple ingredients (Navarro et al., 2014). While studies have looked at reported liver damage from all ages, there are insufficient studies focusing on older adults in independent living, assisted living and nursing homes (Navarro et al., 2014).

Supplement use has been tracked since the 1970's using the NHANES. Only noninstitutionalized U.S. citizens are included in the NHANES sampling design (Ahluwalia et al., 2016). Despite concerns about underuse, overuse, drug interactions, physiological burden on the body, and safety, current information on institutionalized older adults' use of vitamins and dietary supplements is limited. Why supplements are used and what influences older adults has not been thoroughly explored.

The impact of how older adults' ERA impacts supplement use has not been previously examined. It is important to understand the impact perceptions of future health has on health behaviors such as supplement use. This understanding can assist nurses' and other health professionals in providing individualized care to help promote a healthy lifestyle. Knowledge of how ERA influences current health behaviors may also guide development of interventions to optimize use of safe levels of supplements for personal health care of older adults. There is a

need for up to date information on what supplements older adults are taking with an emphasis on vitamin D and dosage.

Gaps Bridged by this Study

The gaps this study seeks to address include: 1) what supplements are older independent living women in the community dwelling or CCRC currently taking and what supplements are older adults in nursing homes prescribed, 2) is use of vitamin D dosage at or above the Tolerable Upper Intake Level present in this population, and 3) how does ERA influence supplement use by older women. The target population is women age 65 years and older. The overall program of research is aimed at optimizing use of VMS by older individuals whose health care abilities, needs, and physiologic burdens are changing. Understanding the factors which impact the use of VMS such as expectations of aging may aid in understanding the behavior of supplement use in the community dwelling or independent living older adult.

Purpose of Proposed Study

This study proposes that a positive expectation of aging is associated with supplement use. The purpose is to describe prevalence of VMS use, prevalence of vitamin D use above the UL, and how ERA and self-efficacy influences supplement use behavior of older women. Quantitative methods will be used to answer the research questions. Variables of age, education, and comorbid conditions that show statistically significance differences will be included as covariates in the regression models.

Research Questions

1. What is the prevalence of VMS use among older adults?
2. What are older women's levels of general self-efficacy and expectations of aging?
3. Is higher age associated with increased number of supplements taken?

4. Do women with higher and lower levels of education differ in their supplement use?
5. Do older women with high, medium and low levels of comorbid conditions differ in their supplement use?
6. What percentage of older women are taking vitamin D at and above the Tolerable Upper Intake Level?
7. Are older women cognizant of their vitamin D dosage?

Research Hypothesis

1. Expectations of aging will predict high VMS use.

Controlling for age, comorbidity, and education level; prior supplement use, high expectations of aging and high general self-efficacy will predict VMS use by older women.

Chapter Summary

This chapter introduced the problem of supplement use in older adults and the need to understand how an older individual's expectations of aging may influence health promoting behaviors such as supplement use. The dissertation study will examine whether factors unrelated to medical need explain the use of VMS in older women. Theoretical models of physiologic homeostasis and health promotion are described which inform the central premise of the study. Using the Health Promotion Model (HPM), this study proposes that positive ERA and high self-efficacy are associated with supplement use.

Dissertation Structure

Three manuscripts in the dissertation are: 1) a report of an original descriptive study of frequency and types of supplements used by residents of three Midwestern nursing homes, 2) a descriptive manuscript describing older women's supplement use with an emphasis on vitamin D, and 3) a theoretical manuscript describing the results of the hypothesis of this dissertation

study. The descriptive study of frequency and types of supplements used by residents of three Midwestern nursing homes is presented in Chapter 2. The methodology for the study is described in Chapter 3. The descriptive vitamin D manuscript and the theoretical manuscript describing the results of the hypothesis of this dissertation study are presented in Chapter 4. The implications for future research, practice, policy, and the summary are presented in Chapter 5. References are located at the end of the dissertation.

Chapter 2

This chapter will elucidate the HPM theory more comprehensively and present the manuscript *Supplement Use by Frail Elderly in Nursing Homes.* While the theory was introduced in Chapter 1, expansion of the details of this complex theory are presented. This chapter begins with the background and theoretical constructs of the theory that informs this study. The variables included in the theoretical framework for the study are clarified. The manuscript provides a more comprehensive review of supplement use by nursing home residents, VMS facts and requirements and a secondary analysis of data regarding VMS use by residents of three Midwestern nursing homes. This study was done as a part of requirements for completion of a doctoral degree in nursing. The manuscript is in response to the first research question and describes prevalence of VMS use by older institutionalized adults. The results of the noninstitutionalized adults surveyed regarding prevalence of VMS use will be reported in Chapter 4, the data manuscript.

Pender's Health Promotion Model to Explore Factors Which Predict Older Adults Use of Dietary Supplements

Health behaviors are the actions individuals employ to maintain or enhance their health. The World Health Organization (WHO) produced a glossary of terms to help clarify the meanings and relations between terms used in health promotion (Nutbeam, 1998). The WHO (Nutbeam, 1998) defined health behavior as "any activity undertaken by an individual, regardless of actual or perceived health status, for the purpose of promoting, protecting or maintaining health, whether or not such behavior is objectively effective towards that end" (p.355). This widely acknowledged definition of health behavior is congruent with the HPM concept of health behavior (Pender et al., 2015).

Older adults incorporate a wide variety of health behaviors into their lives. Health professionals are interested in promoting those health behaviors which preserve, protect, or sustain health during the aging process. Conceptual models are useful for exploring and examining phenomena (Meleis, 2012). The use of conceptual models and theory can advance science and move the nursing discipline forward (Meleis, 2012). When current practice and research engages with conceptual models the discipline advances not only with new knowledge but refined understanding of the conceptual models (Meleis, 2012).

The Health Promotion Model (HPM) is a framework that is useful to the study of health behaviors (Pender et al., 2011; Pender et al., 2015). Health behaviors have been examined using a wide variety of models and theories (Glanz, Rimer, & Viswanath, 2008). Key information guiding theories of health behavior include the factors which influence the behavior and the determinants that may lead to changes in behavior to improve health. Health behavior is influenced at multiple levels and the available health behavior theories reflect this complexity (Glanz et al., 2008). The HPM explores factors which influence health behaviors and is suitable for research concerning VMS use (Pender, 2006).

Health Promotion Model

In the 1980's the Health Promotion Model (HPM) was proposed as a framework to explore processes that motivate people to engage in health behaviors to enhance health (Pender, 1996; Pender et al., 2011). The HPM is an individual level mid-range theory that has been used to explore a variety of health behaviors, interventions, and counseling (Pender, 1996). The HPM is applicable across the life span, and has been used with older adults (Pender, 1996; Sousa, Gaspar, Vaz, Gonzaga, & Dixe, 2015). A wide variety of health behaviors have also been studied including hearing protection, physical activity, and nutrition (Lusk, Ronis, & Hogan,

1997; Mohebi et al., 2013; Wu & Pender, 2002). A central assumption of the HPM is that positive health behaviors have the potential to create healthy lifestyles and healthy outcomes.

Theoretical Underpinnings of the HPM

The HPM incorporates constructs from Social Cognitive theory and expectancy-values theory (Pender et al., 2011). These constructs are based within a nursing perspective of holistic functioning and are central to the theoretical framework for the current study. The Social Cognitive theory is based on the perspective that people are not just reactive but are self-reflecting, self-regulating, self-organizing, and proactive (Bandura, 2001). Social Cognitive theory examines the determinants and psychosocial mechanisms which influence cognition, affect and action (Bandura, 2001). An individual's behavior is not driven just by inner thought or by external stimuli. Behavioral determinants, personal determinants, and environmental determinants are interactive and can augment or constrain one another in an interactive dynamic manner (Bandura, 2001; Pender, 1996). Social Cognitive theory posits that self-beliefs are formed through observation and self-reflective thought. The self-beliefs include self-efficacy, self-evaluation, and self-attribution. Self-efficacy is a core component of the Social Cognitive theory. Self-efficacy concerns the belief of personal ability to change health behavior (Pender et al., 2015). The Social Cognitive theory provides a foundation for considering how ERA are formed and influence the individual.

Expectancy-values theories of human motivation suggest that behavior is economical and rational (Pender, 2006). It holds that if the outcome of an action has positive personal value and if it is known that the action will cause a desired outcome then the person will be likely to engage in the action. Thus, the goal of the action needs to have value and be achievable. Two important concepts in this model are *subjective value of change* and the *subjective expectancy of*

successfully obtaining the change (Pender, 1996; Pender, 2006). The *subjective value of change* is comparable to the individuals' perception of benefits of the health behavior. The *subjective expectancy of successfully obtaining the change* comes from knowledge of personal success or others success in attaining the outcome and the belief that the individual will be able to so the same (Pender, 1996; Pender, 2006). Both concepts deal with motivational significance and both support the supposition of the study, when ERA are viewed positively, the older adult views a positive health outcome as achievable and is more likely to take actions to support future health. Expectancy-values model supports the postulation that how the older adults views their future life to be, may influence and motivate supplement use. When a positive ERA is held, then the current 'action' of supplement use is more likely to be done.

Evolution of HPM

The HPM has gone through revision as studies have tested the power of the component constructs to explain and predict health behaviors (Pender, 1996). Three variables were deleted from the original model (cues to action, importance of health, and perceived control of health) and three new variables were added (Pender, 1996). Other variables were repositioned within the model (Pender, 1996). Cues to action were found to be difficult to measure with reliability, hard to identify, and transient. Importance of health ranked so high in value that it was not useful as a predictor. Perceived control of health was inconsistent and did not contribute to explaining specific health behaviors. The revision also included three new variables: activity-related affect, commitment to a plan of action, and immediate competing demands and preferences (Pender, 1996). The most recent revision and the explanation of the original HPM model can be obtained in the literature (Pender, 1982; Pender, 1987; Pender, 1996; Pender et al., 2015). In studies testing the HPM 5 to 12 variables have been included (Pender, 1996). The

specific variables selected from the HPM to test as predictors of VMS use are explained in the next section.

Components of the HPM to Study VMS

The HPM consists of three areas: individual characteristics and experiences, behavior specific cognitions and affects, and behavioral outcome (Pender et al., 2015).

Individual Characteristics and Experiences

The individual characteristics and experiences consist of prior related behavior and personal factors which influence health behavior. The HPM allows for flexibility to include individual characteristics and experience variables that are highly relevant to a specific health behavior. This allows the HPM to capture variables that are relevant to specific health behavior (Pender, 2006; Pender et al., 2011).

Prior related behavior.

Prior related behavior is proposed to have direct and indirect effects on likelihood of engaging in future health behaviors. Similar behavior in the past is one of the best predictors of engaging in a behavior (Pender, 1996). Past ability to formulate habits predisposes one to engage in a behavior automatically. Strength of the habit builds each time the behavior occurs and happens best with repetition of the behavior (Pender et al., 2015).

Perceptions of self-efficacy through prior behavior is consistent with social cognitive theory. Undertaking the behavior with the associated feedback is a major source of skill information and a major source of efficacy (Pender, 1996). Actual enactment of a behavior and the feedback reinforces the behavior (Pender, 2002). Prior related experience also may provide "outcome expectations", benefits experienced from the prior behavior. Prior related behavior for the purposes of this study is *use of a supplement in the past*. The regular habit of taking a

supplement in the past to improve or protect health influences the possibility of taking supplements in the future.

Personal factors.

Personal factors can be biological, sociocultural, or psychological (Pender et al., 2015). Personal factors are predictive and determined by the target behavior under study (Pender, 2006; Pender et al., 2011). Personal factors found in the literature which may predict VMS use include age, comorbidity and education. VMS use is higher in older age groups (Timbo et al., 2006) and those who are better educated (Dickinson & MacKay, 2014). Supplement users have been described as older and well-educated (Bailey et al., 2011; Conner et al., 2003). Comorbidity can have a confounding influence on studies and it is common for older individuals to have comorbidity (de Groot et al., 2003; Egger, 2012; Marengoni et al., 2011; Valderas et al., 2009).

Behavior-specific Cognitions and Affect

Behavior-specific cognitions and affect are the behaviors that are considered to be of major motivational significance (Pender, 2002; Pender, 2006). These variables are considered critical as they are modifiable through interventions (Pender et al., 2015; Srof & Velsor-Friedrich, 2006). These are the variables can be targeted for intervention to influence change in occurrence or commitment of a health promoting behavior (Pender et al., 2015). The behavior specific cognitions and affect include ERA (perceived benefits to action) and perceived self-efficacy (Pender et al., 2015).

Perceived benefits of action- ERA.

Perceived benefits of action directly motivate behavior and are the perception of the positive consequence of undertaking a health behavior (Pender, 2006; Pender et al., 2011). Anticipated outcomes of a health behavior influence the choice to carry out a health behavior.

The motivational importance of the expected benefits of the health behavior is based on observational learning. Expectancy-value theories holds that if the outcome of an action has positive personal value and if it is known that the action will cause a desired outcome then the person will be likely to do the action (Pender, 2002; Pender, 2006).

Perceptions and interpretations of an individual's experience directly affect behavior (Pender, 2006). Older adults' have varying expectations regarding their own aging. Attitudes towards aging such as expectations of aging have been documented to influence health behaviors (Goodwin et al., 1999; Sarkisian et al., 2003; Sarkisian et al., 2005a). When an older adult has positive expectations of aging those anticipated outcomes may influence VMS use. Perceived benefits of action is a variable that has been consistently found to be an important predictor in tests of the HPM (Lusk et al., 1997; Pender et al., 2015).

Perceived self-efficacy.

Perceived self-efficacy is key in human functioning and the judgement of capability. Self-efficacy plays a central role in a person's belief in their ability to engage in a behavior (Schwarzer, 1992). Self-efficacy beliefs are the result of a cognitive process that depends on diverse efficacy information (Bandura, 1992). Self-beliefs regarding personal self-efficacy are important determinants of action, motivation, affect and thought (Bandura, 1992; Bandura, 2006).

Perceived self-efficacy differs from outcome expectations. Outcome expectations is a judgement of the benefits or costs of the result of the health behavior. It is not skill based but the judgement of what one can do with what they have available. While perceived self-efficacy contains perceptions of skill, competence, and perceptions of efficacy (Pender et al., 2015). Self-efficacy is important to initiation and maintenance of health behavior change (Glanz et al.,

2008).

The HPM postulates that perceived self-efficacy is influenced by the activity-related affect, that is the more positive the affect the greater the perception of efficacy (Pender, 2002). Higher efficacy is posited to decrease perception of barriers to the performance of the targeted health behavior (Pender, 2002). Perceived self-efficacy has a role in self-development, adaptation, and change and has been found to be a powerful determining factor of actual health behavior (Bandura, 2006; Pender et al., 2015). In a study of physical activity among Taiwanese adolescents using the HPM, self-efficacy was found to be the most important predictor of physical activity (Wu & Pender, 2002). If an individual has a higher level of self-efficacy they are more likely to engage in the targeted health behavior (Pender et al., 2015). Self-efficacy has robust support as a predictor in the HPM (Pender, 1996).

Behavioral Outcome

Health promoting behavior is the desired outcome of health decision-making, it is the *desired targeted behavior* (Pender et al., 2015). The health behavior should result in improved health, enhanced function, and better quality of life (Pender, 2002; Pender, 2006). The behavioral outcome in this study is VMS use.

Research and the HPM

In Google Scholar between 2012 and 2013 over 150 papers using the HPM were documented (Pender et al., 2015). The HPM model has been used to study oral health, nutrition, physical activity, hearing protection , exercise, weight loss, bicycle helmet use and colorectal cancer prevention (Pender, 2006; Pender et al., 2015). The HPM has been used with a variety of populations; older adults, males in cardiac rehabilitation, adolescent females, black university students, rural females, older Seventh-day Adventists adults, incarcerated males, military women

with children, and Spanish speaking Hispanic adults, Taiwanese elderly, expatriates in Indonesia, blue-collar workers, and a variety of others (Pender, 2006). The HPM constructs were also effective in the development of a nutritional education intervention (Dehdari, Rahimi, Aryaeian, & Gohari, 2014; Pender et al., 2015).

The choice of theory is important. Theory provides the framework to organize research planning, direct analysis, and develop interventions (Meleis, 2012). Effective health behavior research relies on use of the most appropriate theory (Glanz et al., 2008). Different theories are suited to different types of health behavior, level of threat, or focus of research questions. The choice of the theory should begin with alignment with the problem, goal of research, and be consistent with observations of the behavior (Glanz et al., 2008). Constructs within the HPM have been consistent over different health behaviors (Lusk et al., 1997). Supplement use is a health behavior that has considerable attention focused on prevalence and characteristics but the influences predicting supplement use have not received the same attention. HPM has constructs that align with VMS use behavior and are logical and relevant. HPM is a competence or approach-orientated model which depicts the interaction as a person pursues health (Pender, 1996).

Supplement Use by Frail Elderly in Nursing Homes

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Abstract

Despite concerns about the overuse and safety of supplements, little is known about specific product use by nursing home residents. This descriptive study describes frequency and types of supplements used and examines whether gender, body mass index or length of stay predict the use of specific products. Data were abstracted from the records of 247 residents in three Midwestern nursing homes and categorized as a vitamin, mineral, nutrition or herbal supplement. Ninety-four percent (n=233) of residents were taking a vitamin, mineral, nutrition or herbal supplement. Eighty-one percent (n=201) were taking some type of vitamin, 77% (n=192) were taking a mineral, 43% (n=106) were taking a nutritional supplement and 25% (n=62) were taking an herbal supplement. Vitamin D was the most commonly taken supplement. Health care professionals and food and nutritional professionals should be aware of rising numbers and types of supplements used.

Introduction

Supplements are big business. More than thirty-two billion dollars are spent on supplements each year (Cohen, 2014). Over 100 million Americans use dietary supplements in the form of vitamins, minerals, nutrition supplements, and herbals (Cohen, 2012). Use of supplements is expected to rise as an interest in maintaining health or preventing illness (Bailey et al., 2013; U.S. General Accounting Office, 2000). Older adults residing in nursing homes are not included in the National Health and Nutrition Examination Survey (Ahluwalia et al., 2016). While supplement use has been documented in the community dwelling elderly, it is important to investigate supplement use in the frail elderly in the nursing home setting. Hence, the purpose of

this study is to describe the use of vitamin, mineral, nutrition, and herbal supplements (VMNHS) in nursing home residents.

Despite concerns about overuse and safety, current information on nursing home residents' use of VMNHS is limited (Goorang, Thorpe, Baillod, & Whiting, 2015; Goorang, Ausman, Houser, & Whiting, 2015). Vitamins are commonly used in nursing homes (Avorn & Gurwitz, 1995; Nygaard, Naik, Ruths, & Straand, 2003; Wills et al., 1997). One study in Canada found about half the residents of a long-term care facility were taking a supplement (Viveky et al., 2012). Vitamin D was the supplement used the most followed by calcium and multivitamins (Viveky et al., 2012). The most commonly used supplement by residents in two assisted living facilities in the United States were multiple vitamins (15.7 %) (Lam & Bradley, 2006). A study conducted in Mexico found that vitamins and anti-anemic supplements were the most common type of all drugs taken by nursing home residents (Pérez-Guillé et al., 2001). Twenty-eight percent of men and 39 % of women were taking a vitamin or anti-anemic supplement (Pérez-Guillé et al., 2001).

Many people believe that VMNHS are regulated the same as prescription drugs, however this is a common misconception. There is no requirement for the manufacturer to provide evidence of product safety or effectiveness before marketing the product (United States Congress, 2006). Safety is regulated through a post-market evaluation which tracks adverse events (United States Congress, 2006). However, there are many problems with reporting and tracking. One difficulty is that the voluntary reporting computer system is severely limited and the FDA lacks sufficient staff and resources for tracking and reporting (U.S. General Accounting Office, 2000). The General Accounting Office (GAO) found that "consumers face health risks because current federal laws and agencies' efforts do not effectively and consistently ensure that

these products are safe" (2000, p.25). There is no regulation for the manufacturer to provide safety related information such as dangerous drug interactions (U.S. General Accounting Office, 2000).

In 1994, the Dietary Supplement Health & Education Act (DSHEA) was passed giving the Food and Drug Administration (FDA) regulatory authority to take actions against false or misleading supplement claims, impure supplements, misbranded supplements, and safety issues (United States Congress, 2006). The DSHEA requires a dietary supplement label to identify the product as a supplement, list ingredients, and provide the net quantity and contact information of the manufacturer. A disclaimer statement is also required stating that the FDA has not evaluated the claims made on the label and stating that "… the product is not intended to diagnose, treat, cure, or prevent any disease" (United States Congress, 2006). Yet supplements are being taken to prevent, treat, and, cure health problems.

Background

The theory of physiologic homeostasis and the aging process is useful for understanding the impact that supplements can have on the physical body. Physiologic homeostasis maintains the body's biological stability and balances metabolic activity and regenerative responses (Wang et al., 2014). Aging disrupts homeostasis in several ways, including damage from oxidative stress, dysregulation of cell number, and inadequate repair of damage (Boron, 2012; Wang et al., 2014). People age at different rates with significant differences in physiological response and homeostatic reserves. The physiological burdens placed on the body by VMNHS may impact homeostasis.

The aging process causes a reduction in the function of organs along with a reduction in repair ability (Navaratnarajah & Jackson, 2013). The kidneys and glomeruli decrease in mass

and surface area with subsequent declines in the glomerular filtration rate (Navaratnarajah & Jackson, 2013). There is also an increase in permeability of glomerular membrane associated with proteinuria. Chronic diseases of the liver and kidney limit the ability of these organs to metabolize and excrete VMNHS (Gardiner, Graham, Legedza, Eisenberg, & Phillips, 2006).

Several age-related changes in skin and gastric secretions also impact status of vitamins and minerals. Age related changes in skin result in decline in vitamin D production. This is compounded by insufficient sun exposure due to reduced outdoor activity. The malabsorption of nutrients in elderly persons is compounded by disease such as atrophic gastritis. Folic acid, vitamin B-12, calcium, iron and beta-carotene absorption is affected by low acid conditions in elderly persons' stomach (Russell, 2001).

Polypharmacy and inappropriate prescribing, common in the elderly, contribute to the potential for VMNHS to compromise homeostasis. Potentially inappropriate medications include medication with significant risk of adverse drug event, high frequency of use, multiple medicines with high rate of interactions, and under use of needed medicine (Gallagher et al., 2007). VMNHS can interact with drugs which can increase or decrease the drugs activity (Gardiner et al., 2008) and add to the potential for adverse responses. Qato et al. (2008) found that 1 of 25 supplement users were at risk for a major drug-drug interaction.

Vitamin/Supplement Fundamentals

Vitamins are organic compounds that provide vital nutrients, which are required in limited amounts. B vitamins are a class of water-soluble vitamins that have an important role in cell metabolism (Medline Plus, National Institutes of Health, U.S. National Library of Medicine, 2015). There are eight different B vitamins and each has a unique function. Vitamin C is a water-soluble vitamin and is required for essential metabolic reactions and may also act as

antioxidant against oxidative stress (NIH, Office of Dietary Supplements, 2013b).

Vitamin D is fat soluble vitamin and may be considered a hormone as the synthesis and activity occurs in different locations (NIH, Office of Dietary Supplements, 2016). Vitamin D has a significant role in calcium homeostasis and metabolism and is needed for bone growth and remodeling. Vitamin D may come from diet or be produced endogenously from ultraviolet rays from sunlight. Vitamin D from sunlight and food is biologically inert and to become active must undergo two hydroxylation reactions. The enzymatic conversions take place in the liver and kidney. Due to concerns regarding the risk of cancer from sunlight there is no recommendation for sunlight to meet the daily requirements and rather there is a Recommended Daily Allowance (RDA) from dietary sources. Vitamin D2 (ergocalciferol) and vitamin D3 (cholecalciferol) are both forms of vitamin D which are manufactured for supplement use (NIH, Office of Dietary Supplements, 2016). Vitamin E is a fat-soluble antioxidant and occurs naturally in 8 chemical forms. The antioxidant effect of vitamin E protects cells from damage from free radicals (molecules with an unshared electron) and is involved in immune function (NIH, Office of Dietary Supplements, 2013c).

Calcium, iron, and potassium are minerals which are naturally occurring inorganic substances. Calcium is the most abundant mineral in body and is required for muscle function, nerve transmission, intracellular signaling, as well as vascular contraction and vasodilation (NIH, Office of Dietary Supplements, 2013a). The balance between bone resorption and deposition changes with age: in aging adults, bone breakdown exceeds formation resulting in bone loss. Iron is a mineral that is an essential part of hemoglobin, myoglobin, and is required for growth, development, cell functions and the synthesis of some hormones (NIH, Office of Dietary Supplements, 2015b). Potassium, an electrolyte, plays a role in the transmission of nerve

signals, muscle contractions, fluid balance and chemical reactions.

Dietary supplements are used for many purposes including supporting immune system, supporting the healing process or reducing risk of age-related conditions. Dietary supplements can include vitamins, minerals, fiber, fatty acids, amino acids, and natural food supplements.

Vitamin/Supplement Requirements and Side Effects

The Food and Nutrition Board at the Institute of Medicine of the National Academies establish guidelines for dietary intake which included nutrient standards, dietary guidelines and nutrition labeling. The Food and Nutrition Board also provides authoritative judgments on relationships among nutrition and health. The Food and Nutrition Board publishes dietary guidelines every 5 years using research to address issues of safety and quality. The Dietary Guidelines Advisory Committee (2015) reported that more information is needed regarding dietary intake of older adults, impact of polypharmacy on nutritional adequacy, and the rationale for and the consequences of using high dose supplements (2015). Dietary Reference Intakes (DRI) is the term for values to assess and plan nutrient needs: Recommended Daily Allowance (RDA), Adequate Intake, and Tolerable Upper Intake Level. The RDA is the average daily level of intake that is sufficient to meet the nutritional needs of nearly all healthy people.

While current evidence suggests that most adults, particularly those with limited sun exposure, require a vitamin D supplement, there is controversy regarding recommended dosing and the potential benefits of vitamin D (Hossein-nezhad & Holick, 2013). Different guidelines are used to measure or report vitamin D deficiency or sufficiency levels (Hossein-nezhad & Holick, 2013). The Endocrine Society recommends daily vitamin D supplement of 2,000 IU per day to remain above 30 ng/ml, the Food and Nutrition Board recommends 600 IU/day to remain above 20 mg/ml (Holick et al., 2011). The different ‘ideal’ vitamin D levels lends to controversy

regarding dosage and use (Pludowski et al., 2017). Furthermore, there are different methods to measure vitamin D levels and problems remain regarding accuracy of test results (Binkley et al., 2004; Binkley & Sempos, 2014; Schleicher et al., 2016).

Though the side effects of VMNHS are understudied, evidence suggests that adults and particularly the elderly are at risk for adverse events. Vitamin A toxicity is associated with liver damage (Navaratnarajah & Jackson, 2013). Four percent of supplement uses reported an adverse event they believe was related to the supplement and 13 % of adults using multivitamin, multimineral reported adverse events (Timbo et al., 2006). Self-reported adverse event symptoms from VMNHS include blood pressure problems, nausea, rash, vomiting, dizziness and abdominal pain (Marra & Wellman, 2008; Timbo et al., 2006).

Methods

This report is a secondary analysis of data from a descriptive, correlational and cross-sectional research study. Three not-for-profit nursing homes in the upper Midwest provided the data and were chosen by convenience of proximity to the university. All the long term skilled nursing home residents who had at least a one-month length of stay, except those specifically admitted for short-term rehabilitation, were included and yielded a sample size of 247. The Institutional Review Board (IRB) designated for each site approved the study. All the information collected was de-identified and securely stored.

Four terms are used to categorize supplements: vitamin, mineral, nutrition, and herbal supplements. Vitamin use included multiple forms of vitamin B, vitamin C, multiple forms of vitamin D, and vitamin E. Minerals include calcium, iron, and potassium. Nutrition supplements were products containing protein, amino acids, vitamins and minerals, or calories. The term herbal is used, for ease of reading, to describe both herbal and other nonvitamin,

nonmineral supplements that are botanical or do not fall into other categories. Herbal supplements included cranberry, coenzyme Q-10, arginine, melatonin, probiotics and fish oil supplements. There are VMNHS that were not represented in the medical records such as vitamin A and are thus not reported by this study. Differences in the use of VMNHS based on gender, BMI and length of stay are explored. Because of the recent emphasis on vitamin D and controversy over dosage we specifically looked at dosage of vitamin D prescribed within and outside of USDA guidelines.

Measurement

Data for the original study were collected from the health care records by two nurse researchers and de- identified over one month in 2014. Standardized abstraction forms were used and abstractor monitoring was performed by a senior researcher. For the secondary analysis, data were abstracted and coded by one trained nurse researcher supervised by a senior nurse researcher. Interrater reliability was .85 to 1.0 with an average of .96 for 10 forms.

Categorizations found in the literature, common guidelines and the medication administration records (MARs) were used to code the specific VMNHS into SPSS. Data were first broadly categorized as vitamin, mineral, nutrition, and herbal supplements. Since vitamin and mineral products are often produced in a wide variety of combinations there was a category for combinations of vitamin and minerals. Vitamins included the following: B vitamins, vitamin C, vitamin D (vitamin D, vitamin D2, vitamin D3 and D Complex), and vitamin E. Nominal coding was used to indicate whether a specific category of vitamin was taken or not. All eight types of B vitamins (thiamin, riboflavin, niacin, Pantothenic acid, pyridoxine, biotin, folic acid and cobalamins) while chemically distinct were categorized as vitamin B. Due to interest in vitamin D, the different prescriptive forms of vitamin D and dosages were coded categorically

per RDA with normal being considered as within 10% above and below RDA. The 3 levels differentiated for vitamin D for adults over the age of 51 years was: below RDA < 540 IU, within RDA 540 - 880 IUs and above RDA > 880 IUs. The 10 % was an arbitrary amount chosen to help differentiate dosages and prescriptions to fit into the categories.

Minerals include the following; calcium, iron and potassium. Nominal coding was used to indicate whether a specific category of mineral was taken or not. Calcium and vitamin D combinations were coded under each category if specific dosages were given for calcium and vitamin D respectively. This is the only combination of a vitamin and mineral in which one prescription had the potential to be coded in two categories (calcium and vitamin D).

Nutritional supplements include the following house supplements, three name brand products (referred to as Purchased Dietary Supplements), and calorie snacks (produced by each nursing home kitchen). Each facility developed house supplements and caloric snacks. No information was gathered to compare differences between facilities regarding house supplements or snacks. Herbal supplements which are prescribed for health benefit and do not fall in other categories, include cranberry, coenzyme Q-10, arginine, melatonin, probiotics, and fish oil. Nominal coding was used to indicate whether a specific category of dietary supplement was taken or not. Also for all categories if a product had multiple prescriptions and different formulations it was noted as yes/ no, did not capture frequency. Only vitamin D captured dosages.

The most recent Body Mass Index (BMI), hemoglobin (hGb), and hematocrit (hct), and demographic data were also abstracted. BMI was calculated by dividing the person's weight in kilograms by the square of the height in meters (kg/m^2). The Centers for Medicare & Medicaid Services recommend for adults 65 years and older the normal parameter for BMI is ≥ 23 and <

30 (Center for Medicaid and Medicare Services, 2015).

Analysis and Results

The sample and use of vitamin, minerals, nutrition and herbal supplements are described using frequencies, percentages, means and standard deviations. Differences in the prescriptive practices based on other variables were examined using Chi Square and t-tests. Since the variable length of stay was skewed, comparisons using this variable were examined with the non-parametric Mann-Whitney U test.

Residents were primarily female and the length of stay ranged from 1 month to 11.5 years (M = 28.0, SD = 27.2). See Table 1 for characteristics of residents. VMNHS did not differ based on gender (p = .148) or length of stay (p = .277). There was a statistically significant difference in the number of vitamins prescribed between the three facilities (χ^2 = 10.269, p = .006; range 71% to 92%). Of all the types of vitamin D prescribed, only D2 varied significantly between facilities (χ^2 = 15.081, p = .001). Vitamin D2 use ranged from .05% (3 out of 63) to 29 % (32 out of 110).

Table 1. Characteristics of Residents (N=247)

Characteristics	*M* (*SD*)	Differences Between the Three Facilities χ^2	*p*
Age	87.7 (7.6) Minimum=54 Maximum=103	110.277	.004
Gender	Males *n* = 65 Females *n* = 182	.232	.891
LOS*	28.0 (27.2) Minimum=1 Maximum=140	161.820	.317
Hgb	11.9 (2.5)	162.300	.003
Hct	36.6 (5.2)	71.032	.255
Average BMI **	26 (5.9)		

Low BMI <23	n=79 (32%)	
Normal BMI 23-29.9	n=119 (48%)	
High BMI ≥30	n=49 (20%)	

*Length of Stay in Months
**Centers for Medicare & Medicaid Services recommended BMI for age > 65

Ninety-four percent (*n* = 233) of residents were taking a VMNHS (see Table 2). Eighty-one percent (*n* = 201) were taking some type of vitamin, 77% (*n* = 192) were taking a mineral, 25% (*n* = 62) were taking an herbal supplement and 43% (*n* = 106) were taking a nutrition supplement.

As seen in Table 2, the most commonly prescribed vitamin was vitamin D with multiple residents being prescribed more than one form of vitamin D. More females took vitamin D (*n* = 120 of 182, 66% of females) than males (*n* = 40 of 65, 62% of males, $\chi^2 = .406$, $p = .524$), though there were no gender differences in the use of vitamin D, D2, D3 or D complex.

Table 2. Frequency and Percentage of Residents Taking Specific Vitamin, Minerals, Combination, Nonvitamin nonmineral and Dietary supplements (N=247)

Total of Residents Who are Prescribed	Frequency *n* (%)*	Vitamin	*n (%)**	Nonvitamin Nonmineral	*n (%)**
Vitamin	201 (81.4)	B	65 (26.3)	Acidophilus/ Probiotics	34 (13.8)
Any Vitamin D (D, D2, D3, D complex)	178 (72.1)	C	18 (7.3)	Arginine	1 (0.4)
Mineral	192 (77.7)	D	160 (64.8)	Coenzyme Q-10	4 (1.6)
Herbal	62 (25.1)	D2	49 (19.8)	Cranberry	11 (4.5)
Nutritional	106 (42.9)	D3	100 (40.4)	Fish Oil	8 (3.2)
VMNHS	233 (94.3)	D complex	1 (.4)	Melatonin	13 (5.3)
Mineral	*n (%)*	E	3 (1.2)	Nutritional	*n (%)*
Calcium	117 (47.4)	Combinations	*n (%)*	House Supplement	91 (36.8)
Iron	58 (23.1)	Combination	100 (40.4)	Purchased Dietary	22 (8.9)

		vitamin/ mineral		Supplement	
Potassium	74 (29.9)	Combination vitamins	17 (6.9)	Snack	10 (4.0)

*** *n* (%)* = *n* (*n*/N %)**

Those taking vitamin D had a longer length of stay (*M* = 30.7, *SD* = 26.9) than those not taking vitamin D (*M* = 23.2, *SD* = 7.1; *p* = .002). Of the entire study sample, 62% (*n* = 154) were prescribed dosages of vitamin D above the RDA, 1 % (*n* = 3) were within RDA, 9 % (*n* = 21) were below RDA, and 28% (*n* = 69) were not prescribed any vitamin D (see Table 3). The percentage of residents taking vitamin D at each facility was statistically significantly different and ranged from 46 % to 78 % (χ^2 = 15.82, *p* < .001).

Table 3. Characteristics of Vitamin D Dosages (N=247)

Individual Dose of Vitamin D, D2, D3 and D Complex			
Vitamin	Below RDA *n* (%)*	Within RDA *n* (%)*	Above RDA *n* (%)*
Vitamin D	70 (28.3)	8 (3.2)	4 (1.6)
Vitamin D2	0 (0)	0 (0)	55 (22.3)
Vitamin D3	3 (1.2)	1 (.4)	102 (41.3)
Vitamin D Complex	0	1 (.4)	0

Total Dosage per Day Vitamin D: Combination of Vitamin D, D2, D3 and D Complex				
	0 Vitamin D	Below RDA *n* (%)*	Within RDA *n* (%)*	Above RDA *n* (%)*
Total Dosage Vitamin D	68 (28%)	21 (9%)	3 (1%)	154 (62%)

* *n* (%)* = Frequency *n* (n/N %)

The most commonly prescribed mineral was calcium followed by prescription for combination vitamins and minerals (see Table 2). Prescribed calcium did differ by gender (χ^2 = 3.236406, *p* = .036 one sided), with 66% of women on a calcium supplement as compared to

62% of men. Potassium and iron supplements were also commonly prescribed. Residents taking iron supplements had lower Hgb (M = 11.0, SD = 1.8) scores than residents not taking an iron supplement (M = 12.2, SD = 2.6, t (224) = 3.038, p = .003).

The most commonly prescribed herbal supplements were acidophilus/probiotics (13.8%) followed by melatonin and cranberry (see Table 2). There were no differences between genders in herbal supplement use (χ^2 = 3.236.596, p = .440).

The most common nutrition supplement used was the house supplement (n = 91, 36.8 %), while the use of the other four nutrition supplements (house snack and 3 Purchased Dietary Supplements) ranged from 2.4% to 4 %. The residents on a nutrition supplement had a significantly lower BMI (M = 24.2, SD = 5.3) than those not on a nutrition supplement (M = 27.3, SD = 6.0; t(238) = 4.233, p < .001). Thirty-two percent of sample (n = 79) had low BMI, 48% (n = 119) had normal BMI and 20% (n = 49) of the sample had high BMI.

Supplements infrequently used were: ginger supplement (n = 1), turmeric supplement (n = 1), zinc sulfate (n = 3), magnesium supplement, (n = 3), and omega 3 (n = 1).

Discussion

Our finding that 94% of residents were taking a VMNHS is higher than results from both long-term care residents with dementia (48.7% use) in Canada (Viveky et al., 2012) and community dwelling older adults (82.5 %) in the U.S (Nahin et al., 2009). We also found differences in use of supplements between the three facilities. Both the higher results and differences between nursing homes may be due to varied prescription practices or sample profiles.

The current study found fewer gender differences in supplement use than found in NHANES trend monitoring reports (Gahche et al., 2011). Our findings suggest that gender

differences in supplement use may show fewer differences once supplements are prescribed within a long-term care setting. The finding that calcium and vitamin D use was significantly higher for women may reflect the increased use of calcium in community dwelling U. S. women from 28% to 61 % from 1988 to 2006 (Gahche et al., 2011)..

Estimates of dietary supplement use results vary depending on when the survey was completed, lack of standardized definitions and categories for VMNHS, the population studied, and the study design. In regard to study design results are impacted by difference in timing, methods of report, and sampling methods. The third NHANES asked residents if they had used supplements over the last month while the 2002 Health and Diet Survey was a national phone survey based on self-report over the last 12 months (Timbo et al., 2006). The NHANES and the 2002 Health and Diet Survey are both self-report, another used pharmacy records (Viveky et al., 2012) and this study used the MAR. The accuracy of reporting will vary depending on study design and controls. Regarding population and sampling the NHANES does not include institutionalized U.S. residents.

Among this sample, the most commonly prescribed products were vitamin D, calcium, and combination products that contained both vitamins and minerals. Vitamin D doses were often above the RDA and may be explained by a population at risk for vitamin D deficiency. Risk factors for vitamin D deficiency include obesity, limited access to sun exposure, wearing more clothing when outside, decrease in ability of skin to produce vitamin D due to age, and the high prevalence of atrophic gastritis decreasing ability of older adults to absorb vitamin D (Holick et al., 2011; Joshi, 2015). Also, the Endocrine Society Clinical Practice Guideline suggests the Tolerable Upper Intake Level of 4000 IU/day vitamin D for maintenance for older adults and for adults with vitamin D deficiency 10,000 IU/day (Holick et al., 2011). Recent

studies have suggested that deficiency of vitamin D is associated with functional impairment and fall risk in older adults (Centeno Peláez, Ausín, Ruiz Mambrilla, Gonzalez-Sagrado, & Pérez Castrillón, 2014) as well as an accelerated cognitive decline (Miller et al, 2015). Joshi (2015) suggested that the evidence is not sufficient to use vitamin D to promote health or prevent aging.

This study found that a wide variety of VMNHS are being used nursing homes. Five of the 15 most prevalent dietary supplements taken by ambulatory elderly in the Ginkgo Evaluation of Memory Study were not represented in our sample: glucosamine and chondroitin (17.9%), garlic (4%), ginkgo biloba (3.8%), saw palmetto (3.6%), and Echinacea (2.3%) (Nahin et al., 2009). While coenzyme Q-10, cranberry, arginine, melatonin, probiotics and fish oil were reported in this study, these supplements did not make the list of the most prevalent in the Ginkgo Evaluation of Memory Study (Nahin et al., 2009). The low rate of vitamin E use in this sample,1%, was surprising as compared to ambulatory elderly rate of 59.4% (Nahin et al., 2009). Our findings suggest there may be substantial differences in patterns of use between ambulatory community dwelling elderly and long-term care residents. Many residents of long-term care are prescribed a wide variety of supplements.

Limitation

Lack of standardized definitions and categorizations of multivitamins, multi-minerals and herbals makes it difficult to compare results across surveys and time. Total dosages for vitamin D only included the specific prescriptions of vitamin D and did not include vitamin D present in food, combination vitamin/ mineral products, house supplements, snacks, or Purchased Dietary Products. The results of total vitamin D for sample thus are expected to be lower than actual intake. This study did not have data to compare blood levels of vitamin D to dosages prescribed. The sample represents residents of three nursing homes were from one geographical area in the

U.S which may impact generalizability of findings.

Recommendations for Future Research

There appear to be differences in supplement use between findings reported in the literature regarding community dwelling adults and our findings from long term care. Examination of patterns of supplement use by institutionalized adults in a variety of settings is needed. There is a need to more clearly understand how nutritional needs and supplement use change over illness trajectories and transitions from community dwelling to acute and long-term care settings. Questions remain regarding benefits and safety of most products. There is a need to examine dosages that are suitable for specific uses and patient profiles.

The motivations for prescribing supplements and for older adult's decision to take supplements may provide important explanations for the costly and potentially unsafe use of many products. It would also be interesting to examine how patterns of use change based on marketing and advertising campaigns. Understanding more clearly the role of physicians, health care practitioners, and marketing campaigns in guiding choices could inform the development of interventions and guidelines.

Conclusion

A significant proportion of older adults in three long term care facilities took a wide variety of dietary supplements. Vitamin D, calcium, and vitamin/ mineral combination products accounted for much of the supplement use. The most common products categorized with the herbals were probiotics followed by melatonin and cranberry. Health care professionals and food and nutritional professionals should be aware all sources of dietary supplement intake in regard to RDA and drug interactions due to increased patterns of supplement use. Based on prevalence of use, cited safety and cost concerns, greater consideration of the need for

supplements and the factors that motivate the prescribing of these products is recommended as a research and public health priority.

Chapter Summary

This chapter presented more detail regarding the HPM and the first manuscript. The HPM theoretical constructs and variables were elucidated. The first manuscript, *Supplement Use by Frail Elderly in Nursing Homes,* described the prevalence of vitamin, mineral, nutrition or herbal supplement use in three nursing homes. Most the residents were taking a supplement of some type and vitamin D was the most commonly taken supplement. The manuscript explored part of the first research question: what supplements are older adults currently taking in an institutional setting.

Chapter 3

Summary of Methodology for Study

This chapter will review the methodology of the research study. The research design and questions, study variables, instrumentation, survey development, settings, sample, protection of human subjects, procedures for data collection, and the data analysis are discussed. Testing of several variables for potential inclusion as covariates was presented. Variables of age, education, and comorbidity that show statistically significant differences will be included as covariates in the regression models.

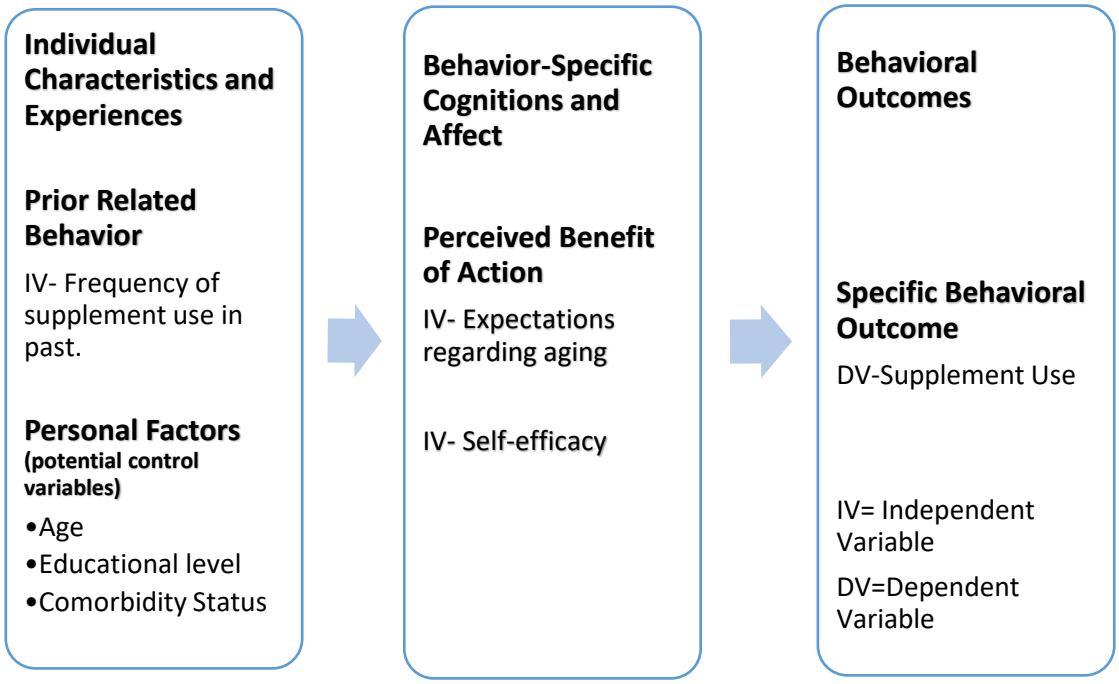
Research Design

The research design was a descriptive cross-sectional design. Descriptive research is nonexperimental with the purpose to observe, describe, and document in the natural setting (Polit & Beck, 2012). A prevalence study has a cross-sectional design that describes patterns at a specific point in time (Hulley, Cummings, Browner, Grady, & Newman, 2013; Polit & Beck, 2012). The research questions and hypothesis which guided this study were developed from the HPM and literature review. Following are the conceptual model, research questions, and the hypothesis that guided this study.

Conceptual Model

Using the HPM to study supplement use (See Figure 1), it is postulated that *prior supplement use, age, comorbidity and education level* influence *expectations of aging and self-efficacy which* influences *VMS use.*

Figure 1. HPM to Illuminate Supplement Use



Research Questions

1. What is the prevalence of VMS use among older adults?
2. What are older women's levels of general self-efficacy and expectations of aging?
3. Is higher age associated with increased number of supplements taken?
4. Is there a difference in supplement use between women with higher and lower levels of education?
5. Is there a difference in supplement use between women with high, medium and low levels of comorbid conditions?
6. What percentage of older women are taking vitamin D over the Tolerable Upper Intake Level?

7. Are older women cognizant of their vitamin D dosage?

Research Hypothesis

1. Expectations of aging will predict high VMS use.

Controlling for age**,** comorbidity**,** and education level; prior supplement use, high expectations of aging and high general self-efficacy will predict VMS use by older women.

Study Variables

The main variables were prior supplement use, expectations of aging, general self-efficacy, and current supplement use. A summary of the study variables is found in Table 4. Independent variables were identified by literature review and use of the HPM as a framework. Independent variables were *use of supplements in the past*, *expectations of aging* (3 subscales: physical, mental and cognitive function), and *general self-efficacy* (GSE). The dependent variable is *supplement use.* The HPM suggests personal factors (age, level of education, and comorbidity) might have influenced the outcome measure. Personal factors which related to outcome measure were used as control variables.

Table 4. Summary of Study Variables

Variables
Independent Variables
Use of supplements in the past (Categorical Variable)
Expectations Regarding Aging (Interval Variable, Total 0-100 range score)
Expectations regarding physical health (Interval Variable, Total 0-100 range score)
Expectations regarding mental health (Interval Variable, Total 0-100 range score)
Expectations regarding cognitive function (Interval Variable, Total 0-100 range score)
General Self-Efficacy (Interval Variable, Total Range 10-40)
Dependent Variable
Current Supplement Use (Interval Variable, Range 0- total number)
Control Variables: Personal Factors
Age (Interval Level, 65 years plus)
Education Level (Ordinal Variable)

Comorbidity (Interval Variable, Range 0-45 Total)

Demographic Variables

Marital Status (Categorical Variable)
Ethnicity (Categorical Variable)
Race (Categorical Variable)
Level of Education (Ordinal Variable)
State of Health (Ordinal Variable)
Osteoporosis (Dichotomous variable Yes/No)
Annual Income (Ordinal Variable)
Rate Finances (Ordinal Variable)

Instrumentation

Instruments to measure comorbidity, expectations of aging and general self-efficacy were used in this study. All instruments were in questionnaire form. Evidence regarding the reliability and validity of each instrument is provided. Demographic information and current supplement use questions were included. The current supplement use questions have been developed using the NHANES Dietary Supplement and Medication Questionnaire as a guide.

The following is a list of the instruments used in this study and permission for use.

1) Self-Administered Comorbidity Questionnaire (SCQ) – measured the potential covariate comorbidity. Dr. Katz gave permission via email (Appendix C) for the use of The Self-Administered Comorbidity Questionnaire and requested the article developed the SCQ be cited (Sangha, Stucki, Liang, Fossel, & Katz, 2003).
2) Expectations Regarding Aging Survey (ERA-12) – measured the independent variable, expectations of aging. The Expectations Regarding Aging Survey (ERA-12) was available at no cost. The authors requested the article regarding the development of the survey be cited in the work (Sarkisian et al., 2005b).
3) General Self-Efficacy Scale (GSE) measured the general sense of perceived self-efficacy. The GSE was available at no cost and explicit permission is not needed to

utilize the scale in research studies (Schwarzer & Jerusalem, 1995). The GSE may be used if recognition was specified and additional items may be written and added to scale to individualize the scale if desired.

Self-Administered Comorbidity Questionnaire

Comorbidity was expected in the sample population due to the age of the participants. Comorbidity can have a confounding influence in studies (de Groot et al., 2003). There were many instruments to measure comorbidity developed for a variety of purposes (de Groot et al., 2003; Hall, Ramachandran, Narayan, Jani, & Vijayakumar, 2004). The study required a comorbidity instrument the participants could fill out. The scale chosen for the study is the Self-Administered Comorbidity Questionnaire (SCQ) (Sangha et al., 2003).

A simple list of chronic health problems is one method to quantify an individual's comorbidity. A list would provide an understanding of the complexity of the health issues but it may not demonstrate the severity of the conditions or the burden of the conditions (Charlson, Pompei, Ales, & MacKenzie, 1987). If the total number of comorbid diseases approach was used there is an assumption that a patient with cancer would have the same illness severity as a patient with hypertension (Charlson et al., 1987). A list of comorbid conditions does not reflect the impact of the conditions on function.

The SCQ was developed to provide a self-administered questionnaire to measure comorbidity. A panel of physicians selected medical conditions per their expert practice and inclusion in comorbidity indexes: Charlson Comorbidity Index, the Cumulative Illness Rating Scale and the Index of Co-Existent Disease (Sangha et al., 2003). The SCQ also allowed for three additional comorbid conditions to be written in by the participant. Each medical condition had 3 points possible: 1 for presence of condition, 1 if received treatment, and 1 if the condition

limited activities. The question on treatment considered disease severity. The question on activities considered the impact of the medical condition on functional limitations. The purpose for questions on treatment and activity was to quantify the impact of the medical conditions. Some comorbid conditions do not limit function, such as hypertension, while others severely limit function (Sangha et al., 2003).

The SCQ had a possible total of 45 points with a range of scores from 0 to 45. The SCQ was easy to administer, self-report and allowed for additional comorbid illnesses to be added (Katz, Chang, Sangha, Fossel, & Bates, 1996; Sangha et al., 2003). It has been tested with the elderly and has terms the elderly are familiar with (Katz et al., 1996; Sangha et al., 2003).

Reliability and validity.

The SCQ test-retest reliability was 0.94 (95% CI, 0.72, 0.99) measured with the intraclass correlation coefficient (ICC) and was compared with test-retest reliability of the Charlson Index of 0.92 (Sangha et al., 2003). The test retest reliability of specific items calculated with kappa statistic and ranged from moderate (back pain = 0.40) to high (> 0.90 for heart disease, hypertension, lung disease, kidney disease, diabetes, anemia and depression) (Sangha et al., 2003).

The spearman's correlation coefficient of 0.55 was between the SCQ and the Charlson Index. The SCQ has moderate association with Charlson Index (Sangha et al., 2003). The SCQ was chosen as it captured the comorbid medical conditions and allowed for additional comorbid conditions. It also included the severity and functional limitations (Sangha et al., 2003). The SCQ medical terms have been simplified making the SCQ easy to read and understand (Sangha et al., 2003).

Expectations Regarding Aging Survey - 12

The Expectations Regarding Aging (ERA-12) was a 12-item instrument to measure expectations regarding aging among older adults (Sarkisian et al., 2005b). The ERA-12 was developed to provide a shorter scale that would be useful in surveys and would take less time to complete. The ERA-12 was developed from the ERA-38.

All ten scales on the ERA-38, other than pain with a Cronbach's alpha of 0.58, had good internal consistency reliability with Cronbach alpha ≥ 0.73 and item discrimination ≥ 0.80 (Sarkisian, Hays, Berry, & Mangione, 2002b). Correlations with age, activities of daily living, the Geriatric Depression Scale, and the physical and mental component cores of the Medical Outcomes Study Short Form-12 supported construct validity. Almost 70 % of community dwelling older adults who participants responded during the cognitive debriefing that all or almost of the ERA-38 addressed important things (Sarkisian et al., 2002b).

Reliability and validity.

In the development of ERA-12, factor analysis was used to identify the dominant factors, principal components with promax rotation (Sarkisian et al., 2005b). The three factors were physical health, mental health, and cognitive function. For each of the three factors the authors identified 2, 3, 4 or 5 item subsets that would explain maximum variation in overall factor score. Based on previous work four items were selected for each of the three factors to form the 12-item scale. The final scale was determined using: variance and internal consistency reliability, focus group findings, redundant items removed, and completed by older adult in 5 minutes (Sarkisian et al., 2005b). The Cronbach's alpha, internal consistency reliability, for the three scales ranged from 0.73 to 0.81. The test-retest reliability was measured on a 2-week retest with intraclass correlation coefficient (a measure of the reliability of measurements) of 0.94.

General Self-Efficacy Scale (GSE)

Perceived self-efficacy was related to subsequent behavior and was relevant to explore behavior, behavior change, and for clinical practice (Schwarzer & Jerusalem, 1995). General self-efficacy was the self-perceived belief in one's self competence to tackle tasks and handle adversity in a broad range of encounters (Luszczynska, Gutiérrez-Doña, & Schwarzer, 2005; Scholz, Gutiérrez Doña, Sud, & Schwarzer, 2002). Generic self-efficacy skills related to different higher-order self-regulatory skills which were used in a variety of activities (Bandura, 2006). Specific self-efficacy was constrained to a specific task (Luszczynska et al., 2005). The GSE scale measured general self-efficacy and allowed for additional items to be included for a specific task (Schwarzer & Jerusalem, 1995). The perceived self-efficacy of the participants was measured with the GSE. Additional questions were added for supplement use as detailed below.

Self-efficacy was conceptualized as the individual's perceived "optimistic self-belief" (Schwarzer, 1992). The GSE was created to assess the general sense of perceived self-efficacy and was designed for the general adult population. The scale was self-administered. Responses to the 10 questions were made on a 4-part scale: 1 = not at all true. 2 = hardly true, 3 = moderately true, and 4 = exactly true. The GSE allows for additional items to be added as desired to encompass a specific behavior. The GSE instrument was scored by summing up the responses to all 10 items. The total score for the GSE ranged from 10 to 40.

Reliability and validity.

The GSE has been used widely in over 23 nations. The Cronbach's alphas ranged from .76 to .90 (Schwarzer & Jerusalem, 1995). Criterion-related validity was documented with correlational studies. Positive coefficients were found with dispositional optimism and favorable emotions. Negative coefficients were found with health complaints, depression and anxiety

(Schwarzer & Jerusalem, 1995).

Additional items to GSE.

Bandura suggested that perceived self-efficacy scales be tailored to the concept of interest and reflect the construct (2006). Perceived self-efficacy was different from locus of control, self-esteem, and outcome expectancies and the perceived self-efficacy items should reflect this difference in phenomena (Bandura, 2006). As there were no self-efficacy scales specific for VMS use, this author developed additional items for VMS use as prescribed by Schwarzer and Fuchs (1995).

Schwarzer and Fuchs (Schwarzer & Fuchs, 1995) suggested phrasing for self-efficacy items which include a barrier is "I am confident that I can (perform something), even if (barrier)" (p. 180). Development of the additional questions followed Schwarzer and Fuchs' processes (1995). The subjects for each item were derived from the literature, feedback from health care professionals, general discussions with older adults, and review of similar self-efficacy scales of nutrition and medication adherence (Fernandez, Chaplin, Schoenthaler, & Ogedegbe, 2008; Schwarzer & Renner, 2014). The additional questions went through two reviews and revisions. Table 5 contains the survey questions for self-efficacy of VMS use.

Table 5. Additional Questions for Self-Efficacy for VMS Use

Subject of Item	Question for Survey
Routine	I am confident that I can make taking my supplements part of my routine.
Memory	I am confident that I can always remember to take my supplements.
Change in Day	I am confident that I will take my supplements when there is a change in my usual day (unexpected things happen).
Schedule	I am confident I can take several supplements on different schedules.
Information	I am confident that I can find information I need to help manage my supplements (for example: to get information, learn more about, avoid side effects).
No Help	I am confident I can manage my supplements without help.
List all	I am confident I can list my supplements, including the doses and schedule.

Maintain supply	I am confident I can remember to get refills of my supplements before I run out.

Descriptive and Potential Covariate Variables

Descriptive data were collected to describe the sample. Data were self-identified. The following descriptive variables were gathered: marital status, ethnicity, race, level of education, state of health, osteoporosis diagnosis, annual income, and how rate finances. State of health was a good indicator of overall health. Potential confounding variables identified from the literature review were age, education level, and comorbidity. Education level was used to identify the highest level of schooling. Comorbidity was self-identified using the SCQ.

Current Supplement Use

Operational definition for VMS users were those who reported taking a VMS within the past 30 days. Non-users were those who did not report taking a VMS in the past 30 days. Using a time frame to identify VMS users captures users who take VMS on different schedules and the 30-day time frame commonly used (Bailey, Fulgoni, Keast, & Dwyer, 2012). Participants were also asked to bring their supplements on the day of the survey. If a participant brought in their supplements, the inventory (check list) and 24-hour recall were confirmed with participant against the supplements brought in.

The first question on VMS use, requested that participants check off the inventory any VMS they have taken in the past 30 days. The list was formulated using the classification system (Appendix A) and space was provided to write in any additional supplements not on the inventory. Participants were asked to identify what they took, the name of the product, and how long they have taken this or a similar product. The second question asking about VMS use was a 24-hour recall of all VMS taken. Total for current supplement use was the sum of each VMS

reported taken in the last 30 days. For example, is a calcium is taken three times a day, it is counted as one VMS towards the total. If a VMS is taken once a week it is counted as one VMS towards the total. The total is not a pill count per day, but a reflection of total number of different VMS taken in the past 30 days.

It is a challenge to collect accurate data regarding supplement use (Neuhouser, 2003; Thompson & Nichter, 2007)). The methods to obtain supplement data include using a classification system, defining supplement use, providing supplement inventory, including a 24-hour recall, and specifying how to measure VMS usage, have been described in other studies (Foote et al., 2003; Patterson, Levy, Tinker, & Kristal, 1999; Viveky et al., 2012; Wold, Wayne, Waters, & Baumgartner, 2007). A detailed supplement inventory approach or check list has been found to correlate well with nutrient intake estimates (Park, Harnack, & Jacobs, 2009). The method of asking participants to show the supplement products has been described to improve reliability (Lam & Bradley, 2006; Patterson, Levy, Tinker, & Kristal, 1999; Wold, et al., 2007).

Reliability and validity.

Recruitment material informed participants to bring their VMS. This allowed the participants to show the researcher what they are currently taking. This also allowed the researcher to compare what they brought with what was written on survey. This allowed for validation to confirm what was reported on the survey to what participants brought. The expectation was that the physical supplement bottles would increase the reliability of VMS reported.

Survey Development

The data was gathered on current supplement use by means of a survey compiled by this researcher. The individual questions to gather the data needed for the research questions,

separate from the instruments used, were first constructed and then combined to make a questionnaire (Peterson, 2000). Close ended questions and open ended questions were employed by the survey (Fink, 2013; Fowler, 2009; Peterson, 2000). Close ended questions were: past use VMS, current VMS use, vitamin D prescription, and the demographic questions. Open ended questions were; reasons to use vitamin D and list all VMS taken in past 24 hours. Informative instructions were provided and for list all VMS taken in past 24 hours a definition of VMS was given for clarity. Guidelines used to develop questions included: one thought per question; question should be meaningful, concrete, clear; answer choices were mutually exclusive and exhaustive (Fink, 2013; Peterson, 2000). Dr. Julie Ellis provided the annual income and rating of finance questions.

Two methods were used to gather information on VMS usage; a checklist of VMS taken in last 30 days and a 24-hour recall of what VMS taken. Using two methods captured a larger fraction of VMS use (Nicastro, Bailey, & Dodd, 2015). The NHANES Dietary Supplement and Medication Questionnaire has been tested and found to be successful in gathering information and can be easily modified. The NHANES Dietary Supplement and Medication Questionnaire demonstrated the importance of clarity, clarify understanding of questions, explain definitions, and asking in several different ways to elicit correct information. However, the NHANES questionnaire was extensive (over 30 pages long) and has many items that do not apply to the research questions and hypothesis of this dissertation. Several questions on VMS use were developed for this study using the NHANES Dietary Supplement and Medication Questionnaire as a guide (Division of Health and Nutrition Examination Surveys, 2016). The questions, regarding vitamin D use and the other VMS use followed the NHANES Dietary Supplement and Medication Questionnaire. The question for vitamin D asked strength, dose, how much per day,

name of supplement, how much is last 30 days and length the time the product had been taken. The question regarding other VMS was an inventory checklist, the types of products were listed, and asked to check if product was taken in last 30 days, name or type of product, and length of time the product had been used. The order of the VMS in question on what VMS used was guided by the classification system of VMS used for this study (Appendix A; Bailey et al., 2013).

The questionnaire was constructed to make it easy to read, enough space for answers, informative instructions, and definitions and explanations where needed (Peterson, 2000). The information instructions included on the first page that dietary supplements included the use of vitamin, mineral, herbal dietary supplements including antacids and any prescription supplements. When asked to list all VMS taken in last 24-hours, a definition was provided. Dietary supplements include vitamins, minerals, antacid/calcium supplements, fiber supplement, amino acids, performance enhancers, herbs, herbal medicine products, and plant extracts. The term dietary supplements does not include meal replacement beverages, weight loss or performance booster drinks, food bars or tea.

The questions were also listed in order of most important to less important information (Fink, 2013). This allowed the older participant to have the most attention and energy given to the most important questions (Peterson, 2000). The first two questions were screening questions that were designed to start the participants to think of the questionnaire topic but also be easy to answer (Peterson, 2000). The substantive questions followed the screening questions, including use of VMS and all the instruments. The survey ended with the comorbidity and demographic questions (Fink, 2013; Peterson, 2000).

The questions in the survey were listed in order of lest sensitive to more sensitive

information to establish baseline comfort in providing information and moving to more sensitive. The sensitive questions regarding finances and education were at the end of the survey. The questions regarding use of supplements were first and demographic questions were last. The demographic questions are typically placed at the end of questionnaires (Peterson, 2000). Demographic questions were factual and easier to answer which helps to avoid problems with fatigue (Peterson, 2000). Easy to answer and clear questions are less likely to impede an older individual from answering (Peterson, 2000).

To minimize response bias in the survey as suggested by Bandura, the self-efficacy scales were identified by a nondescript title rather than self-efficacy (Bandura, 2006). Early survey development feedback was provided by several individuals to refine the questions, change the order of questions, and confirm amount of time to complete survey. Assistance with layout and spacing was provided by UWM CON professional staff. Feedback for the readability and feasibility of the survey was conducted with nine individuals. Four changes were suggested and implemented in the survey; increased font size, one question was moved to different page, past use question the length of time was clarified, and numbering system with larger fonts was added. The question asking the participant to list the VMS they had taken in the past 24 hours was moved from bottom of page 3 to top of page 4, and additional space was provided. Several individuals mentioned they had missed the question and several required more room to write.

Setting

The study participants were recruited from independent living community settings: senior dining sites, a church, and local Continuing Care Retirement Community facilities which have independent living as part of the continuum of care. Participants were recruited from sites in Southeastern Wisconsin.

Sample

Sample/Participants

The target population for this study were independent living women. Criterion sample allows for selection of cases that meet predetermined important criteria (Polit & Beck, 2012). Important criteria for the study were 1) 65 years of age or older, 2) female, 3) able to speak and read English, 4) in an independent living setting, 5) no memory problems, 6) all consent requirements are met and willing to participate in the study.

Potential participants were excluded if they were unwilling to give their age, reported memory problems, or did not complete a minimum of 95% of the survey. Potential participants were enrolled only from independent living apartments in a Continuing Care Retirement Community or the community settings which had given prior approval for the study.

Sample Size

Regression analysis allowed for predicting the outcome variable from one or more predictor variables (Field, 2009). Field (2009) suggested the number of cases per predictor does not address the strength of relationship measured or the power required to detect effects. Munro suggested specification of the assumptions for statistical power, significance level, and effect size desired for the study using Cohen's formula (2005). Expert advice and a priori power analysis for hierarchal regression were used to determine the necessary sample size for the study. A prior power analysis was used to determine lowest threshold of sample size. Too few subjects may result in a lack of statistical power to detect a difference (type II error). An adequate sample size helps avoid type 1 error (Hulley et al., 2013).

The conventional proposed statistical power level was 0.80, a value less than 0.80 incurs a risk of Type II error the failure to reject a false null hypothesis (Cohen, 1992). A value higher

than 0.80 would require a sample size that exceeds available resources (Cohen, 1992). The significance criterion (alpha) was set at 0.05, to avoid committing a Type 1 error the risk of mistakenly rejecting the null hypothesis (Cohen, 1992). Across various studies using HPM, the variance explained by the HPM variables tested ranged from 19% to 59% (Pender, 1996). A moderate effect size (R2) of 0.15 was assumed as this was the first time HPM has been studied with VMS. The 3 possible control variables (age, education, comorbidity) were included in step A of the calculator and the 3 independent variables (prior use of supplements, expectations of aging, and general self-efficacy) were included in step B of the calculator (Soper, 2016). Using the parameters described above, Soper's priori sample size calculator for hierarchical multiple regression result was 79 (Soper, 2016). The expert adviser suggested increasing the sample size to 110.

Control strategies such as a variety of sites and an adequate sample size helped minimize bias and preserve validity in the study (Polit & Beck, 2012). Sample imbalance may cause bias, to prevent this a variety of different sites were sought. While this does not ensure ability to fully reflect the population of the United States it does seek to avoid sample imbalance found if only one facility was utilized for data collection. Flawed implementation could cause biases if the survey was not carefully implemented (Polit & Beck, 2012).

Protection of Human Subjects

Approval for this study was granted from this researcher's dissertation committee and the University of Wisconsin-Milwaukee Institutional Review Board (IRB). Letters of support were granted from each site before any recruitment of participants took place. The primary investigator was a licensed registered nurse and had received training from Collaborative Institutional Training Initiative Program, including IRB- Biomedical and Social & Behavioral

Combined Researchers.

Consent Procedure

Older adults were considered a vulnerable population due to age. Steps were taken to ensure participants' understanding of the consent procedure. Direct recruitment was utilized at senior dining centers and the church (see Appendix D). No direct recruitment was used in the three Continuing Care Retirement Communities (CCRC). The Health Insurance Protection Accountability Act (HIPAA) protects individuals who are in nursing home settings. Informational sessions regarding the potential survey were provided or IRB approved handouts were posted for potential participants from CCRC's.

Fully informed consent was obtained from each subject. Key points in the consent form (See Appendix E) included: study goals, type of data collected, procedure for collecting data, time commitment, , risks and benefits, no compensation, confidentiality pledge, voluntary consent, right to withdraw and researchers contact information (Fink, 2013; Polit & Beck, 2012). The University of Wisconsin-Milwaukee IRB approved a Waiver to Document Informed Consent. After consent information was read and any questions answered, the consent was implied by the completion of the survey.

Risks vs Benefits

Participation in the study posed no apparent risk, harm, or hazards to the participants. The Expectations Regarding Aging Survey (ERA-12) contains questions regarding aches and pains, energy levels, less time with friends, being lonely, worry, normal to be depressed, forgetfulness, and mental slowness (Sarkisian et al., 2005b). The participant rated the question on a scale of definitely true, somewhat true, somewhat false, and definitely false. The ERA-12 had been used in self-administered studies by mail (Sarkisian et al., 2005b). The ERA-12 survey

posed no apparent risk for harm. The major potential risks were loss of time and fatigue or boredom. This research project had minimal risks to subjects. This research project had modest benefits. The major potential benefits include: being able to talk with a friendly person, escape from normal routine, excitement of being part of a study, contributing to a worthwhile project, and satisfaction that the information they provide was valuable (Fowler, 2009; Polit & Beck, 2012).

IRB approval was granted to allow the primary researcher to provide a 20-minute general education talk for a Continuing Care Retirement Center which requested a general education talk as a service for residents prior to the survey. The title of the topic was "Your New Year's Resolution: General Fitness, Wellness and Health Aging". The 20-minute general education talk was provided at the facility on two days for any resident of the facility.

Recruitment Techniques

There was one data collector for recruitment, consent, and data collection. Key contact people were identified at each site. Set days were planned with key contact person to recruit participants at the sites contingent on accessibility. The primary researcher and each key contact person planned the information dates, reminder announcement dates, where to post flyer, and the survey dates. The amount of time spent at each site was dependent on number of potential participants, other competing activities, and as determined with key contact person. Recruitment began after IRB approval and letter of support was received from each facility.

To ensure consistency during the recruitment phase the recruitment materials were prepared in advance, all materials were approved by IRB, and the same materials were used at each site. Recruitment materials included a flyer for sites, a reminder announcement, an informational session outline, and a handout for use in place of the informational session (See

Appendix D). The key contact person made the reminder announcements and assisted in distribution of flyers. The key contact person also helped identify the best time to start and end data collection, identified private areas for participants to fill out the survey, and identified an area to use if the survey needed to be read to a participant. The key contact person also assisted to ensure data collection did not disrupt participants planned activities such as the bingo time or during the meal time at senior dining sites.

All sites distributed the flyers per their organizational process. Reminder announcements were made at all senior dining sites, at the church, and one Continuing Care Retirement Community. The timing of the information session differed depending on site needs. At senior dining sites and one Continuing Care Retirement Community the informational session immediately proceeded the survey. At the church and one Continuing Care Retirement Community the informational session was a week preceding survey. And at the third Continuing Care Retirement Community the handout of the informational session was distributed by the facility per organizational guidelines the week before survey collection. The primary researcher also gave an informational session regarding the survey preceding all survey recruitment at each site.

Age was assessed by self-report. Prospective participants' ability to speak and read English were assessed by ability to understand and process instructions, responses to researcher, and ability to read the consent form. Participants with visual impairment were assisted by the primary researcher by reading the consent in a private setting (or where the participant requested) and answering any questions. If the participant with visual impairment wished to do the survey after hearing the consent read, the primary researcher then read the survey questions and filled out the survey form with responses as directed by the participant.

A key ingredient to successful recruitment of older women was to address barriers to recruitment such as mistrust, fear of lack of confidentiality, and burdens (McHenry et al., 2015; Mody et al., 2008). Maintaining a respectful partnership with the institutions and participants also engendered trust with the participants (Mody et al., 2008). The key contact person was invaluable for introduction of primary researcher to participants. The primary investigator was respectful and expressed gratitude for participation in the survey, these are means to engender trust (McHenry et al., 2015; Mody et al., 2008). At each site to protect confidentiality the key contact person and primary investigator gave attention to the provision of adequate space and privacy to complete the survey and answer all questions (Mody et al., 2008). While designated private areas were provided at each site, participants choose where they wanted to sit.

Participant concerns or questions were addressed as they arose. If the participant chose to withdraw from the study the data collected was not utilized in the study. Concerns regarding confidentiality were addressed by reviewing consent with the potential participant. Requests to take the survey home and return another day were refused, and explained importance of primary researcher being present during the survey completion.

De-identification and Protection of Data

Each survey form was identified by a unique number assigned after data collection. No identifiable information such as name, social security number, address, or phone number were collected. All the research records were kept in a locked file cabinet by the primary investigator. De-identified data was collected and entered into SPSS and kept on a password protected computer. Backup files were kept on an external hard drive. De-identified data were shared for consulting on the dissertation process with Dr. Kovach, members of research committee, and statistician. Original surveys will be destroyed within five years of the end of the study. As

stated in the consent de-identified data on SPSS may be kept indefinitely and used in the future for research or educational instruction purposes.

Data Management Plan

Effort was taken to ensure no missing survey data at time of collection. At the time of collection, the primary investigator checked for completeness and any outliers before the participant left when circumstances allowed. All participants were aided with survey completion as needed. Survey forms were collected at the site, placed in a folder and then conveyed that day directly to the primary researcher's office. The surveys were kept in locked file cabinet that is used only by the researcher (Fink, 2013).

A codebook was maintained during data collection and data analysis. The codebook contained decisions with data entry, summary of study variables, variable names, variable label definition, coding descriptions, notes, and identified the question on survey each variable corresponds with. For the data analysis, the codebook contained a worksheet for research questions, variable and level of measurement, and planned statistical test (Hulley et al., 2013). Decisions regarding data analysis were also noted in the codebook as they occurred.

The Statistical Package for the Social Science (SPSS) data was kept on the primary investigator's personal computer that is password protected. The primary investigator is the only person who uses the computer. A two-person method was used to enter the data, one person reading the data and one person typing into SPSS. The data was hand-entered and double checked for accuracy. As the data was gathered it was entered into SPSS, generally within 24 hours. The data was visually checked and analyzed for outliers, illogical or missing data. Missing data was coded as missing and given a label missing. Decision on data entry were noted in the code book as they occurred.

Data Analysis

The data analysis was conducted using IBM SPSS Statistic 23 student version. Prior to analysis, the data was screened by checking that all variables values fell within the range of possible values for the specific variable. Any irregularity in the SPSS data file was checked with survey and any errors were corrected and noted in codebook. All variables were examined using range, minimum and maximum values, mean and skew prior to analysis. Assumptions for analysis and frequency distributions of all variables were checked before proceeding with the analysis. Sufficient variability in the dependent measure of supplement was confirmed with a range of 0-16 VMS taken per day. A conventional alpha level of .05 was chosen as standard for all significance testing. Skew, missing values, and transformation of variables was discussed in following section regarding assumptions of the parametric data for analysis.

Assumptions of Parametric Data

The data was analyzed to ensure the necessary assumptions for the planned statistical analysis were met. Parametric tests were based on a normal distribution and the following assumptions were tested: variables were quantitative or categorical, non-zero variance, normal distribution including skew, linearity of data, multicollinearity, and homoscedasticity (Field, 2009; Pallant, 2016). Scatterplots of variables were confirmed for linearity. Two outliers were identified with stem and leaf plot for VMS use in the past, data was confirmed against the surveys. The data were not altered as the responses were categorical, the participants who had never used VMS in the past. Multicollinearity was not a problem, an initial linear regression analysis found Variance Inflation Factor (VIF) was close to 1. Scatterplot with multiple regression was checked and found homoscedasticity.

Tests for skewness in distributions were performed and the following variables were

skewed in the data set: use of VMS in past, SCQ, ERA mental health subscale, VMSSE, and the dependent variable supplement use. The use of VMS in the past was a categorical variable which the raw data showed was negatively skewed. There were a small disproportion number of individuals who never used VMS (3%) or hardly used VMS in the past (11 %). The decision was made not to transform or merge the categories of VMS use in the past.

SCQ, the variable for comorbidity, raw data showed positive skew demonstrating that a larger proportion of the individuals had no (12 %) or fewer comorbidities. As the SCQ has true zero responses a square root transformation was completed lowering the skew from 4.16 to 2.66 and the histogram displayed a clustering of zero responses with an approximately normal curve. The SCQ was a control variable and did not relate significantly to the dependent variable (p = .95) and did not correlate to dependent variable (.018) and was not used in the final multiple regression. Non-parametric was used where necessary to answer the research questions due to skew.

The ERA mental health subscale was negatively skewed as a large proportion (53% in the top 25% percent of total score) of the individuals responded that the mental health responses were 'definitely false' and 21% scored all responses as 'definitely false'. When the ERA mental health scale was transformed with logarithm or square root the skew went from 3.14 to 10.8 and 6.13 respectively. Decision was made to not transform the data and use non-parametric tests as needed. The ERA mental health subscale was not used in the multiple regression as the subscales were highly correlated with the total ERA.

The raw data showed a negative skew (-8.6) for VMSSE, a large proportion of the sample chose exactly true for most responses. The individuals reported they were very confident in their ability with VMS. Thirty-seven percent of responses were clustered at right of the histogram.

VMSSE was not transformed as both log and square root transformation increased the skew and did not convert VMSSE into a normal distribution. VMSSE did not relate significantly to the dependent variable (p = .94) and did not correlate to dependent variable (-.007) and was not used in the multiple regression. Non-parametric was used where necessary due to skew to answer the research questions.

The dependent variable supplement use was negatively skewed with 50% of individuals taking 4 or less VMS per day. The dependent variable VMS use was transformed using square root as variable had true zero scores. The skew was transformed into normal parametric distribution from -4.43 to 1.54, with normal appearing histogram.

All missing data on the dataset were verified against original surveys. The Expectation-Maximization (EM) method was chosen to replace missing values. The EM method was reasonable to replace missing data values when regression analysis is the method selected to examine the variables. EM method was useful for multiple regression as it retained relationships with other variables. The EM method is suitable if there is less than 5% missing data: all variables had 5% or less missing variables. The EM method used other variables to impute a value and checked until it reached the most likely value. The EM method was used to impute single missing values for variables VMSSE, GSE, SCQ, and ERA for use in the first multiple regression.

Descriptive questions

Descriptive statistics (marital status, race, ethnicity, range of income, financial situation, state of health, and presence of osteoporosis) and the potential control variables (age, education, and comorbidity levels) were used to summarize demographic information and sample characteristics. Continuous variable such as age were described using the mean, range, and

standard deviation. Categorical variables such as race, state of health, marital status and use of VMS currently and in the past, were described using frequency, frequency distribution and percentage. The SCQ was skewed and was described with the median, the most suitable measure of central tendency (Polit & Beck, 2012).

Question 1, regarding prevalence of current VMS use, was described using means, standard deviations, ranges, and frequencies of VMS use. Classification system was applied to report dietary supplement categories.

Question 2 regarding the results of the instruments used; GSE, and ERA total and ERA subscales physical health and cognitive function, were reported using means, standard deviations, and ranges. As GSE median was often used to divide the sample, the median was reported. The VMSSE and ERA subscale mental health were skewed and the median was used to reflect the measure of central tendency. The reliability of each scale for use in this study was given.

Question 3 examined the association, measured by Pearson correlation coefficients or Spearman's rho, between age and amount of VMS use. The relationship between age and amount of use of supplements was also examined between young-old (65 to 74 years) and those 75 years and older by means of chi-square.

Question 4 described the difference in VMS use between women with different levels of education. The non-parametric Mann-Whitney U Test was used due to skew of variables. The dependent variable was use of VMS (interval scale) and the independent variable is education with 2 discrete levels. Also, reported the frequency and percentage of the untransformed education levels and use of VMS.

Question 5 identified if there was a difference in supplement use between women with

high, medium and low levels of comorbid conditions. As the assumptions for parametric statistical analysis were not meet, the non-parametric Kruskal-Wallis Test was used.

Question 6 considered if older women were aware of their vitamin D dosage. The frequency and mean were reported. A chi-square was used to compare those who could report their dose to the response on VMSSE question regarding confidence of dosage knowledge.

Question 8 reported on the frequency and percentages of women in the sample are taking vitamin D over the Tolerable Upper Intake Level.

Theoretical Question

Hierarchical multiple regression was the statistical test used for the research hypothesis. There was an interest in the relationship between the dependent variable of VMS use and the independent variables of past use, self-efficacy, and expectations of aging. Multivariate regression has the advantage to adjust for several control variables in the analysis phase and allowed the researcher to control the order of entry based on theoretical considerations and current literature (Field, 2009).

Multicollinearity is the presence of a strong correlation between two or more predictors in a multiple regression model (Field, 2009; Polit & Beck, 2012). Multicollinearity is a concern as the unique estimate of the regression coefficients cannot be determined and it becomes difficult to judge which variables are important (Field, 2009; Polit & Beck, 2012). A correlation matrix of all the control and predictor variables was examined for correlations above .80 (Field, 2009). The ERA total score had high correlations (.84, .82, and .85) respectively with ERA physical health, ERA mental health and ERA cognitive function. The decision was made to use the ERA total in the multiple regression. ERA total score is a combination of ERA physical health, ERA mental health and ERA cognitive function. There were no other variables with

correlations ≥ 80 (Field, 2009). The variables VMS use in the past and education level were ordinal variables but were treated as interval for hierarchal regression.

Following Fields strategy for multiple regression, a two-step process was followed. First a regression analysis with all the control variables and predictors were entered to observe the variables which contribute significantly. Once the control variables and independent variables were determined significant and are important, a regression analysis was run to define the model. For the first regression, step 1 contained the control variables: age, education level and comorbidity. Step 2 contained the independent variables prior supplement use, general self-efficacy, VMSSE, and expectations of aging. The second multiple regression was run with the control variables, the independent variables that were found to be significant and important.

Limitations and Ethical issues

The design of the study was non-experimental and strategies such as specification and matching to reduce confounders was limited (Hulley et al., 2013). Descriptive cross-sectional research was to describe relationships among variables, was inherently weaker than experimental study, and did not support inferences of causality (Hulley et al., 2013; Polit & Beck, 2012). However this research design did have the advantage of avoiding dropout problems and lower time and expense (Hulley et al., 2013; Polit & Beck, 2012). A convenience sample had the advantage in cost and logistics is chosen as participants are easily accessible and meet the inclusion criteria (Hulley et al., 2013). Random sampling would increase expense and require an increased number of facilities for an adequate sample size. Convenience sampling is the weakest form of sampling and has the highest sampling bias (Polit & Beck, 2012). The convenience sample may not represent the population (Hulley et al., 2013). The limitation of using a convenience sample is this type of sample is not highly rigorous, limits the ability to have a

representative sample and does not meet scientific standards for generalizing findings of the sample to the general population (Polit & Beck, 2012). The statistical testing was centered on a logical theory-based hypothesis to avoid using large amounts of random variables which can lead to type I error (false positive).

The data for the study was self-report which is efficient and participants are aware of their own supplement use, and thoughts and beliefs regarding expectations of aging and perceived general self-efficacy. Two of the variables can only be gathered by self-report from the participants, expectations of aging and perceived general self-efficacy. The three instruments used in the study were developed for self-report. The validity and accuracy of the self-report data is a concern and may be a limitation (Polit & Beck, 2012). There is also the effect that the participant may want to report what they think the researcher wants to hear and this can bias the data. Participants sometimes respond in order to make a favorable impression (Polit & Beck, 2012). Having the subjects show the actual supplements is one method to improve accuracy and validity of the study.

Measurement error is inherent in all studies. Missing data can threaten the validity of the conclusions. Measurement attrition is the failure to complete the outcome measurement, for this study ensuring the survey questions were completed helped avoid this (Shadish, Cook & Campbell, 2002). There may have been a difference between participants who enter the study and those who do not participate in the survey. There was no way to measure this difference.

Ethical Issues

One of the most important ethical issues was protection of study participants. Two of the ethical issues of concern were informed consent and confidentiality for all participants (Fink, 2013; Polit & Beck, 2012). Informed consent and confidentiality were taken into consideration

during the planning phase. Participants needed to aware of enough information that they can make an informed decision on participation. The flyer, announcement, informational session and consent documents were prepared to provide sufficient information for informed choice and consent. Confidentiality was protected, no names or identifying information were gathered. Privacy at each site was available to participants, and they had the option of sitting where they desired. Participants were assured that their participation was strictly voluntary and they could stop at any time. Protecting confidentiality continued beyond the data gathering phase. Procedures to ensure data is de-identified and secured were followed during analysis and after.

Chapter Summary

This chapter presented the methodology for the research survey. The design of the research study included the targeted research questions, study variables, instrumentation, and survey development. The settings, sample, and steps taken for the protection of human subjects were discussed. The data collection and the steps of the data analysis were detailed. The steps taken for the variables which did not meet the assumptions for parametric data were explained. Limitations of the cross-sectional study were presented. The key ethical issues of confidentiality and informed consent were considered throughout the research study.

Chapter 4

Introduction

This chapter will describe the sample and present the statistical results for the research questions and research hypothesis. The research questions are divided into two manuscripts, the second and third manuscripts of the dissertation. References for both manuscripts in chapter 4 are located at the end of the dissertation. The second manuscript reports the results of the non-theoretical research questions and third manuscript reports the results of the theoretical research questions and research hypothesis. The research questions reported in the second manuscript comprise: prevalence of VMS use including the complexity of herbal use; the relationship between age, education, comorbidity with VMS use, and the questions related to supplement of interest, vitamin D. The second manuscript also describes the sample. The third manuscript reports the levels of general self-efficacy and expectations of aging and describes the results of the hypothesis regarding whether expectations of aging and self-efficacy are predictors of VMS use by older women. Results that do not apply to either manuscript, such as the comparisons in supplement use between older adults living in the community and in nursing homes, are reported after the third manuscript.

Vitamin D and Supplement Use by Older Women in Independent Living Settings

Abstract

Dietary supplements, such as vitamins, minerals and herbal products, are commonly used by older women. It is vital that health care professionals have information regarding current use patterns due to new products and safety concerns. Additionally, as vitamin D use surges there is a need for current information regarding presence of use over Tolerable Upper Intake Level. A self-report survey was collected from 110 women 65 years or older from community or

Continuing Care Retirement Centers in the upper mid-west of the United States. The majority of the sample (*n* = 73, 67%) report frequent use of vitamin, mineral and herbal supplements over the course of their life. Ninety-two percent were using a vitamin, mineral or herbal supplement (*Md* = 4.5, *SD* = 3.6, range 0 to 16) at the time of the survey. About a third of the sample used herbal products (*n* = 34, 30.9%). Vitamin D (*n* = 82, 74.5%) was the most frequently reported used supplement. From major category, the most frequently used was multi-vitamin, multi-mineral. Calcium (*n* = 55, 50.5%) was the most frequently reported from minor category. The most frequently used herbal was coenzyme Q-10 (*n* = 14, 12.7%). The most frequently cited reason for using vitamin D was lack of sunlight and to supplement diet. Seven percent who took vitamin D were at the Tolerable Upper Intake Level or above for dosage. In this study, there was not a significant association between VMS use and age or comorbidity, however education was significantly associated with VMS use. In conclusion, a majority of older women are using a wide variety of vitamin, mineral and herbal products. Many reasons were given for use of vitamin D and a small number of older women were taking doses of vitamin D over the Tolerable Upper Intake Level. Health care professionals should educate themselves and their patients about issues regarding dosage and use of VMS.

Introduction

Dietary supplements are essential for health. Too little or too much is detrimental for overall wellness. The U.S. population, 65 years and older, is larger now than in any previous census (United States Census Bureau, 2014). In 2014, there were 46.2 million people over 65 years old and by 2030 they will make up 20% of the U.S. population (Ortman, Velkoff, & Hogan, 2014; United States Census Bureau, 2014). There has been mounting use of VMS in the United States over the past several decades (Bailey et al., 2011; Briefel & Johnson, 2004; Millen,

Dodd, & Subar, 2004; Radimer et al., 2004). The use of VMS in the United States increased from 14% in 1998 (Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002) to 63% in 2010 (Qato, Wilder, Schumm, Gillet, & Alexander, 2016). Older adults use VMS more than younger adults (Radimer et al., 2004; Timbo et al., 2006). One study found 84% of US adults over age 54 used a multivitamin, multimineral supplement and 34% used an herbal or other dietary supplement in the previous year (Timbo et al., 2006) Older women use more VMS than men and white women are more likely to take supplements than other racial groups (Bailey et al., 2011; Sebastian et al., 2007). One study found that older women increased their use of vitamins, minerals, and herbal products over time (Wold et al., 2005). Vitamin D is the supplement of interest in the study. There is a concern regarding use of vitamin D in dosages above Tolerable Upper Intake Level. To avoid gender differences this study was conducted to describe VMS use by older women in independent living settings. Continuing care retirement centers were included as women in this setting are excluded from national surveys such as the NHANES. This study is intended to inform health care professionals of current VMS use by older women with a focus on vitamin D.

There are potential risks and harm from the use of VMS by older adults. Supplements are regulated differently than medication, supplements do not require premarket testing (Cohen, 2014). Supplements have been found to be adulterated with adulterated with hazardous contaminants including banned weight loss medications, steroids, stimulants, lead, arsenic, mercury, cadmium, and pesticides (Cohen, 2014; Kutz, 2010). About 23,000 emergency department visits occur each year due to adverse events from VMS use (Geller et al., 2015).

Drug interactions result from VMS use and polypharmacy (Cassileth, Heitzer, & Wesa, 2009). Almost three-fourths of community dwelling older adults were found to combine one

dietary supplement with a prescription drug and one third used three or more supplements with three or more prescription drugs (Nahin et al., 2009). VMS have been found to interact with prescription drugs and chemotherapy in ways that are potentially harmful (Cassileth et al., 2009; Wold et al., 2005). Herbal products are biologically active and may interfere with other VMS or prescriptions medications (Cassileth et al., 2009). Older adults are at risk of drug interactions due to polypharmacy and increasing VMS use. Health care providers need current information on VMS use by older women.

Age related changes in physiology impacts vitamin and mineral needs of the elderly. There is a decline in renal and hepatic function with age (Rowe, Andres, Tobin, Norris, & Shock, 1976; Tan, Eastment, Poudel, & Hubbard, 2015). Decreased renal function may affect vitamin D metabolism and result in lower vitamin D levels (Wells & Dumbrell, 2006). Increasing age causes changes in the absorption, distribution, metabolism and excretion of VMS. Dietary supplements are essential for good health but there are health and safety concerns especially for older adults (Timbo et al., 2006).

Patterns of supplement use in adults change over time and it is important that health care professionals are cognizant of current trends of VMS use. There are more VMS available on the market than ever before. Over the last 20 years the number of VMS available in the U.S. has exploded from an estimated 4,000 to over 55,000 (Cohen, 2012). It is estimated that between $20 and $30 billion is spent on dietary supplements yearly (Cassileth et al., 2009). Growth in supplement use may be due to new products availability, perception of benefits, published research, marketing, and public media (Cassileth et al., 2009). Older adults are consuming a wider variety of VMS than ever before (Archer, 2005; Timbo et al., 2006; Wold et al., 2005). Health care professionals need to be aware of what VMS are being taken, why VMS are being

taken, potential drug interactions, and appropriateness of use.

Purpose

Because of the increased use of available products on the market, safety concerns, and the historical factors, this study is timely and needed. The purposes of this study were to: a) describe the prevalence of VMS use among older women; b) describe vitamin D use including dose, use at or above the Tolerable Upper Intake Level, and reasons for use; and c) compare differences in VMS use based on age, education, and comorbid conditions.

Methods

Study Design, Setting, and Sample

This report is a descriptive, cross-sectional study conducted at three Continuing Care Retirement Centers, one church, and senior dining program sites in the Midwest. Soper's priori sample size calculator for hierarchical multiple regression was used with statistical power set at 0.80, an alpha of 0.05, and a moderate effect size of 0.15 based on previous literature review (Pender, 1996). Power analysis yielded the need for a sample size of 79. To provide increased ability to detect smaller effects, the target sample size was set at 110.

Convenience sampling was used. Inclusion criteria were: female, age 65 or older, able to speak and read English, in an independent living setting, with no memory problems as determined by self-report. Recruitment included the use of flyers, announcements and informational sessions. Consent was demonstrated by return of completed surveys and no identifying information was collected. Participants with vision impairment who wished to participate were read the consent and survey, and responses were marked as directed. A total sample of 110 women completed a survey over a three-month period. The University of Wisconsin-Milwaukee Institutional Review Board (IRB) and researcher's dissertation committee

granted approval for this study.

Data Collection

Data was collected by means of self-report survey. Information regarding the research study was provided at each site per sites organizational process prior to survey. At each CCRC a private area was provided where interested individuals could go to participate. The church and senior dining sites had the consents and surveys handed out at a designated table. At each site after participants read consent those who chose to participate were given a survey to fill out. Each site had a private area designated to fill out the survey, however participants could choose to sit where they desired. For participants with visual impairment the private setting was utilized for confidentiality and privacy. The flyers suggested participants bring VMS on day of survey. If a participant brought in their personal VMS, the researcher and participant compared the VMS bottles with the 24-hour recall and check list questions on the survey. If there was a discrepancy between survey data and VMS brought in by participant, the researcher clarified and corrected any incongruities on the survey working with the participant. The surveys were completed at the site with researcher present.

Measurement

The survey contained various demographic, lifestyle and health items to describe the sample; marital status, race, ethnicity, range of income and financial situation, state of health, and presence of osteoporosis. Age, education, and comorbidity were collected for comparison to VMS use. Age was based on self-report of number of years old. Education level was categorized and asked for the highest level of school completed; less than high school, high school degree or equivalent, some college credit, associate degree, bachelor's degree or graduate degree. Assessment of knowledge of osteoporosis diagnosis was bimodal response of yes or no.

Comorbidity was assessed by response to the Self-Administered Comorbidity Questionnaire (Sangha et al., 2003). The Self-Administered Comorbidity Questionnaire (SCQ) includes 12 medical conditions with 3 additional comorbid conditions to be written in by the participant as needed. Each medical condition had 3 questions: presence of condition, if received treatment, and if the condition limited activities. The SCQ has a possible total of 45 points with a range of scores from 0 to 45 and has been used with older adults (Katz et al., 1996; Sangha et al., 2003). The SCQ test-retest reliability was 0.94 (95% CI, 0.72, 0.99) and has moderate association with Charlson Index (Sangha et al., 2003). The SCQ had good reliability with Cronbach $\alpha = .81$ in the current study.

There were questions regarding past VMS use, questions specific to vitamin D, and questions on prevalence of VMS use. There were two questions concerning past and recent VMS use, the first asking how much VMS use over the course of their life, and the second asking if VMS were used in past month. For vitamin D, participants were asked to list any form of vitamin D taken in last 30 days, this included vitamin D, vitamin D2, vitamin D3 and calcium and vitamin D. Participants were asked for each vitamin D they listed, the dose/strength, how much did they take on a single day, supplement name, how many days taken in past 30 days, and length of time supplement taken. An open-ended question was used to enquire about reasons for vitamin D use. A question regarding prescription of vitamin D by health care professional had bimodal response of yes/no. And a question regarding osteoporosis status had bimodal response of yes/no. A question asking if the participants were confident they could list their supplements including doses and schedule had 4 item Likert scale responses (not at all true, hardly true, moderately true, and exactly true). The question on confidence followed all other VMS use questions.

Included in the survey were two separate methods to gather VMS prevalence information as this has been found to capture larger number of VMS users (Nicastro, Bailey, & Dodd, 2015). The two methods were a check list of common vitamins, mineral and herbal supplements and a 24-hour recall. Both the checklist and the 24-hour recall questions were developed using current literature, the NHANES Dietary Supplement and Medication Questionnaire, and a classification system for VMS (Bailey et al., 2013; Division of Health and Nutrition Examination Surveys, 2016). There are no standardized categories or classification system for supplements (Comerford, 2013). For this study, the classification system (see Appendix A) used was originally developed to report NHANES VMS data (Bailey et al., 2013).

The classification system divides VMS into 3 categories and provides definitions and examples for each category (Bailey et al., 2013). The category groupings are major, minor, and other. Major VMS categories included; multi-vitamin, multi-mineral (MVMM), multi-vitamin (MV), multi-mineral (MM), and herbals. Minor categories included: fatty acids, calcium containing, joint supplements, protein and sport, and fiber and colon health. The other category contained single nutrient supplements, these were stand-alone single nutrient supplements not otherwise categorized such as vitamin D or iron. The check list for each of the categories were asked in a nominal coding format (yes/no) to indicate whether a specific VMS was taken or not.

Two pages of the survey were devoted to the checklist asking about VMS use in the last 30 days. For each of the items the participants were asked to check if they had taken the supplement in the past 30 days. If the answer was affirmative the participant was asked to provide the name/ brand name of product and length of time they have taken product. The checklist items were multi vitamin; multi-vitamin, multi-mineral; vitamin A, vitamin B, vitamin C, vitamin E, calcium, chromium, iron, selenium, zinc, magnesium, potassium, multi-mineral,

botanicals and herbals, fatty acids, joint supplements, protein and sport supplements, fiber and colon health, and other. Examples were given for categories. There was also space provide to write in anything not on the checklist.

The 24-hour recall response was a question asking participants to list all the vitamin, mineral and herbal supplements they have taken in the past 24 hours. The following additional information was provided for clarification for participants, "Dietary supplements include vitamins, minerals, antacid/calcium supplements, fiber supplement, amino acids, performance enhancers, herbs, herbal medicine products, and plant extracts. Dietary supplements do not include meal replacement beverages, weight loss or performance booster drinks, food bars or tea." The question as at the top of a page and the participants had the entire page to write in.

The total VMS use included the vitamin D reported, checklist of last 30 days and the 24-hour recall. For data entry, the vitamin D was entered followed by VMS on the checklist. Any additional VMS from the 24-hour recall were entered into SPSS. A two-person method was used for data entry. The responses from all questions were categorized according to the classification system definitions. Herbal supplements with multiple ingredients were organized by major ingredient. Example of this is an herbal sleep aid which was categorized by major ingredient under bromelain but also contained melatonin, lemon balm, chamomile, lavender and an unknown proprietary blend. Due to the interest in vitamin D, calcium with vitamin D was coded into 2 categories: vitamin D and calcium containing. This was the only VMS that was coded in two categories. All types of B vitamins are chemically distinct and were reported separately. All nutrient supplements which contained 2 or more vitamins without minerals were coded as MV except for B complex. B-complex was coded separately, however for MV's total the B-complex was combined with the MV's for the total MV category. Replies for reason the participants use

vitamin D were coded per theme. The reply of not enough sunshine, not enough sun in the winter, and not enough in my diet to make up for lack of sunshine were coded under lack of sunshine/supplement diet.

Data Analysis

All data analysis was conducted using SPSS 23 student version. Prior to analysis the data was checked to ensure the necessary assumptions for the planned statistical analysis were met. The SCQ and VMS total were right-skewed (positive skewness) which was to be expected as both measurements have true zero or low number responses. For SCQ and VMS total a square root transformation was completed lowering the skew to acceptable scores and both histograms displayed a clustering of zero responses with approximately normal curves. Non-parametric tests were used where necessary and are detailed below. Descriptive statistics (frequency, percent, SD, range) were used to describe participant characteristics; actual vitamin, mineral and herbal use; dosage levels of vitamin D; vitamin D use over the Tolerable Upper Intake Level; and reasons to use vitamin D. The Tolerable Upper Intake Level, maximum daily intake that is not likely to cause adverse health effects, for vitamin D is 4,000 IU for adults over the age of 51 years.

Chi-square tests were conducted to assess differences between participants living in the community or CCRC's. To differentiate meaningful groups for age those between 65 to 74 years old were designated young-old as compared to those 75 years and older (Neugarten, 1975; Youmans, 1977). Chi-square analysis were used to examine differences in age. To compare low use to high use of VMS, the low use group was defined as taking 0-4 VMS and the high use group taking 5-16 VMS, the median (4.5) was used to determine groups. A chi-square test was used to compare participants who could or could not report their vitamin D dose in relation to

their confidence of dosage knowledge. Fisher's exact test was reported if cell was less than expected for Chi-square tests. The question regarding vitamin D dosage was asked before the question regarding confidence of knowledge of the dosage.

A focus of the study was the relationship of VMS use to age, education and comorbidity. As total VMS use was positively skewed the Spearman rank order correlation was reported to describe the strength and direction of relationship of VMS total and age. The Mann-Whitney U Test was used to examine the difference in VMS use between women with different levels of education and different comorbidities. An independent samples t-test was conducted, as sample size was adequate, to compare total amount of VMS use (interval level) and education levels. The Kruskal-Wallis was used to report difference in supplement use between women with high, medium and low levels of comorbid conditions. A conventional alpha level of .05 was used for all statistical tests.

Results

Sample

There were 110 participants with an average age of 78 (*SD* = 7.6, range 65 to 93). The majority described themselves as white (91%, *n*=100), and 38% had a bachelor degree or higher. Only 22% (*n* = 24) were married/partnered, with 46% (*n* = 51) widowed and 32% (*n* = 35) single.

Of the 72% (*n* = 79) who reported income level, 13% were under 100% Federal Poverty level, 64% were between $12,000 to $50,000, and 23% were over $50,000. Fifty-three percent (*n* = 55 of 103), had more than enough money at the end of the month. Forty percent had just enough money at the end of the month, and 7% did not have enough money at the end of the month. At all income levels, there were respondents who indicated that they had more than

enough finances at the end of the month.

About half (49%, *n* = 54) reported very good health, followed by 27% (*n* = 30) with good health, and the same number reported excellent or fair health (12%, *n* = 13). There were no reports of poor health. Thirty nine percent (*n* = 43) were aware they had an osteoporosis diagnosis. The SCQ median was 7 (*SD* = 4.8) with an actual range of 0-25 out of a possible 0-45 total. The higher the score the higher the comorbidity level (combination of diagnosis, treatment and impact on function). The SCQ found thirteen participants (12%) reported no comorbidity. The three most common diagnosis' reported for the SCQ were arthritis (64%, *n* = 70), high blood pressure (57%, *n* = 63), and back pain (36%, *n* = 40). On the three open-ended sections for additional diagnosis on the SCQ instrument, 21% (*n* = 23) had 1 additional diagnosis, 5% (*n* = 5) had 2, and 1% (1 person) had 3 additional diseases. These diseases included thyroid (*n* = 8), high cholesterol (*n* = 5), fibromyalgia (*n* = 3), glaucoma (*n* = 3), irritable bowl (*n* = 3), atrial fibrillation (*n* = 2), chronic pain (*n* = 2), gout (*n* = 1), Scleroderma (*n* = 1), hypoglycemic without diabetes (*n* = 1), lupus (*n* = 1), postural orthostatic tachycardia syndrome (*n* = 1), sciatic (*n* = 1), Sjogren's syndrome (*n* = 1), sleep apnea (*n* = 1) torticollis (*n* = 1), and Raynaud's disease (*n* = 1).

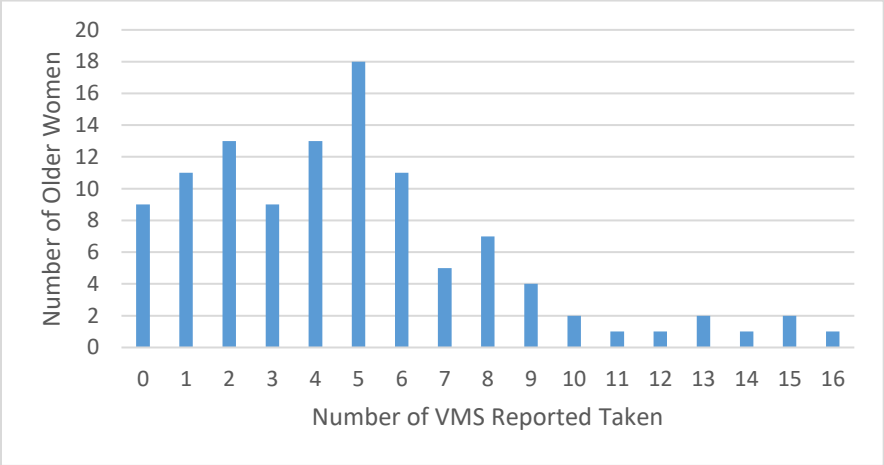
There were 78 (71%) older women recruited from community sites and 32 (29%) from the CCRC's. There were no statistically significant differences in ethnicity, race, marital status, age, state of health, osteoporosis diagnosis, report on end of month finances or comorbid conditions between those living in community or CCRC's. Eighty-four percent of women living in CCRC's had a college education or higher as compared to 61% of women living in the community, χ^2 (1) = 5.647, *p* = .024. A larger percent of women living in CCRC (39% CCRC vs 16% community) reported their income over $50,000, Fishers exact test *p* = .01. The women

living in the CCRC's did take more VMS than those in community, 5-16 VMS per day (66% CCRC vs 44 % community), and fewer women in CCRC took 0-4 VMS than those in community (35% CCRC vs 56% community), χ^2 (1) = 4.407, p = .04.

Prevalence of VMS

Only 3 participants had never used a VMS over the course of their life, but the majority of the sample (n = 73, 67%) frequently used VMS. At the time of the survey 92% (n = 101) were using a VMS and the median number of VMS used were 4.5 (SD = 4, range 0 to 16; See Figure 2). Ten participants (9%) were taking 10 or more VMS.

Figure 2. Total Number of Vitamins, Minerals, and Herbal Supplements Taken



Vitamin D was the most frequently used supplement from all categories. The most frequently used supplement from the major category was MVMM and calcium from the minor category (see Table 6). Fatty acids, in the minor category, included; fish oil (22%, n = 24), flaxseed (9%, n = 10), and omega 3 (8%, n = 9). Nineteen percent of the sample were using fiber and colon health products with psyllium products (9%, n = 10) and probiotics (11 %, n = 12) being most commonly used. The joint supplements were products with glucosamine or chondroitin with the majority taking a combination glucosamine and chondroitin (87.5%, n = 14

of 16). Few women were using protein supplements, protein powder (2.7 %, *n*=3), lysine (2.7 %, *n*=3), and 1 Cysteplus (sulfur containing amino acid, .9%).

Table 6. *Vitamin, Mineral, and Herbal Supplements [VMS] Used Most Frequently by Older Women (N=110)*

Major categories	%* (*n*)	Single Nutrient Vitamin Supplements	%* (*n*)
MVMM	50.0 (55)	Vitamin A	3.6 (4)
MV	34.5 (38)	Vitamin B1	.9 (1)
Herbals	30.9 (34)	Vitamin B2	.9 (1)
MM	2.7 (3)	Vitamin B7	5.5 (6)
Total for All VMS	%* (*n*)	Vitamin B12	15.5 (17)
VMS	91.8 (101)	Folate	1.8 (2)
Minor categories	%* (*n*)	Vitamin B Complex	19.1 (21)
Calcium containing	50.0 (55)	Vitamin B not identified	3.6 (4)
Fatty acids	33.4 (37)	Vitamin C	25.5 (28)
Fiber and colon health	19.1 (21)	Vitamin D	74.5 (82)
Joint supplements	14.5 (16)	Vitamin E	14.5 (16)
Protein and sport	6.4 (7)	Lutein	5.5 (6)
Single Nutrient Other Supplements	%* (*n*)	Most Frequently Used Herbals	%* (*n*)
Magnesium	18.2 (20)	Coenzyme Q-10	12.7 (14)
Potassium	9.1 (10)	Melatonin	8.2 (9)
Zinc	5.5 (6)	Cranberry	5.5 (6)
Selenium	3.6 (4)	Garlic	4.5 (5)
Iron	2.7 (3)	Turmeric	4.5 (5)
Chromium	1.8 (2)	Cinnamon	3.6 (4)

* % = *n/N*

A third of the sample used herbal products (see Table 6). The use of herbals was not significantly different between young old (65-74 years) and those 75 years and older, χ^2 (1) = .342, p = .56. Of those taking herbals, 68 % (n = 23 of 34) were above 75 years old. There were 31 separate herbals products reported. The herbals products reported were (products reported once have a [1] following the name): alfalfa, herbal appetite suppressant (1), alpha lipoic acid

(1), arnica (1), bilberry (1), broccoli extract (1), bromelain (1), candida cleanse (1), charco caps (1), coenzyme Q-10, Chinese herbals (1), cinnamon, cranberry, cumin (1), D-mannose (1), Echinacea (1), gingko (1), garlic, ginger (1), green tea extract (1), hawthorn (1), melatonin, milk thistle (1), oil of peppermint (1), red rice yeast, resveratrol (1), Pau D'Arco (1), rosemary (1), turmeric/ curcumin, mineral oil (1), and tart cherry herbals extract (1). All herbals products were taken orally and were supplement products.

As seen in Table 7, the participants who used herbals products, most used only one. Sixteen participants (15%) took more than one herbal. The participants who took the most herbals are listed in Table 7 with the products taken. The participants who took the most herbals also took other vitamin and mineral supplements.

Table 7. *Most Frequent Users of Herbals with Types of Herbals Taken (N=110)*

Herbals usage	% (*n*)	Herbals Taken	Total VMS (*n*)	State of Health	SCQ Score 0-45
User taking 9	.9 (1)	Coenzyme Q-10, Cranberry, Garlic Oil, Green tea extract, Cinnamon extract, melatonin, Milk thistle, Mineral oil, Bromelain	16	Good	2
User taking 7	.9 (1)	Alfalfa tablets, Arnica, B-Mannose, Candida cleansev, Charco caps, Pau d'Arco (Tabebuia impetiginosa), Turmeric	15	Fair	24
Users taking 4	2.7 (3)	1)Garlic Oil, Melatonin, Hawthorn, Bilberry	9	Excellent	1
		2) Garlic, CoQ10, Resveratrol, Alpha lipoic acid	13	Very Good	11
		3) Broccoli extract, Ginger, Turmeric, Cumin	13	Good	8
Users taking 3	1.8(2)	1) Curcumin (compound in Turmeric), Chinese herbal, CoQ10	12	Very Good	2
		2) CoQ10, Garlic, Melatonin	10	Very Good	0
Users taking 2	8.2 (9)				
Users taking 1	16.4 (18)				
Users taking 0	69.1(76)				

Use of Vitamin D

Seventy-five percent of the participants took vitamin D (n = 82). The most frequently cited reason for vitamin D, see Table 8, was lack of sunlight/supplement diet. Sixty-one percent (n = 67) report the vitamin D was prescribed. There was a significant association between the knowledge of osteoporosis diagnosis and use of vitamin D (p = 0.002, Fisher's exact test). Thirty-nine percent (n = 43) of the participants reported they had a diagnosis of osteoporosis. Of those 43 with a diagnosis of osteoporosis, 91 % (n = 39) were taking vitamin D. Nine percent (4) of the participants aware of an osteoporosis diagnosis choose not to use vitamin D.

Table 8. Reasons to Use Vitamin D (N=110)

	%[a] (n)
Lack of sunlight/supplement diet	18.2 (20)
Physician suggested	16.4 (18)
Bones/Osteoporosis	15.5 (17)
Low blood levels	10.9 (12)
Desire to be heathy	3.6 (4)
Help with immune system	1.8 (2)
Do not know why take it	1.8 (2)
Depression	.9 (1)
Seasonal affective disorder	.9 (1)
Advised by friend or family	.9 (1)
Heart	.9 (1)
Polymyalgia rheumatic	.9 (1)
Do not use or answer missing	27.3 (30)

[a] % = n/N

Of the 82 participants who took vitamin D, 28% (n = 23) of them did not know the dose they were taking. The response to the question regarding confidence to list their supplements including the doses and schedule, 92% of those taking vitamin D (n = 75 of 82) felt confident. In the question on vitamin D use, 18 of the 23 (78%) who did not know their dose of vitamin D reported on the confidence question that they felt confident that they could list their supplements,

including the doses and schedule and only 4 reported they were not confident, χ^2 (1) = .45, p = .50.

Of the entire sample, 6% (n = 6) took a dose below RDA, 4 % (n = 4) took within the RDA, and 39% (n = 43) took more than RDA but less than UL (Tolerable Upper Intake Level). There were 7 % who were at UL or above. Of the 4 % (n = 4) who were above the UL, two were taking 5,000 IU daily (one prescribed for low blood level, second not prescribed and taking for bone health), one took 25,000 IU twice a week (did not answer prescription question or reasons for use), and one took 50,000 IU twice a week (prescribed for low blood level). The most frequently reported dosage level of vitamin D were 1,000 IU per day (16.4%, n=18 of the 110) and 2,000 IU per day (10.9%, n=12 of the 110).

Key Variables and VMS Use

The literature has shown that age, education and comorbidity are associated with VMS use; this study examined the relationship of age, education level and comorbidity with VMS use by older women. Spearman rank order correlation (r_s = -.07, p = .49) did not show a significant relationship between age and number of VMS taken. Nor was there a significant difference between the young old (65-74 years) and those 75 years and older in regard to low (0-4 VMS) or high use (5-16 VMS) of VMS used, χ^2 (1) = 0.63, p = .43. The participants with high school education took less VMS (M = 3, SD = 3) than those with a college (M = 6, SD = 4) education; t(107) = -3.53, p = 0.001.

The SCQ (Md = 7.0, SD = 4.84) had a range from 0 to 25 out of a possible 45 points. There was no difference in levels of supplement use between women with low, medium and high levels of comorbid conditions, Kruskal-Wallis test (H, p = 0.979). Participants had significant differences in amount of VMS use for 2 comorbidities. The total VMS use was less for those

with heart disease (*M* = 3.6 VMS, *SD* = 3.0) than for those without heart disease (*M* = 5.2 VMS, *SD* = 3.7), Mann Whitney test (U = 825.5, *p* =.039); and total VMS use was less for those with high blood pressure (*M* = 4.0 VMS, *SD* = 3.0) than those without high blood pressure (*M* = 5.9 VMS total, *SD* = 4.0), Mann Whitney test (U = 1044.0, *p*= .008).

Discussion

There were few differences between the older women living in the community setting and living in the CCRC's, this may be different in other regions of the country. Women living in the CCRC's reported higher educational and income levels and also had higher use of VMS. Consistent with other studies those with a higher education and income did take more VMS (Archer et al., 2005; Bailey et al., 2011; Dickinson & MacKay, 2014; Foote et al., 2003; Gray, Paganini-Hill, & Ross, 1983; Kennedy, 2005; Lee & Kim, 2009; Radimer et al., 2004; Satia-Abouta et al., 2003).

Use of VMS

In this study, participants reported a high rate of current VMS use and most participants had used VMS during their life. Only a small percentage of participants reported that they had never used VMS, this is in alignment with another study were 6% had never tried a supplement (Gray & Rutledge, 2013). As seen in Table 9, the high current use of VMS is consistent with other studies (Bailey et al., 2011; Bailey et al., 2013; Elder & Nisly, 2011; Gray et al., 1983; Radimer et al., 2004). The high use of VMS highlights the popularity of VMS with older women. Health care professionals need to be aware of high use by older women and the impact VMS may have on the plan of care.

Surprisingly demographic factors, such as age, state of health, income level, and comorbidity, were less predictive of VMS use. Many studies have found that VMS use increases

with age (Bailey et al., 2011; Bailey et al., 2013; Foote et al., 2003; Miller et al., 2008; Radimer et al., 2004; Satia-Abouta et al., 2003). One study found the use of VMS did not increase for women when participant characteristics were controlled (age, education, race/ethnicity, and BMI; Satia-Abouta et al., 2003). The studies that did find the increase of VMS use with age also had wider range in age, adults from 18 years and older (Kennedy, 2005; Miller et al., 2008), or 45 years and older (Foote et al., 2003). In this study, older women (75 and above) were not taking significantly more than the young-old women (65 to 74 years). Table 9 provides prevalence rates of VMS use for women over the age of 50 reported in the literature. The prevalence rates for women alone are higher than when men are included. One possible reason for higher use of VMS in older women may be attributed to the increased use of vitamin D and calcium to prevent osteoporosis and maintain bone health. The higher use in this study may also result from the location of the study, less sunlight during winter months, and women's awareness of the need for vitamin D in winter months.

Table 9. Prevalence of Older Women Using Supplements by Age, Year and Study

Women's Age	Prevalence	Type[a]	Year [b]	Study	Primary Authors Name
> 58	75%	VMS	1982	Part of cohort study	Gray
≥ 55	66 % 85 %	VMS	1986 2004	Iowa Women's Health Study 1986 cohort	Park
> 45	72%	8 VM	1993-1996	Multiethnic Cohort	Foote
>51	47%	VM	1994-1996	Continuing Survey of Food Intakes by Individuals, Diet and Health Knowledge Survey	Sebastian
60-99	14% 20 % 20 %	NVNM NVNM NVNM	1994 1995 1996	New Mexico Aging Process Study	Wold

	27 % 42% 46%	NVNM NVNM NVNM	1997 1998 1999		
50-59	56%	VMS	1997-1999	INTERMAP	Archer
> 50	75%	VMS	2000-2002	VITAL study	Satia-Abouta
>54	75 %	VMS	2002	2002 Health and Diet Survey	Timbo
51 to 70 > 70	72 % 75 %	VMS	2003-2006	NHANES	Bailey
≥ 65	92%	VMS	2016-2017	Present Study	Hekel

[a] VMS = vitamin, mineral or herbal supplement, NVNM = Nonvitamin, nonmineral supplement, VM = Vitamin and mineral supplements
[b] Year data gathered

Some studies have reported supplement use is more common among those who report themselves as healthy versus those who report poor health (Archer et al., 2005; Kennedy, 2005). The 'inverse supplement hypothesis' has been described as adults who use VMS but need the supplements the least (Conner et al., 2003). Studies which support the inverse supplement hypothesis report VMS users to have higher dietary nutrient intakes, report themselves as healthy, higher incomes, and higher education than VMS non-users (Braun & Venter, 2008; Kirk et al., 1999; Kofoed et al., 2015; Sebastian et al., 2007). There was no significant difference between income or state of health and VMS found in this study. As no participants in the current study reported poor health this limits the ability to compare with studies who had participants with poor health. Higher education level is often associated with higher income level (Johnson et al., 2000), this was not reflected in the sample where the educational level and range of income were not significantly correlated.

Individual medical diagnosis has been found to influence supplement use. Cancer patients are using increasing amounts of VMS (Cassileth et al., 2009). One study suggested that cancer survivors had higher supplement use as a preventative measure (Miller et al., 2008). While this was not supported by the study, 24% (n = 26) of the sample reported cancer, and all but one of those were using VMS, there was not a significant difference in VMS usage found between those with cancer and those without. Regarding specific health problems only high blood pressure and heart disease had significant relationships with VMS total use, participants with the conditions used less VMS. Other studies have found that supplement use increased with the number of chronic conditions (Miller et al., 2008). In this study, where the comorbidity score considered treatment and impact on function, there were no differences in supplement use between women with low and high levels of comorbid conditions. The difference in findings of comorbidity and VMS use may be due to differences in comorbidity tools, difference in goals of the studies as some studies are examining one specific comorbidity, and differences in samples.

There is variation found between studies on what VMS are most commonly used. Vitamin D, MVMM, and calcium were the vitamins and minerals most frequently taken in the current study. Many studies have found that MVMM is the most commonly used VMS (Bailey et al., 2011; Foote et al., 2003; Satia-Abouta et al., 2003; Sebastian et al., 2007). The most commonly taken VMS reported in a 1980's study were vitamin C, vitamin E, and thiamine (Gray et al., 1983), in the late 1990's United Kingdom study fish oil, multivitamins, garlic tables and vitamin C were reported (Johnson et al., 2000), and in a 2000's study MV, vitamin C and vitamin E were reported (Foote et al., 2003). A small study of 49 seniors found the most common VMS were calcium, MV, fish oil, and vitamin B (Elder & Nisly, 2011). There was a wide difference in most common VMS taken, this may be from the different years the studies

took place, the different regions of the country, different measurement of VMS, and changes in popularity of VMS. This highlights the necessity for continuing research on VMS use.

Use of Herbals

About a third of the participants from this study took herbals. This in similar to results from other studies where rates of herbal use range from around 20% (Kennedy, 2005; Marinac et al., 2007; Wold et al., 2005) to 46% (Gray & Rutledge, 2013; Wold et al., 2005). Wold et al. (2005) found the use of nonvitamin nonmineral products increased over time, as seen in Table 9. The individuals who took the largest number of herbals (Table 7) demonstrate the wide variety in use. The current study had over 31 separate herbal categories represented for 110 participants. The number of products used does not represent the total number of different herbals ingested as many products had multiple ingredients. The high number of herbals was consistent with other studies (Archer et al., 2005; Marinac et al., 2007; Timbo et al., 2006; Wold et al., 2005).

The use of herbal products was not significantly associated with age in the current study. Kennedy (2005) found that herbal use was highest for adults aged 45 to 64. While not a significant finding in this study, the use of herbals was higher for those over 75 years old. This may reflect differences in use of herbals such as self-treatment, greater acceptance of herbals over time, or different presence of health conditions (Wheaton, Blanck, Gizlice, & Reyes, 2005).

The popularity and use of herbals changes over time (Cassileth et al., 2009; Wold et al., 2005). The most frequently used herbals this study found were Coenzyme Q-10, melatonin, and cranberry. Other commonly reported herbals include glucosamine, Echinacea, ginkgo biloba and garlic (Kennedy, 2005; Marinac et al., 2007; Wold et al., 2005).

There are several things that may impact the difference in findings regarding the most popular herbals. The lack of a uniform classification system causes differences in reporting. For

example, the classification system for the current study has glucosamine and chondroitin as joint supplements under the minor category, thus they are not included into the herbal category. Other studies included joint supplements in the herbal category (Marinac et al., 2007; Wold et al., 2005). How the data was gathered may cause differences in findings. This study used 30 days as a time frame and a 24-hour recall, these time periods may miss periodic or seasonal use of VMS. The change in popularity of VMS over time is impacted by media reports of research and may also reflect the differences between regions, availability, or marketing (Cassileth et al., 2009).

Use of Vitamin D

There was a small number of older women who were taking vitamin D dosages at or above the Tolerable Upper Intake Level. This number is lower than actuality as other sources of vitamin D were not included; vitamin D in diet and vitamin D in VMS such as MVMM's. Several authors have found that vitamin and mineral supplements can contribute to excessive intake (Archer et al., 2005; Bailey et al., 2010; Bailey et al., 2012; Murphy, White, Park, & Sharma, 2007). Excessive intakes of folic acid, iron, magnesium, zinc, vitamin A, vitamin C and niacin have been found in supplement users (Archer et al., 2005; Bailey et al., 2010; Murphy et al., 2007). Older adults have been found to take excessive amounts above the Tolerable Upper Intake Level (UL) for folic acid, vitamin A, vitamin B-6, vitamin C, vitamin D and vitamin E (Bailey et al., 2010; Bailey et al., 2012). Excessive intakes are often found when a MVMM is taken with additional vitamins and minerals. To reduce excessive intakes while providing enough to provide for adequate intake, Murphy et al. (2007) has suggested a change in the formulation of multivitamin products.

Most women with osteoporosis were taking vitamin D and followed their health

providers' recommendations. Common vitamin D doses were 1,000 IU and 2,000 IU per day. Both doses are above the RDA but well below the UL of 4,000 IU's per day. There are a wide variety of vitamin D dosages that are available over the counter and vitamin D is being added to more products. The combination of more products containing vitamin D in wide ranges of doses increases the risk for dose above the UL. One third of women taking vitamin D did not know the dose of the vitamin D supplement that they were taking daily. This highlights the importance for the health care professional to communicate and educate about the use of VMS.

It was interesting to note that in the survey the participants listed their VMS taken and dosages of vitamin D before they completed the measurements for self-efficacy. Of those who were unable to list their dose of vitamin D, 18 reported they felt confident that they could list their supplements even though they had been unable to answer the question earlier in the survey. This brings up an interesting phenomenon which is helpful for health care professionals to take into consideration. Self-perception of awareness and use may not reflect actual practice or knowledge. This highlights the importance of older adults bringing all the VMS used into the health care appointments.

There was high use of vitamin D in this study. The high use of vitamin D in this report may be partially explained by location and time of year, northern state and in the winter months. Women reported lack of sunlight, use of blood tests to determine vitamin D status, and treatment recommendations by health professional if vitamin D level is low. Older women living in the northern parts of the United States get less sun light in the winter months and may be a population at risk for vitamin D deficiency. A fifth of women taking vitamin D were aware of the lack of sunlight and need for vitamin D. Of those who took vitamin D, 11 % were cognizant they had low blood levels and 16 % took vitamin D due to recommendations by their health care

professional.

The survey did not ask about screening for low blood levels so the percentage of older women who reported they had a vitamin D screening (11%) may be lower than the actual number. Currently the USPSTF does not recommended screening for vitamin D deficiency in asymptomatic adults over the age of 18 years as the current evidence is insufficient to balance benefit and risks of harm (Moyer & U.S. Preventive Services Task Force, 2013). The USPSTF has recommended use of vitamin D to prevent falls for women over the age of 65 years who are at high risk for falls (Moyer & U.S. Preventive Services Task Force, 2013). The USPSTF is currently in the process of updating this recommendation. The USPSTF recommendation does not apply to treating people with vitamin D deficiency or osteoporosis. The high use of vitamin D and the small number taking doses above the UL have important implications for health of older women.

Limitations

This study lacked the ability to determine total vitamin D levels as dietary intake of vitamin D was not gathered and vitamin D in MV, MVMM and other supplements were not included in the total. The last participant of the survey brought in a glucosamine which had 4,000 IU of vitamin D listed under ingredients, other participants which used glucosamine may also be taking vitamin D doses that were not reported. The actual number of participants taking vitamin D above the UL may be higher than reported in this study.

This descriptive study describes frequency and types of supplements by self-report and many participants did not have their actual supplements with them to confirm ingredients. Some supplements had multiple ingredients and were categorized under the major ingredient thus some ingredients in herbals was not represented in the results. The use of VMS is difficult to compare

across studies due to the lack of a standardized definitions and categorizations. The sample was primarily white which limits generalizability of findings. The sample represents participants from various senior dining sites, a church, and three Continuing Care Retirement Centers from Wisconsin which also limits generalizability of findings.

Recommendations for Future Research

An area for future research is awareness of dosage of vitamin D and the discrepancy between perception and knowledge. Twenty-eight percent of the older women did not know how much vitamin D they were taking. The majority of those who did not know the dose reported they perceived themselves as being confident (78%, 18 of the 23). There was incongruity between confidence (regarding dosage and schedule of supplement use) and ability to report dosage of vitamin D. Future research exploring dosage taken to dosage prescribed as well as the inconsistency between perception of confidence and knowledge would be valuable to inform practice.

Several participants used vitamin D at the UL or above. Additional studies are needed to examine amount of use above tolerable upper intake limit for vitamin D. Questions remain regarding what influences older adults to use VMS and what influences older adults to use vitamin D at or above the Tolerable Upper Intake Level. Future studies are needed to investigate the decision to use vitamin D at or above the Tolerable Upper Intake Level and physiological impact of use at higher than recommended daily amount. There is a need to more clearly understand the effects of overuse of VMS. Research that would monitor the effectiveness, toxicity, side effects, and impact on the health systems is needed (Cassileth et al., 2009). With the rising costs of health care, the fiscal impact of improper VMS use is also warranted. Research on potential public health policies regarding VMS safety are needed to protect the

health of older adults.

Conclusion

Supplements are an important source of vitamins and minerals for many older adults. Older women who use VMS tend to have a higher educational level. In this study, the majority of women used VMS. Vitamin D, MVMM, and calcium were the VMS most frequently used. There were many reasons for taking vitamin D and a small percentage were taking vitamin D dosages at or above the tolerable upper intake limit. The majority of older women with osteoporosis were following their health professional's recommendations for taking vitamin D. Health care professionals need to be aware of the VMS older adults are taking to monitor use over recommended amount. Greater communication, consultation, and education is needed regarding VMS use. Future studies are needed to examine the influences to use VMS in the older population. Public health policies and VMS safety regulations are needed to protect the health of older adults regarding VMS use.

Influence of Expectations of Aging on Supplement Use by Older Women

Abstract

The use of vitamins, minerals, and herbal supplements (VMS) is changing and increasing. This study examined the relationship of independent living older women's individual characteristics and behavior-specific cognitions, from the Health Promotion Model, to the use of vitamins, minerals, and herbal supplements. A proposed model was used to extrapolate potential influences of vitamin, mineral and herbal supplement use by older women. Variables of interest are expectations of aging and perceived self-efficacy. The research design is a descriptive cross-sectional design. Data were abstracted from the surveys of 110 community dwelling participants. As predicted by the theory, prior health behavior, education, and expectations of aging were associated with vitamin, mineral and herbal supplement use. The three predictors explained 27 % of the variance. Unexpectedly self-efficacy, age, and comorbidity did not impact vitamin, mineral and herbal supplement use for older women in this study. Findings from this study suggest that expectations of aging may be an important consideration to understand health behavior of older women. Findings also support the association that past health behaviors may have on current behavior. The current study supports the relevancy of the Health Promotion Model to examine older women's use of supplements and a revised model is presented.

Introduction

The use of VMS by older women is increasing and VMS are being used for a wide variety of reasons (Bailey et al., 2011; Bailey et al., 2013; Radimer et al., 2004). There are concerns regarding safety, side effects, drug interactions, and use above recommended amounts. As the population of older women continues to increase, health maintenance is extremely important. Older adults have taken VMS to improve their diet, provide essential nutrients,

prevent disease, treat illness and manage chronic disease. Understanding the factors that influence VMS use is essential to designing interventions and providing counselling.

The health promotion model (HPM) provides a framework to explore the variables that encourage vitamin, mineral and supplement use to enhance health. The HPM has been used to explain health-promoting behaviors. The theoretical underpinnings of the HPM are social cognitive theory and expectancy-values theory (Pender et al., 2011). Determinants of health promoting behaviors are categorized as *individual characteristics and experiences*, which influence behavior indirectly, and *behavior-specific cognitions and affect* which influence the behavior directly (Pender, 2006; Pender et al., 2015). As seen in Figure 3, individual characteristics and experiences included in the model are prior related behavior and personal factors (age, education, and comorbidity). Two behavior-specific cognitions were selected for the proposed model, perceived benefits of action (expectations of aging) and self-efficacy. Both are considered to be modifiable and significant motivators. There is evidence to support the validity of each as correlates of health behaviors (Pender, 2002; Pender et al., 2015).

Prior related behavior is the occurrence of a similar or same behavior in the past (Pender et al., 2015). Empirical evidence support the importance of prior behavior; prior behavior is often one of the best predictors of subsequent behavior (Pender, 2002; Pender et al., 2015). Prior related behavior is the use of VMS in the past. The regular habit of taking a supplement in the past influences the possibility of VMS use.

The nature of the targeted health behavior studied influence which personal factors are relevant (Pender, 2006; Pender et al., 2011). In the literature, personal factors which are associated with supplement use include age, comorbidity, and education level (de Groot et al., 2003; Johnson et al., 2000; Kim, 2009; Levy et al., 2002; Meisner & Baker, 2013; Sebastian et

al., 2007; Valderas et al., 2009). Supplement use increases with age and is a personal factor that may impact VMS use (Bailey et al., 2011; Dickinson & MacKay, 2014; Gahche et al., 2011; Radimer et al., 2004). Older adults have a greater chance of having multiple chronic disease and comorbidity has been found to have a confounding influence (de Groot et al., 2003; Egger, 2012; Marengoni et al., 2011; Valderas et al., 2009). Educational level is a representation of income and has been associated with supplement use (Dickinson & MacKay, 2014; Johnson et al., 2000; Meisner & Baker, 2013). The personal factors that are associated with VMS use will be used as control variables.

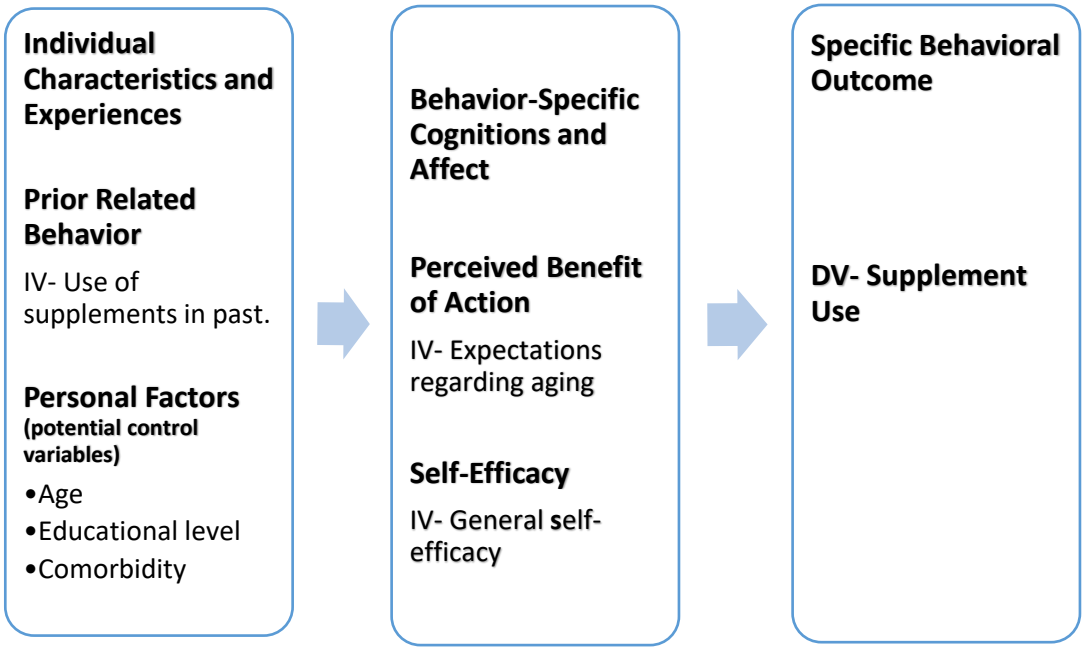
Perceived benefits of actions are expectations of positive outcomes that ensue from engaging in a health behavior. Perceived benefits of action have been associated with improving eating behaviors such as increasing fruits and vegetables and physical activity (Conn, Tripp-Reimer, & Maas, 2003; Walker, Pullen, Hertzog, Boeckner, & Hageman, 2006) . Older adults with positive views of their aging were found to practice more preventative health behaviors over time (Levy & Myers, 2004).

Expectations Regarding Aging (ERA) are an older adult's perceptions of their aging and had been used to examine relationships between perceptions of aging, health behaviors and outcomes (Sarkisian et al., 2005a; Sarkisian et al., 2005b). ERA measures the expectations one has of future health and cognitive function in conjunction with aging (Joshi, Malhotra, Lim, Østbye, & Wong, 2010). ERA vary and have been documented to influence health behaviors both current and future (Goodwin et al., 1999; Leventhal & Prohaska, 1986; Levy et al., 2002; Rakowski & Hickey, 1992; Sarkisian et al., 2003; Sarkisian et al., 2005a). Older adults with higher ERA expected to maintain their functioning and performance and were more likely to continue health behaviors over time (Levy et al., 2002; Meisner & Baker, 2013; Sarkisian et al.,

2002a). This study hypothesized that ERA would influence the current health behavior of supplement use. ERA represent the perceived benefits of action, as seen in the proposed model in Figure 3.

Perceived self-efficacy is the individual's belief or conviction that one has the competence and skill to execute the behavior for the desired outcome (Pender et al., 2015; Schwarzer, 1992). Self-efficacy beliefs are important determinants of motivation, thought and action (Bandura, 1992; Bandura, 2006). In several studies, self-efficacy has been a consistent predictor of success in various health behaviors including healthy eating and physical activity (Conn, 1997; Pender, 1996; Wu & Pender, 2002). A higher level of self-efficacy increases the possibility that the individual will engage in a health behavior (Pender et al., 2015). It is proposed that individuals with positive self-efficacy are more likely to engage in supplement use.

Figure 3. Proposed Model to Study Factors that Influence the Use of Vitamins, Minerals, and Herbal Supplements



The HPM, the framework for the study, has not been used to investigate modifiable factors that influence the use of VMS. The research hypothesis for the study is: Controlling for age, comorbidity and education level, expectations of aging, self-efficacy, and prior related behavior will predict VMS use. The study describes the ERA, general self-efficacy, prior related behavior and personal factors (age, education level and comorbidity). Personal factors which relate to VMS use will be used as control variables for the multiple regression. A multiple regression model will be used to determine predictors of VMS use.

Methods

A descriptive cross-sectional design was used to study the factors that influence the use of VMS. The University of Wisconsin's Human Research Protection Program Institute Review Board approved the project and provided waiver to document informed consent. Sample size of 79 was determined by a priori sample size estimation for multiple regression. The statistical power level was 0.80, the significance criterion (alpha) was set at 0.05, and a moderate effect size (R2) of 0.15 was assumed from previous studies of HPM variables (Pender, 1996). The sample size was set at 110 to provide improved capability to detect smaller effects.

Data were collected by self-report survey from older independent living women in the upper Midwest. Data was collected at two County senior nutritional programs, one church, and three Continuing Care Retirement Communities (CCRC). A key contact person at each site made announcements and posted flyers asking women 65 years and older to participate in a survey regarding VMS which took up to 45 minutes to complete. An informational session prior to survey was provided depending on organization protocol. Informed consent was obtained, after reading the consent form and consent was given by completion of survey. An area at each site was provided for confidentiality and privacy, however participants choose where they

wished to fill out the survey in the different settings. Participants were excluded if they were younger than 65 years, could not speak or read English, self-reported a memory problem, male, or not in an independent living setting. Vision impaired women who desired to do the survey could participate, the primary researcher read the consent and survey and marked indicated answers.

Measurement of Variables

Control Variables

Age was measured by self-report of current number of years old. Education level had 6 categories: less than high school; high school degree or the equivalent (for example: GED); some college credit, no degree; associate degree; bachelor's degree and graduate degree. Comorbidity was measured using the Self-Administered Comorbidity Questionnaire (SCQ). The SCQ has been tested with elderly, contains familiar terms, is self-report, easy to administer, and includes treatment and function impact (Katz et al., 1996; Sangha et al., 2003). The SCQ has 15 possible medical conditions, 12 listed and 3 fill in the blank. Each condition has 3 yes/no questions and each yes is scored for a point; presence of condition, receive treatment, and does this limit activity (Sangha et al., 2003). Range of possible scores is 0 to 45. The SCQ has moderate association with Charlson comorbidity index and the test-retest reliability intraclass correlation coefficient was 0.94 (95% CI, 0.72, 0.99) (Sangha et al., 2003).

Predictor Variables: Expectations of Aging, Self-efficacy, and Prior Related Behavior

Aging expectations were measured with the Expectations Regarding Aging -12 (ERA) (Sarkisian et al., 2005b). The ERA-12 is comprised of 12 questions with 4-point scale: definitely true, somewhat true, somewhat false, and definitely false. There are 3 subscales (physical health, mental health, and cognitive function) and a global scale, each scale has measurement has a

range of 0 to 100. A lower score indicated the participant's expectation of decline with aging, the higher score indicated the expectation of preservation and attainment of high physical and mental function with aging (Sarkisian et al., 2005b). The Cronbach's alpha for the three scales were ranged from 0.73 to 0.81 and for the global alpha was 0.88 (Sarkisian et al., 2005b). The test-retest reliability on a 2-week retest with intraclass correlation coefficient of 0.94 (Sarkisian et al., 2005b).

General Self-Efficacy Scale (GSE) measured the general sense of perceived self-efficacy. It is self-administered and the responses to the 10 questions are: 1 = not at all true. 2 = hardly true, 3 = moderately true, and 4 = exactly true. Scoring is by summing up the responses to the 10 questions, range from 10 to 40 possible. The GSE has been widely used and alphas ranged from .76 to .90 (Schwarzer & Jerusalem, 1995). Criterion-related validity was documented with correlational studies, positive correlation with optimism and favorable emotions and negative correlation with health complaints, depression and anxiety (Schwarzer & Jerusalem, 1995). The median has been used to divide a sample into low or high self-efficacy and this was used to divide sample for the current study (Schwarzer, 2009).

The GSE allows for additional items which relate to the concept of interest (Schwarzer & Fuchs, 1995). The subject for the additional items were derived from the literature, feedback from health care professionals, general discussions with older adults, and review of similar self-efficacy scales of nutrition and medication adherence (Fernandez et al., 2008; Schwarzer & Renner, 2014). VMS self-efficacy (VMSSE) items were developed following Schwarzer and Fuchs guidelines (1995). The additional items are seen in Table 10. The response range for each of the VMSEE items was 1 to 4: 1 = not at all true. 2 = hardly true, 3 = moderately true, and 4 = exactly true. The possible range of scores for VMSSE was 8 to 32.

Table 10. Eight Items for VMS Self-Efficacy	
Item Subject	Question for Survey
Routine	I am confident that I can make taking my supplements part of my routine.
Memory	I am confident that I can always remember to take my supplements.
Change in Day	I am confident that I will take my supplements when there is a change in my usual day (unexpected things happen).
Schedule	I am confident I can take several supplements on different schedules.
Information	I am confident that I can find information I need to help manage my supplements (for example: to get information, learn more about, avoid side effects).
No Help	I am confident I can manage my supplements without help.
List all	I am confident I can list my supplements, including the doses and schedule.
Maintain supply	I am confident I can remember to get refills of my supplements before I run out.

Past use of VMS was a close ended question, "Over the course of your life how much have you used or taken any VMS?" A Likert-type scale was used for responses. The four available response choices were; never used, hardly have used, occasionally have used, and frequently used.

Vitamin, Mineral, and Herbal Total Use

Prior use of supplements was measured by two questions, use over the course of life and over the last 30 days. Participants were asked over their life how much have they used or taken any VMS, the choices were never, hardly, occasionally or frequently. Participants were also asked if they had taken VMS over the last 30 days. Non-users were those who did not report taking a VMS. Using a time frame to identify VMS users captures users who take VMS on different schedules and the 30-day time frame commonly used (Bailey et al., 2012).

The operational definition for current VMS use were those who reported taking a VMS from a 24-hour recall or a check list asking about VMS use within the past 30 days. The 24-hour recall question asked participants to list all the vitamin, mineral and herbal supplement they have

taken in the past 24 hours. There was a definition of VMS to provide clarification. The question on VMS use in past 30 days was a checklist with additional space to write any VMS not on check list. The check list was formulated using a classification system that Bailey et al. (2013) developed to examine the 2007 to 2010 NHANES data. The categories are major category (multi-vitamin, multi-mineral; multi-vitamin, multi-mineral and herbals), minor category (fatty acids, calcium-containing, joint supplements, protein, fiber and color health), and other single nutrient supplements (single nutrient supplement not in any other category such as vitamin D). A prior manuscript reported older women's VMS prevalence, complexity of vitamin, mineral and herbal use, relationship with demographic characteristics and described reasons for and amount of vitamin D use. The total VMS count is not a pill count per day, but a reflection of total number of different VMS taken in the past 30 days from the checklist and 24-hour recall. Each point represents a VMS taken. This method of reporting and measuring VMS usage has been described in the literature (Viveky et al., 2012).

Analysis

Statistical analysis was conducted with SPSS Statistic 23 student version. The sample characteristics, SCQ, GSE, VMSSE and ERA total and ERA subscales and VMS totals were reported using mean, median and percentages of the non-transformed data. Normality was assessed and linearity between variables assured. SCQ, ERA mental health subscale, VMSSE, and VMS total were skewed and non-parametric analyses were used. The median was reported for the measure of central tendency for skewed variables. Spearmen's correlations analysis was used to identify variables having significant relationships with VMS use due to skew and ordinal level of data. An independent sample t-test was conducted to determine if there was a difference between the VMS total used between those with low versus high GSE scores (2 groups divided

by mean).

Multiple regression was used to test the null hypothesis of no difference in VMS use from prior supplement use, ERA, GSE, VMSSE and control variables. A square root transformation for SCQ and VMS total normalized each distribution. Transformation of VMSSE and ERA mental health increased the skew and transformation was not utilized. The Expectation-Maximization (EM) method was reasonable for regression analysis to replace missing data values as it retained relationships with other variables. All missing data on the dataset were verified against original surveys. Missing values were imputed using the EM algorithm in the Missing Values Analysis modules of SPSS. The EM method replaced missing variables; VMSSE (6 missing), SCQ (3 missing), and ERA total (5 missing), ERA physical health (1 missing), ERA mental health (2 missing), and ERA cognitive function (3 missing). Each variable had 5.5 % or less missing data following guidelines for the EM method. The Little's missing completely at random (MCAR) test $\chi^2 = 32.080$ ($df = 31$, $p = .413$), reflects the missing data was missing completely at random. Assumptions of regression model, such as linearity of variables with VMS total were confirmed after transformations and EM method.

To examine the results of the hypothesis a two-step process followed Field's strategy for multiple regression (Field, 2009). For the first regression variables were entered to observe which contribute significantly, step 1 contained the control variables (age, education level and SCQ) and step 2 contained the independent variables (prior supplement use, GSE, VMSSE, and ERA). ERA was entered last as the variable of interest following Field's design (Field, 2009). The second multiple regression contained the control variable and independent variables found to be significant and important.

Results

Description of Sample and Control Variables

As seen in Table 11, the participants were predominately widowed or single (78%) and white (91%) and had at some college or higher (67%). The majority were over the poverty level (87%) and reported they had just enough or more than enough money at the end of the month (93%). The reported state of health was good or better (88%). Sixty-eight percent had used VMS frequently over the course of their life and 92% were using VMS currently. Age was not significantly associated with VMS use and education had a weak positive relationship to total VMS use. The median score of the SCQ which includes treatment and function was 7 (*SD* = 4.8). The median comorbid diagnosis for the participants was 3 problems (*SD* = 2). The most common diagnosis' were arthritis (*n* = 70), high blood pressure (*n* = 63), and back pain (*n* = 40). SCQ has a weak, non-significant relationship with VMS use. The SCQ had acceptable Cronbach alpha of .810 (Tavakol & Dennick, 2011).

Table 11. Characteristics of Study Participants (*N*= 110)

Participant Characteristics	*n* (%)	r_s Total VMS	*p*
Marital Status (*N* = 110)			
Married	23 (21)		
Partnered	1 (1)		
Single	35 (32)		
Widowed	51 (46)		
Ethnicity (*N* = 110)			
Hispanic or Latino	3 (3)		
Not Hispanic or Latino	99 (90)		
Prefer not to answer	8 (7)		
Race (*N* = 110)			
White	100 (91)		
American Indian	6 (5)		
Black or African American	2 (2)		
Prefer not to answer	2 (2)		
Range of income (*N* = 79)		.05	.66
Less than $12,000	10 (13)		

$12,000 - $15,000	12 (15)		
$15,000-$18,000	11 (14)		
$18,000-$25,000	8 (10)		
$25,000-$50,000	20 (25)		
Over $50,000	18 (23)		
Rate Finances (*N* = 103)		.06	.56
Have more than enough money at the end of the month	55 (53)		
Have just enough money at the end of the month	41 (40)		
Do not have enough money at the end of the month	7 (7)		
Education Level (*N* = 109)		.19	.05*
Less than high school	1 (1)		
High school degree or equivalent	34 (32)		
Some college	19 (17)		
Associate degree	13 (12)		
Bachelor degree	22 (20)		
Graduate degree	20 (18)		
State of health (*N* = 109)		.03	.72
Poor	0 (0)		
Fair	13 (12)		
Good	30 (28)		
Very good	53 (48)		
Excellent	13 (12)		
Osteoporosis Diagnosis (*N* = 110)			
Yes	43 (39)		
No	62 (56)		
Do not know	5 (5)		
Supplement use over life course (*N* = 108)		.40	.01**
Never used	3 (3)		
Hardly used	12 (11)		
Occasionally used	20 (18)		
Frequently used	73 (68)		
Current supplement use (*N* = 110)			
Yes	99 (90)		
No	11 (10)		
Age M (*SD*), range (*N* = 110)	77.7 (7.6), 65 to 93	- .07	.49
SCQ Md (*SD*), range (*N* = 110)	*Md* 7.0 (4.8), 0 to 25	.011	.91

r_s is the Spearman's Rho statistical analysis, control variables are italicized.
*Correlation is significant at the 0.05 level
** Correlation is significant at the 0.01 level

Description of Predictor Variables: Expectations of Aging, Self-efficacy, and Prior Related Behavior

The average ERA subscale scores, from low to high, were 46 (*SD* = 22) for physical health, 50 (*SD* = 22) for cognitive function, and a median of 75 (*SD* = 23) for mental health. The average global ERA score was 57 (*SD* = 18). There was a negative skew for ERA mental health as the participants tended to expect a high level of function in aging. ERA total had a nonsignificant weak relationship with VMS use. The ERA total and subscales had acceptable Cronbach alpha's ranging from .72 to .86 as seen in Table 12 (Tavakol & Dennick, 2011).

The average for GSE was 33 (*SD* = 4.6) with actual range of 19 to 40. The participants with low GSE took on average 4.8 VMS per day while those with higher GSE took on average 4.9 VMS a day, there was no significant differences between the two groups $t(108) = -.25$, $p = .804$. GSE had significant moderate relationships with ERA total ($r_s = .39$. $p < .01$). The GSE had acceptable Cronbach alpha of .89 as seen in Table 12 (Tavakol & Dennick, 2011).

The median score for VMSEE was 29 (*SD* = 4). There was negative skew for VMSSE as participants tended to report that they were very confident in the use of VMS. This was reflected as the median for all eight questions was 4 out of the possible range of 1-4. VMSSE had a weak relationship with GSE (Spearman's rho $r_s = .33$, $p < .01$). VMSSE had a weak negative non-significant relationship with total VMS use as seen in Table 12. The VMSSE had acceptable Cronbach alpha's ranging from .72 to .86 as seen in Table 12 (Tavakol & Dennick, 2011).

The majority of the participants frequently used supplement (66%, *n* = 73). There were 13.6 % (*n* = 15) of participants who reported never or hardly have used VMS. And 18 % (*n* = 20) who occasionally used VMS. Supplement use over life course had a positive moderate relationship with VMS use as seen in Table 11. The median number of supplements taken a day

was 5 (*SD*= 4) with a range of 0-16 VMS taken. Positive skew was found for VMS total as there were high numbers who used 5 or less supplements.

Table 12. Results of Expectations Regarding Aging, General Self-efficacy and Vitamin, Mineral and Herbal Supplement Self-Efficacy Measurements

Scales	M (SD)	Range of Scores	Cronbach's coefficient alpha	Correlation to VMS total	p
Global ERA	57.0 (18.4)	11 to 97	.862	-.148	.13
ERA physical health	46.4 (22.2)	0 to 100	.715	-.086	.38
ERA mental health	Md 75.0 (22.6)	8.3 to 100	.744	-.183	.06
ERA cognitive function	50.2 (21.7)	0 to 100	.790	-.026	.79
General Self-Efficacy (Possible Range 10-40)	33.1 (4.6)	19 to 40	.893	.005	.96
VMS self-efficacy (Possible range 8-32)	Md 28.5 (4.0)	8 to 32	.841	-.014	.89

Research Hypothesis - Variables Which Influence VMS Use

The first regression analysis was completed with all the control variables and predictors entered to observe which contribute significantly. The step 1 variables age and SCQ were not used in final regression due to weak correlation, as seen in Table 11, and non-significant low (age, $\beta = -.04$, $p = .673$; SCQ, $\beta = .048$, $p = .620$) standardized beta-coefficients. Step 2 variables GSE and VMSSE were removed as neither were significant nor correlated with VMS use in older women and did not add to the model (GSE, $\beta = -.02$, $p = .869$; VMSSE, $\beta = -.01$, $p = .939$). Age, SCQ, GSE, and VMSSE were not included in the final regression.

As shown in Table 13, in Step 1of the second multiple regression, education level accounted for 2.3 % of the variance in VMS use. At Step 2 with the addition of past use of VMS

and ERA there was a significant increase of 23.3 % variance in the model. The results of the hierarchal regression indicated that education level, prior use of VMS, and ERA explained 27 % of the variance.

Education level, prior use of VMS, and ERA were significant predictors of VMS use in the model. For past use of VMS, the standardized beta-coefficient was .469. This means that controlling for education and ERA, when prior use of VMS increases by one unit, it is predicted that VMS use will increase by .469. For ERA, the standardized beta-coefficient was -.197. This means that controlling for past use of VMS and education level, when ERA increases by one unit, it is predicted that VMS use will decrease by .197. Past use of VMS was the strongest predictor of current VMS use followed by ERA.

Table 13. Final Regression for Determinants of Vitamin, Mineral, and Herbal Supplement Use in Older Women (N=110)

Step and Predictor Variable	R^2	Adjusted R^2	ΔR^2	Standardized ß	*t*	*p*
Step 1						
Education Level	.033	.023	.033	.180	1.888	.062
Step 2						
Education Level				.182	2.216	.036
Use VMS in Past	.265	.244	.233**	.469	5.523	<.001
ERA Total				-.197	-2.285	.024

$F(3, 104) = 12.53$, $p < .001$
* $p < .05$, ** $p < .001$

Discussion

The primary objective of this study was to identify factors associated with supplement use. The expectations of future mental health, physical health and cognitive function on the use of VMS were a significant predictor. Expectations of aging negatively predicted VMS use. The older women who expect declines of physical, cognitive and mental functioning with aging had higher VMS use. While older women who had higher ERA, expect to preserve high physical

and mental function with aging, had lower VMS use. This is contrary to other studies where older adults with higher scores or positive self-perceptions or expectations of aging generally practiced more preventative health behaviors.(Sarkisian et al., 2003; Sarkisian, Liu, Ensrud, Stone, & Mangione, 2001).

The health behavior VMS supplement use may not be equivalent to other health behaviors such as exercise or nutrition. There may be influences that motivate VMS use for older women that are distinctive from motivations for other behaviors. Supplement use does not require the same level of behavior change or lifestyle change that exercise and nutrition require. The cognitions influencing those with lower expectations of aging to use more VMS could be examined using qualitative methods to further explore this finding. Expectations of aging is a modifiable factor. It would be valuable for primary care professionals to be aware of how ERA influences different health behaviors.

This study also did not examine the appropriateness of the VMS use by older women. Are women who need the VMS the ones taking the supplements? The literature often shows that women who exercise more, eat healthier diets, higher education level and higher incomes tend to take VMS. This is a very interesting finding that ERA has a significant negative relationship with VMS use. Is there a difference in appropriateness in VMS use between those with lower or higher ERA? Are women with lower expectations of aging taking more VMS to buffer or protect their future health. These are questions that have clinical implications for health care practitioners and further study is warranted.

While other studies of other health behaviors have found self-efficacy to be a predictor, GSE and VMSSE were not found to be significantly associated with VMS use in this study (Gray & Rutledge, 2013; Pender, 2002; Walker et al., 2006). The construct of self-efficacy has

frequently had empirical support in the health promotion model. In 86% of studies using the health promotion model, self-efficacy was found to be significant and was retained in the model (Pender, 2002). A study, also using the GSE to measure self-efficacy, found Polish athletes (20 to 30 years old) with lower GSE scores more likely to use vitamin supplements (76% low GSE vs 56% higher GSE) than those with higher GSE scores (Gacek, 2016). A significant difference in use was not found between those with low and high GSE scores in the current sample. While there are many differences between the two studies, this does highlight the importance of self-efficacy in the study of health behaviors and in future studies.

Self-efficacy has a role in adopting a health behavior and has been found to help maintain health behaviors such as physical exercise (Conn, 1997; Schwarzer & Fuchs, 1995). Self-efficacy has a major role in the intention to change a behavior (Schwarzer & Fuchs, 1995). In the current study, self-efficacy does not appear to be a determinant for maintenance of VMS use. The majority of the sample had used VMS frequently over the course of their life. Self-efficacy may have an impact on intention to use supplements and early adoption or use of VMS. This does not rule out that self-efficacy may have been predictive for the intention to use the VMS early in life, but this was not explored in the current study. Supplement use is complex and a combination of social, economic, psychological, and economic factors may influence older women (Conner, Kirk, Cade, & Barrett, 2001). Factors other than self-efficacy may be the motivators for current use. The challenge is to identify the behavior-specific cognitions and affect that impact older adults.

In studies using the health promotion model about 60% of demographic characteristics were found significant and were retained (Pender, 2002). Education level, age and comorbidity were measured in this study because these variables affect numerous elements of older women's

lives and have been found in previous studies of VMS use. As found in the current study, education level has been found to be a significant predictor for supplement by older adults (Johnson et al., 2000; Kim, 2009; Sebastian et al., 2007). While studies have found that VMS use increases with age (Bailey et al., 2011; Bailey et al., 2013; Foote et al., 2003; Miller et al., 2008; Radimer et al., 2004; Satia-Abouta et al., 2003), the current study did not find differences between older women in the sample. While comorbidity was not found to be associated with VMS in this study, having heart disease and high blood pressure was related to VMS use. It may be helpful to continue to examine individual diseases and VMS use. It is also important for clinicians to be aware that there are supplements that are hazardous with certain health states and to discuss VMS use with patients.

This study was predominately white women, this is a group who have been found to be more likely to take supplements than other racial groups (Sebastian et al., 2007). In the literature ethnicity has been found to be a factor but inadequate representation in the participants in this study suggests further research is needed. The high proportion of white women decreases the generalization of the findings. Other studies have found that while VMS use was high across ethnic groups there are differences in type and length of use for VMS (Albright et al., 2012; Foote et al., 2003; Murphy et al., 2011). To study ethnicity additional research with probability samples in other geographic regions would be informative. This information would also be valuable for health care professionals in providing care, prescribing and avoiding drug interactions.

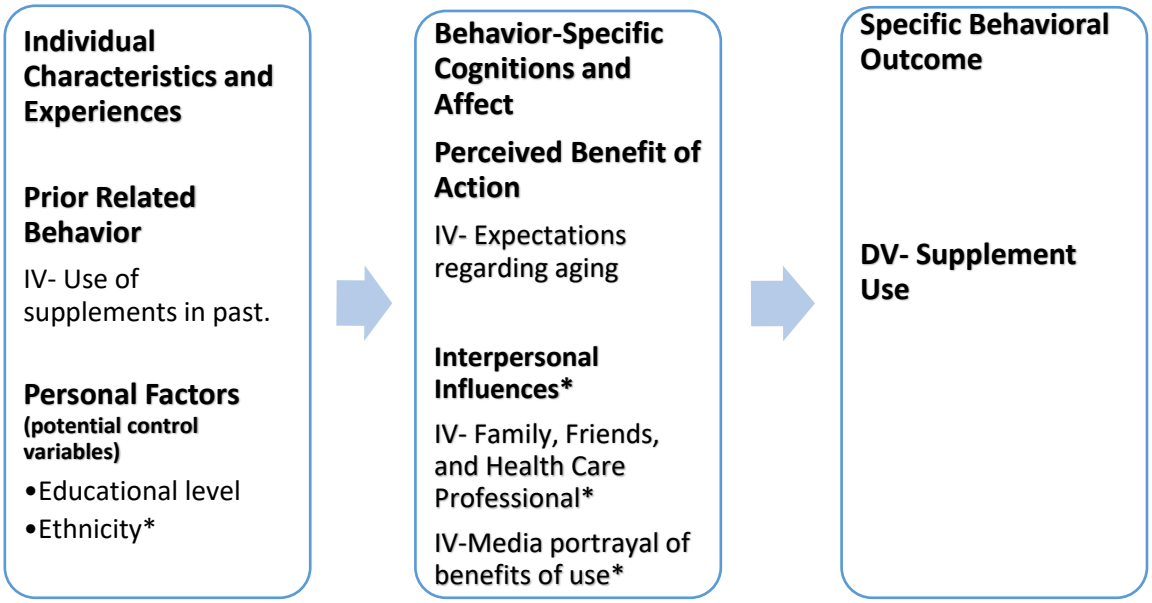
Prior use has been found to be a significant determinant and retained in 75% of studies testing the construct with the health promotion model (Pender, 2002). Prior use has been found to have both a direct effect and indirect effect on current health behavior. The direct effect may

be due to habit formation. The HPM suggests indirect influence includes relations to perceptions of past self-efficacy, past benefits, and activity-related effect of prior use. It is important to be aware of prior use in older adults as prior use can alert health care professionals to discuss current and future use of VMS with older women. The findings of this study support the importance of future research to examine predictors of VMS use.

Research Hypothesis Revised

The variance explained by the model indicates the existence of additional predictor variables. Determinants that were found to be significant were retained in the model and the determinants which were poorly correlated and not significant were removed from the model. The health promotion model and participant responses on the survey offer additional variables which could be examined to identify predictors of VMS use. The personal factor of the HPM associated with supplement use was education and is retained in the revised model, while comorbidity and age were not significant and were not retained. Behavior-specific cognitions and affect that could be explored include interpersonal influences. Interpersonal influences are the cognitions regarding the beliefs, behaviors or attitudes of others. Interpersonal influences incorporated are; influence of family, friends and health care professionals; and media.

Figure 4. Revised Model to Identify Factors that Influence Supplement Use



*Added to Model

Limitations

The study's findings should be interpreted with the following limitations in mind. First, the amount of variance explained in the variables was small to moderate and indicate the existence of additional predictor variables. Second, there are additional variables for study suggested by the theoretical model which were not within the scope of this study. The cross-sectional design of the study prohibits the ability for definite conclusions regarding cause and effect in the relationship between education, prior use, and ERA with older women's VMS use. Finally, additional research and measurement development is needed for measure of VMS self-efficacy and measurement of Tolerable Upper Intake Level use of VMS. Identification of behavior-specific cognitions and affect is also of key importance in future research as these are the constructs which are modifiable and may be used to develop interventions.

Conclusion

In summary, the health promotion model was useful to begin an exploratory study of predictors of VMS use in older women. Variables found to have an impact on VMS use include educational level, past prior use, and expectations regarding aging. This study suggests that further research examine additional potential predictors of VMS use. Future studies focusing on predictors of VMS use by older adults may allow interventions to improve or protect the health of older adults.

Comparison of Supplement Use Results from Nursing Home Residents and Independent Living Older Women

While all the independent living adults were women, 26% of the residents in the nursing home were men. There was a wider range of age in the nursing home residents, 54 to 103, than in independent living sample, 65 to 93 years. There is no data for comparison for most of the demographics, comorbidity, ERA and GSE as the data from nursing home was a secondary analysis.

At the time of the survey 92% of the independent living women (ILW) were using a VMS, while in the nursing home 94 % were taking a VMS and/or nutritional supplement. Vitamin D was the most frequently used supplement from all categories for both groups followed by calcium and MVMM. Both groups are from the same geographical area though the results were gathered 2 years earlier for nursing home residents.

Very similar amounts of use were found between the ILW and nursing home residents for vitamin D, 75% for ILW and 72% for nursing home residents. In the nursing home, more females took the basic form of Vitamin D (n = 68, 37%) than males (n = 14, 22%) (χ^2 = .406, p = .524). For the ILW 39 % (n = 43) had a diagnosis of osteoporosis. No diagnosis' were available

from the secondary analysis of the nursing home.

There are similarities regarding dosage of vitamin D between the two groups. Low numbers were using dosages below or within RDA for both groups. Of the ILW, six percent (*n* = 6) took a dose below RDA and 4 % (*n* = 4) took within the RDA, for the nursing home residents, 9 % (*n* = 21) were below RDA, 1 % (*n* = 3) were within RDA. Both groups were taking dosages above the RDA for vitamin D. For ILW 39% (*n* = 43) took more than RDA but less than UL (Tolerable Upper Intake Level), and 7 % who were at UL or above. For the nursing home group 62% (*n* = 154) were prescribed dosages of Vitamin D above the RDA, and 28% (*n* = 69) were not prescribed any vitamin D.

There were wide differences in the herbals used between nursing home residents and ILW, twenty percent higher use of herbal in the ILW. In the nursing home setting, 11.3 % (*n* = 28) were taking an herbal supplement (with Acidophilus removed from herbal category and added to colon health category) and 43% (*n* = 106) were taking a nutrition supplement. Both nursing home residents and IWF had melatonin and cranberry as frequently used herbals and coenzyme Q-10 use was higher in ILW, see Table 14. For nursing home residents, the most commonly prescribed herbal supplement was melatonin and for ILW it was coenzyme Q-10. There were no differences between genders in herbal supplement use (χ^2 = 3.236.596, p = .440) in the nursing home setting. The ILW also took a much wider variety of herbal supplements 31 versus 5 reported from the nursing home secondary analysis. In the nursing homes, there were 2 herbals reported as infrequently used: ginger supplement (*n* = 1) and turmeric supplement (*n* = 1).

Table 14. Comparison between Independent Living Women (N = 110) and Nursing Home Residents (N = 247)

Major categories	ILW %* (n)	Nursing Home %* (n)	Single Nutrient Vitamin Supplements	ILW %* (n)	Nursing Home %* (n)
MVMM	50.0 (55)	40.4 (100)	Vitamin A	3.6 (4)	0
MV	34.5 (38)	6.9 (17)	Vitamin B1		
Herbals	30.9 (34)	11.3 (28)	Vitamin B2	Total for B Vitamins	Total for B Vitamins
MM	2.7 (3)	0	Vitamin B7		
Total for All VMS			Vitamin B12	36.4 (40)	26.3 (65)
VMS	91.8 (101)	94.3 (233) [a]	Folate		
Minor categories			Vitamin B Complex		
Calcium containing	50.0 (55)	47.4 (117)	Vitamin B not identified		
Fatty acids	33.4 (37)	4.5 (11)	Vitamin C	25.5 (28)	7.3 (18)
Joint supplements	14.5 (16)	0	Vitamin D	74.5 (82)	72.1 (178)
Fiber and colon health	10.0 (11)	13.8 (34)	Vitamin E	14.5 (16)	1.2 (3)
Protein and sport	6.4 (7)	0	Lutein	5.5 (6)	0
Single Nutrient Other Supplements			Most Frequently Used Herbals		
Magnesium	18.2 (20)	1.2 (3)	CoenzymeQ10	12.7 (14)	1.6 (4)
Potassium	9.1 (10)	29.9 (74)	Melatonin	8.2 (9)	5.3 (13)
Zinc	5.5 (6)	1.2 (3)	Cranberry	5.5 (6)	4.5 (11)
Selenium	3.6 (4)	0	Garlic	4.5 (5)	0
Iron	2.7 (3)	23.1 (58)	Turmeric	4.5 (5)	0.4 (1)
Chromium	1.8 (2)	0	Cinnamon	3.6 (4)	0

Note ILW are Independent living women (N= 110), Nursing Home are individuals in long term care facility (N=247)
* % = n/N
[a]Also includes House Nutritional Supplements given to nursing home residents

Chapter Summary

This chapter presented the results in two manuscripts; the first manuscript reported the results of the research questions focused on VMS prevalence, vitamin D and variables of interest and the second presented the results of the research hypothesis. The comparison of VMS use between long term care residents and community dwelling residents was described and will be

discussed in Chapter 5.

A higher number of older women are taking VMS than has been reported previously. Vitamin D is the most common VMS taken and there is a small percentage who are taking vitamin D over the Tolerable Upper Intake Level. A wide variety of reasons were given for use of vitamin D. Three variables were found to have an impact on VMS use: educational level, past prior use, and expectations regarding aging. Surprisingly age, comorbidity and self-efficacy were not found to be well correlated or significant in relation to VMS use. Further research is suggested that will examine additional potential predictors of VMS use and further theoretical development of the model.

Chapter 5

Overview

This chapter presents a summary of the studies major findings and a discussion of the differences in VMS use between nursing home residents and independent living older women. Proposed implications for VMS use are offered. Potential goals for public health policies are presented. Strengths and limitations of the study are reviewed followed by recommendations for future research.

Background

There are a host of historical factors which corroborate the need for continued VMS research. VMS are not regulated as prescription medications. Contents of supplement products are not uniform regarding dosage or ingredients and have been found to be adulterated. The FDA has vast enforcement challenges. The side effects of VMS are not thoroughly studied nor are VMS tested before marketed and sold. The potential actions and burdens of VMS on organs are not clearly understood. Liver injury from VMS use is increasing and is more severe with outcomes such as liver transplantation and death (Navarro et al., 2014). Dietary supplements are used for many purposes, proven and unproven. The use of VMS among older adults has been steadily increasing over the last 40 years (Bailey et al., 2011). The elderly adults are taking more VMS than in the past (Timbo et al., 2006).

Vitamin D is the supplement of interest in this research study. Vitamin D deficiency is thought to be prevalent due to inadequate sun exposure, inadequate dietary sources, malabsorption and chronic disease. Vitamin D receptors are found in almost every cell in the body. Immune function, cell growth, neuromuscular function and inflammation reduction are impacted by vitamin D. Currently there are many studies regarding the role vitamin D has with

diseases, infections, disorders, cancers and fracture. The concern regarding vitamin D deficiency as well as underconsumption and overconsumption highlights the importance to gather current information regarding use.

The theoretical underpinnings of this study were aging with physiological homeostasis and the HPM (Pender et al., 2015). Each theory complements the premise of the study. First, the physiological changes of aging and aging's impact on physiological homeostasis puts older adults at higher risk for complications or risk from under or overconsumption of VMS. Second, factors not related to medical need may influence VMS use and the HPM helps to explore the use of VMS by older women.

Due to the changes in physiologic homeostasis from aging, older adults are at higher risk from vitamin dosages above the UL. Physiologic homeostasis maintains the body's biological order by balancing metabolic activity and regenerative responses (Wang, Karpac, & Jasper, 2014). Aging causes a widespread loss of homeostasis which can result in damage, inadequate repair of damage or dysregulation of cell number (Boron & Boulpaep). The aging body potentially has difficulty maintaining homeostasis when substances outside the body, such as VMS, are introduced (Wang et al., 2014). Age related changes may alter the pharmacokinetic and pharmacodynamics which increases the risk of adverse events (Castelino, Hilmer, Bajorek, Nishtala, & Chen, 2010; Hamilton, Gallagher, & O'Mahony, 2009).

The HPM provided the structure to explore the factors that predict VMS use. For the current study variables from the HPM were chosen to construct a parsimonious model. This was the first use of HPM focusing on VMS use by older women. Age, education, and comorbidity were measured as control variables. Prior supplement use, ERA, GSE, VMSSE were measured as potential predictors of VMS use. ERA, GSE, and VMSSE are modifiable factors and ERA

has been reported to influence current and future health behaviors. Education level, prior use of VMS, and ERA were found to be significant predictors of VMS use by older women.

Discussion of Research Questions from Survey Results

Research Question One: What is the Prevalence of VMS use Among Older Women?

A majority of older women were taking VMS's. The findings from the survey suggest that vitamin D was the most prevalent supplement taken. About a third were using herbals. There is a vast field of research concerning prevalence of VMS that reaches back over 50 years. Frequently MVMM were found to be the supplement most commonly used (Bailey et al., 2011; Foote et al., 2003; Satia-Abouta et al., 2003; Sebastian et al., 2007). The results of the current study support the literature regarding the expanding use of vitamin D, herbals, and other supplements (Bailey et al., 2011; Gahche et al., 2011; Radimer et al., 2004). There was a small number of women who took up to 16 VMS products. The use of multiple VMS in the older population raises the risk of drug interactions. This study offers current prevalence use of VMS by older women from the community and CCRC's and the results demonstrate the reported use does vary in type and amount of VMS reported from earlier studies.

Research Question Two: What are Older Women's Levels of General Self-efficacy and Expectations of Aging?

General self-efficacy influences how older adults think, feel and act (Scholz et al., 2002). Low GSE has been associated with helplessness, pessimistic thoughts regarding accomplishment, and depression. High GSE has been associated with decision making, optimism and achievement (Scholz et al., 2002). The mean GSE of the sample (33.1, *SD* = 4.6) was higher than means reported by Scholz et al. (2002) who sampled 19,120 persons from 25 different countries (*M* = 29.5, *SD* = 5.32). GSE has been studied in relation to many constructs

but only one other study has tested GSE and supplement use. Gacek (2016) looked at GSE and use of dietary supplements in Polish athletes (M = 31.3, SD = 3.2). Athletes with lower GSE used MV supplements significantly more often (Gacek, 2016). In the current study, older women with lower GSE did not take differing amounts of VMS. However, this study did not look at individual VMS in relation to GSE as Gacek did in the study of athletes (2016). GSE may be a valuable construct in the study of different populations than that represented by the sample.

This may be the first study to measure ERA in regard to VMS use by older women. It is important to understand older women's perceptions of their aging because of the impact those perceptions have on health care behaviors. Older women with lower expectations of aging used more VMS. Older women's expectations of aging may affect how they perceive their health potential and impact health care prevention and promotion practices.

In this sample, there was a wide difference in the ERA subscales, lowest for physical health and highest for mental health. The participants had very high mental health subscale score which shows a majority did not feel it was true that: they would spend less time with friends and family, being lonely was something that happens as you get old, that quality of life declines as people age, and it is normal to be depressed when you are old. Similar patterns with physical health subscale lowest and highest for mental health subscale was seen in other studies. Davis, Bond, Howard and Sarkisian (2011) found the ERA subscales for primary care clinicians (age M = 48.6, SD = 11.6, age range in years = 23-87) followed the same pattern. A study including middle-aged and older adults also found the same pattern (Meisner & Baker, 2013). Weltzien (2007) also found that expectations of young, middle-aged and older women were lower for physical health than mental health also which is similar to the results of the current study.

There has been a challenge to ageism over the past 30 years in the population (Palmore, 2005) and idea of successful aging may be changing people's expectations of aging. Davis et al. (2011) suggest there may be a cohort effect for ERA. Weltzien (2007) looked at aging expectations and health behaviors and found older women had less positive future health expectations and lower expectations for physical health than young and middle-aged women. A generation's exposure of life experience, media, new research on aging, and changes in image and perception of aging may influence the levels of ERA. Expectations of aging may differ from one generation to another.

Research Question Three: Is Higher Age Associated with Increased Number of Supplements Taken?

In this study, a significant relationship between age and an increase in the number of supplements taken was not found. In studies with a wider range of age an increase in VMS use was found (Foote et al., 2003; Kennedy, 2005; Miller et al., 2008). While not significant, the Spearman rank order correlation (r_s = -.07, p = .49) reported a negative correlation between age and VMS suggesting that for this sample as age increased there was a non-significant slight decrease in VMS use. The current study may not be representative of the population. The results of this study were different from the studies reported VMS use increasing with age (Foote et al., 2003; Kennedy, 2005; Miller et al., 2008). There is limited research on VMS use by the oldest segment of the population however it has been reported that as people enter hospice they are taking a wide variety of VMS (Holmes, Kaiser, Jackson, & McPherson, 2010). Use of VMS by the oldest adults in the study may differ by type of VMS used from the youngest in the sample, this study did not examine patterns of use by ages. The current study only included women living in CCRC's or the community setting.

Research Question Four: Do Women with Higher and Lower Levels of Education Differ in Their Supplement Use?

The participants were asked to choose the highest level of schooling they completed from 6 levels of education. The answers were dichotomized into high school or less and greater than high school education. The women with a high school or less education took fewer VMS than the women with a college education. The findings from the study suggest that education does contribute to VMS use in older women. The research on VMS has included education frequently and the results are consistent with other studies. This is also one of the factors that is sometimes included in the inverse supplement hypothesis, that VMS users tend to have higher dietary nutrient intakes, report themselves as healthy, have higher incomes and higher education than VMS non-users (Braun & Venter, 2008; Kirk et al., 1999; Kofoed et al., 2015; Sebastian et al., 2007).

Research Question Five: Do Older Women with High, Medium and Low Levels of Comorbid Conditions Differ in their Supplement Use?

There are a burgeoning number of studies regarding VMS and different disease categories. To measure comorbidity the Self-Administered Comorbidity Questionnaire (SCQ) was used which allowed for a total of 15 comorbid conditions. The problems the SCQ included were heart disease, high blood pressure, lung disease, diabetes, ulcer or stomach disease, kidney disease, liver disease, anemia or other blood disease, cancer, depression, back pain, and arthritis (osteoarthritis, degenerative arthritis or rheumatoid arthritis) with three additional medical conditions that could be written in. In this study, there was no significant difference in the level of supplement use between women with low medium or high levels of comorbid conditions. When each comorbid condition was examined separately with VMS use two did differ in

supplement use; high blood pressure and heart disease. The participants with high blood pressure or heart disease took less VMS than those without the conditions. It was not the purpose of this study to examine the types of supplements taken associated with each reported comorbidity, and the participants were not asked why each supplement was being taken. There is extensive and ongoing research on VMS use with heart disease and cancer.

Research Question Six: What Percentage of Older Women are Taking Vitamin D at and Above the Tolerable Upper Intake Level?

At this time, there are 301 current clinical Trials ongoing and over 3,000 studies are found for vitamin D on the registry and results database of clinical studies. Vitamin D is a topic of interest to many adults. About three-fourths of the independent living older women in the current study were taking vitamin D. There were 7 % of the participants who were taking vitamin D at the UL or above, 3 % were at the UL and 4% were above the UL. Of the 4 % (n = 4) who were above the UL, two were following their health care professional's advice for low blood levels, one reported taking it for her bone health but her doctor did not prescribe it, and the fourth women did not answer the questions. The results are in alignment with other research regarding use of VMS over UL, that a small segment does take vitamin D in amounts over the UL. The Office of Dietary Supplements leads and sponsors efforts which include assessment of vitamin D status (Bailey et al., 2010). There are health risks from excessive vitamin D, the calcium levels can increase in the blood leading to damage to heart, kidney and blood vessels (NIH, Office of Dietary Supplements, 2016). There is emerging information that use of vitamin D at high levels may over time cause adverse health effects. There is a need for research in the use of vitamin D over UL and long-term use.

Research Question Seven: Are Older Women Cognizant of Their Vitamin D Dosage?

About a third of the participants who were taking vitamin D were not able to list amount of vitamin D dose and reported they did not know the dose they were taking. Even when participants were unable to report their dose of vitamin D, two-third replied they felt confident they could list their supplements including the doses and schedule. The question on confidence came later in the survey. Perception of confidence did not align with knowledge of dosage regarding vitamin D. Health care professionals should be aware that confidence in regarding supplement use reported by a client may not equate to accurate knowledge.

The dosage of vitamin D was only for the vitamin D supplement alone and did not include vitamin D found in other supplements or in the diet. Total dosage of vitamin D was not accounted for by the survey. Bailey et al. (2010) estimated vitamin D intake from dietary sources and dietary supplements, females and males over 70 years old had lowest prevalence of meeting the adequate intake and dietary supplements helped to meet adequate intake of vitamin D. With the increasing numbers of women taking VMS and the higher dosages available, an estimate of total vitamin D intake from food, water, and VMS would aid in monitoring total nutrient intake.

Discussion of Results Regarding Hypothesis and Proposed Model

Several of the variables were not well correlated with VMS use, did not add to the model and were not included in the final multiple regression; age, SCQ, GSE, and VMSSE. The age range may not have been great enough to show differences as most of the participants had used or were currently using a supplement. The SCQ was chosen as the instrument included the impact of treatment and function, however comorbidity was not found to impact amount of VMS use. This may be that VMS are used for preventative reasons as well as treatment. Women with

low comorbidity may have been taking VMS to maintain health, while those with higher comorbidity levels may have been taking VMS to treat their illness. There is a growing number of studies regarding VMS use for specific disease and chronic health issues. It may be helpful to identify why each VMS is being taken and allowing for investigation regarding VMS use and specific health issues. VMS use was not significantly correlated with GSE or VMSE. This may be due in part as the majority of the sample had been using VMS frequently over the course of their life and GSE may have greater impact on early adoption of the behavior and less on maintenance of VMS use.

Education and prior use are significant predictors of VMS use. As the education level increases the amount of VMS used also increases. Other studies have also found that education level to be associated with supplement use. Prior use has direct and indirect effects on current health behaviors and is frequently found to be significant variable for predicting health behaviors with the health promotion model (Pender, 2002). A majority of the women who participated in the survey had used VMS in the past and many of them were frequent users of VMS. Prior use has the greatest impact on VMS use in the current study.

The expectations of aging on the use of VMS was a significant predictor. Expectations of aging negatively predicted VMS use, the lower the expectations of aging the higher the VMS use. A study found older adults with higher ERA scores practiced more preventative health behaviors and those with lower ERA scores practiced less (Sarkisian et al., 2003). There may be a practical difference in health behaviors studied. While studies have found for some health behaviors that a higher ERA leads to higher behaviors this may not relate to other types of health behaviors. Each health behavior needs to be studied to see the effect of ERA. Taking a supplement may also be easier for an older adult to do than starting a lifestyle change such as

exercise and healthy eating.

Discussion of Nursing Home and Community Older Women's Use of VMS

The women living in the community or CCRC's (independent living women) and adults in the three nursing homes lived in the same geographic area. The data from the nursing homes were gathered 2 years prior to the survey for the independent living women. The independent living women and adults in the nursing homes have similar use of vitamin D, 75 % and 72 % respectively; and similar VMS total use, 92 % and 94 % respectively.

Both nursing home residents and independent living women were taking dosages above the RDA for vitamin D. Thirty-nine percent of independent living women took more than RDA but less than UL (Tolerable Upper Intake Level), and 7 % who were at UL or above. For the nursing home residents 62% (n = 154) were prescribed dosages of Vitamin D above the RDA. The research suggests that nursing home residents may be at high risk for vitamin D deficiency due to lack of sun exposure, age, obesity, and high number of chronic conditions and more may be on a high dose of vitamin D for treatment. The secondary analysis did not have access to diagnosis or laboratory results of vitamin D screening.

There was higher use of herbals in both variety and numbers by the independent living women than in the nursing home setting. The medication reconciliation process used with admission to nursing homes may be a screening point and may limit the types of supplements. In this dissertation only 3 nursing homes were included in the secondary analysis and while there were differences in amount of vitamin D prescribed between the nursing homes there were only 5 herbals on the Medication Administration Records from the 3 facilities. The five herbal supplements nursing home residents were taking were coenzyme Q-10, melatonin, cranberry, turmeric, and ginger. The residents may have been taking herbals that family brought in and that

was not captured in the secondary analysis. The results of number and types of herbal prescribed may reflect the attitudes and beliefs regarding VMS use of the prescriber. The prescriber attitudes and beliefs regarding VMS use may differ across the United States. The prescription of herbals may also be due to new research regarding specific supplements. Family members may request the primary health care provider to prescribe herbal remedies.

The higher use of potassium and iron by nursing home residents may be a result of treatment. Also, the probiotic use was higher in nursing home residents, this may be due to possible nursing home prescribers ordering probiotics to be started with an antibiotic. The use of VMS by nursing home residents demonstrates the impact others have on VMS use. With entry into long term care the health care provider may have a significant impact on VMS use. The current study did find differences between facilities with one supplement, there may differences found in other regions and types of facilities in prescription of VMS.

Strengths of Study

This was an original study to examine how expectations of aging and other factors influence the use of VMS by older women. The study also examined current vitamin D dosage and reasons for use along with prevalence of VMS use. The results provided new and critically needed information. Prevalence studies of VMS use are periodically needed to determine current use patterns and inform health care professionals of contemporary trends. This is especially key for health care professionals with older adult clients.

A theoretical framework such as the health promotion model plays an important role in guiding the research study. The health promotion model has been shown in previous studies to merit use for health behavior research with older adults and identification of modifiable factors for intervention development (Pender et al., 2011; Pender et al., 2015). The literature review and

the theoretical framework guided identification of pertinent variables and suggest relationships between the variables to examine VMS use. Using the health promotion model relationships between variables were explained and prediction of relationships was possible. Having a theoretical framework provided a basis for hypothesis formulation and development of the research questions for the current study.

Quantitative methods allowed for objective measurements and the statistical analysis of data collected by survey. A priori power analysis is a best practice to determine sample size and is an ethical consideration (Hayat, 2013). For this study, it was important to have enough participants to ensure with a high degree of certainty that the statistical analyses results were accurate. The a priori power analysis also has an ethical consideration to prevent additional older adults being included needlessly.

The cross-sectional design is an economic and practical design. The cross-sectional design limits effort needed to find and follow up with the older participants. Another strength was incorporating older women from CCRC who are not included in national studies on VMS.

The methodology used to gather the data was a survey. The survey was an effective means to collect self-report information for the variables of ERA, GSE, VMSSE, prior use, SCQ, and current VMS use along with the demographic variables. The definitions of supplement use, prior supplement use, age, and education are fully supported and the concepts are simple, clearly and specifically defined and easily understood. The measurement tools ERA, GSE and SCQ are well-established and have been used in studies.

It is difficult to gather accurate and reliable VMS data. The method to gather the data for the outcome measure and provide the sum for total VMS use was reported in the literature and similar methods have been used with other studies. This method uses more than one question to

gather the data on VMS and reduces the chance that VMS would not be reported by the participants. The outcome measure provides a sum of total VMS use that provides clear and easily understood value of how many types of VMS are being used.

A codebook was part of the methodology for the study. The codebook was used to document decisions regarding data and to collect or track unusual or unexpected data during the study. Several participants wrote in comments on the survey, the codebook allowed for documented of the unexpected data. The codebook allows for another researcher to be able to replicate the results of the study. The codebook also assists the primary researcher to track decision points and retain fidelity.

Limitations of Study

There were several limitations of the study. Convenience sampling was used in this study which limits generalizability. The sample, women 65 years and older, for the study was not representative of national ethnic, racial, or gender groups. The primary researcher explored including the Spanish and Asian community sites however it was beyond the scope of the study. The need for translators and translation of survey and instruments was a barrier for the current study to include older ethnic minorities.

There were some limitations to design and timing of the study. A cross-sectional design that collected data at one point in time for each participant was used in this study. The cross-sectional design does not allow the identification of causal or predictive relationships. The data collection took place over winter months in the north central United States. Data collection over a longer period would potentially reflect additional VMS that are used seasonally. Future studies would allow for examination of VMS use over time and in different regions of the country.

The settings where the study took place may also be problematic. The community

settings included senior dining sites. Older adults who attend senior dining sites may be more aware of and interested in nutrition. Older women who attend senior dining sites may also take different types or different amounts of VMS than women who do not attend senior dining sites. Another factor regarding the setting is the women who filled out the survey were mobile enough to come to the site where the survey was given. Women with barriers to mobility may have different VMS use patterns.

The survey was limited to the length and number of questions to avoid fatigue and burden on participant. The most pertinent variables were identified by literature review to provide a parsimonious model. There are additional variables in the HPM that were not included in the survey and the revised proposed model reflects the need for continued research.

The structured survey used for quantitative research methods has close ended questions. The close ended questions limit the responses by the participants, there may be responses not represented by the options. This was true for some of the participant as several wrote in additional comments to some of the close ended questions. The results of close-ended questions cannot represent the totality of possible participant responses.

There were five participants who wrote additional comments on the survey; three on ERA and two on GSE. The comments on ERA were: "*expectation of aging was not be a burden on family*" (at the top of the page), and the second response "*having pain **shouldn't be** an expected part of aging"*, and the third wrote in "*some parts of the body wear out"*. On GSE one individual wrote in that her "*faith helps"* her and that she remains calm with "*meditative choices*". Another participant wrote in GSE that when someone opposes her she doesn't *"let this bother me, I usually get what I want whether today or a month from now so why bother*". Open ended questions and open space for feedback does provide richer response, however using

established instruments with close ended questions does not allow for the richness of individual feedback.

The study may have suffered from a "Hawthorne effect" simply by the researcher being present. The Hawthorne effect suggests that individuals are aware of their participating in a study and modify their behavior to their perception of what the researcher is seeking. Several potential participants did ask if the survey was just for people who took supplements. This could drastically impact the findings. While the researcher used a set introduction speech for all sites and all were asked to participate the question still arose with a few potential participants.

The constructs of expectations of aging and self-efficacy were considered separate constructs however there may have been some overlap. There was a significant weak relationship ($r = .38$, $p < .001$) between the variables of interest GSE and ERA in this study. This result suggests the possibility that the two instruments are measuring similar factors that are present in expectations of aging and general self-efficacy.

The total types of VMS and amount of vitamin D taken per day were difficult to capture. Many VMS had multiple ingredients which were not captured by the categories. The coding of the VMS especially the herbals was by the major ingredient. Vitamin D was an ingredient in many supplements not only for supplements labeled as vitamin D. This impacts the accuracy of the total vitamin D dosage accuracy.

Recommendations

Implications for Practice

This study supports previous findings that the majority of older adults are using a wide variety of VMS and taking differing amounts. Health care professionals play an important role in supporting successful aging and primary, secondary and tertiary preventive health care.

Health care professionals can assist older women in managing their VMS. Health care professionals and food and nutritional professionals should be aware of VMS use by clients regarding amount and type of VMS use, use in relation to RDA, and potential drug interactions. Studies have shown a low disclosure rate of herbal supplements (Eisenberg et al., 1998; Gardiner et al., 2006; Holmes et al., 2010). Improving disclosure of VMS to health care providers is an important goal. A standardized procedure for health care providers regarding communication, assessment, teaching, and documentation could help identify VMS use and encourage disclosure of VMS use. Implications for practice include having; guidelines for communication and documentation of all VMS use, guidelines for evidence based recommendations for use, guidelines for screening of vitamin D, and evidence-based guidelines for treatment.

This study also supports previous findings of possible overconsumption, a small percentage of older women are using vitamin D over the UL. If there is high VMS use, health care professionals should be aware of the increased potential for drug-nutrient interactions and potential for toxicity. Health care professionals and food and nutritional professionals should be alerted to assess for overuse of specific nutrients. Vitamin disorders are usually masked by current chronic disease (Joshi, 2015). Direct care health professionals need to be aware of guidelines for assessment of vitamin deficiency and toxicity to distinguish if VMS use is impacting current health.

An unexpected finding that is of interest to health care providers are the small percentage of older women who are not taking the supplement their health care provider suggested. Identification of nonadherence may be difficult but valuable. Many factors are involved in nonadherence and intentional non-adherence (Hughes, 2004). Identification of nonadherence allows an opportunity to identify barriers and engage in participatory decision making. Non-

adherence may result in poor outcomes which is a greater risk in the elderly (Hughes, 2004).

VMS should be examined for underconsumption and overconsumption. Up to date knowledge of what the VMS the media and family are encouraging older adults to take would be helpful. Current guidelines and evidence based information of the benefits or risks of VMS can help guide practice. It is also important to communicate with clients and clarify if client's perception of benefits and risk align with health care providers.

Health care professionals need to understand older women's expectations regarding aging in relation to different health promoting behaviors. For VMS use, older women with lower ERA may be taking more VMS. Expectations of aging is modifiable and interventions to improve expectations of aging can be developed. Kim (2009) suggests that any interventions to improve expectations regarding aging should be linked with the health promoting behavior desired to change. There is a consideration regarding interventions to modify expectations of aging. If the person's expectation of aging is low but is realistic due to personal health history and current diagnosis than an intervention to improve expectation of aging would not be desirable.

Suggestions for Policy Avenues

While this dissertation did not focus or study health care policy or regulation a majority of older women were using vitamins, minerals and herbal supplements. This may suggest that future policy and regulations focus on protecting the safety and health of older adults. Several health policies are suggested to ensure and support the health of older adults. Policy changes over time and modifications at the Federal level could improve monitoring for supplement safety. Several suggestions are also provided for the health care professional such as acting as an advocate and adopting evidence based practice when sufficient evidence is available.

The Dietary Supplement Health and Education Act of 1994 allows for supplements to be

marketed and sold without premarketing approval and testing. Anything labeled as a supplement is only removed after harm has been caused and the supplement identified. There have been several tragic cases that have caused organ failure or death. Both the very old and very young are being prescribed and taking probiotics. The Centers for Disease Control and Prevention (CDC) put out a CDC Health Advisory in 2014 regarding an infant death from a supplement (probiotic powder) used in the hospital (Vallabhaneni et al., 2015). The probiotic was contaminated by a fungus and the infant died from a rare fungal infection to the entire bowel. When an older adult is prescribed an antibiotic with an illness it is not unusual to also take or be prescribed a probiotic. Regulation of VMS for purity, cleanliness, and adulteration needs to be seriously considered. Health care professionals need to become aware of the issues surrounding VMS use and advocate when and where health professionals can have an impact. Being willing to speak to State and Federal representatives regarding issues surrounding VMS is one area to advocate.

Health care professionals can remain informed on the current recommendations, recommendations in progress and information for health professionals provided by the U.S. Preventions Services Task Force and other literature. There is a need for consensus regarding vitamin D guidelines. Different guidelines are used to report vitamin D deficiency or sufficiency levels (Hossein-nezhad & Holick, 2013). The different 'ideal' vitamin D levels lends to controversy regarding dosage, use and scope of vitamin D deficiency in the United States (Holick, 2005; Holick & Chen, 2008; Pludowski et al., 2017; Shah & Gupta, 2015). Different studies regarding vitamin D deficiency have used different cutoff levels for the definition of deficiency resulting in different results (Shah & Gupta, 2015). Wijnen, Salemink, Roovers, Taekema and de Boer (2015) suggest that some current guidelines for supplementation doses are

too low for frail older adults with vitamin D deficiency. While current evidence suggests that most adults, particularly those with limited sun exposure, require a vitamin D supplement, controversy regarding recommended dosing and the potential benefits of vitamin D abound. The U.S. Preventive Services Task Force Final Research Plan for vitamin D, calcium or combine supplementation is seeking answers to some of these questions regarding dose response and harm in relation to fractures (U.S. Preventive Services Task Force, 2016). Additional research is needed to resolve the controversies.

A policy for the local level is to ensure that evidence based guidelines are in place for care of older adults. The U.S. Preventive Services Task Force guidelines and the Endocrine Society guidelines recommend routine screening only for those at risk of vitamin deficiency (Chung, Lee, Terasawa, Lau, & Trikalinos, 2011; Holick, et al., 2011; Pfotenhauer & Shubrook, 2017). The U.S. Preventive Services Task Force and the Endocrine Society also provide guidelines on screening, disease states and treatment recommendations (Chung, Lee, Terasawa, Lau, & Trikalinos, 2011; Holick, et al., 2011). The Institute of Medicine recommends the RDA for adults 51-70 years for vitamin D is 600 IU and for adults over 70 years the RDA is 800 IU (NIH, Office of Dietary Supplements, 2016). Health care professionals are the gatekeepers of medication reconciliation and follow up. Health care professionals can help older adults ensure the dosages and type of VMS are appropriate.

Health care professionals should consider the overall physical health and potential side effects when recommending VMS. The CDC recommendation, published after an infant died from a contaminated probiotic, stated that physicians should consider that the FDA does not regulate supplements as drugs when they consider the use of any dietary supplement (Vallabhaneni et al., 2015). For vitamin D, further evidence is needed to establish the claims of

benefit and before recommending for use that is not established (Pfotenhauer & Shubrook, 2017).

Implications for Future Research

There appear to be differences in supplement use between findings reported in the literature and the findings from the secondary analysis of the long-term care residents. Future research of supplement use by institutionalized adults in a variety of settings is needed and research on differences between health care providers prescriptive practices is warranted. There is a need to understand how supplement use changes over illness trajectories and transitions between community dwelling, acute care, long-term care settings, and hospice. The secondary analysis found differences in VMS use between nursing homes. The interaction between primary care providers motivations, older adult's perceptions and desires to take VMS and influences from family and friends may provide important explanations for the costly and potentially unsafe use of many products.

Future research is required to identify safety and benefits of VMS products and determine suitable dosages for specific uses and patient profiles. A small percentage of adults are using dosages of vitamin D over the Tolerable Upper Intake Level. Additional studies are needed to examine self-medication of vitamin D above the Tolerable Upper Intake Level including what influences older adults to use at or above the Tolerable Upper Intake Level. The Dietary Guidelines Advisory Committee (2015) suggests more information is needed regarding overconsumption of vitamin D and rationale for and consequences of using high dose supplements. Research is needed to monitor the effectiveness, side effects, toxicity, and impact on health (Cassileth et al., 2009). Qualitative research with older adults who take multiple VMS may identify reasons for overuse that could be explored in subsequent quantitative research. The

current study provided some initial information regarding vitamin D dosage in older women, further research is needed.

Further longitudinal studies are indicated to demonstrate cause and effect relationships between factors that influence and actual use of VMS. Future studies should explore constructs that were not measured in this study that might explain variation in VMS use. Comorbidity score did not have a significant impact on VMS use in this study, however the health conditions heart disease and high blood pressure had significant impact on amount of VMS. Other health conditions may be warranted for further study such as malnutrition or undernutrition. The lack of proper nutrition or an undersupply of nutrients has been linked to decreased quality of life, prolonged hospital stays, and increased morbidity and mortality (Kyle & Coss-Bu, 2010). Using an instrument like the Mini Nutritional Assessment would help to indicate nutritional status (DiMaria-Ghalili & Guenter, 2008). Nutritional status and other health conditions associated with VMS use are indicated for further research.

A revised model is offered for further research regarding VMS use. It would be valuable to continue research regarding use of VMS using the HPM as the theoretical framework. Further longitudinal research to examine if ERA does decrease with age as has been suggested by some studies (Kim, 2009, Sarkisian, Hays, & Mangione, 2002a; Sarkisian, Steers et al., 2005b). In these studies, older participants had lower scores. Increasing age with the advent of health difficulties and the experiences of loss of family and friends may cause a lower ERA (Sarkisian, Hays, & Mangione, 2002a; Sarkisian, Steers et al., 2005b). A longitudinal study would allow examination of the relationship between ERA and VMS, does a change in ERA cause a change in VMS use. Davis et al. (2011) found a difference in ERA between men and women primary care clinicians, with women having higher ERA than men while the women in the study tended

to be younger on average.

Future research needs to examine how factors such as interpersonal influences such as family, friends, health care professionals and the media may influence ERA and VMS use. The current study had barriers which prevented the inclusion of non-English speaking ethnic minorities. These ethnic groups use VMS and future research should include non-English speaking minorities. Men should be included in future research.

Longitudinal data from larger and more diverse populations would enhance the ability to understand the role of the variables and identify other variables that predict the use of VMS over time. Research on potential public health policies regarding VMS safety and policy guidelines for use are needed to protect the health of older adults. With soaring health care costs, research of the fiscal impact of improper VMS use is also warranted.

Conclusion

The HPM is a theory that is suitable for research of VMS use and the development of interventions (Pender et al., 2015). Prior use, expectations of aging, and education contribute to VMS use by older women. A majority of older independent living women and nursing home residents were taking a variety of VMS. Vitamin D was the most commonly taken supplement by nursing home residents and independent living women. More independent living women used herbal supplements and used a wider variety than residents in nursing homes. The was a difference found in prescription of supplements between the three nursing homes. A small percentage of independent living women were using vitamin D at or over the UL. Further research is warranted to examine other variables that influence the use of VMS by older adults.

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Appendix A: Classification System for Dietary Supplement Categories

Major Categories

Category	Definition	Examples
Multi-vitamin, multi-mineral (MVMM)	3 or more vitamins and 1 or more mineral	Centrum Silver
Multi-vitamin (MV)	2 or more vitamins and no minerals and was not considered a MVMM	B-complex
Multi-mineral (MM)	2 or more minerals, no vitamins, not considered a MVMM, and calcium was not primary ingredient	Magnesium and Zinc
Herbals	Botanical ingredient, such as melatonin and coenzyme Q-10.	Cranberry, Melatonin

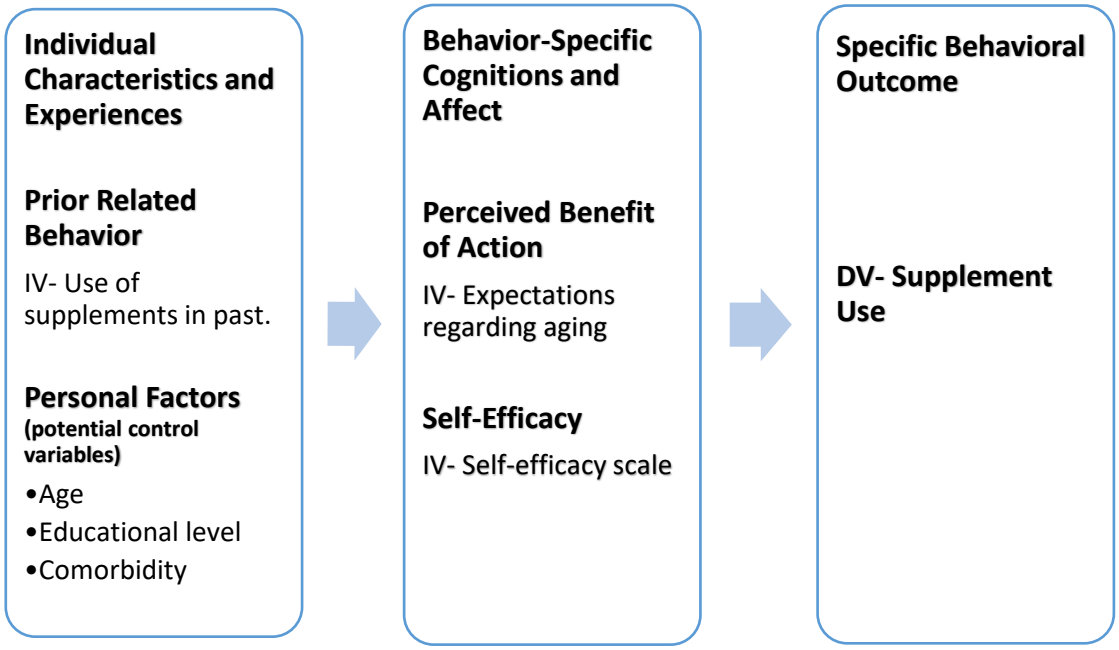
Minor Categories

Category	Definition	Examples
Fatty acids	Omega-3 or fatty acids as primary ingredient	Fish oil, flax seed
Calcium—containing	Calcium as the primary ingredient, with or without other minerals or vitamins; not part of a MVMM. This contains antacid products if calcium is the primary ingredient.	Calcium, calcium and vitamin D,
Joint Supplements	Glucosamine, chondroitin or a	Glucosamine and/or

	combination	chondroitin,
Protein and sports	Protein, amino-acids, or intended to enhance athletic performance.	Creatine, Lysine,
Fiber and colon health	Fiber as primary ingredient or laxative in name. Probiotics are classified in this group	Psyllium
	Other	
Single nutrient supplements	Single nutrient supplement products not included in other categories	Vitamin A, vitamin E, iron, magnesium, vitamin D

(Bailey et al., 2013 © American Medical Association.)

Appendix B: Theoretical Framework for the Study



IV = Independent Variable
DV = Dependent Variable

Appendix C: Permission for Use of Self-Administered Comorbidity Questionnaire

(Dr. Katz has given permission via email received on March 3, 2016, see below.)

Permission granted, Barbara. Please simply cite the paper of Sangha et al in work that uses the instrument.

Wishing you every success on the project,

Jeff

Jeffrey N. Katz, MD, MSc

Professor of Medicine and Orthopedic Surgery, Harvard Medical School

Clement B. Sledge and Thomas S. Thornhill Chair in Orthopedic Surgery

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Appendix D: Materials for Recruitment

Flyer

Women over 65

Research Study Survey about

Vitamins, Mineral, and Herbal Supplements

Next Week _____

Time _____

Bring your vitamins, mineral and herbal supplements with you!

Questions? Call

Barb Hekel 309-472-1679

Reminder Announcement

"I have an announcement for …(date)…….. for the women. You have an opportunity if you are interested to be a part of a research study. The research study will be looking at the use of vitamins, mineral and herbal supplements. A nurse will be coming …(date)…….. with surveys and will be here from ……..to …….time. If you are interested bring in your vitamin, mineral, and herbal supplements to make it easier to fill out the survey. The surveys take 10-45 minutes to complete. The nurse will be here to help answer any questions, and if you need assistance filling out the survey she will help you."

Thank you for being the key contact person. Please feel free to pass out the flyer and if you need more please call me.

Please call me if you have any questions or problems. I will call as we arranged for planning on what days and times work best. Thank you!

Barb Hekel RN

309-472-1679

Information Session Outline

Information Session for

INFLUENCE OF EXPECTATIONS OF AGING ON OLDER WOMENS' USE OF DIETARY SUPPLEMENTS USING THE HEALTH PROMOTION THEORY

SPI will plan with key contact person at each site to determine informational session day and time. Each site will vary determined by site necessities and key contact person's input. For example, at the Church, the informational session will take place at the beginning of the Young at Heart Adult Bible Fellowship. Flyers will be handed out and some left with the key contact person for the class. At senior dining, have discussed with the Director that the informational session could occur on senior dining days at the beginning or end of the time.

SPI will conduct the information sessions. Information session will cover the following information

- A brief overview of the study:

Over 100 million Americans use vitamin, mineral and herbal supplements (Cohen, 2012). The use of vitamin, mineral and herbal supplements is expected to increase due in part to interest in preventative health and maintenance of health. The purpose of the study is to describe what vitamin, mineral and herbal supplements older women use, how much vitamin D is being taken, and if certain factors influence vitamin, mineral and herbal supplement use by older women. These factors include past vitamin, mineral and herbal supplement use, expectations of aging, and self-efficacy.

- Survey and Confidentiality

The information will be gathered by survey. The information will be collected in a manner so the responses cannot be linked back to the person and the information on surveys will

be treated as confidential. This survey will ask you questions about your; past and current vitamin, mineral, and herbal supplement use; medical diagnosis; expectations of aging; belief in ability to use supplements, and background questions. This will take approximately 10 to 45 minutes of your time. If someone with visually impairment would like to participate, I will be happy to read the consent information and if the person wishes to continue will read the survey and mark the indicated responses.

- Eligibility for the study: female, 65 and older, speak and read English, live in independent living setting, no known memory loss, and will to participate in study.
- Give the place, day and time for the survey
- Reminder to bring vitamin, mineral and herbal supplements that they have taken the last 30 days with them to help complete survey
- Answer any questions
- Expect Information Session to be 5-10 minutes' total time.

Information Session Handout

University of Wisconsin – Milwaukee

Study Title: INFLUENCE OF EXPECTATIONS OF AGING ON OLDER WOMENS'USE OF DIETARY SUPPLEMENTS USING THE HEALTH PROMOTION THEORY

Hello, my name is Barb Hekel. I am a PhD student at the University of Wisconsin at Milwaukee. I am a nurse and returned to school to become a nursing professor. I am working on my doctoral thesis and I am studying supplement usage and gerontology, the study of aging.

Did you know over 100 million Americans use supplements and some of you may take a supplement or know someone who does. People take supplements for a wide variety of reasons and the most common are to improve or maintain health. I am interested in studying supplement use by older adults. There are questions about what supplements people take and what factors influence supplement use.

I am requesting your assistance. In order to complete my research, I'd like to get some information from you. I have a survey that will ask you some questions about your use of supplements. **Site** was chosen to participate in this research study. Your answers in the survey will provide information on what supplements you are taking and how your use of supplements, your own abilities, and your beliefs on aging impacts supplement use. Your responses are very important as well as completeness and accuracy.

The purpose of this survey is to ask what vitamin, mineral, and herbal supplements you use, how many of you take vitamin D and how much, and about things that may impact your use of supplements. The things that may impact your supplement use that are on this survey are; past use of supplements, how you feel about aging, and your belief in your own ability which is called self-efficacy to use supplements. I am looking for women to fill out the survey. The

women need to be willing to read the consent form, speak English, live at home or an apartment, be 65 years or older, and have no memory problems. Again it is really important that the survey is completely filled out and it will take between 10 and 45 minutes. I will be here _DATE and TIME_____ and you can bring in the supplements you are taking to help fill out the survey.

The survey does not ask for any information that would identify you. The survey is unsigned and confidential. The survey has been approved by the University of Wisconsin's Human Research Protection Program Institute Review Board. The survey asks some background questions such as medical diagnosis and education level. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin Milwaukee. This survey is voluntary.

Thank you very much.

Appendix E: Consent to Participate in Survey Research

University of Wisconsin – Milwaukee

Study Title: INFLUENCE OF EXPECTATIONS OF AGING ON OLDER WOMENS'USE OF DIETARY SUPPLEMENTS USING THE HEALTH PROMOTION THEORY

Person Responsible for Research: PI-Dr. Christine Kovach: SPI- Barbara E. Hekel

Study Description: The purpose of this research study is to study what vitamin, mineral, and herbal supplements are being taken and also specific factors which influence the use of these supplements. These factors include past vitamin, mineral and herbal supplement use, expectations of aging, and self-efficacy. Approximately100 women will participate in this study. If you agree to participate, you will be asked to complete a survey. This survey will ask you questions about your; past and current vitamin, mineral, and herbal supplement use; medical diagnosis; expectations of aging; belief in ability to use supplements, and background questions. This will take approximately 10 to 45 minutes of your time.

Risks / Benefits: Risks that you may experience from participating are considered minimal. There are no costs for participating. There are no benefits to you other than to further research.

Confidentiality: Identifying information such as medical diagnosis, race, ethnicity, income and age will be collected for research purposes. Your responses will be treated as confidential and all reasonable efforts will be made so that no individual participant will be identified with her answers. The research team will label your information with a number which will have no link to your name. All study results will be reported so that no one viewing the results will ever be able to match you with your responses. Data from this study will be saved on a non-networked, password-protected computer kept in a personal office only used by the Student Primary Investigator. Surveys will be kept in a locked file drawer in the Student Primary Investigator's personal office and destroyed after 5 years. Beyond this study de-identified data will be kept on a statistical software file for potential use in a secondary study or teaching. Only the primary investigator, the student investigator, and doctoral committee will have access to the data from your information. However, the Institutional Review Board at UW-Milwaukee or appropriate federal agencies

like the Office for Human Research Protections may review this study's records.

Voluntary Participation: Your participation in this study is voluntary. You may choose not to take part in this study, or if you decide to take part, you can change your mind later and withdraw from the study. You are free to not answer any questions or withdraw at any time. Your decision will not change any present or future relationships with the University of Wisconsin Milwaukee.

Who do I contact for questions about the study: For more information about the study or study procedures, contact the Primary Investigator Dr. Christine Kovach at (414)708-4454 or ckovach@uwm.edu or the student primary investigator Barbara E. Hekel at (309)472-1679 or behekel@uwm.edu.

Who do I contact for questions about my rights or complaints towards my treatment as a research subject? Contact the UWM IRB at (414)229-3173 or irbinfo@uwm.edu.

Research Subject's Consent to Participate in Research: By completing this survey, you are indicating that you have read the consent form, are female and 65 years or older, have no memory problems, and that you voluntarily agree to participate in this research study.

Appendix F: Curriculum Vitae

Barbara E. Hekel, MS, MPH, RN

Dissertator, University of Wisconsin, Milwaukee

School of Nursing

Education:

Institution			Major Area of Study
University of Wisconsin-Milwaukee	Dissertator	August 2012-present	Gerontology, Nursing Research
University of Illinois at Chicago	Master of Science in Nursing	August 2006	Nursing
University of Illinois at Chicago	Master of Public Health	August 2006	Public Health
University of Iowa	Bachelor of Science Nursing	May 1981	Nursing

Current Research:

Dissertation: Influence of expectations of aging on older women's use of dietary supplements using the health promotion theory.

Dissertation focus:

1) describe prevalence of vitamin, mineral, and herbal use, with vitamin D special interest

2) identify factors, using health promotion model, that influence older women's use of vitamin, mineral and herbal supplements

Licenses/Certification:

Wisconsin licensed Registered Nurse

Illinois licensed Registered Nurse

Graduate Certificate in Applied Gerontology (University of Wisconsin at Milwaukee, Center for Aging and Translational Research, Spring 2015)

Campus Certificate in Teaching/Learning in Nursing and Health Sciences (University of Illinois at Chicago, May 6, 2011)

Clinical Faculty: A New Role (Indiana School of Nursing Office of Life Long Learning, 2010)

Professional Experience:

January 2014 – December 2014: Research Assistant for Dr. Christine Kovach, multi-site gerontological study regarding ineffective and unneeded treatment for nursing home residents. Oversaw training nurses, development of data collection tools, collection of data and coding of data

August 2012 – December 2013: Adjunct Instructor at Alverno College, JoAnn McGrath School of Nursing

October 2009- December 2011: Instructor Methodist College of Nursing, Peoria IL.

April 2007-September 2008: Clinical Supervisor, Kane County Health Department, Aurora IL. Supervised staff in Family Case Management/Women Infant Children, High Risk Infant Follow-up Program, and Health Works Program providing medical case management for children in foster care

August 2003- 2006, MS, MPH:

- Co-wrote grant to decrease Sexually Transmitted Diseases during internship at Heartland Community Health Clinic, a federally qualified health center, funded fifty percent

- Assisted with policy development for lead work group
- Assisted with policy development for food borne illness investigation
- Provided staff education on communicable disease at Peoria City and County Health Department
- Completed a Mobilizing for Action through Planning and Partnerships (MAPP) assessment for Marshall County high risk prenatal population

January 2004-May 2006: Research Assistant, Dr. Kathleen Baldwin. Assisted research phase for new doctoral program (Doctor of Nursing Practice), literature reviews, and writing

January 2001- May 2005: Staff Nurse, Tazewell County Health Department Tremont IL.

Professional Experience (continued):

Utilized organizational, communication, physical assessment, and referral skills while working as a Family Case Manager and in the Women Infant Children Program. Breastfeeding counselor

1994 to 1998 Lived in Japan and Belgium

January1993-May 1994: Staff Nurse, Associated Oral and Maxillofacial Surgeons Peoria IL.

Assisted in office surgery and recovery of patients after surgery

May 1991-May 1994: Industrial/ occupational Health Nurse. On call. Caterpillar, Inc. Peoria IL.

May 1989-September 1989: Urgent Care after-hours clinic nurse. Kaiser Permanente, Vancouver Medical Clinic, Vancouver WA.

February 1984- February 1985: Staff Nurse- float to medical-surgical, post-partum, pediatrics, and nursery. North Trident Regional Medical Center, Charleston S.C.

October 1981- February 1982: Staff Nurse on Neonatal Intensive Care Step down nursery. University of Iowa Hospital and Clinics, Iowa City IA.

May 1981 – October 1981: Staff Nurse on neurological unit. Mercy Hospital, Des Moines IA.

Intellectual Contributions:

Hekel, Barbara. (November 2016). Poster presentation. Supplement use by frail elderly in nursing homes. Sigma Theta Tau, Eta Nu Chapter poster symposium University of Wisconsin-Milwaukee.

Hekel, Barbara. (2016). PhD program category poster presentation. Supplement use by frail elderly in nursing homes. 2016 Midwest Nursing Research Society Annual Research Conference.

Kovach, C. R., & Hekel, B**.** & Rababa, M. (2016). Testing a protocol to stop ineffective drug and non-drug treatments. [Midwest Nursing Research Society Abstract of Distinction]. *Western Journal of Nursing Research, 38*(10), 1395-1396. doi:10.1177/0193945916658206

Kovach, C. R., & Hekel, B**.** & Rababa, M. (2015). Testing a protocol to stop ineffective drug and non-drug treatments. Gerontologist, 55 (Suppl_2) (*283*). doi:10.1093/geront/gnv582.03

Hill, P. D., Aldag, J., Hekel, B., Riner, G., & Bloomfield, P. (2006). Maternal Postpartum Quality of Life Questionnaire. *Journal of Nursing Measurement*, 14(*3*), 205-230.

Courses Taught:

Alverno College, JoAnn McGrath School of Nursing August 2012 – December 2013: Nursing Theory of Healthy Populations

Methodist College of Nursing Fall 2009 – December 2011

Fall 2011 Semester

Clinical Coordinator for Obstetrical Community Clinical Sites

Clinical Instructor for Community OB rotation

Clinical Instructor for Public Health Nursing

Student Advisor

Spring 2011 Semester

N210 Standards in Nursing Practice

Clinical Instructor for Community OB rotations

Clinical Instructor for Public Health Nursing

Student Advisor

Fall 2010 Semester

Clinical Instructor for Community OB rotations

Clinical Instructor for Public Health Nursing Class

N335 Inquiry and Evidence: Knowing: Reasoning, and Evidence

Student Advisor

Spring 2010 Semester

Learning Resource Center lab for Fundamentals class

Clinical Instructor for Fundamentals class

Clinical Instructor for Community OB rotation

Awards/ Affiliations

American Public Health Association

Midwest Nursing Research Society

Sigma Theta Tau International, Eta Nu Chapter

UWM College of Nursing's Milton and Joan Morris PhD Fellowship for 2016 – 2017

April 2012, Methodist College of Nursing Presidents recognition regarding work with Salvation Army

Community Activities:

Volunteer for Breathe at Redeemer Evangelical Free Church, a Special Needs Respite, coordinated the First Aid Office. 2015 to 2016

Volunteer as an usher and in the nursery at Redeemer Evangelical Free Church. September 2013-2017

Awana Leader for 4th and 5th graders at Redeemer Evangelical Free Church. September 2013-2017

Awana Leader for 6th graders at Bethany Community Church September 2009- May 2010

Awana Leader for 6th graders at Bethany Baptist Church, Peoria, September 2005- May 2006

Assistant Band Treasurer, Washington Community High School, 2001-2003

Volunteer Health Education Nurse for 5th and 6th grades for International School of Brussels, Belgium, September 1998-1999

Volunteer with development of screening programs and operated nurses' office post Great Hanshin Earthquake, Canadian Academy School, Kobe, Japan