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## Evaluation of Serum Vitamin D Levels in Older Adults who Fall and Sustain a Fracture: A Retrospective Chart Review

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Suzanne L. Pilon, Student

Dr. Martha Biddle, Advisor

**DNP Practice Inquiry Project Report: Evaluation of Serum Vitamin D Levels in Older Adults  
who Fall and Sustain a Fracture: A Retrospective Chart Review**

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College of Nursing

Spring 2016

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## **Dedication**

I would like to dedicate this practice inquiry project to my husband, Larry, whose love and support contributed greatly to my success of achieving a Doctorate of Nursing Practice. I love him dearly and have been blessed to be his wife for over 26 years. I would like to thank my children, Conrad and Nolan, although they did not always understand what was going on they willingly came along for the journey, and what a journey it has been!

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## **Introduction to Final DNP Practice Project Inquiry**

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## Introduction

Falls are the leading cause of death due to accidental injury among older adults. Individuals aged 65 years or older are at increased risk for experiencing falls (International Osteoporosis Foundation, [IOF], 2015). Ninety percent of hip fractures are caused by falling and less than half of the older adults who survive a hip fracture regain their previous level of functioning (CDC, 2015). Hip fractures are a serious injury often resulting in long term functional impairment, nursing home admission and increased mortality (CDC, 2015). Forty percent of older individuals are unable to walk after sustaining a hip fracture and approximately 60% of these older adults still require assistance with activities of daily living a year later (IOF, 2015). The morbidity rate associated with fractures affects the individual's quality of life by affecting mobility, independence and overall functionality.

Vitamin D has an effect on muscle strength, due to specific vitamin D receptors (VDR) present in human muscle tissue (Barr et al., 2010, Ceglia, 2009, Onder et al., 2008). Vitamin D has been shown to be important in bone metabolism and muscle tissue leading to improved function and performance (Barr et al., 2010, Bischoff-Ferrari et al., 2009, Ceglia, 2009, Murad et al., 2011, Onder et al., 2008, Pfeifer et al., 2009). When vitamin D binds to specific nuclear VDR in muscle tissue it leads to improved muscle composition and performance (Barr et al., 2010, Ceglia, 2009, Onder et al., 2008). Vitamin D increases muscle power, which is the ability of the muscle to generate force as quickly as possible. Increased muscle power leads to improved balance and improved muscle function and strength (Barr et al., 2010, Bischoff-Ferrari et al., 2009, Ceglia, 2009, Murad et al., 2011, Onder et al., 2008, Pfeifer et al., 2009). Vitamin D

supplementation has been shown to reduce type II muscle atrophy in patients with a vitamin D deficiency (Ceglia, 2009, Kalyani et al., 2010).

Vitamin D deficiency is a worldwide problem and is prevalent in the older population (Dawson-Hughes et al., 2010, Girgis, et al., 2013, Knutsen et al., 2014, Lips et al., 2010, Souberbielle et al., 2012). Vitamin D deficiency is associated with skeletal and muscular dysfunction, weakness, pain and can lead to bone loss. Using vitamin D supplementation to reverse this deficiency in the older adult population and improve muscle strength and function may lead to fall prevention and decrease the number of falls and fractures (Dam, VonMuhlen, & Barrett-Connor, 2009, Dawson-Hughes et al., 2010, Girgis et al., 2013, Knutsen et al., 2014, Souberbielle et al., 2012).

Increased morbidity, mortality and negative patient outcomes combined with healthcare costs related to falls/fractures warrant preventative measures. Evaluating serum vitamin D levels in this population may give insight into to the importance of vitamin D supplementation and the possibility of intervening earlier to improve health outcomes and lower healthcare costs.

## **Manuscript 1**

Literature Review: Vitamin D Supplementation as a Fall Prevention Intervention in the Older  
Adult

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## Abstract

The purpose of this study was to review the literature and investigate the use of vitamin D as a fall prevention intervention in the older adult, aged 65 years and older. Fractures as a result of a fall are detrimental for older adults. The mortality rate in individuals aged 65 years and older one year after sustaining a severe fracture as a result from a fall is 25.2%. Key to bone metabolism and muscle function is vitamin D. Supplementation with vitamin D may serve as means to reduce fractures due to falls. By lowering the mortality and morbidity rates associated with fractures in the older population their quality of life could greatly be impacted. The implication of this review would be improved health, function and quality of life for the increased number of older adult population.

# Literature Review: Vitamin D Supplementation as a Fall Prevention Intervention in the Older Adult

## **Background**

The population is growing and aging worldwide. In 2013, the United Nations report, “World Population Aging”, the number of older adults was estimated at 841 million, or four times higher than the population in 1950. Globally, the older adult population is expected to nearly triple by 2020 to approximately two billion people. The advanced practice nurse (APN) is ideally positioned to design interventions that would lead to favorable health outcomes for the aging population. In addition, the APN role is in keeping and advantageous with Healthy People 2020 goals to improve the health, function and quality of life of older adults.

Older adults are at risk for falling due to impaired balance due to increased body sway, diminished muscle mass, low bone density and osteoporosis which are all the result of decreased muscle power (Barr et al., 2010). They are the leading cause of death due to unintentional injury among the older adult who is at increased risk for falls (CDC, 2014). Indeed, a positive predictive relationship exists between falls and aging (International Osteoporosis Foundation, [IOF], 2011). Mortality and morbidity rates are higher among the older adult after sustaining a severe fracture (Coutinho, Bloch, & Coeli, 2012).

The mortality rate one year after sustaining a fracture is 25.2% compared to 4% in older adults without a fracture (Coutinho, Bloch, & Coeli, 2012). Death results from the injury itself or from complications arising from the injury. Less than half of the older adults who survive a hip fracture regain their previous level of functioning (CDC, 2014; International

Osteoporosis Foundation, 2011). The morbidity rate associated with fractures affects the individual's quality of life by affecting mobility, independence and overall functionality.

Ninety percent of hip fractures are due to falls. Falls have been shown to lead to functional impairment and premature nursing home admissions (CDC, 2014). Forty percent of older individuals are unable to walk after sustaining a hip fracture, and approximately 60% of these older adults will require assistance with activities of daily living a year later (IOF, 2011). A large proportion of fall deaths are a result of complications after suffering a hip fracture (CDC, 2014).

Financial costs to the community and society are also associated with falls (Kates et al., 2010; American Geriatric Society Workgroup, 2014). For example, during the year 2012 the estimated cost reduction for the older adult following a hip fracture is \$65,000 while the direct costs is approximately thirty billion (Frick, Kung, Parrish, & Narrett, 2010; American Geriatric Society Workgroup, 2014; CDC, 2014). If hip fractures due to falling could be reduced by using fall prevention interventions the financial benefit would be remarkable. Reducing the functional decline and loss of mobility associated with falls and fractures would significantly decrease the burden of cost to the individual patient, their families and the healthcare system. Reducing falls in the older adult would reduce the number of hip fractures and decrease the associated high morbidity and mortality rates. This would improve the quality of life for older individuals as well as sustain their independence and functionality.

### **Objective**

The aim of this literature review is to explore the benefits of vitamin D supplementation as a therapeutic intervention for fall prevention in the older adult. The use of



vitamin D supplementation implemented by all health care providers including advanced practice nurses, may reduce the mortality and morbidity rates associated with fractures, as a result of a fall, and greatly benefit this population.

The question that guided this review process was: Does existing research support use of the supplement vitamin D to decrease or prevent falls among older adults? If so, this intervention would reduce the incidence of falls in this population, thereby reducing the incidence of fractures sustained by falling.

### **Methods**

A systematic search was conducted to identify relevant articles. The search was conducted by using the databases CINAHL (Cumulative Index for Nursing & Allied Health Literature), the Cochrane Libraries, PubMed and MedLine. The key words used were: nursing, interventions, geriatric or elderly or older, fall prevention, vitamin D and fracture prevention or hip fracture prevention. The search was limited to peer-reviewed, English language articles published from 2008 to 2014. The World Health Organization's (WHO, 2012) definition for an older person, a person aged 65 years or older, was used for the purposes of this review.

Inclusion criteria were articles that focused on fractures resulting from a fall, vitamin D studies involving human subjects and studies that referenced the intervention of vitamin D being used as a fall prevention intervention. Exclusion criteria were articles that addressed idiopathic fractures and those that did not focus on a geriatric/elderly population.

The search yielded 19 articles that met the criteria. Articles were rated using Melnyk's pyramid (Melnyk & Fineout-Overholt, 2011), a hierarchical evidence rating system. Six of the articles are Level I, which includes systematic reviews and one pooled-analysis of evidence

based practice and review of randomized controlled trials. Five articles are Level II, consisting of original randomized controlled trials. Four articles are classified as Level IV, one case-controlled study and three cohort studies. One article is Level V, a systematic review of descriptive studies. The remaining three articles are Level VII, expert opinion.

### **Findings**

Gillespie, et al. (2012) assert that vitamin D, as a supplement, is an ineffective means of fall prevention with therapeutic serum levels. However, supplementation has been shown valuable in the reduction of falls among older adults with sub-therapeutic levels of vitamin D (Bischoff-Ferrari et al., 2009; Murad et al., 2011; Knutsen et al., 2014). Vitamin D deficiency is commonplace (Girgis, Clifton-Bligh, Hamrick, Holick, & Gunton, 2013). Deficient levels of vitamin D results in skeletal and muscle dysfunction, pain, as well as a factor in demineralization and bone loss (Bischoff-Ferrari et al., 2009; Kalyani et al., 2010; Murad et al., 2011; Girgis et al., 2013; Prince et al., 2008; Lips et al., 2010; Knutsen et al., 2014; Dam, VonMuhlen, & Barrett-Connor, 2009; Dawson-Hughes et al., 2010; Souberbielle et al., 2012). Thus, enhancing vitamin D levels may support or augment a fall prevention intervention (Bischoff-Ferrari et al., 2009; Girgis et al., 2013).

Vitamin D has a direct effect on muscle strength. Human muscles possess discrete vitamin D receptors. When vitamin D binds to the discrete receptors muscle strength is increased especially the muscle fiber type II (Bischoff-Ferrari et al., 2009; Murad et al., 2011; Girgis et al., 2013; Lips et al., 2010; Knutsen et al., 2014; Dam et al., 2009; Dawson-Hughes et al., 2010). This may explain the association between vitamin D and muscle function. Older

adults with a vitamin D deficiency may experience muscle weakness that leads to an increased risk of falling.

Improvement of type II muscle atrophy was noted in patients with vitamin D deficiency after supplementation (Kalyani et al., 2010). Type II muscle fibers are fast-twitch fibers and are the first to be recruited to reduce falls (Kalyani et al., 2010; Girgis, et al. 2013; Knutsen et al., 2014). Therefore, vitamin D supplementation may enhance muscle function and strength and may be a valuable intervention to reduce falls (Kalyani et al., 2010; Murad et al., 2011).

Vitamin D increases muscle power, which is the ability of the muscle to generate force as quickly as possible. Increased muscle power leads to improved balance and improved muscle function and strength. With increased muscle strength, function and balance there is less chance of falling (Bischoff-Ferrari et al., 2009; Barr et al., 2010; Lips et al., 2010; Murad et al., 2011; Kalyani et al., 2010; Pfeifer et al., 2009; Onder et al., 2008; Dam et al., 2009; Dawson-Hughes et al., 2010; Beudart et al., 2014)). This increased muscle power was also shown to decrease sway. Increased strength of the lower extremities leads to gait stability and reduction in falls (Bischoff-Ferrari et al., 2009; Barr et al., 2010; Lips et al., 2010; Murad et al., 2011; Kalyani et al., 2010; Pfeifer et al., 2009; Onder et al., 2008; Dam et al., 2009; Dawson-Hughes et al., 2010; Beudart et al., 2014)). With vitamin D improving muscle function and strength there was a 16-19% reduction in the risk of falling among independently living older adults and up to a 10% reduction of hip fracture with supplementation (Bischoff-Ferrari et al., 2009; Pfeifer et al., 2009; Beudart et al., 2014)).

What dose of vitamin D is necessary to achieve the goals of increased muscle power, strength and function? What is an adequate serum vitamin D level? Vitamin D levels are

evaluated or measured through 25 hydroxyvitamin (25 (OH)D) in the serum or plasma. Souberbielle et al. (2012) suggests prior testing of the serum vitamin D levels is not necessary due to the low toxicity risk of vitamin D. While a consensus on the daily recommended doses has not been established doses up to 4,000 IU/day have been found to be safe (Souberbielle et al., 2012). The minimum dose of 800 - 1,000 IU/day to maintain therapeutic levels has been recommended (American Geriatric Society Workgroup, 2014; Bischoff-Ferrari et al., 2012). A serum level of 25-hydroxyvitamin d of 60 nmol/L or higher is beneficial, though serum levels of 75 nmol/L is key to reduce injury, falls or fractures (Bischoff-Ferrari et al., 2009; Bischoff-Ferrari et al., 2012; American Geriatric Society Workgroup, 2014; Kalyani et al., 2010; Pfeifer et al., 2009; Prince et al., 2008; Sanders et al., 2010).

Vitamin D is a factor in the regulation of calcium transport and protein synthesis in muscle cells (Girgis et al., 2013). In addition, vitamin D has a direct impact on the homeostasis of calcium in muscle cells so this may contribute to increased bone health when calcium and vitamin D are combined (Girgis et al., 2013). In the event of a fall the risk of a fracture would be decreased. Vitamin D and its role in muscle morphology, the regulation of calcium and protein synthesis improves muscle power, strength and gait stability (Girgis et al., 2013, Prince et al., 2008, Pfeifer et al., 2009).

## **Discussion**

Vitamin D supplementation may be a low cost and beneficial fall prevention intervention. Vitamin D has direct effects on muscle strength and power and has the potential to help prevent falls in older adults and moderate morbidity and mortality rates. Current research supports the intervention of vitamin D supplementation in order to decrease falls and

improve health outcomes for older adults, thereby reducing the mortality and morbidity rates of fall-related hip fractures in this population. Using vitamin D as an intervention to reduce falls could greatly improve health, function and quality of life for older adults.

Vitamin D supplements are a relatively inexpensive intervention that could off-set the propensity for falls in the older adult population and the benefits it provides compared to the cost of a hip fracture and rehabilitation are very cost effective. Knowing the beneficial effects of vitamin D, practitioners, such as advanced practice nurses, should implement vitamin D supplementation early in the health regimen of their older patients. The review findings cannot be generalized to the older adult population only in those who participated in the included studies. Additional study consideration methods need to be considered in order to determine if practitioners' are aware of the fall prevention benefits of vitamin D and whether or not they are encouraging older individuals to take the daily supplement.

It is important for future research to be designed for testing levels of vitamin D that are effective as a fall prevention intervention because articles reviewed for this study were based on ranges of of vitamin D taken daily, not a specified dose that proved effective. Knowing the best level is important for clinical practice interventions. It needs to be determined then accepted which amount of vitamin D taken daily gives the best results in fall prevention.

### **Conclusion**

Hip fractures are a major reason for mortality among older people and over 90% of fractures are the result of a fall (CDC, 2014). Hip fractures severely affect the functional and health outcomes of older individuals. Designing fall prevention interventions that are low cost and easy to adopt could potentially reduce the number of falls - reducing the number of hip

fractures and greatly benefitting this population. Advanced practice nurses have a direct influence on their patients' care and outcomes therefore they may be able to prevent loss of mobility and decline in activities of daily life by simply providing a vitamin D supplement.

The findings in this literature review could be used to promote the dissemination of research of the potential of vitamin D as a fall prevention intervention and therefore reduce the incidence of hip fractures related to falls. By lowering the mortality and morbidity rates associated with hip fractures in the older population, quality of life could greatly be impacted. The implication of this review would be improved health, function and quality of life for this growing population.

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## **Manuscript 2**

Theory Exploration: Health Belief Model in Geriatrics

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## Theory Exploration: Health Belief Model in Geriatrics

Nursing theories are useful to help direct, explain and guide nursing interventions in particular situations. The health belief model is a psychological model that attempts to explain and predict health behaviors. It has been one of the most widely used conceptual frameworks in behavior research, both to explain change and maintenance of health related behaviors and as a guiding framework for health behavior interventions (Champion & Skinner, 2008). The health belief model focuses on the factors that influence peoples' health behaviors. The model's main purpose is early detection and prevention of disease and illness.

For the past two decades the health belief model has been expanded, compared to other frameworks, and used to support interventions to change health behaviors. The model is comprised of six key concepts that help predict why people will take action to prevent, screen for, or control illness conditions (Champion & Skinner, 2008). By using these key concepts the practitioner is guided in how they may successfully motivate an individual to adopt the new health behavior and decrease or eliminate negative effects of a disease process or illness. The purpose of this paper is to propose the possible use of the health belief model to motivate the geriatric population adopt the use of a vitamin D supplement as a fall prevention intervention, to reduce falls and fractures as a result from falls.

Using "The Essentials of Doctoral Education for Advanced Nursing Practice" (2006) as a springboard to providing safe nursing practice and provide quality nursing care to improve care delivery and patient outcomes helps incorporate the importance of nursing theory throughout the advanced nursing discipline. By using scientific foundations and theory to guide nursing

practice will enable the advanced practice nurse to be a leader and generate change to make improvement in patient and population outcomes.

### **History**

In the 1950s, social psychologists Hochbaum and Rosenstock, working for the U.S. Public Health Services, developed the health belief model to explain why people did not participate in programs to prevent and detect disease (Champion & Skinner, 2008). They specifically addressed the failure of people to participate in a free tuberculosis health screening program. Since then the health belief model has been adapted to study many long-term and short-term health behaviors.

In 1952, Hochbaum studied probability samples of more than 1200 adults in three cities that had conducted recent tuberculosis screening programs in mobile x-ray units (Strecher & Rosenstock, 1997). His study focusing on individuals' readiness to obtain an x-ray revealed findings indicating readiness was impacted by two main factors: whether they felt susceptible to tuberculosis and their beliefs about the benefits of early detection (Strecher & Rosenstock, 1997). Perceived susceptibility to tuberculosis contains two elements, the belief about whether contracting tuberculosis is realistic and the belief that they may already have tuberculosis in the absence of symptoms. Perceived benefits also included two elements, whether respondents believed that x-rays could detect tuberculosis prior to symptoms and whether early detection and treatment would improve prognosis. Hochbaum's findings expanded understanding because his studies revealed that an individual's readiness to take action could be potentiated by other factors, such as "cues", to instigate action. For example, bodily events such as a sneeze

or cough and environmental events such as media publicity in the form of posters may influence the individual (Strecher & Rosenstock, 1997).

From this initial beginning the model has been adapted during the past few decades to help individuals adopt new behaviors for improving health. By using the model an advanced practice provider can help guide an individual to adopt a new behavior to prevent or detect an illness so that early interventions can improve the prognosis and outcome for that individual.

### **Concepts and Definitions**

The health belief model is based on the concept that a person will adopt a health related action if they feel they can avoid a negative health condition, they have a positive expectation that by adopting the recommended action a negative health condition may be avoided, and they believe that they can successfully perform the recommended health action (Champion & Skinner, 2008). There are six key concepts that define the health belief model. These concepts encompass a person's beliefs related to the threats and benefits of a health condition and include perceived susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action, and self-efficacy (Champion & Skinner, 2008). These concepts are listed and defined in Table 1 (Champion & Skinner, 2008, p.48).

Table 1

#### *Health Belief Model Key Concepts*

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<u>Concepts:</u>	<u>Definition:</u>
Perceived susceptibility	Belief about the chances of experiencing a risk or getting a condition or disease.

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Perceived severity	Belief about how serious a condition and its consequences are.
Perceived benefits	Belief in efficacy of the advised action to reduce risk or seriousness of impact.
Perceived barriers	Belief about the tangible and psychological costs of the advised action.
Cues to action	Strategies to activate “readiness.”
Self-efficacy	Confidence in one’s ability to take action.

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The model alleges that individuals will take action to ward off, screen for, or control ill-health conditions if they regard themselves susceptible to the condition, believe it to have serious consequences, believe there are resources available and attainable to reduce susceptibility or severity of the condition, and if they believe their actions to overcome barriers will be beneficial (Strecher & Rosenstock, 1997).

#### **Relevance of the Health Belief Model to Advanced Nursing Specialty of Geriatrics**

The health belief model would be a beneficial framework to use when providing care to the older adult population when helping patients successfully adopt recommended health behaviors to improve health outcomes. One area of application of the health belief model to improve health outcomes in the older adult population is to off-set a catastrophic event, such as a fall that leads to a sustained fracture. It is well documented that falls are one of the main detriments to older adults’ health and that they are the leading cause of death due to unintentional injury among older adults ("Older Adult Falls," 2015). In addition, individuals aged

65 years and older are at an increased risk for experiencing falls, and the risk of a fracture sustained as a result from a fall progressively increases as an individual ages ("Older Adult Falls," 2015).

The mortality rate one year after sustaining a severe fracture is 25.2% for individuals aged 65 years and older (Coutinho, Bloch, & Coeli, 2012). Furthermore, the morbidity rates associated with fractures affect the individual's quality of life by diminishing mobility, independence and overall functionality. One possible intervention to help reduce falls among older adults, thereby reducing fractures sustained from falling, is vitamin D. Vitamin D has been shown to be important in bone metabolism and muscle function (Girgis, Clifton-Bligh, Hamrick, Holick, & Gunton, 2013). Vitamin D deficiency is a worldwide problem and is prevalent in the older population due to the decrease in sun exposure and synthesis of vitamin D as an individual ages (Girgis et al., 2013; Kalyani et al., 2010). Human muscles have vitamin D receptors. Having adequate vitamin D levels could improve muscle function and strength (Kalyani et al., 2010). Vitamin D supplementation has shown an improvement in type II muscle atrophy in patients with a vitamin D deficiency (Kalyani et al., 2010). Type II muscle fibers are fast-twitch fibers and would be the first fibers recruited to prevent a fall (Kalyani et al., 2010). Improving muscle strength may improve gait stability and reduce falls. Therefore, the health belief model may be a way to guide practitioners to increase vitamin D supplementation in the older adult population and in turn reduce falls and fractures.

#### **Potential Application of the Health Belief Model for Advanced Nursing of Geriatrics**

This paper will propose the application of the six components of the health belief model for the advanced nursing specialty of geriatrics. Those six components include perceived

susceptibility, perceived severity, perceived benefits, perceived barriers, cues to action and self-efficacy. By reviewing the literature on many different health issues and disease processes, each of these six concepts will be analyzed and discussed in relation to the geriatric population. This information will then be modified as potential use for an advanced practice nurse specializing in geriatrics to improve health outcomes by adopting a vitamin D supplement as a fall prevention intervention.

### **Perceived Susceptibility**

Perceived susceptibility is the concept most commonly addressed when using the health belief model for research. Five articles reviewed address perceived susceptibility in an older population. Two of the reviewed studies found that if individuals perceived that they were susceptible to the condition of interest they were more likely to adopt the recommended tests and/or treatment (Cry, Dunnagan, & Haynes, 2010; Molina-Barcelo, Salas Trejo, Peiro-Perez, & Malaga Lopez, 2011). These authors also found that individuals of low socioeconomic status were less likely to participate in screening/testing for the identified condition. This decreased perceived susceptibility was related to low health literacy and belief of low vulnerability to the disease due to lack of knowledge of the condition. Conversely you would expect high health literacy would result in a more realistic perceived susceptibility based on knowledge.

Using the health belief model to study HIV/AIDS interventions in an aging U.S. population showed perceived susceptibility to be low (Jacobson, 2011). Populations of older adults underestimate the problem and do not have much knowledge about the risks of HIV/AIDS, therefore they have a low perceived susceptibility. In contrast, a study by Park and colleagues (2014) suggested high perceived susceptibility of chronic pain in older individuals.

Their study sample included individuals aged 60 years and older from different ethnicities with non-cancer related chronic pain. All categories scored high for the perceived susceptibility for chronic pain to increase. Demonstrating older individuals have a higher health literacy related to chronic pain as opposed to diseases such as HIV/AIDS and their possible perceived susceptibility.

Maes and Louis (2011) reported on use of the health belief model to identify the sexual history taking practices of nurse practitioners for patients 50 years of age and older. The authors found that nurse practitioners taking a sexual history with populations of patients 50 years of age and older led to a reduction of sexually transmitted diseases and early interventions to promote health outcomes related to sexual behaviors. These data help to demonstrate that discussion of health related behaviors may lead to higher health literacy related to these illnesses and in turn a reduction in risky behaviors to lower their perceived susceptibility.

An advanced practice practitioner wanting an older individual to begin taking a vitamin D supplement as a fall prevention intervention may focus on education and discussion as the first step in addressing perceived susceptibility. If a practitioner can help the patient understand why vitamin D may be beneficial and how it works to decrease falls and fractures, this knowledge may lead to higher compliance with the intervention. Paired with education on how the risk for falls increases with advanced age this knowledge would likely increase the geriatric populations' level of perceived susceptibility to falling and the risk for fractures.

## **Perceived Severity**

In three studies related to colorectal cancer it was found that older individuals with low socio-economic status claimed to know nothing about certain diseases and risk factors (Cry et al., 2010; Molina-Barcelo et al., 2011; Ueland, Hornung, & Greenwald, 2006), resulting in a low health literacy relating to this disease process. These scientists focused on increased disease awareness to promote prevention and screening thus finding that participants reported increased belief of seriousness of certain disease processes, after being given information about the disease and hearing how preventable and treatable the process could be (Molina-Barcelo et al., 2011; Ueland, Hornung & Greenwald, 2006).

In studies where the disease being investigated was perceived to possibly cause pain and death as the severity (Kleier, 2004; Rivers, Underwood, & Jones, 2007), participation in screening might increase given it coincided with perceived susceptibility. For instance, stating that if an individual perceived the condition to have adverse effects and they were susceptible they may be more likely to participate in the recommended behavior. Therefore, when trying to motivate a population to adopt a new behavior it seems that education, to gain a higher level of knowledge of susceptibility and severity, is important.

Another example to address perceived severity using the health belief model is based on a project by Nexoe, Kragstrup and Sogaard (1998) who studied the decision on using the influenza vaccination among the elderly in a random sample of Danish individuals aged 65 years and older. The investigators studied the participants' personal perception of health for evaluating risk status related to influenza based on their own perceived severity of contracting influenza. The author's demonstrated that individuals that were vaccinated believed influenza

to be more serious and believed the vaccine more effective compared to the individuals that were not vaccinated (Nexoe, Kragstrup, & Sogaard, 1998). This information further enhances the idea of the importance in assessing older individuals' perception of their risk for falling, the severity of the potential of sustaining a fracture, and understanding that vitamin D could help prevent a fall thus off-setting a fracture.

### **Perceived Benefits**

Perceived benefits are an important concept of the health belief model. The benefits are usually very important to the individuals' decision to adopt or not adopt the suggested behavior. Participants in many studies identified early detection and early medical care as primary benefits that would extend their lives (Cry et al., 2010; Kleier, 2004; Nexoe et al., 1998; Rivers et al., 2007). In one study, (Ueland, Hornung, & Greenwald, 2006), perceived benefits were the most influential predictor of the participants' decision to be tested for colorectal cancer. The authors found that one of the strongest perceived benefits related to colorectal prevention and screening was that early detection of colorectal cancer is essential and enables a cure rate of over 90%.

In the report, identifying sexual history taking practices of the nurse practitioners caring for older patients (Maes & Louis, 2011), the authors found that nurse practitioners who were willing to discuss these sensitive areas with older adults, led to a reduction of sexually transmitted diseases and early interventions to promote health outcomes related to sexual behaviors. This model proposes that perceived benefits of health related behaviors not only among patients but healthcare providers are associated with the desire to avoid illness or to get well and the belief that a specific health action will prevent or reduce the impact of illness.

This desire to avoid illness and prevent or reduce the impact of illness could be used to encourage the older population to take vitamin D supplementation to reduce or prevent injury as a result from a fall. Perceived benefits pivotal in motivation to adopt this behavior include benefits of vitamin D supplementation to increase favorable health outcomes, prolong quality of life and enhance functional independence in the older patient.

### **Perceived Barriers**

The concept of perceived barriers has also been covered extensively in the research. Perceived barriers are the cost, either psychological or tangible, of implementing the recommended behavior. Perceived barriers can impede an individual from adopting a health change behavior.

Many of the studies reviewed reported cost as a perceived barrier to beneficial health behaviors (Cry et al., 2010; Nexoe et al., 1998; Richard, Kosatsky, & Renouf, 2011; Rivers et al., 2007). Other commonly perceived barriers were limited access to the intervention or activity, discomfort and the possibility of side effects (Rivers et al., 2007; Kleier, 2004; Nexoe et al., 1998; Richard et al., 2011). Two reports (Koch, 2002; Sullivan, Young, & Scott, 2009) addressed older adults and exercise to prevent a disease process or reduce risk factors. Both studies indicated that participants tended to think they did not have enough time or that the behavior may be too difficult or painful.

Getting older adults to take a vitamin D supplement may have barriers similar to the ones in these reviewed studies. For instance, cost may be a concern as well as whether or not taking a supplement would cause side effects and whether or not they would remember to take the supplement as recommended. A provider could help alleviate these barriers by providing

education on cost, side effects and comparison of pain should a fall and fracture occur.

Recommended daily dose is 800 IU/day to 2,000 IU/day depending on BMI and sun exposure (Dawson-Hughes et al., 2010). Side effects, associated with vitamin D, are very low and an individual would have to far exceed the recommended daily dose to reach toxic levels, taking 40,000 IU/day repeatedly (Dawson-Hughes et al., 2010). A practitioner could alleviate the barrier as to whether they could remember to take the supplement each day, by having them take it the same time each day they take other medications or supplements, set a reminder to alarm on a smart device, or solicit the help of a family member to call and remind them each day to take their vitamin D supplement.

### **Cues to Action**

When using the health belief model it is important to address the cues to action for the population being observed. Cues to action are the strategies needed to promote and encourage individuals to participate in the recommended health behaviors so that it may be more likely implemented and adopted. The most common cues to action found in reviewing studies, involving older adults, seems to be recommendations from a physician or advanced practice practitioner to participate in the suggested behavior (Cry et al., 2010; Kleier, 2004; Richard et al., 2011; Ueland et al., 2006). It was also demonstrated that discomfort related to the illness itself was a cue to action (Kleier, 2004; Richard et al., 2011).

If an advanced practice practitioner feels that a patient needs to begin vitamin D supplementation for fall prevention, motivating the patient to adopt this behavior may be as simple as recommending it. It would also be advisable for the provider to discuss the potential



of negative outcomes related to a fall in order to motivate the individual to take a vitamin D supplement to prevent falling that may lead to a fracture.

### **Self-Efficacy**

Self-efficacy, the final concept in this review of the health belief model, means the self-confidence or ability of an individual to adopt the recommended health behavior.

Unfortunately, self-efficacy is often overlooked and not addressed in studies using the health belief model. However, studies that did address this concept indicated that, self-efficacy was significantly increased after education sessions where the participants believed that they would discuss the recommended intervention/behavior with their primary care provider at their next office visit (Koch, 2002; Ueland et al., 2006). Self-efficacy increased if the recommended behaviors were perceived positively and the participants' believed that they were achievable (Rivers et al., 2007; Sullivan et al., 2009; Ueland et al., 2006; Koch, 2002). Achieving the recommended behavior would be more probable by reducing or removing as many barriers as possible.

To increase the self-efficacy of having older adults take a vitamin D supplement goes back to education. Giving the individual a solid knowledge base of the identified problem and information about skills and motivation for adopting the recommended behavior would positively affect health outcomes. The potential ways to alleviating barriers and making it an achievable goal may increase the older adult's motivation to adopt the new behavior.

### **Conclusion**

Using the reviewed information, related to the health belief model in the older adult population, to better foster the adoption of vitamin D supplementation as a fall prevention

intervention, is conceivable. Table 2 outlines a possible way the health belief model may be used to motivate older individuals to take a vitamin D supplement, outlining each concept of the theory and how it may be viewed by the targeted population.

Table 2

*Health Belief Model Motivating Older Adults to take a Vitamin D Supplement*

<u>Concepts:</u>	<u>Motivation:</u>
Perceived susceptibility	Am I at risk for falling? If I fall am I at risk for sustaining a fracture? Would a fall/fracture impact my life negatively? Would taking a vitamin D supplement reduce my risk?
Perceived severity	Would a fall/fracture reduce my independence, cause pain and possibly lead to death?
Perceived benefits	Would a vitamin D supplement promote my health, reduce falls/fractures and prolong my functional independence?
Perceived barriers	How much does it cost? Will I remember to take vitamin D every day? What are the side effects?
Cues to action	Advanced practice provider's recommendation. Fear of falling. Fear of losing independence.

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Capability and confidence. The ability to control and improve health outcomes. Is it achievable?

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Reviewing other studies using the health belief model in older populations provides insight on how advanced practice practitioners can use the model to help motivate older individuals to take a vitamin D supplement to reduce falls that may lead to fractures. Reducing falls/fractures in this population would greatly increase health outcomes by reducing morbidity and mortality rates associated with fractures that result from falls.

Vitamin D is a low cost intervention that may improve outcomes related to falls and fractures in the older population. As illustrated in Table 2, the use of the health belief model is one example of how to motivate this population to adopt a new health behavior. If successful, mortality and morbidity rates associated with falls and fractures could be reduced and it may lead to improved quality of life and a reduction in health related expenses for this population.

The health belief model is a psychological model that attempts to explain and predict health behaviors. The model's main purpose is early detection and prevention of disease and illness. Identifying the six concepts of the health belief model in each situation as illustrated in Table 2, provides a framework for success in gaining patients adherence to care and treatment. By applying the health belief model in a variety of different advanced geriatric nursing practice settings has the potential to improve health outcomes by early detection and timely treatment for many different illnesses and diseases. The use of the health belief model can assist the advanced practice nurse to heighten clinical prevention enabling enhancement of health

promotion and health status of our nation. By practicing within the doctoral education essentials these providers will be equipped to provide leadership for healthcare as a whole.

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## **Manuscript 3**

Evaluation of Serum Vitamin D Levels in Older Adults who Fall and Sustain a Fracture: A  
Retrospective Chart Review

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## Abstract

**Purpose:** This practice inquiry project was designed to (i) evaluate serum vitamin D levels in individuals aged 65 years and older who had fallen and sustained a fracture and (ii) identify if the serum vitamin D levels were within therapeutic range.

**Background:** Older adults are at increased risk of falling and sustaining a fracture as a result of falls. Vitamin D has been shown to be effective in fall prevention yet vitamin D is deficient in the older population worldwide. Evaluating current serum vitamin D levels in older adults who fall and sustain a fracture may provide additional insight in to how to increase vitamin D levels with consideration for supplementation to reduce the incidence of falls/fractures in this population.

**Methods:** This retrospective descriptive study of electronic medical records data from participants meeting the inclusion criteria admitted to the University of Kentucky Chandler Medical Center from August 2010 through August 2015. Chi-square test and Fisher exact tests were used to test for significance of association between variables.

**Results:** The sample consisted of 2,767 records of subjects aged 65 years and older, who had fallen and sustained a fracture. The mean age of the subjects was 80.99 years (SD 8.56); the majority of the sample was female and Caucasian. Of the 2,767 records reviewed serum vitamin D level were assessed in 208 subjects (7.5%). Of the 208 subjects whose serum vitamin D level were assessed 28% had an optimal serum level of vitamin D, 32% had an insufficient serum level of vitamin D and 40% had a deficient serum level of vitamin D, the mean serum vitamin D level was 24.32 ng/ml (SD 12.79). A vitamin D level of 30 ng/mL or above was considered optimal. There was a statistically significant association between age and vitamin D level,  $p =$

0.004. There was no statistical differences between, gender and vitamin D level,  $p = 0.1$ , race and vitamin D level,  $p = 0.18$ , nor between fracture type and vitamin D level,  $p = 0.202$ .

**Conclusion:** Vitamin D levels were assessed in 7.5% of the study sample. Of those 7.5% the vitamin D level was most often insufficient.

Evaluation of serum vitamin D levels in older adults who fall and sustain a fracture: A  
Retrospective Chart Review

**Introduction**

Falls are the leading cause of death due to accidental injury among older adults. Individuals aged 65 years or older are at increased risk for experiencing falls (International Osteoporosis Foundation, [IOF], 2015). The risk of a fracture progressively increases as an individual ages (Centers for Disease Control, [CDC], 2015). In keeping with Healthy People 2020 (2012) fall prevention would be advantageous to improve the health, function and quality of life of older adults. According to, the United Nations report “World Population Aging” (2013) the number of older persons, aged 65 years and older, was 841 million worldwide in 2013. The older population is expected to triple by 2050, with an estimated two billion globally. As the population ages an increase in falls/fractures of these individuals is also expected. Identifying interventions to decrease the incidence of falls leading to fractures could greatly improve the health outcomes of this population.

Ninety percent of hip fractures are caused by falling and less than half of the older adults who survive a hip fracture regain their previous level of functioning (CDC, 2015). Hip fractures are a serious injury often resulting in long term functional impairment, nursing home admission and increased mortality (CDC, 2015). Forty percent of older individuals are unable to walk after sustaining a hip fracture and approximately 60% of these older adults still require assistance with activities of daily living a year later (IOF, 2015). The morbidity rate associated with fractures affects the individual’s quality of life by affecting mobility, independence and overall functionality.

Reducing the decline and lack of mobility associated with falls and fractures could significantly decrease the burden of cost to the individual patient, their families and the healthcare system. For example, in 2012 one injury related fall resulted in average Medicare costs of \$13,797 to \$20,450 in addition to disability, lack of independence, depression and caregiver burden (Albert & Shelton, 2015). More importantly, the mortality rate one year after sustaining a severe fracture is 25.2% for individuals aged 65 years and older (Coutinho, Bloch, & Coeli, 2012). Death results from the injury itself or from complications arising from the injury. Older adults are at an increased risk for falling due to impaired balance and increased body sway that may both be a result from decreased muscle power (Barr et al., 2010, Kalyani et al., 2010).

Vitamin D has an effect on muscle strength, due to specific vitamin D receptors (VDR) present in human muscle tissue (Barr et al., 2010, Ceglia, 2009, Onder et al., 2008). Vitamin D has been shown to be important in bone metabolism and muscle tissue leading to improved function and performance (Barr et al., 2010, Bischoff-Ferrari et al., 2009, Ceglia, 2009, Murad et al., 2011, Onder et al., 2008, Pfeifer et al., 2009). When vitamin D binds to specific nuclear VDR in muscle tissue it leads to improved muscle composition and performance (Barr et al., 2010, Ceglia, 2009, Onder et al., 2008). Vitamin D increases muscle power, which is the ability of the muscle to generate force as quickly as possible. Increased muscle power leads to improved balance and improved muscle function and strength (Barr et al., 2010, Bischoff-Ferrari et al., 2009, Ceglia, 2009, Murad et al., 2011, Onder et al., 2008, Pfeifer et al., 2009). Vitamin D supplementation has been shown to reduce type II muscle atrophy in patients with a vitamin D deficiency (Ceglia, 2009, Kalyani et al., 2010). Type II muscle fibers are fast-twitch fibers and

would be the first fibers recruited to prevent a fall. These muscle tissues have improved composition of muscle fibers when vitamin D is attached to the VDR, improving diameter and percentage of type II muscle fibers (Ceglia, 2009, Kalyani et al., 2010,).

Vitamin D deficiency is a worldwide problem and is prevalent in the older population (Dawson-Hughes et al., 2010, Girgis, Clifton-Bligh, Hamrick, Holick & Gunton, 2013, Knutsen et al., 2014, Lips et al., 2010, Souberbielle et al., 2012). Vitamin D deficiency is associated with skeletal and muscular dysfunction, weakness, pain and can lead to bone loss. Using vitamin D supplementation to reverse this deficiency in the older adult population and improve muscle strength and function may lead to fall prevention and decrease the number of falls and fractures (Dam, VonMuhlen, & Barrett-Connor, 2009, Dawson-Hughes et al., 2010, Girgis et al., 2013, Knutsen et al., 2014, Souberbielle et al., 2012). Therefore, the hypothesis for this practice inquiry project is that individuals aged 65 years and older who have fallen and sustained a fracture and have had their serum vitamin D levels assessed will have, insufficient or deficient levels.

Increased morbidity, mortality and negative patient outcomes combined with healthcare costs related to falls/fractures warrant preventative measures. Evaluating serum vitamin D levels in this population may give insight into to the importance of vitamin D supplementation and the possibility of intervening earlier to improve health outcomes and lower healthcare costs.

### **Purpose**

This Doctor of Nursing Practice (DNP) evaluation project was designed to evaluate serum vitamin D levels in individuals aged 65 years and older who had fallen and sustained a

fracture and were admitted to the University of Kentucky Chandler Medical Center, located in Lexington, Kentucky. The project was based on a retrospective medical chart review.

The DNP inquiry project objectives were to (i) evaluate serum vitamin D levels in individuals aged 65 years and older who had fallen and sustained a fracture and (ii) identify if the serum vitamin D levels were within therapeutic range. Based on these objectives, the primary goal of this project is to develop vitamin D supplementation recommendations for older individuals who have sustained a fall/fracture with deficient serum vitamin D levels. Recommendations would include taking a vitamin D supplement, for the purpose of, obtaining and/or maintaining optimal serum level of vitamin D, thus helping to prevent falls and reduce the incidence of fractures as a result from a fall.

## **Methods**

### **Setting:**

Approval was obtained by the Institutional Review Board, at the University of Kentucky, and patient consent was waived in compliance with IRB regulations (Appendix A). The study was conducted at the University of Kentucky Chandler Medical Center, an American College of Surgeons accredited level 1 trauma center located in Lexington, Kentucky.

### **Design and Sample:**

A retrospective electronic medical chart review was conducted. The study population inclusion criteria were all adult patients, aged 65 years and older, admitted with a diagnosis of a fracture as a result from a fall. The medical record review generated a report of 2,767 patients who met the inclusion criteria. The data collected included the following: demographics (age, gender and race), type of fracture, admission date, and serum vitamin D level if assessed. Of the

2,767 subjects that met inclusion criteria 208 subjects had a recording of serum vitamin D level assessment.

**Measures:**

Vitamin D levels were measured from blood samples in units of nanograms per milliliter (ng/mL). These measurements were used to determine if vitamin D levels were within therapeutic range. The measurement of 30-80 ng/mL was considered optimal (best or most favorable). The measurement below 30 ng/mL to 20 ng/mL was considered insufficient (not enough or inadequate). The measurement below 20 ng/mL was considered deficient (lacking or absent). The types of fractures included: hip, wrist, arm, ankle, leg, and back. Wrist and arm were categorized as upper extremity fractures and ankle and leg were categorized as lower extremity fractures.

**Data Analysis:**

Data analysis was performed using SPSS version 23.0 (SPSS Inc. Chicago, IL). Data were analyzed using descriptive statistics. Chi-square and Fisher's exact tests were used to evaluate for significance of association between variables. This study considered values of  $p < 0.05$  to be statistically significant for the analysis.

**Results**

**Sample Characteristics:**

The ethnicity of the sample subjects was primarily Caucasian, 84 subjects were African American, 5 were Hispanic, 16 were Asian, 1 was Native American and 32 were classified as unknown. Of the 2,767 study subjects 1,940 (70.1%) were female and 827 (29.9%) were male. Distribution of fracture types for the 2,767 study subjects are presented in Graph 1.



## **Analysis:**

Chi-square tests and Fisher's exact tests analysis were performed to evaluate for association between patient demographics, fracture characteristics and vitamin D status (Table 1). There was a significant association identified between older adults and vitamin D levels,  $p = 0.004$ . There was no significant association identified between vitamin D levels and gender, race or fracture type ( $p = 0.14$ ,  $p = 0.18$ ,  $p = 0.202$ ).

The current recommendation for vitamin D supplementation, by the IOM, is that an individual take 800 – 2,000 International Units (IU) per day depending on BMI and sun exposure (Dawson-Hughes et al., 2010). Side effects associated with vitamin D supplements, such as dry mouth, headache and fatigue, are very rare and an individual would have to take approximately 40,000 IU/day to reach toxic levels (Dawson-Hughes et al., 2010).

The result of a fracture from a fall leads to significant health risks and financial burden. This requires the attention of every health care provider in the care of older adults. Healthy People 2020 (2012) recommend fall prevention could improve the health, function and quality of life of older adults and should be paramount. Since vitamin D supplementation has been shown to be effective in fall prevention then providers should be promoting and encouraging older adults to take a vitamin D supplement.

## **Discussion**

Serum vitamin D levels, as found with this study, are not often assessed in older individuals. This study found that 7.5% of a sample of 2,676 older individuals who had fallen and sustained a fracture had their serum vitamin D levels assessed. When serum vitamin D levels were assessed they were most often found to be at insufficient or deficient levels as

presented in Graph 2. The mean serum vitamin D level was 24.32 ng/mL (SD 12.79). Less than one-third of the subjects had serum vitamin D levels that were in optimal therapeutic range. This is consistent with the findings that there is a worldwide vitamin D deficiency problem (Dawson-Hughes et al., 2010, Girgis, Clifton-Bligh, Hamrick, Holick & Gunton, 2013, Knutsen et al., 2014, Lips et al., 2010, Souberbielle et al., 2012).

Upon further sub group analysis of age, we found that in individuals aged 65-74 years old, only 13.8% of the study subjects assessed had serum vitamin D levels within optimal range (see graph 3). In the group of individuals 75-84 years old, it was shown those with serum vitamin D levels assessed, 31.0% were in optimal range. In the age group of 85 years and older with serum vitamin D levels assessed, 55.2% were in optimal range. This was a surprising finding being that as an individual ages the synthesis of vitamin D from sun exposure decreases. Older individuals synthesize 50% less pre-vitamin D in the epidermis as a response to sun exposure compared to younger adults (Gallagher, 2013). It was reported by Cheema and Chaudhry (2016) that vitamin D supplements did not demonstrate a significant reduction in number of falls in individuals aged 70 years and older even though serum vitamin D levels increased. The authors indicated, although serum vitamin D levels improved in this population, already having preexisting musculoskeletal degenerations may have been why there was no decrease in falls.

Our data indicate the majority of fractures sustained were hip fractures. Of the total participants included in this study, 79.2% sustained a hip fracture as a result from a fall. Of the 208 participants whose serum vitamin D levels were assessed, 80.8% of those participants sustained a hip fracture. Of the study participants who sustained a hip fracture and had their

serum vitamin D levels assessed (N=168), 42% of the subjects had a serum vitamin D level in the deficient range and 29% of the subjects had a serum vitamin D level in the insufficient range. As the older adult population grows the risk of the number of potential hip fractures increases (CDC, 2015). All types of fracture categories had high levels of insufficient and deficient serum vitamin D levels (see Graph 4). This represents how vitamin D deficiency is a problem and prevalent in the older population (Dawson-Hughes et al., 2010, Girgis, Clifton-Bligh, Hamrick, Holick & Gunton, 2013, Knutsen et al., 2014, Lips et al., 2010, Souberbielle et al., 2012). In a review of vitamin D benefits by Allan et al. (2016), vitamin D supplementation did reduce the number of falls in the older population as well as vitamin D supplementation contributed to a reduction in fractures.

### **Limitations**

The limitations of this project include that the sample was primarily female and Caucasian. The lack of gender and race diversity minimizes the generalizability of the conclusions. Clinical significance could be gained by repeating this review in diverse geographical locations to compare results. The retrospective design of the study using a chart review method represents documentation of tasks completed; no real-time observations were conducted when reviewing the results. One finding of this study was that the majority of fractures in our sample were hip fractures. These data suggests that hip fractures are proportionally larger in this age group as a result of a fall. Replication of this study in other geographic areas would be beneficial to see if similar results are found.

## Conclusions and Recommendations

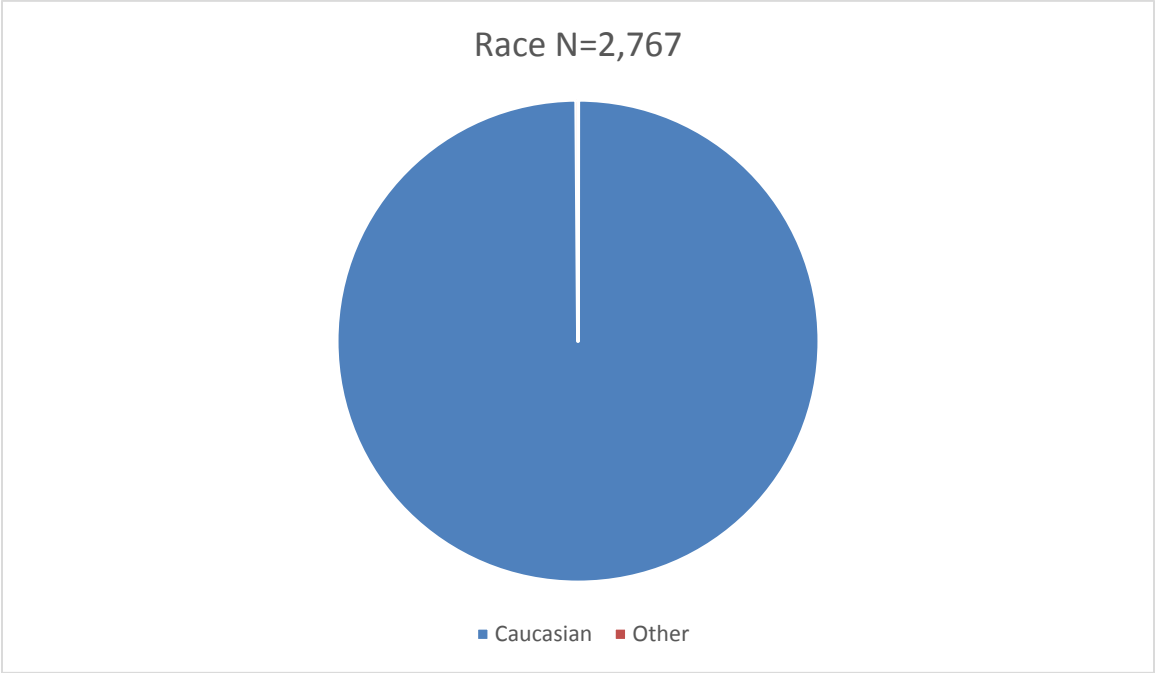
The benefits and importance of vitamin D supplementation should be explained to individuals at risk for vitamin D deficiency. If the vitamin D deficiency problem could be resolved many health outcomes could potentially be improved. There needs to be consensus among the medical community that vitamin D supplementation is important so providers can be the change agents to improve health outcomes. Providers could check serum vitamin D levels and recommend a vitamin D supplement earlier prior to a falls/fractures occurring. Providers could provide educational information, on the benefits and risks of vitamin D supplementation, in pamphlets or handouts, to help patients make an informed decision about vitamin D supplementation.

The results of this study provides evidence that serum vitamin D levels are screened in only 7.5% of individuals aged 65 years and older who have fallen and sustained a fracture. When these individuals have their serum vitamin D levels assessed they are most likely insufficient and deficient. These data indicate additional translational research is needed to explore the benefits of vitamin D supplementation.

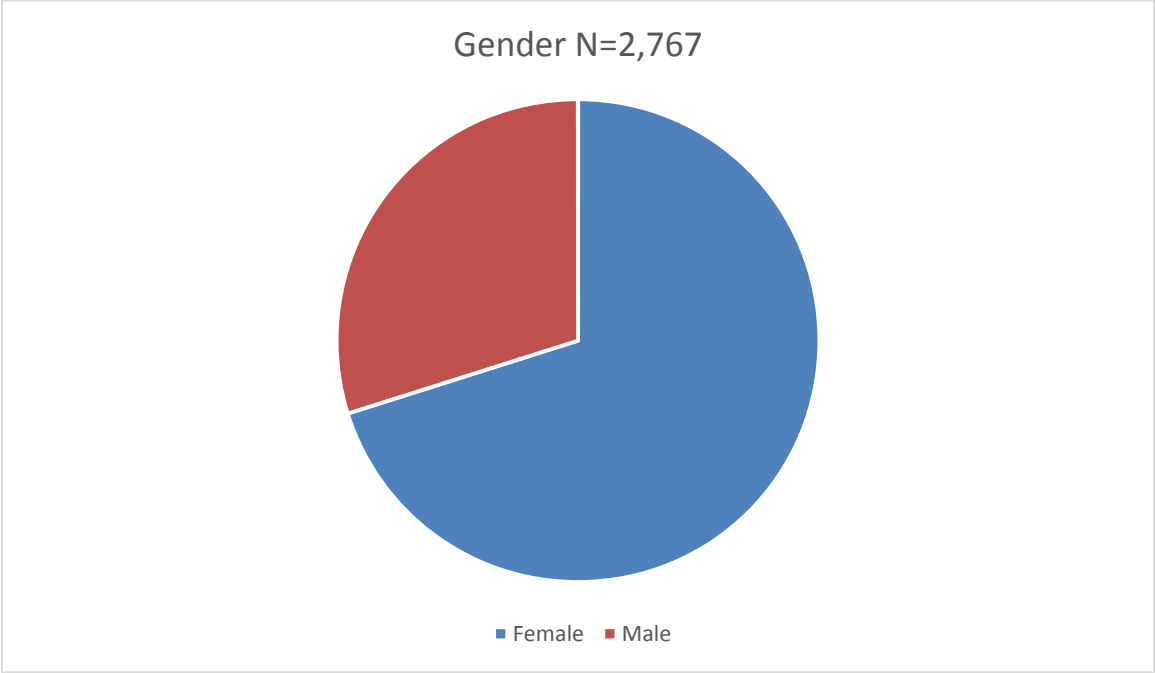
Vitamin D supplementation is a low cost intervention with low risk of adverse effects. The benefits of supplementation are improved muscle strength and function that may lead to less falls/fractures. With vitamin D supplementation being considered an effective fall prevention intervention, reducing falls by at least 19 % (Bischoff-Ferrari et al., 2009, Prince et al., 2008), healthcare providers should consider the recommendations. The Institute of Medicine (IOM) recommends an older adult, aged 65 years and older, take at least 800 IU's of vitamin D every day to reduce the risk of fractures (Bischoff-Ferrari et al., 2012). The risk of

toxicity is low; an individual would have to far exceed the daily recommend amount of supplemental vitamin D, taking as much as 40,000 IU's (International Units) a day to reach toxic levels (Dawson-Hughes et al., 2010). Practitioners currently providing medical care to older individuals need to be aware of the benefits of vitamin D supplementation and share this information with their patients.

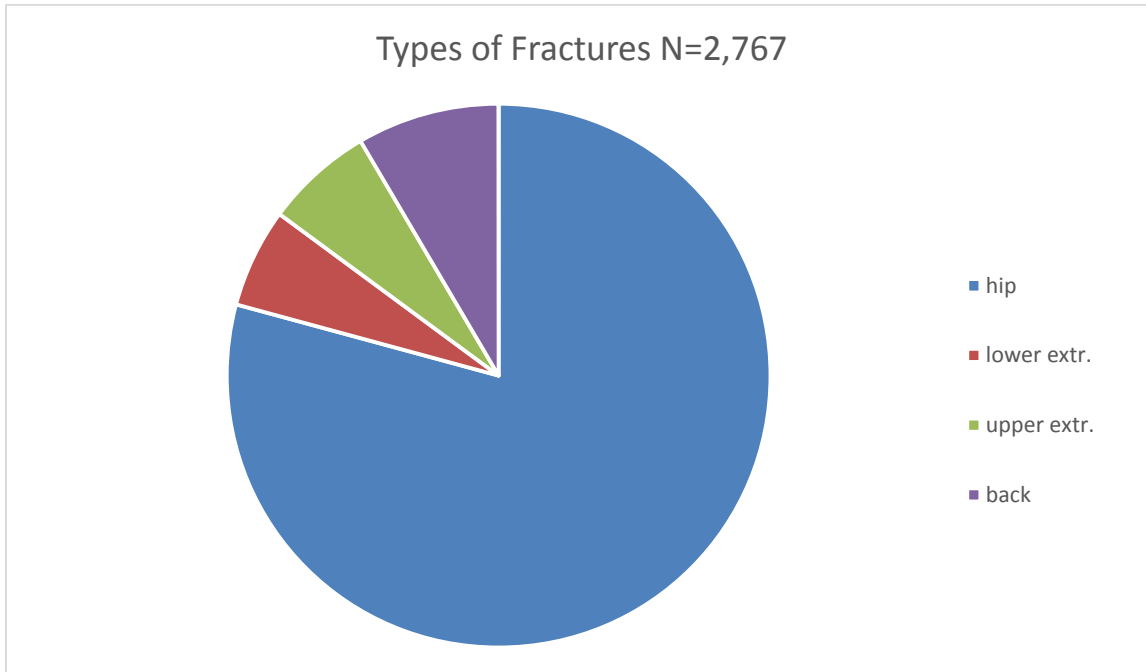
Graph 1. Race distribution, N = 2767.



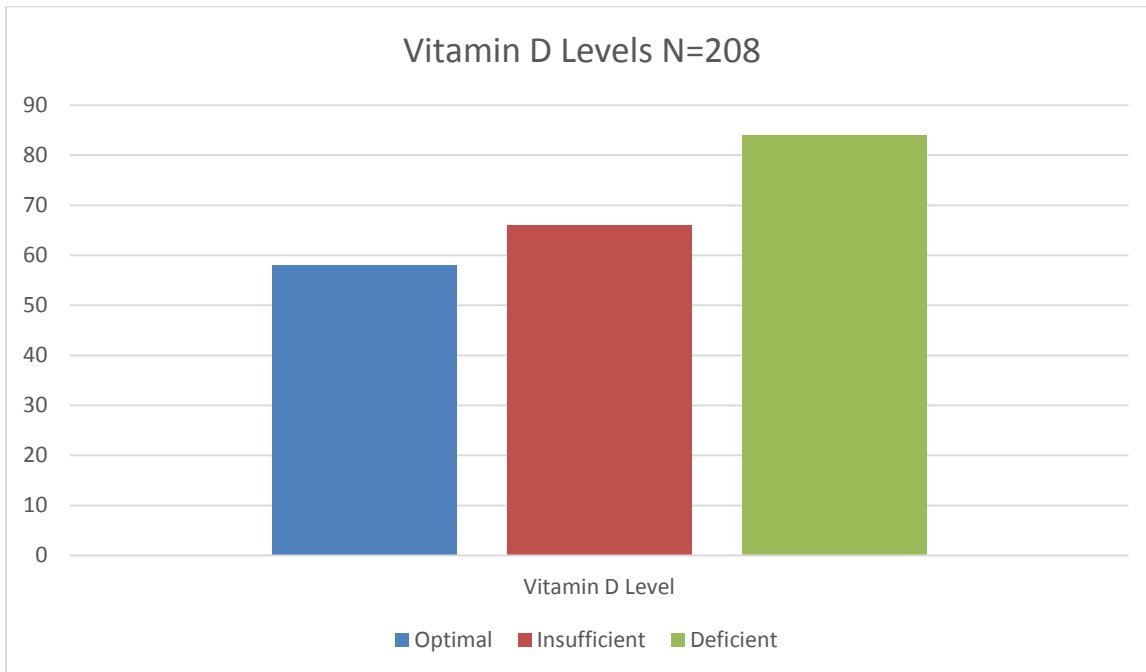
Graph 2. Gender distribution, N = 2767.



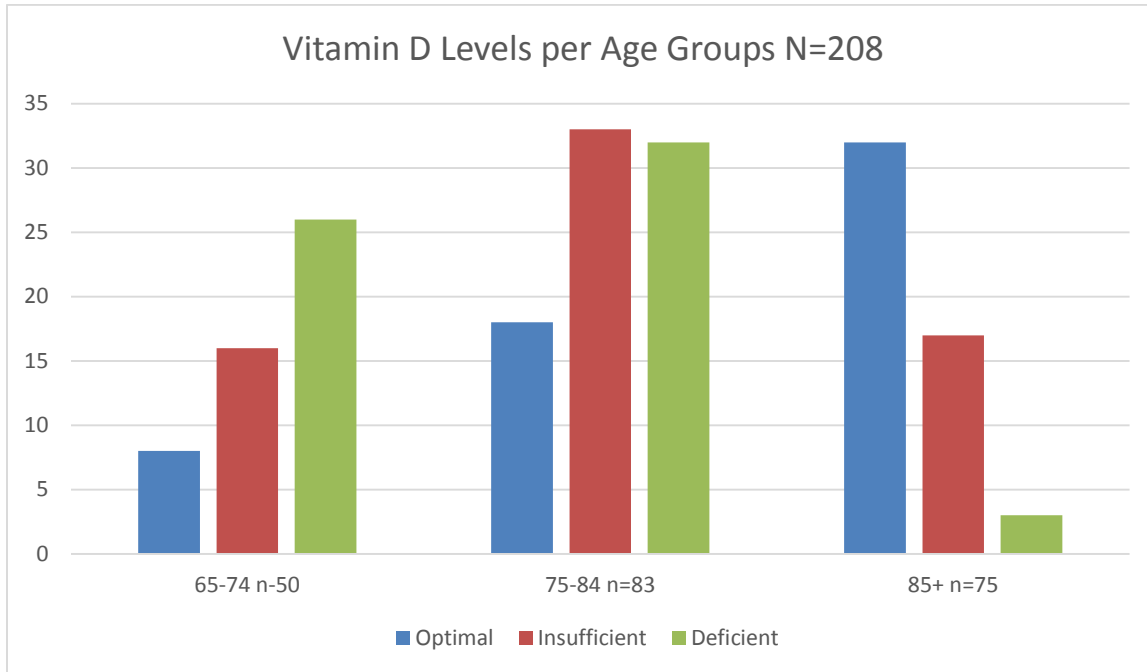
Graph 3. Fracture distribution, N = 2767.



Graph 4. Vitamin D levels, N = 208.



Graph 5. Vitamin D levels per age subcategories, N = 208



Graph 6. Vitamin D level status per fracture type, n=208.

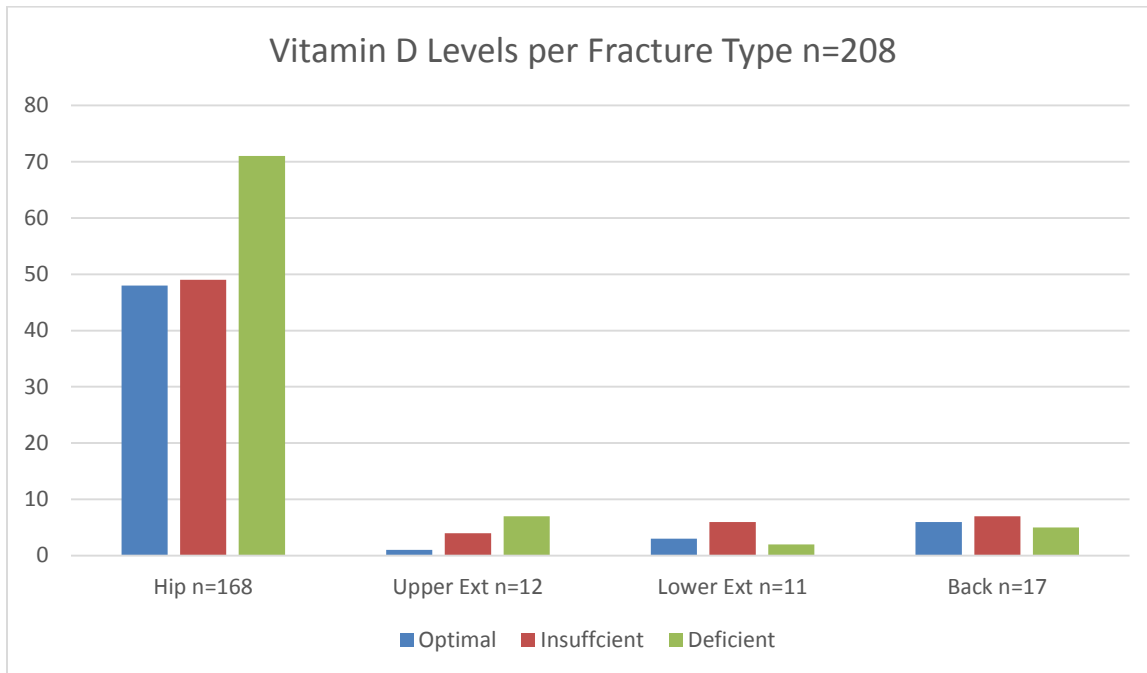




Table 1. Test of association between demographic and clinical factors and Vitamin D status (N = 208)

	<b>Deficient n (%)</b>	<b>Insufficient n (%)</b>	<b>Optimal n (%)</b>	<b>p</b>
Age				.004
65-74	26 (31.0%)	16 (24.4%)	8 (13.8%)	
75-84	32 (38.1%)	33 (50.0%)	18 (31.0%)	
85+	26 (31.0%)	17 (25.8%)	32 (55.2%)	
Gender				.14
Male	19 (22.6%)	24 (36.4%)	20 (34.5%)	
Female	65 (77.4%)	42 (63.6%)	145(69.7%)	
Race				.18
White	80 (95.2%)	66 (10.0%)	57 (98.3%)	
Other	4 (4.8%)	0 (0%)	1 (1.7%)	
Fracture				.202
Hip	71 (84.5%)	49 (74.2%)	48 (82.8%)	
Lower Extr.	2 (2.4%)	6 (9.1%)	1 (1.7%)	
Upper Extr.	7 (8.3%)	4 (6.1%)	3 (5.2%)	
Back	4 (4.8%)	7 (10.6%)	6 (10.3%)	

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## **Conclusion to Practice Inquiry Project**

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## Conclusion

Healthy People 2020 (2012) states fall prevention would be advantageous to improve the health, function and quality of life of older adults. According to, the United Nations report “World Population Aging” (2013) the number of older persons, aged 65 years and older, was 841 million worldwide in 2013. The older population is expected to triple by 2050, with an estimated two billion globally. As the population ages an increase in falls/fractures of these individuals is also expected. Identifying interventions to decrease the incidence of falls leading to fractures could greatly improve the health outcomes of this population.

Vitamin D supplementation is a low cost intervention with low risk of adverse effects. The benefits of supplementation are improved muscle strength and function that may lead to less falls/fractures. With vitamin D supplementation being considered an effective fall prevention intervention, reducing falls by at least 19 % (Bischoff-Ferrari et al., 2009, Prince et al., 2008), healthcare providers should consider the recommendations. The Institute of Medicine (IOM) recommends an older adult, aged 65 years and older, take at least 800 IU’s of vitamin D every day to reduce the risk of fractures (Bischoff-Ferrari et al., 2012). The risk of toxicity is low; an individual would have to far exceed the daily recommend amount of supplemental vitamin D, taking as much as 40,000 IU’s (International Units) a day to reach toxic levels (Dawson-Hughes et al., 2010).

This practice inquiry project found that serum vitamin D levels in older individuals, aged 65 years and older, who have fallen and sustained a fracture are not being evaluated. It was found in only 7.5% of these individuals’ serum vitamin D levels were evaluated. It also has

shown that when serum vitamin D levels are evaluated they are most often sub-optimal. The need for translational research in this area is very high; the information on the benefits of vitamin D needs to be shared with healthcare providers so they can share it with their patients. This could improve health outcomes of the older population.





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**EXEMPTION CERTIFICATION**

MEMO: Suzanne Pilon, RN/BSN  
632 Seattle Drive  
Lexington, KY 40503  
PI phone #: (859)523-8403

FROM: Institutional Review Board  
c/o Office of Research Integrity

SUBJECT: Exemption Certification for Protocol No. 15-1055-X1B

DATE: December 22, 2015

On December 22, 2015, it was determined that your project entitled, "*Retrospective Chart Audit to Evaluate Current Vitamin D Level Screening in Older Adults who Fall and Sustain a Fracture*", meets federal criteria to qualify as an exempt study.

Because the study has been certified as exempt, you will not be required to complete continuation or final review reports. However, it is your responsibility to notify the IRB prior to making any changes to the study. Please note that changes made to an exempt protocol may disqualify it from exempt status and may require an expedited or full review.

The Office of Research Integrity will hold your exemption application for six years. Before the end of the sixth year, you will be notified that your file will be closed and the application destroyed. If your project is still ongoing, you will need to contact the Office of Research Integrity upon receipt of that letter and follow the instructions for completing a new exemption application. It is, therefore, important that you keep your address current with the Office of Research Integrity.

For information describing investigator responsibilities after obtaining IRB approval, download and read the document "PI Guidance to Responsibilities, Qualifications, Records and Documentation of Human Subjects Research" from the Office of Research Integrity's IRB Survival Handbook web page [<http://www.research.uky.edu/ori/IRB-Survival-Handbook.html#PIresponsibilities>]. Additional information regarding IRB review, federal regulations, and institutional policies may be found through ORI's web site [<http://www.research.uky.edu/ori>]. If you have questions, need additional information, or would like a paper copy of the above mentioned document, contact the Office of Research Integrity at (859) 257-9428.

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