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DECREASING OVERALL BREAST CANCER RISK THROUGH ASSESSMENT, TREATMENT, AND PREVENTION OF VITAMIN D DEFICIENCY IN THE ADULT POPULATION

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DECREASING OVERALL BREAST CANCER RISK THROUGH ASSESSMENT, TREATMENT, AND PREVENTION OF VITAMIN D DEFICIENCY IN THE ADULT POPULATION

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DECREASING OVERALL BREAST CANCER RISK THROUGH ASSESSMENT, TREATMENT, AND PREVENTION OF VITAMIN D DEFICIENCY IN THE ADULT POPULATION

An Abstract of the Scholarly Project by
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The primary objective of this study is to examine the effectiveness of an educational initiative aimed at enhancing nurse practitioners' understanding and recognition of vitamin D deficiency. The purpose of this program is to equip them with the skills to screen, diagnose, and manage this condition to mitigate the overall risk of breast cancer in patients. Vitamin D deficiency is a prevalent global health issue that affects over one billion people, and it can manifest at any stage of life without showing any symptoms, making it challenging for healthcare providers to detect. However, even mild or prolonged deficiencies can lead to an increased risk of osteoporosis, cardiovascular disease, diabetes, and specific types of cancer. Breast cancer is a major global health concern that affects millions of women every year, with studies suggesting that low serum vitamin D concentrations could contribute to an increased risk of breast cancer, recurrence, and mortality. A significant proportion of breast cancer survivors have inadequate levels of vitamin D. To evaluate the impact of the educational intervention, this quasi-experimental study will use a pre-and post-test approach, with participants recruited via a private social media group for advanced practice nurses in Southwest Missouri, Southeast Kansas, and Northeast Oklahoma. The data collected will be analyzed to determine if the educational initiative has enhanced practitioners'

awareness of vitamin D deficiency and their confidence in integrating it into their clinical practice.

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CHAPTER I

Introduction

Approximately 35% of the United States population and 50% of the world's population are vitamin D deficient, and most are unaware of this deficiency (Sizar et al., 2023). Vitamin D deficiency can lead to a multitude of health problems. These health problems range from bone fractures, anemia, susceptibility to cardiovascular disease, an increased risk for many types of cancers, and physical development issues (Sirajudeen et al., 2019).

Vitamin D is crucial in maintaining good health as a fat-soluble vitamin that can be acquired through the skin's dermal synthesis or dietary intake (Sizar et al., 2023). Two main types of vitamin D, D3 and D2, are essential for the body. D3 is primarily synthesized in the skin while D2 is obtained from diet (Matyjaszek-Matuszek et al., 2015). This vitamin is responsible for promoting calcium absorption in the digestive system and reabsorption in the bones, maintaining calcium and phosphate levels, regulating cell growth, and preventing hypocalcemic tetany.

Vitamin D deficiency is a common problem that affects people of all ages, ethnicities, geographic regions, and socioeconomic statuses. Unfortunately, healthcare providers often fail to assess, treat, and prevent this deficiency, which can increase the

risk of developing breast cancer in adults who are already at risk. Therefore, the project aimed to raise awareness among healthcare providers about the importance of assessing, treating, and preventing vitamin D deficiency to reduce the overall risk of breast cancer in the at-risk population.

Description of Clinical Issue/Problem

Vitamin D deficiency is a worldwide health problem that causes most patients to present as asymptomatic. Even a mild, chronic deficiency can lead to an increased risk of osteoporosis, falls, fractures, cardiovascular disease, diabetes, and certain types of cancer (Sirajudeen et al., 2019). Vitamin D deficiency is a result of decreased dietary intake, decreased dietary absorption, decreased sun exposure, decreased endogenous synthesis, increased hepatic catabolism, or end-organ resistance (Sizar et al., 2023).

Vitamin D deficiency affects all ages, ethnic groups, and geographical regions worldwide. Vitamin D promotes healthy bones and bone growth and decreases the risk factors for many other diseases. According to Sizar et al. (2023), the population at greatest risk for developing vitamin D deficiency are those with poor nutrition, poor absorption, obesity, the older population, darker skin tones, and those with autoimmune disorders (Sizar et al., 2023). In 2010, the Institute of Medicine (IOM) defined vitamin D deficiency as a serum 25(OH)D level of less than 20 ng/ml and vitamin D insufficiency at levels between 21-29 ng/ml in their 2011 Report on Dietary Reference Intakes for Calcium and Vitamin (Ross et al., 2011). “In accordance with these definitions, it has been estimated that 20-100% of U.S., Canadian, and European elderly men and women still living in the community are vitamin D deficient” (Holick et al., 2011, p. 1914).

Breast cancer poses a serious threat to women's health worldwide with an estimated 2.3 million cases being diagnosed globally, making it the most diagnosed cancer (Arnold et al., 2022). According to the American Cancer Society, one out of every eight women (13%) living in the United States, will develop invasive breast cancer in her lifetime and one in thirty-nine (3%) will die from breast cancer (American Cancer Society, 2022). Risk factors for breast cancer include age, family history, dense breast tissue, obesity, high alcohol intake, and genetics (specifically the BRCA mutation). Thabet et al. (2022) reported that "vitamin D has been observed to exhibit a protective effect against breast cancer, has increased the anticancer response, and has been associated with improved clinical outcomes and cancer survival" (p. 2). While all of these other groups have negative effects related to vitamin D deficiency, it is those with breast cancer who can reduce their likelihood of the onset of cancer through the assessment, treatment, and prevention of vitamin D deficiency.

Significance

According to Brickly et al. (2017), vitamin D deficiency is now identified as one of the most common health conditions worldwide. Vitamin D deficiency is a condition that can manifest at any stage of life. It begins with the pregnant woman and her developing fetus and continues into adolescence, adulthood, and beyond. Vitamin D is an essential nutrient critical for maintaining healthy bones and optimal immune system functioning. It is imperative to ensure adequate intake of this nutrient through a balanced diet and/or supplements to prevent complications related to deficiency. According to Sizar et al. (2023), approximately one billion people worldwide are vitamin D deficient,

and 50% of people worldwide have a vitamin D insufficiency. Vitamin D plays a crucial role in maintaining bone health and bone metabolism and ensuring proper absorption of calcium and phosphorus in the body. According to Holick et al. (2011), the body can only absorb about 10 to 15% of dietary calcium and approximately 60% of phosphorus without vitamin D. However, adequate levels of vitamin D can enhance the absorption of calcium and phosphorus by 30-40% and 80%, respectively. Unless the deficiency is severe, it often goes unrecognized by healthcare providers. A mild deficiency can have adverse consequences that range from anemia, susceptibility to cardiovascular disease, many types of cancer, and physical development issues (Wang et al., 2017).

Cancer is the second leading cause of death in the United States (Xu et al., 2022), with breast cancer being the most diagnosed cancer in American women (American Cancer Society, 2022). According to the American Cancer Society, "approximately 1 in 8 women (13%) will be diagnosed with invasive breast cancer in her lifetime and 1 in 39 women (3%) will die from breast cancer" (p. 3). Breast cancer is a complex disorder, but a relationship has been established between low vitamin D serum plasma levels and breast cancer risk (Thabet et al., 2022). Vitamin D is beneficial in the prevention of breast cancer, with a significantly decreased risk in post-menopausal women (Thabet et al., 2022). Calcitriol, a metabolite of vitamin D3, has been found to possess antiproliferative properties in multiple body systems. Additionally, it can activate the vitamin D receptor (VDR) to promote the differentiation of hematopoietic cells. The VDR is a nuclear receptor responsible for regulating cell proliferation, apoptosis, and metastasis. By activating this cascade, calcitriol can effectively hinder the growth and spread of breast

cancer cells by stimulating cell differentiation, inducing apoptosis, and thwarting migration and invasion (Sirajudeen et al., 2019; Thabet et al., 2022).

Healthy People 2030 is a national initiative that sets goals and objectives to improve the overall health and well-being of the American people. The goal for cancer is to "reduce new cases of cancer and cancer-related illness, disability, and death" (US Department of Health and Human Services, 2020). The objectives include "reducing the female breast cancer death rate and increasing the proportion of cancer survivors who are living 5 years or longer after diagnosis" (US Department of Health and Human Services, 2020).

Assessing, treating, and preventing vitamin D deficiency in at-risk adults is highly significant for the nursing profession. Vitamin D deficiency has no boundaries and is not isolated from any specific age range, gender, ethnicity, geographic region, or socioeconomic status. "There needs to be an appreciation that unprotected sun exposure is the major source of vitamin D for both children and adults and that in the absence of sun exposure, it is difficult, if not impossible, to obtain an adequate amount of vitamin D from dietary sources without supplementation to satisfy the body's requirement" (Holick et al., 2011, p. 1925). By actively assessing those at risk and providing education to those patients, the nursing profession can prevent negative health outcomes. This project provided an opportunity to not only impact the patient's overall health but to potentially decrease healthcare expenses related to providing health promotion and disease prevention measures.

Purpose

The purpose of this DNP scholarly project was to increase healthcare provider frequency of assessment, treatment, and prevention of vitamin D deficiency in the adult population at risk for breast cancer. Research based on empirical evidence has shown a positive correlation between vitamin D deficiency and several health conditions, including but not limited to osteoporosis, cancer, and dietary insufficiencies. It was therefore essential to acknowledge and address the potential risks associated with inadequate vitamin D intake as part of a balanced diet and overall health management. This project sought to educate providers on the importance of screening and treating vitamin D deficiency with a focus on decreasing the patient's risk of developing breast cancer. With the growing evidence and concern about vitamin D deficiency's role in various health conditions, it was important to evaluate and educate healthcare providers' knowledge on screening, diagnosing, and treating those at risk. It was expected that following an educational session, the providers' knowledge would be increased, and they would increase the frequency of screening patients in their clinical practice. The goal was to improve patient healthcare outcomes.

Theoretical Framework

The project utilized Nightingale's environment theory (figure 1.1) as the theoretical framework. This theory can be described as one where the environment surrounding the patient will positively or negatively impact their overall health (*Nightingale's Environment Theory*, 2016). The theory is grounded in the belief that keeping people healthy is dependent upon environmental control (Nightingale, 1859).

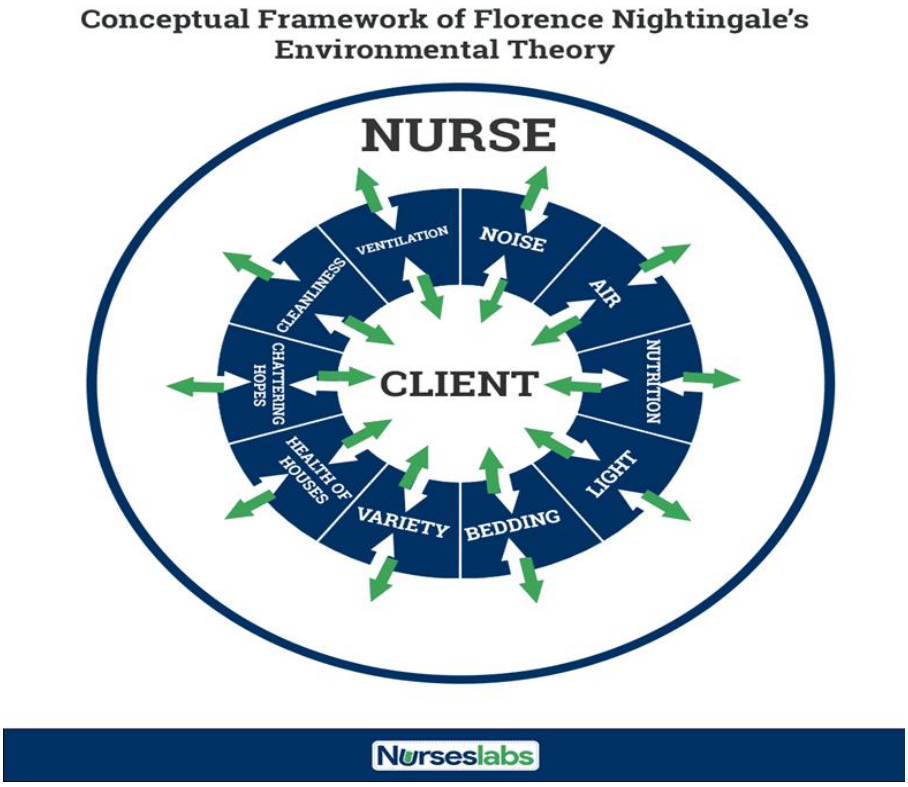
The manipulation of that environment by nursing to best fit the patient's needs can lead to the optimization of the patient's health through gradual restoration. Since the environment is seen as the main agent acting upon the patient to produce disease, the nurse is viewed as a change agent of both the environment and the patient (Wagner & Whaite, 2010). Fresh air, pure water, sufficient food supplies, efficient drainage, cleanliness of the patient and environment, and light (such as direct sunlight) are the identified environmental factors that affect health (*Nightingale's Environment Theory*, 2016). The major assumptions of this theory are that health and illness are dictated by natural laws, that nursing is a distinct field that is not only science but an art, and that nursing is separate from medicine. Nightingale (1859) suggests it isn't symptoms of the disease that lead to suffering, it is the lack of fresh air, of light, of warmth, of quiet, of cleanliness, of punctuality of care (Nightingale, 1859).

The theoretical statements that would apply to the topic of vitamin D deficiency are light and sufficient food supplies. Nurses are taught that the plan of care should be individualized and that they must intervene early at the signs of symptoms and disease, whereas medicine's focus is to cure disease. Vitamin D is directly synthesized from direct sunlight and if patients are not receiving an adequate amount of direct sunlight, then alternative sources must be utilized. These alternative sources are fortified foods and/or supplements. The assumptions that apply to this topic are that health and illness are dictated by natural laws, that nursing is separate from medicine and that nursing is an art. The concept of caring for the whole person presents nursing as a helping process and a

holistic art. Thus, according to Nightingale nursing is seen both as an art and a science (Smith & Parker, 2015).

Figure 1.1

Florence Nightingale's Environmental Theory



Note. Adapted from "Florence Nightingale: Environmental Theory" by A. Gonzalo, 2019 (Gonzalo, 2019)

Scholarly Questions

Educating healthcare providers about the assessment, treatment, and prevention of vitamin D deficiency among the adult population at risk of breast cancer increases their knowledge and affects their self-reported clinical practice.

1. Prior to an educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?
2. Prior to an educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?
3. After the educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?
4. After the educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?

Expected Outcomes

1. Of the participating providers, 100% will report an increase in their knowledge of vitamin D deficiency and its impact on decreasing the overall breast cancer risk following the educational session.
2. Of the participating providers, 25% will self-report the utilization of screening and treatment tools for vitamin D deficiency for those patients at an increased risk of breast cancer following the educational session.

Definition of Key Terms and Variables

Clinical practice- self-reported by providers on their confidence level and management of vitamin D in the at-risk populations. Corresponds to questions 13-17 on the pre-and-post questionnaires.

Knowledge- measurement of the cumulative average score on the knowledge portion of the pre-and-post questionnaires. Corresponds to questions 4-12 on questionnaires.

Nuclear receptor- a large group of proteins responsible for sensing steroids, thyroid hormones, vitamins, and other molecules with the essential function for cell signaling, survival, and proliferation.

Vitamin D deficiency- "as a 25(OH)D below 20 ng/ml (50 nmol/liter)" (Holick, et al., 2011, p. 1911).

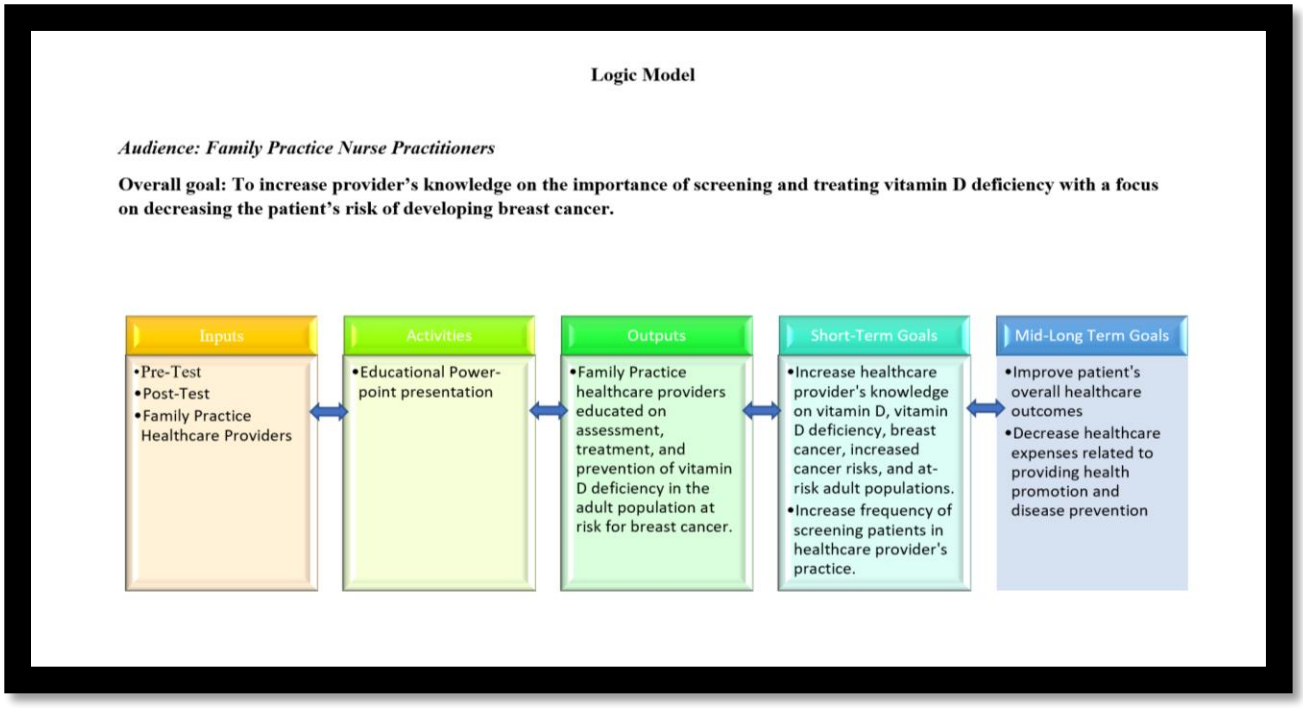
Vitamin D insufficiency- "as a 25(OH)D of 21–29 ng/ml (525–725 nmol/liter)" (Holick, et al., 2011, p. 1911).

Logic Model

A logic model (Figure 1.2) was developed to represent the scholarly project visually. This model facilitated the identification of necessary inputs, activities, and outputs for implementing the project intervention. Additionally, it was instrumental in establishing the short-term and mid-long-term goals of the scholarly project. The short-term goals of this scholarly project included increasing healthcare provider knowledge on vitamin D, vitamin D deficiency, breast cancer, increased cancer risk, and the at-risk adult population. It also aimed to boost the frequency of patient screenings within healthcare provider practices. Enhancing provider knowledge will help achieve mid-long-term goals of improving overall healthcare outcomes for patients and reducing associated expenses.

Figure 1.2

Logic Model of DNP Scholarly Project



Summary

Vitamin D deficiency affects all ages, races, regions, and religions worldwide. Vitamin D promotes healthy bones and bone growth and decreases the risk factors for many other diseases. The adult population that are at the highest risk for vitamin D deficiency are pregnant/lactating women, patients with chronic kidney disease, the elderly, especially if they have dark pigmented skin and live in a northern climate, and adults taking certain medications.

Vitamin D deficiency is a common health issue that can have serious implications on overall health and well-being. Unfortunately, healthcare providers often fail to adequately assess, treat, and prevent this condition. It is important for healthcare

providers to prioritize the detection and management of vitamin D deficiency to ensure optimal health outcomes for their patients. While the testing of the entire patient population is not recommended, it is recommended by the Endocrine Society to assess serum 25(OH)D in patients that fall into the at-risk category. Testing the at-risk adult population and either treating those who are deficient or starting vitamin D supplementation will lead to a positive impact on the patient's overall health. Research has proven that it may potentially decrease the frequency of many acute and chronic disease processes such as breast cancer. It is anticipated that addressing vitamin D deficiencies will decrease healthcare expenses related to acute and chronic diseases. By screening and treating vitamin D deficiencies, it is anticipated that there will be a decrease in mortality, morbidity, and a decrease in overall healthcare expenses related to the associated acute and chronic disease processes.

CHAPTER II

Review of Literature

The literature review focused on the identification of providers' knowledge of vitamin D deficiency. The literature review sought to identify the correlation of vitamin D deficiency with the increased risk for developing breast cancer in adult women. This project served as a quality improvement project to educate healthcare providers on screening for vitamin D and treating deficiencies to decrease the potential risk of developing breast cancer.

In performing a systematic review of the literature, previous research studies were investigated from ProQuest Nursing & Allied Health, Cumulative Index to Nursing (CINAHL), PubMed Medline, and Allied Health Literature. Additional resources include the Endocrine Society, the Institute of Medicine (IOM), American Cancer Society, CDC and the US Department of Health and Human Services. Evidence-based guidelines and supporting literature serve as the cornerstone for this project. The search criteria consisted of the following:

- Breast Cancer
- Vitamin D
- Vitamin D Deficiency

- At-Risk Population
- Screening Guidelines
- Increased Cancer Risk
- Cancer Prevention

These topics were investigated individually as well as in combination to identify relevant articles and studies. Additional articles and studies were found for review utilizing the reference lists of the identified sources. Sources were limited to those published in the past ten years and from scholarly and peer-reviewed publications. The chosen studies and reports applied to the framework of this project. Additional searches were completed to obtain information relating to Nightingale's environmental theory. The sources were grouped into the following topics.

Provider Knowledge

There is no broad consensus on what constitutes vitamin D deficiency. Several organizations have slightly different definitions based on serum levels of 25(OH)D. Over the past 10-15 years, many different international and regional guidelines have been published on the prevention and treatment of vitamin D status. Many of these guidelines have not been updated since their original publication. With the emerging research and inconsistencies in the current clinical guidelines, further research is needed to implement better clinical guidelines in practice regarding vitamin D status evaluation and vitamin D dosing (Bleizgys, 2021).

In 2018, the American Academy of Family Physicians (AAFP) did not recommend testing individuals for vitamin D deficiency as there were no established

health benefits. The AAFP position is that routine screening for vitamin D deficiency leads to hundreds of millions of dollars in wasted testing annually and that even placing patients on low-dose daily supplementation will increase patient's risk of developing kidney stones. The AAFP researchers based their decision on insufficient evidence to reveal any benefits and/or harms of screening for vitamin D deficiency. The AAFP researchers concluded in their study that there was a widely inconsistent clinical practice by physicians when it came to screening, treating, and diagnosing vitamin D deficiency. The inconsistencies arose from their varied knowledge, attitudes, and behaviors. This study recommended better clinical guidelines and encouraged the use of evidence-based management practices (Lin, 2018; Rockwell et al., 2018).

Breast Cancer and Vitamin D Deficiency

Vitamin D deficiency is very common in patients with breast cancer, and research has proven that low levels of vitamin D enhance the associated risk for breast cancer development and its progression (Welsh, 2018). According to Jacobs et al., (2011), numerous studies identify a correlation between breast cancer rates with decreased sunlight exposure and low vitamin D serum levels. Breast cancer mortality rates for women residing in the Southeastern areas of the United States are much higher than for women residing in the Northeastern areas of the United States (Jacobs et al., 2011). This is attributed to the five months of decreased sun exposure in the Northeastern region (Jacobs et al., 2011).

Recent research has shown that an estimated 75% of breast cancer survivors suffer from suboptimal vitamin D levels (Hines et al., 2010). This is tied to the treatment

modalities of aromatase inhibitors (AI) and tamoxifen that are used in the treatment of estrogen receptor-positive breast cancer. These modalities raise concerns related to the negative side effects on bone health, the increased incidence of fractures, and the development of osteoporosis/osteopenia. Recent reports have suggested that a noteworthy amount of breast cancer patients who have been newly diagnosed may have lower than optimal levels of vitamin D. In a study conducted by Napoli et al. in 2010, close to 44% of such patients were identified as vitamin D deficient before receiving any treatment (Napoli et al., 2010). Furthermore, the study revealed that a significant proportion of these patients experienced bone and muscle pain, which is a commonly associated symptom of vitamin D deficiency. However, once these patients received vitamin D replacement therapy, their symptoms were successfully relieved (Napoli et al., 2010).

According to a 2017 study conducted by Atoum and Alzoughool, there appears to be a correlation between vitamin D deficiency and an elevated risk of breast cancer. Imtiaz et al. (cited in Atoum and Alzoughool, 2017) found that patients with low levels of vitamin D at the time of breast cancer diagnosis had a less favorable prognosis. Shockingly, the study showed that almost all (94%) of the participants with vitamin D levels below 20 ng/ml developed metastases, and a significant majority (73%) ultimately passed away due to advanced disease (Imtiaz et al., 2012).

In another research study, O'Brien et al. (2017) investigated the association between vitamin D deficiency and breast cancer over five years. For this study, they utilized a study called the Sister Study. The Sister Study included 50,884 women enrolled from the years 2003-2009 who had a sister with breast cancer, but study participants had

never had breast cancer. It was found that participants with vitamin D levels greater than 38 ng/ml had a 21% lower hazard risk of developing breast cancer themselves (O'Brien et al., 2017). After the five-year follow-up, they found that with vitamin D supplementation at least four times a week, there was an associated 11% lower hazard risk. The groups with the greatest association were among the post-menopausal women. These results support the need for optimal vitamin D levels as an effective method for the prevention of breast cancer and the need for established clinical benchmarks for beneficial vitamin D levels (O'Brien et al., 2017).

Based on a meta-analysis study completed by Song et al. (2019), observational studies were evaluated for the association of vitamin D intake and blood vitamin D levels with breast cancer susceptibility. This study identified 70 relevant studies on vitamin D intake and blood levels. This review clarified the involvement of calcitriol, the by-product of vitamin D, in the proliferation, apoptosis, differentiation, inflammation, invasion, and the metastasis of tumors. This occurred through the regulation of various signaling pathways which disrupts the growth and development of tumors. This study concluded that the risk of breast cancer was inversely related to blood vitamin D levels (Song et al., 2019). Results were unable to determine a significant relationship between high doses of vitamin D intake and a reduced breast cancer risk overall. It did find a significant association between higher vitamin D intake in premenopausal women and a reduced risk of breast cancer (Song et al., 2019).

Acceptable Levels of Vitamin D

There is not yet a broad consensus on what constitutes vitamin D deficiency. Different organizations have varying definitions, based on serum levels of 25 (OH)D. The Endocrine Society (2011) defines deficiency as less than or equal to 20 ng/ml, insufficiency at 21-29 ng/ml, and an optimal level greater than or equal to 30 ng/ml (Holick et al., 2011). The Institute of Medicine (IOM, 2011) defines deficiency as less than 12 ng/ml, insufficiency as 12-20 ng/ml, and optimal as greater than or equal to 20 ng/ml (Ross et al., 2011). The Mayo Clinic defines a severe deficiency as below 10 ng/ml, mild to moderate deficiency at 10-24 ng/ml, and optimal being 25-80 ng/ml (Kennel et al., 2010). Lastly, the American Association of Clinical Endocrinologist (AACE, 2020) define a deficiency as less than 30 ng/ml and optimal being 30-50 ng/ml (Camacho et al., 2020).

In a 2021 review conducted by Bleizgys (2021) on current vitamin D dosing principles, it was determined that there were gaps in the literature for optimal vitamin D levels. It was also concluded that there is an absence of data on current vitamin D levels which may lead to provider difficulty in judgement prescribing vitamin D replacement therapy. This review concluded that guidelines need to be updated and that the adage “get out in the sun more” is not a reliable source of vitamin D repletion in the at-risk population (Bleizgys, 2021). There is a need to establish treatment guidelines for both the prevention and treatment of vitamin D deficiency (Bleizgys, 2021).

The optimal range for vitamin D intake is still a topic that causes disagreement, and there is inconclusive evidence regarding the safety of higher levels for different

populations. However, based on research, it is reasonable to conclude that healthy adults who receive sufficient sun exposure should aim for an upper limit of 50 ng/ml and a lower limit of 30 ng/ml. If an individual's levels fall below 30 ng/ml, they are considered suboptimal and may benefit from a 12-week vitamin D replacement therapy followed by a maintenance therapy dosage.

Screening Guidelines

According to the medical community, testing asymptomatic patients universally was not recommended. The evidence did not support its cost-effectiveness or significance for important health outcomes. Instead, reputable organizations like the Endocrine Society, Mayo Clinic, the US Preventive Services Task Force, and the American Association of Clinical Endocrinologists (AACE) suggest screening individuals with risk factors (Holick et al., 2011). The Endocrine Society provided a comprehensive list of high-risk individuals, including those with malnutrition, obesity, dark-pigmented skin, age $\geqslant$65, conditions that cause GI malabsorption, hepatic disease or failure, chronic kidney disease, cystic fibrosis, and those taking medications that alter the metabolism of vitamin D (Holick et al., 2011). Mayo Clinic included poor oral intake and limited sun exposure on the list, along with laboratory and radiology findings that suggested a possible vitamin D deficiency. Vitamin D testing was necessary when laboratory findings revealed decreased serum calcium or phosphorus levels, elevated parathyroid hormone, or a decreased DEXA scan showing osteopenia or osteoporosis (Camacho et al., 2020).

Summary

Vitamin D is well-known for its benefits on the overall human health and well-being. Research and current recommendations have highlighted the need for cost-effective measures that target at-risk populations and implement strategies to identify individuals at the highest risk for vitamin D deficiency. Current research showed a need for a consensus on what constitutes vitamin D deficiency. The literature revealed that current guidelines are inconsistent, which led to varying practices and attitudes among providers. Many of the existing guidelines have not been updated since their original publications. The recommendations from the Endocrine Society and the Institute of Medicine (IOM) were based on guidelines established in 2011.

Research studies have shown the association between vitamin D and breast cancer risk. Low levels of vitamin D were associated with an increased risk of developing breast cancer, an increased risk for reoccurrence, and an increased risk of death from breast cancer. Vitamin D insufficiency was prevalent among breast cancer patients and contributes to bone loss and a higher incidence of fractures who are receiving treatment with aromatase inhibitors (AI) and tamoxifen. Maintaining optimal vitamin D levels has shown an association with overall better outcomes in breast cancer patients and a decrease in severe arthralgias and myalgias that were associated with vitamin D deficiency and aromatase inhibitors (AI) treatment modalities.

CHAPTER III

Methodology and Project Plan

Given the increasing incidence of breast cancer and the high prevalence of vitamin D deficiency among those at elevated risk, this project aimed to enhance provider knowledge and promote the use of effective treatment modalities. According to Atoum & Alzoughool (2017), "Most of the vitamin D studies supported the inverse association between vitamin D level and breast cancer risk, and retrospective and prospective epidemiologic studies revealed that vitamin D deficiency is associated with increased breast cancer risk" (p. 5). Breast cancer represents 25% of all cancers in women globally. Efforts are underway to identify modifiable risk factors, with vitamin D being a notable area of focus (Elimimian et al., 2021).

Project Design

Quantitative research methods were utilized by using a quasi-experimental design. The project's purpose was to increase the rate of assessment, treatment, and prevention of vitamin D deficiency in the adult population who are at an increased risk for breast cancer. When educated about the assessment, treatment, and prevention of vitamin D deficiency in the adult population that is at risk for breast cancer, healthcare providers increased their knowledge and clinical practice. This project's design allowed the

principal investigator to gather objective data and statistically examine the results to answer the scholarly questions:

1. Prior to an educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?
2. Prior to an educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?
3. After the educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?
4. After the educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?

The design of this project was to assess healthcare providers' knowledge before and after an educational presentation using a pre-test and a post-test. The pre-test questionnaire collected data on the provider's demographics, pre-interventional knowledge, diagnosis, and treatment of vitamin D deficiency, and their understanding of how vitamin D deficiency is linked to an increased risk for breast cancer. The providers received education on vitamin D deficiency. The post-test questionnaire addressed the same demographic and vitamin D deficiency questions but also included inquiries about potential changes to their clinical practice for screening vitamin D deficiency. The purpose of the post-test questionnaire was to enable the principal investigator to gauge the effectiveness of the educational PowerPoint in increasing the participants' knowledge

of vitamin D deficiency and to assess the participants' confidence level in integrating their new knowledge into their current or future clinical practice.

Target Population and Setting

Data was collected via a pre-test and post-test. The data collected contained indirect demographic identifiers. To maintain confidentiality, participants selected a 5-digit numerical code as their identifier. They were instructed to avoid using their date of birth or social security numbers. The project involved giving a pre-test, presenting a pre-recorded educational PowerPoint presentation, and giving a post-test. The data was collected to support a scholarly project focused on enhancing awareness among nurse practitioners about the significance of screening, diagnosing, and addressing vitamin D deficiency. The goal is to decrease the overall risk of breast cancer in patients.

Target Population

The target population for this scholarly project consisted of nurse practitioners who were members of a private Facebook group titled 4-State Advance Practice Nurses (APN). To determine the minimum number of participants, a sample size calculator was used. According to the calculator, to achieve a confidence level of 95% with a margin of error of 5%, the minimum number of participants required was 20.

Recruitment and Inclusion/Exclusion Criteria

Healthcare professionals were recruited using convenience sampling, which involved collecting research data from a readily accessible group of participants. This method was cost-effective as volunteers were easily accessible. Participants were invited to take part in the project via an "Invitation to Participate in Scholarly Project Research"

post in the private 4-State Advanced Practice Nurses (APN) Facebook group by Tracy Stahl, the faculty sponsor and APN member. The pre-test, educational PowerPoint, and post-test were delivered to participants through the Qualtrics system. Both tests were identical, and the results were compared to determine if there was a change in nurse practitioner practices for screening, diagnosing, and preventing vitamin D deficiency. Participation was voluntary, and subjects had the right to withdraw from the study at any time without penalty. To be included in the study, participants must have been 18 years or older, fluent in English, and a member of the 4-State APN private Facebook group. Those who were under 18 years of age, not fluent in English, or not a member of the 4-State APN private Facebook group were excluded from the study.

Protection of Human Subjects

An application was submitted to the Pittsburg State University Institutional Review Board (IRB) for approval for the investigation involving the use of human subjects. According to the Pittsburg State University human subjects' guidelines, the project qualified for exempt status. Subjects included in this study were over eighteen years of age, did not include vulnerable or protected individuals or groups such as minors or prisoners, and the disclosure of responses would not reasonably place the subjects at risk for criminal or civil liability, or be damaging to financial standing, employability, educational advancement, or reputation. This study was presented to the human subjects committee and was approved.

Participation in this study was entirely voluntary, and data was collected with strict anonymity. An informed consent statement was included at the beginning of each

questionnaire. With the completion and submission of the questionnaires, voluntary consent was granted to participate in this project. Individual results were maintained as confidential and were not revealed to any person outside of the conductor of this study and those completing computations of the data as applicable.

Ethical Considerations

The ethical considerations for the study included ensuring that the participants and their responses on the questionnaires remained anonymous. Demographic information on the questionnaires was analyzed to assess the participants' current provider knowledge, clinical practice, and years in practice. Care was taken to ensure that the demographic information did not reveal the identity of any participant.

Instruments

The principal investigator developed an educational PowerPoint presentation that was comprised of an evidence-based data review from the literature review previously discussed. Current guidelines from the Endocrine Society on the screening, diagnosing, and treatment of vitamin D deficiency and from the AACE were included in the educational presentation. A pre-test and post-test were developed by the principal investigator and reviewed by the project advisor before submission and IRB approval (see Appendix A and B for Pre-test Questionnaire and Post-test Questionnaire).

Procedure

After receiving project approval from the IRB, an “Invitation to Participate in Scholarly Project Research” letter was posted into the private Facebook group by faculty sponsor and member, Tracy Stahl. At the bottom of the invitation was a link to the

Qualtrics system that will take the participants to the pre-test, the educational PowerPoint, and the post-test. To maintain confidentiality, the participants were to select their own 5-digit numerical code to use as their identifier on their pre and post-tests. They were instructed to avoid date of birth or social security numbers. The emails and responses were kept confidential with the use of the Qualtrics software. Informed consent was granted with the respondents accepting the invitation to participate.

The pre-test questionnaire collected data on the provider's demographics, as well as their baseline clinical knowledge regarding the diagnosis and treatment of vitamin D deficiency, and their understanding of how vitamin D deficiency correlates with an increased risk of breast cancer. The presentation consisted of a PowerPoint presentation that the principal investigator developed which was composed of evidence-based data on vitamin D, vitamin D deficiency, an overview of at-risk populations, optimal vitamin D blood levels, and breast cancer risk factors that all have been reviewed in the previously discussed literature review.

The post-test questionnaire revisited the provider's demographic information and questions related to vitamin D deficiency. Additionally, it included items designed to assess whether the provider intended to implement changes in their clinical practice to enhance screening for vitamin D deficiency in populations at elevated risk for breast cancer. The purpose of the post-test questionnaire was to allow the principal investigator to evaluate the effectiveness of the educational PowerPoint in increasing the participants' knowledge of vitamin D deficiency and evaluating the participants' confidence level in incorporating their new knowledge into current or future clinical practice.

Financial Analysis

Indirect costs include personal time for the advanced practice professionals participating by taking the pre-test and post-test and viewing the educational PowerPoint. Qualtrics software was used to administer the pre-and post-tests and the educational PowerPoint and to gather the data at no additional cost and was free through the Qualtrics website. The program used to evaluate the data and formulate the results was provided by Pittsburg State University.

Treatment of Data/Outcomes/Evaluation Plan

The pre-test and post-test for this research were collected online through an anonymous survey system called Qualtrics. The Qualtrics privacy statement can be viewed online at https://www.qualtrics.cm/privacy-statement/. To protect anonymity, the system excluded the internet protocol (IP) addresses and locations of the participants from the results. The anonymized responses can be accessed through the Qualtrics system online at https://www.qualtrics.com/support/survey-platform/survey-module/survey-options/survey-protections/#AnonymizeResponses. The principal investigator and faculty sponsor, Tracy Stahl, had secure login access. After data was compiled, it was stored on the faculty sponsor's university computer, which requires two-factor authorization to access. The data will be destroyed after three years. Access to the data was limited to the principal investigator, faculty sponsor (Tracy Stahl), and committee members (Jennifer Harris and Greg Belcher).

Evaluation Measures Linked to Objectives

The goal of this project was to increase healthcare providers' knowledge on how to assess, treat, and prevent vitamin D deficiency in the adult population to decrease overall risk of breast cancer. An additional goal for this project was to increase healthcare provider's clinical screening practices on the assessment, treatment, and prevention of vitamin D deficiency. A pre-test questionnaire was administered before the viewing of the educational PowerPoint to assess the provider's current knowledge base. The education was delivered by utilizing the PowerPoint platform. A post-test questionnaire was administered following the completion of the educational presentation to assess the overall effectiveness of the presentation.

Outcomes/Evidenced-based Measures are Appropriate for Objectives

At the beginning of the educational presentation, it was discussed who was included in the at-risk populations for vitamin D deficiency. The presentation educated participants on vitamin D levels and the categories of deficiency, insufficiency, and sufficiency. To address the treatment methods, the participants were educated on the appropriate pharmacological supplement for vitamin D replacement, recommended dietary intake of vitamin D, and how a deficiency in vitamin D increased the overall risk of developing breast cancer.

Tools/Instruments Described and Linked to Measures and Objectives

The measurement tool used for this study was a pre-test and post-test format. These tools were specifically designed for this project. To test the validity and significance of the tools, they were distributed to physicians, nurse practitioners,

physician assistants, and colleagues currently enrolled in a graduate program. These providers had the foundation to understand the outputs from current and new diagnostic assessments, aid in decision-making, and ultimately improve healthcare for patients.

Methods of Analysis for Each Measure

Statistical analysis was performed on each questionnaire to evaluate the overall effectiveness of the project. The principal investigator completed descriptive statistics on the data and then compiled that data into an Excel spreadsheet. The data was analyzed using inferential statistics. The goals for this project were to improve healthcare providers' knowledge of vitamin D deficiency; and to increase the provider's clinical screening practices for assessing, treating, and preventing vitamin D deficiency in the adult population at an increased risk for breast cancer.

Project Sustainability

Vitamin D screening and the need for vitamin D supplementation have increased in recent years with convincing data showing the benefits of health promotion and disease prevention, especially in those patients who are severely deficient. Vitamin D supplementation is an inexpensive and safe adjunct therapy. The pathophysiological association of vitamin D with the regulation of immune and endocrine systems shows strong associations. Educating healthcare providers on the importance of screening and treating for Vitamin D deficiency has improved outcomes and ultimately led to a decrease in breast cancer rates.

CHAPTER IV

Evaluation of Results

This project's purpose was to increase the rate of assessment, treatment, and prevention of vitamin D deficiency in the adult population who are at an increased risk for breast cancer. When educated on the assessment, treatment, and prevention of vitamin D deficiency in the adult population that is at risk for breast cancer, healthcare providers increased their knowledge and clinical practice. This project's design allowed the principal investigator to gather objective data and statistically examine the results to answer the scholarly questions:

1. Prior to an educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?
2. Prior to an educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?
3. After the educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?

4. After the educational intervention, what is the provider's self-reported screening rate for patients at an increased risk for breast cancer?

Description of Sample Population

Demographics on the questionnaires were evaluated to determine current provider knowledge, current clinical practice, and years in practice. The majority of respondents (95%) identified themselves as Nurse Practitioners. The largest percentage of NPs had been in practice for either 6-10 years or 16-plus years (30%). A significant majority (80%) also stated that their practice was in the family practice specialty.

Table 1

Participant Demographics

Profession of participant		Frequency	Percent
	Nurse Practitioner	19	95.0
	Missing	1	5.0
Total		20	100.0
Years in Practice		Frequency	Percent
	0-5 years	5	25.0
	6-10 years	6	30.0
	11-15 years	3	15.0
	16 plus years	6	30.0
	Total	20	100.0
Practice Type		Frequency	Percent
	Family Practice	16	80.0
	Other	4	20.0
	Total	20	100.0

Description of Key Terms and Variables

Clinical practice- self-reported by providers on their confidence level and management of vitamin D in the at-risk populations. Corresponds to questions 13-17 on the pre-and-post questionnaires.

Knowledge- measurement of the cumulative average score on the knowledge portion of the pre-and-post questionnaires. Corresponds to questions 4-12 on questionnaires.

Nuclear receptor- a large group of proteins responsible for sensing steroids, thyroid hormones, vitamins, and other molecules with the essential function for cell signaling, survival, and proliferation.

Vitamin D deficiency- "a 25(OH)D below 20 ng/ml (50 nmol/liter)" (Holick, et al., 2011, p. 1911).

Vitamin D insufficiency- "a 25(OH)D of 21–29 ng/ml (525–725 nmol/liter)" (Holick, et al., 2011, p. 1911).

Analysis of Project Questions

The pre-test questionnaire obtained pre-interventional clinical knowledge level in diagnosing and treating vitamin D deficiency and knowledge of how vitamin D deficiency relates to an increase in risk for breast cancer. The post-test questionnaire addressed whether the provider plans to implement any changes into their current clinical practice to increase screening for vitamin D deficiency in populations at an increased risk for breast cancer.

To perform a proper analysis of the results, questions 4-12 were scored using a five-point scale. Five points were awarded for the correct answer, and zero points were

given for each incorrect answer. Each question had only one correct answer, making a total of 45 points possible for this section. Questions 13-20 used a Likert scale, with 1 point for "strongly disagree," 2 points for "disagree," 3 points for "undecided," 4 points for "agree," and 5 points for "strongly agree."

1. Prior to an educational intervention, what is the provider's knowledge of vitamin D deficiency and its impact on decreasing the overall breast cancer risk?

Table 2

Provider Understanding of Vitamin D Deficiency Prior to Intervention

	Pre-test Scores	Frequency	Percent
	0-10	5	25
	11- 20	3	15
	21-30	7	35
	31- 40	6	30
	Total	20	100
Mean = 23.5, SD =11.93			

The highest proportion of respondents (35%) scored between 21 and 30 points on the pre-assessment, accounting for 35% of the total. The mean score was 2.5 with a standard deviation of 11.93.

2. After the educational intervention, what is the provider's knowledge level on vitamin D deficiency and its impact on decreasing the overall breast cancer risk?

Table 3

Provider Understanding of Vitamin D Deficiency After Intervention

Post-test Scores		Frequency	Percent
	0-10	0	0
	11-20	0	0
	21-30	5	25
	31-40	15	75
	Total	20	100.0
Mean= 35.3, SD=3.80			

The post-test assessment revealed that the highest number of respondents (75%) scored between 31-40 points, resulting in a mean score of 35.3 with a standard deviation of 3.80.

3. Prior to an educational intervention, what is the provider's self-reported likelihood of screening for vitamin D deficiency for patients at an increased risk for breast cancer?

Table 4

Pre-test Self-Reported Screening Behaviors

Pre-Rating		Frequency	Percent
	1.00-1.99	3	15
	2.00-2.99	6	30
	3.00-3.99	7	35
	4.00-4.99	3	15
	5.00	1	5
	Total	20	100.0
	Mean=3.1, SD=1.00		

During the pre-test, the highest percentage of respondents (35%) fell within the 3.00-3.99 interval, indicating an undecided response. The next highest percentage (30%) fell within

the 2.00-2.99 interval, indicating a disagreeable response. The mean score was 3.07 with a standard deviation of 1.00.

4. After the educational intervention, what is the provider's self-reported screening rate on patients at an increased risk for breast cancer?

Table 5

Post-test Self-Reported Screening Behaviors

Post-Rating		Frequency	Percent
	1.00-1.99	1	5
	2.00-2.99	2	10
	3.00-3.99	10	60
	4.00-4.99	5	25
	5.00	2	10
	Total	20	100
	Mean=3.6, SD=0.89		

In the post-test assessment of self-reported behaviors, the 3.00-3.99 interval attracted the highest number of respondents (60%). The mean score for this interval was 3.6, with a standard deviation of 0.89.

5. Is there an increase in knowledge between the pre-and post-assessment?

Table 6

Post-test Self-Reported Screening Behaviors

Paired Samples Test			t	df	Sig. (2-tailed)
	Mean	Std. Deviation			
Pre-test score vs post-test score	-11.750	13.20636	-3.979	19	.001

A statistically significant disparity exists between the pre-test and post-test scores, with respondents demonstrating an average increase of 11.7 points on the post-test.

6. Is there an increase in the self-reported screening rating between the pre-and post-assessment?

Table 7

Paired T-test on Self-Reported Behavior

Paired Samples Test	Mean	Std. Deviation	t	df	Sig. (2-tailed)
Pre-Screening Behavior vs Post-Screening Behavior	-.51339	1.19624	-1.919	19	.070

According to the analysis, there is no statistically significant disparity in the self-reported screening behaviors of respondents between the pre-test and post-test.

Summary

This project aimed to improve the rate of assessing, treating, and preventing vitamin D deficiency in adults at a higher risk of breast cancer. After receiving education on assessing, treating, and preventing vitamin D deficiency in this population. Respondents demonstrated an average increase of 11.7 points on the post-test, indicating an enhanced understanding of vitamin D deficiency and its link to an elevated breast cancer risk. While no statistically significant differences were found in the providers' self-reported behaviors between the pre-and post-tests, there was a slight increase in the reported screening behaviors.

CHAPTER V

Discussion

The aim of this DNP scholarly project was to increase healthcare providers' frequency of assessing, treating, and preventing vitamin D deficiency in the adult population at risk for breast cancer. This project aimed to educate providers about the significance of screening and treating vitamin D deficiency, with a specific emphasis on reducing the patient's risk for developing breast cancer. Given the increasing evidence and concerns about the role of vitamin D deficiency in various health conditions, it is crucial to assess and educate healthcare providers on screening, diagnosing, and treating those at risk. It was expected that following an educational session, providers' knowledge would increase, leading to an increased frequency of patient screening in their clinical practice. The ultimate objective was to improve patient healthcare outcomes.

Relationship of Outcomes to Research

Current research shows a need for a consensus on what constitutes vitamin D deficiency. The literature has revealed that current guidelines are very inconsistent and have led to varied practices and attitudes among providers. Many of the existing guidelines have not been updated since their original publications. The Endocrine Society and the Institute of Medicine (IOM) made their recommendations in 2011. However,

research studies have shown the association between vitamin D and breast cancer risk. Low levels of vitamin D are associated with an increased risk of developing breast cancer, an increased risk for reoccurrence, and an increased risk of death from breast cancer. Vitamin D insufficiency is prevalent among breast cancer patients and contributes to bone loss and a higher incidence of fractures who are receiving treatment with aromatase inhibitors (AI) and tamoxifen (Hines et al., 2010). Maintaining optimal vitamin D levels has shown an association with overall better outcomes in breast cancer patients and a decrease in severe arthralgias and myalgias that are associated with vitamin D deficiency and aromatase inhibitors (AI) treatment modalities (Hines et al., 2010).

The intended outcomes of this project were:

1. 100% of participating providers will report an increase in their knowledge of vitamin D deficiency and its impact on decreasing the overall breast cancer risk following the educational session.
2. 25% of participating providers will self-report the utilization of screening and treatment tools for vitamin D deficiency for those patients at an increased risk of breast cancer following the educational session.

After conducting the study, we found a statistically significant difference in scores between the pre-test and post-test regarding providers' knowledge levels before and after the educational presentation. Respondents showed an average increase of 11.7 points on the post-test, indicating a better understanding of the connection between vitamin D deficiency and an increased risk of breast cancer, thus achieving the first outcome. There was a slight increase in reported screening behaviors, with at least 25% of providers

expressing plans to increase screening in their practices, but this was not statistically significant.

Evaluation of Theoretical Framework

This project used Nightingale's environmental theory (Figure 1.1) as the theoretical framework for illustration purposes. The main assumptions of this theory are that health and illness are influenced by natural laws, that nursing is a distinct field which combines both science and art and that nursing is separate from medicine. Nightingale (1859) suggests that suffering is not caused by the symptoms of the disease, but rather by the lack of fresh air, light, warmth, quiet, cleanliness, and timely care (Nightingale, 1859).

The theoretical statements that apply to the topic of vitamin D deficiency are exposure to light and adequate food supplies. Nurses are taught that the care plan should be tailored to each individual and that they should act promptly at the first signs of symptoms and disease, whereas medicine focuses on curing disease. Vitamin D is synthesized from direct sunlight, so if patients are not getting enough sunlight, alternative sources such as fortified foods and/or supplements should be used. The idea of caring for the whole person portrays nursing as a supportive and holistic process. Thus, according to Nightingale, nursing is considered both an art and a science (Smith & Parker, 2015).

Based on the study's findings, the participants reported an increase in their knowledge level concerning vitamin D and its correlation with breast cancer following the educational presentation. However, only a marginal improvement was observed in their self-reported utilization of screening tools within their medical practice. The

participants expressed a strong willingness to further integrate the newly acquired knowledge into their clinical decision-making processes. Moreover, the study revealed that the educational presentation had a beneficial impact on the participants' confidence in discussing vitamin D and breast cancer with their patients. Nevertheless, the study also identified the need for continued support and resources to assist healthcare professionals in effectively implementing new knowledge into practice.

Evaluation of Logic Model

The logic model (Figure 1.2) created for this study included the intended audience (nurse practitioners) and the intervention (pre-test, educational presentation, post-test). The expected immediate effects or results of the activity included an increased clinical knowledge level in diagnosing and treating vitamin D deficiency and its relation to an increased risk for breast cancer. According to the survey results, all participants indicated an enhanced understanding of vitamin D deficiency and its link to an elevated breast cancer risk. The next expected effect was a change in practice regarding screening, diagnosing, and treating vitamin D deficiency. While there wasn't a statistically significant increase in self-reported behaviors to increase screening in providers' clinical practice, there was still an increase.

As we take a closer look at the future outcomes outlined in the logic model for the project, it's important to acknowledge that these anticipated results are currently awaiting further clarification. The project is designed to bring about a multitude of improvements in overall patient health, encompassing a wide range of aspects. These may include advancements in chronic disease management, such as better control of conditions to

prevent complications and reduce the need for hospitalizations. Furthermore, the project also aims to address healthcare-associated expenses by implementing strategies to improve care coordination, potentially leading to reduced hospital readmissions and emergency room visits. Additionally, efforts to minimize medication errors and optimize prescribing patterns could contribute to the overall goal of reducing healthcare costs.

Limitations

The principal investigator has identified a few limitations in this project. The largest limitation was the small sample size. Despite making several attempts to increase participation by posting invitations to take part in the study, along with links to pre and post-tests and an educational PowerPoint, on various social media groups such as the 4-State APN group, the Kansas Nurse Practitioner Network group, and the Irene Ransom Bradley School of Nursing at Pittsburg State University page, the study only managed to remain open for 8 weeks to obtain the minimum number of participants.

Implications for Future Projects and Research

Despite the small sample size, the project's findings indicated a statistically significant increase in provider knowledge regarding the association between vitamin D deficiency and an elevated risk of breast cancer. As more valuable information continues to emerge on the impact of vitamin D in improving overall healthcare outcomes, this project could serve as a foundation for future research. It is important to recognize the potential implications of these findings in the context of preventive care and treatment strategies for breast cancer. Additionally, the results suggest the need for further

investigation into the role of vitamin D in promoting overall wellness and disease prevention, highlighting the significance of ongoing research in this area.

Implications for Practice/Health Policy/Education

The principal investigator recommends that advanced nursing professionals maintain an ongoing pursuit of knowledge regarding the impact of vitamin D deficiency and adhere to recommended treatment protocols. The outcomes of this project demonstrated a notable improvement in knowledge pertaining to screening, diagnosing, and managing vitamin D deficiency. Although there was only a modest enhancement in participants' self-reported clinical practices concerning vitamin D, including the integration of new knowledge into their clinical approach, the principal investigator suggests that these findings be disseminated among broader groups of healthcare providers through continuous education.

Conclusion

This project aimed to improve the assessment, treatment, and prevention of vitamin D deficiency in adults at a higher risk of breast cancer. The objective was to educate healthcare providers about the importance of screening and treating vitamin D deficiency, with a focus on reducing the risk of developing breast cancer. It is crucial to raise awareness among healthcare providers about screening, diagnosing, and treating those at risk due to increasing evidence of the role of vitamin D deficiency in various health conditions.

Research studies have demonstrated a link between vitamin D and breast cancer risk. Low levels of vitamin D are associated with an increased risk of developing breast

cancer, recurrence, and death from the disease. Vitamin D insufficiency is common among breast cancer patients and can lead to bone loss and a higher incidence of fractures among those receiving aromatase inhibitors (AI) and tamoxifen treatments. Maintaining optimal vitamin D levels has been associated with better outcomes in breast cancer patients and a decrease in severe joint and muscle pain related to vitamin D deficiency and aromatase inhibitors (AI) treatment.

Following education on assessing, treating, and preventing vitamin D deficiency, healthcare providers' knowledge and clinical practice improved. The study showed a statistically significant difference in providers' knowledge levels before and after the educational presentation, with an average increase of 11.7 points on the post-test. While there were no significant differences in providers' self-reported behaviors between the pre-and post-tests, there was a slight increase in reported screening behaviors, with at least 25% of providers expressing plans to enhance screening practices in their clinics.

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APPENDIX

Appendix A

Pre-Questionnaire

Dear Participant:

This questionnaire is the first of two questionnaires regarding current knowledge of vitamin D deficiency and associated risks. Responses to this questionnaire will be utilized to determine the effectiveness of my quality improvement project for the completion of my Doctor of Nursing Practice (DNP) degree. Participation is strictly voluntary, and you have the right to leave the study at any time without penalty. You may withdraw from the study prior to submission of the questionnaires. All submissions will be confidential; but in order to match your pre-test with your post-test, I ask that you enter a 5-digit numerical code as a personal identifier on the questionnaires. Avoid using date of birth or social security numbers as your identifier. Thank you for your time and participation.

Personal 5-digit code: _____

Demographics of participants:

1. Profession of participant
    a. Nurse Practitioner
2. Years in Practice
    a. 0-5 years
    b. 6-10 years
    c. 11-15 years
    d. 16 plus years
3. Practice type
    a. Family Practice
    b. Internal Medicine
    c. Orthopedic Specialty
    d. Other

Knowledge questions regarding Vitamin D:

4. What is the recommended daily dietary intake of Vitamin D for most adults is?
    a. 400-800 IU
    b. 2,000 IU
    c. 5,000 IU
    d. 500-1000 IU
5. TRUE or FALSE, the following is a list of at-risk patients for Vitamin D deficiency?
   Darker colored skin, Obese children, and adults (BMI >30), Pregnant/Lactating women, Elderly, Chronic Kidney Disease

    a. True
    b. False
6. Vitamin D deficiency is the number one nutritional deficit worldwide?
    a. True
    b. False
7. Vitamin D deficiency enhances risk of the development of breast cancer or the progression of it?
    a. True
    b. False
8. Chronic illness is affected by vitamin D deficiency?
    a. True
    b. False
9. At which serum vitamin D level is it recommended to initiate vitamin D supplementation?
    a. <20 ng/ml
    b. <30 ng/ml
    c. <10 ng/ml
    d. <50 ng/ml
10. What is the preferred vitamin D supplementation?
    a. Ergocalciferol
    b. Calcium + Vitamin D
    c. Multivitamin
    d. Cholecalciferol
11. At what serum vitamin D level is a patient considered to be suboptimal?
    a. <20 ng/ml
    b. <30 ng/ml
    c. <50 ng/ml
    d. >30 ng/ml

12. Low vitamin D levels have been shown to increase the risk of prognostically unfavorable characteristics of breast tumors.
    a. True
    b. False

Personal Practice Questionnaire

1-STRONGLY DISAGREE, 2 -DISAGREE, 3- UNDECIDED, 4-AGREE, 5-STRONGLY AGREE

13. I tend to educate my patients regarding vitamin D deficiency on each of the office visits that I have with them.	1	2	3	4	5
14. The serum laboratory study that I tend to use the most for testing for vitamin D is the 25-hydroxyvitamin D-25(OH)D	1	2	3	4	5
15. The serum laboratory study that I tend to use the most for testing for vitamin D is the 1,25 dihydroxy vitamin-D1,25(OH)	1	2	3	4	5
16. I typically screen patients for vitamin D deficiency	1	2	3	4	5
17. I usually prescribe vitamin D supplementation for the prevention of vitamin D deficiency	1	2	3	4	5
18. I am confident in the process of how patients are screened for vitamin D deficiency in my office.	1	2	3	4	5
19. I am confident in how patients are diagnosed with vitamin D deficiency in my office.	1	2	3	4	5
20. I am confident in my ability to treat patients with vitamin D deficiency.	1	2	3	4	5

Appendix B

Post-Questionnaire

Dear Participant:

This questionnaire is the second of two questionnaires regarding current knowledge of vitamin D deficiency and associated risks. Responses to this questionnaire will be utilized to determine the effectiveness of my quality improvement project for the completion of my Doctor of Nursing Practice (DNP) degree. Participation is strictly voluntary, and you have the right to leave the study at any time without penalty. You may withdraw from the study prior to submission of the questionnaires. All submissions will be confidential; but in order to match your pre-test with your post-test, I ask that you enter a 5-digit numerical code as a personal identifier on the questionnaires. Avoid using date of birth or social security numbers as your identifier. Thank you for your time and participation.

Personal 5-digit code: _____

Demographics of participants:

1. Profession of participant
    a. Nurse Practitioner
2. Years in Practice
    a. 0-5 years
    b. 6-10 years
    c. 11-15 years
    d. 16 plus years
3. Practice type
    a. Family Practice
    b. Internal Medicine
    c. Orthopedic Specialty
    d. Other

Knowledge questions regarding Vitamin D:

4. What is the recommended daily dietary intake of Vitamin D for most adults is?
    e. 400-800 IU
    f. 2,000 IU
    g. 5,000 IU
    h. 500-1000 IU
5. TRUE or FALSE, the following is a list of at-risk patients for Vitamin D deficiency?
   Darker colored skin, Obese children, and adults (BMI >30), Pregnant/Lactating women, Elderly, Chronic Kidney Disease

    a. True
    b. False
6. Vitamin D deficiency is the number one nutritional deficit worldwide?
    c. True
    d. False
7. Vitamin D deficiency enhances risk of the development of breast cancer or the progression of it?
    c. True
    d. False
8. Chronic illness is affected by vitamin D deficiency?
    a. True
    b. False
9. At which serum vitamin D level is it recommended to initiate vitamin D supplementation?
    a. <20 ng/ml
    b. <30 ng/ml
    c. <10 ng/ml
    d. <50 ng/ml
10. What is the preferred vitamin D supplementation?
    a. Ergocalciferol
    b. Calcium + Vitamin D
    c. Multivitamin
    d. Cholecalciferol
11. At what serum vitamin D level is a patient considered to be suboptimal?
    a. <20 ng/ml
    b. <30 ng/ml
    c. <50 ng/ml
    d. >30 ng/ml

12. Low vitamin D levels have been shown to increase the risk of prognostically unfavorable characteristics of breast tumors.
    a. True
    b. False

Personal Practice Questionnaire

1-STRONGLY DISAGREE, 2 -DISAGREE, 3- UNDECIDED, 4-AGREE, 5-

STRONGLY AGREE

13. I tend to educate my patients regarding vitamin D deficiency on each of the office visits that I have with them.	1	2	3	4	5
14. The serum laboratory study that I tend to use the most for testing for vitamin D is the 25-hydroxyvitamin D-25(OH)D	1	2	3	4	5
15. The serum laboratory study that I tend to use the most for testing for vitamin D is the 1,25 dihydroxy vitamin-D1,25(OH)	1	2	3	4	5
16. I typically screen patients for vitamin D deficiency	1	2	3	4	5
17. I usually prescribe vitamin D supplementation for the prevention of vitamin D deficiency	1	2	3	4	5
18. I am confident in the process of how patients are screened for vitamin D deficiency in my office.	1	2	3	4	5
19. I am confident in how patients are diagnosed with vitamin D deficiency in my office.	1	2	3	4	5
20. I am confident in my ability to treat patients with vitamin D deficiency.	1	2	3	4	5

Appendix C

Invitation to Participate in Scholarly Research Project

This is an invitation to participate in a research study for the partial fulfillment of the requirements for the degree of Doctor of Nursing Practice at Pittsburg State University by the principal investigator, Rachel Jamison.

Project Title: Provider Knowledge on Vitamin D Deficiency and Associated Risks

Purpose of the Research: Vitamin D deficiency is a global public health issue with approximately 35% of the United States' population and 50% of the world's population being vitamin D deficient, which constitutes about 1 billion people worldwide. Vitamin D deficiency can be associated to a multitude of health problems and is often overlooked by healthcare providers despite it being prevalent in all age groups, socioeconomic status, ethnicities, and geographic regions. This research study is to understand the current provider knowledge of vitamin D deficiency and the associated risks.

Confidentiality: Participation is voluntary, and you have the right to leave the study at any time without penalty. You may withdraw from the study at any time prior to submission of the questionnaires. All submissions will be confidential; but in order to match your pre-test with your post-test, I ask that you enter a 5-digit numerical code as a personal identifier on the questionnaires. Avoid using date of birth or social security numbers as your identifier. Thank you for your time and participation.

For any questions, please contact:
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