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Evaluating Provider Knowledge on the Impact of Vitamin D Deficiency in Chronic Health Conditions

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**Evaluating Provider Knowledge on the Impact of Vitamin D
Deficiency in Chronic Health Conditions**

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A DNP project submitted to the faculty of the College of Nursing in partial fulfillment of
the requirements for the degree of Doctor of Nursing Practice in the graduate college at
Mississippi University for Women

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Abstract

Vitamin D deficiency affects nearly one billion individuals globally. It is an essential vitamin to maintain bone health as well as the overall health of the body. Recent research reveals the significance of vitamin D deficiency in chronic health conditions like osteoporosis, depression, breast cancer, dementia, and viral infections like COVID-19. The Doctor of Nursing Practice (DNP) project aimed to evaluate if education regarding vitamin D deficiency was effective in improving provider knowledge, increases practice confidence levels, and results in self-reported practice changes. An educational session and two questionnaires were administered to healthcare providers in the state of Mississippi. Before the educational session, participants were asked to complete Questionnaire 1. Questionnaire 2 was to be completed immediately following the educational session. Each questionnaire was considered as independent samples and evaluation of the data was completed using descriptive and inferential statistics ($p = <.001$). Practice confidence levels in assessing and managing vitamin D deficiency increased from 10.7% to 77.8% following the educational session. Further data revealed that 88.9% of the participants were very likely to implement changes in their current clinical practice because of the educational session. As a result, continued education for healthcare providers regarding screening, diagnosing, and treating vitamin D deficiency is recommended to improve healthcare outcomes of adult patient populations.

DEDICATION

I dedicate this project to my family and friends. To my husband, Alex, thank you for your constant reminder of how proud you are of me while achieving all my goals. With your everlasting support, you certainly kept me motivated to continue working

towards this goal of achieving my DNP while simultaneously opening my own clinic. I loved you first. To my parents and sisters, thank you for your endless support and words of wisdom. You have been with me since the beginning of my nursing career for 16 years now. Thank you for all the encouraging words and prayers. To my past students, who were able to empathize with me as students yourselves, thank you for celebrating with me on different milestones. I was completing this degree while teaching you during your first year as a BSN student yourself. To Cali and Devyn, especially, thank you for all the texts and phone calls to make sure I was handling the load, always offering your help, and showing your love.

To Cassie, my twin sister and best friend, who started this journey with me when we returned together to obtain our BSN degree, then our master's degree, and now completing this DNP degree together. It has been quite the journey: lots of laughs, tears, and frustrations have been shared. This is it for us! Thank you for being with me every step of the way. I would not have done this without you! Love you most.

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Evaluating Provider Knowledge on the Impact of Vitamin D Deficiency in Chronic Health Conditions

Vitamin D is an essential vitamin known for its important contribution to bone health in the human body. Other less known contributions of vitamin D include its function to reduce inflammation, increase immunity function, and improve glucose metabolism (NIH, 2021). A recent research article published by Omeed Sizar et al. reveals that vitamin D deficiency may impact the severity of various chronic health conditions like osteoporosis, depression, and cancer. Because of decreased dietary intake, decreased gastrointestinal absorption, decreased sun exposure, and increased metabolism of vitamin D secondary to certain medication usage, vitamin D deficiency has become a global public issue. Recommendations are now forthcoming to begin identifying those at-risk populations, evaluate vitamin D serum levels, and implement treatment accordingly (2021). Further research studies have also concluded that patients with vitamin D deficiency could have worsening symptoms of viral infections like the most recent COVID-19 virus (Anshul, 2020).

Significance of the Problem

According to Omeed Sizar et al., their research article reported an estimated one billion people worldwide to have vitamin D deficiency. Those populations at greater risk for developing vitamin D deficiency include those with autoimmune disorders, poor nutritional intake or absorption, older age population, obesity, darker skin tones, and those housed in nursing homes. The researchers further expanded their results reporting that in the United States, 50-60% of nursing home residents or those in long term hospitalizations were deficient in vitamin D. Of the younger populations, 47% of African

American infants and 56% of Caucasian infants suffer from vitamin D deficiency while 90% of infants in Middle Eastern countries have vitamin D deficiency. In the United States, 35% of adults have vitamin D deficiency while those living in the Middle Eastern countries were at over 80%. In the United States, 61% of the elderly population are affected by vitamin D deficiency (2021).

Research continues to reveal the significant impact of vitamin D deficiency in the healthcare outcomes of patients. As a result, healthcare providers must be willing to improve their practice habits by screening and treating those at-risk populations. However, this normal practice of not addressing the vitamin D statuses of patients could be due to the lack of knowledge of the impact vitamin D has on everyday patient health. A study performed among Indian Medical Undergraduate students revealed a significant gap in the knowledge of vitamin D, its sources, at-risk populations, and associated health risks with deficiency (Lhamo, et al, 2017).

A second research study was performed in Pakistan to assess the knowledge, attitude, and practice guidelines of providers in diagnosing and treating vitamin D impairments. Madeeha Hassan et al. performed a cross-sectional descriptive questionnaire comprised of 188 practicing doctors across Pakistan. After their study, they determined that though most of the participants were treating vitamin D impairments, there was no uniform guideline to follow leading to several differences in when to diagnose and when to treat the disorder. Therefore, the researchers concluded their study with the recommendation of a national guideline for diagnosing and treating vitamin D deficiency (2018).

A recent report released by the U.S. Preventative Services Task Force (USPSTF) reveals that there is a lack of evidence in screening those individuals at low risk of vitamin D impairment. Their report remarks that individuals at low risk for the disorder are still at high risk for chronic health diseases like bone fractures, falls, and depression. As a result, the USPSTF continues to discourage healthcare professionals from universal screening for vitamin D deficiency. Mozaffarian et al. recommend instead for individuals to obtain vitamin D from sun exposure and nutritional foods like fatty fish, mushrooms grown with UV light, fortified milk, juices, and breakfast cereals. At the same time, however, they recommend that those with vitamin D deficiency to receive supplementation from their healthcare provider (2021). Despite the USPSTF recommendation of not screening for those low-risk individuals, healthcare providers should continue to identify, diagnose, and treat those at-risk individuals with vitamin D impairment.

Purpose of the Research Study

The purpose of this project was to evaluate providers' knowledge and improve the provider confidence level in identifying at-risk patient populations for vitamin D deficiency as well as screening and treating the disorder. It also aimed to evaluate the implementation of self-reported practice changes by the participating providers. The researcher developed a virtual educational PowerPoint presentation with the objectives of defining vitamin D deficiency, the global impact of vitamin D deficiency, the effect it has on different health conditions, and treatment recommendations. The researcher also developed questionnaires that were administered before and after the educational presentation which aimed to assess if provider knowledge and clinical practice

confidence levels increased. It also aimed to assess if the participating providers planned to change their current practice habits to increase diagnosing and treating vitamin D deficiency among their patient population. To assist those participating providers, the researcher also developed a treatment algorithm formulated by using recent evidence-based practice guidelines with recommended diagnostic levels of vitamin D impairment, pharmacological recommendations for treatment, and any recommended follow-up evaluations.

Problem Statement

With growing evidence and concern for the impact of vitamin D deficiency in various health conditions, it was important to evaluate provider knowledge as it related to screening, diagnosing, and treating those with this disorder. Following the educational sessions given by the current researcher, it was expected that providers' knowledge would be impacted in improving their clinical practice and their patient healthcare outcomes.

Expected Outcomes

1. 100% of the participating providers will report improved knowledge of vitamin D deficiency and its impact on chronic health conditions following the educational session.
2. 25% of the participating providers will report utilizing screening and treatment tools for vitamin D deficiency following the educational session.

PICOT Question

Does education regarding Vitamin D deficiency increase healthcare providers' knowledge and affect self-reported clinical practice?

Conceptual Framework

The conceptual framework for this project followed Kurt Lewin's Change Theory focusing on the aspects of his unfreeze-change-refreeze model. The use of this model for this current project helped facilitate the necessary practice changes to improve patient outcomes. Stage I of Lewin's theory is termed unfreeze. This means that a problem has been identified such as vitamin D deficiency and addresses the readiness of providers to improve their practice. Initiating change in healthcare practice requires education and motivation. It was anticipated that following the educational session on the impact of vitamin D deficiencies and patients' health that providers would easily identify a need for change in their current practice. The second stage of Lewin's theory is called change. Once a need had been identified to improve their practice, it was important for those participating providers to carry through with continuing education to further identify, evaluate, and treat vitamin D deficiency. Change ideas could range from policy changes to educating all staff on the importance of identifying those at-risk populations. The last stage of Lewin's Change Theory is called refreezing. This means that once providers were educated and practice changes were identified, it was anticipated that the necessary changes would be implemented to improve the management of vitamin D deficiency in their patient populations. Kurt Lewin's Change Theory guided this current research project in facilitating education and bringing attention to the prevalence of vitamin D deficiency in the healthcare system (Nursing Theory, 2020).

Key Terms

1. **Education**—theory of teaching participants using an educational PowerPoint presentation on screening, diagnosing, and treating vitamin D deficiency.
2. **Diagnosis**—identifying a medical condition by medical signs and symptoms.
3. **Vitamin D**—a fat-soluble vitamin required for normal growth and bone development in the body. It also plays an important role in fighting infections and decreasing the severity of several medical diagnoses.
4. **Deficiency**—lacking the appropriate level of vitamin D in the human body to maintain overall good health.
5. **Healthcare providers**—educationally and clinically trained physicians, nurse practitioners, and specialists who assess, diagnose, and treat different health conditions in individuals.
6. **Knowledge**—measurement of the cumulative average score for the knowledge portion of pre-and post-questionnaires question numbers 4-12.
7. **Clinical practice**—healthcare providers' description of their confidence level and routine management of vitamin D as determined by questions 13-17 on the pre-questionnaire and questions 13-16 on the post questionnaire.

Population and Setting

The target population was healthcare providers located within the state of Mississippi who provide direct care to patients with the inclusion of any healthcare practitioner. Participating parties were those that agreed to participate in both the educational session and survey questionnaires. The educational session was offered with the option of being presented as a virtual or in-person presentation. The goal of offering

different presentation options was to improve the research study sample size. All participants requested to attend the virtual platform which was performed by a voice-over recorded PowerPoint presentation.

Review of Literature

Search Method

The evidence-based guidelines and supporting literature that serve as the cornerstone of this DNP project were found through keyword searches utilizing Google Scholar, the Fant Memorial Library at Mississippi University for Women, and other search engines including PubMed and MEDLINE. However, most of the literature used in this study was discovered through the Fant Memorial Library website. Research studies, guidelines, and recommendations utilized for this study were published from 2016 to the present.

Keywords and phrases used when searching the literature databases were vitamin D deficiency, primary care clinics, at-risk populations, diagnosing, and screening tools which yielded approximately 313,000 articles. After adding more specific terms, viewing peer-reviewed sources, and limiting years of publication to 2017, the researcher was successful in finding a smaller volume to utilize in the current study (see Appendix D for Search Strategy Map). There were other searches performed to obtain information relating to Kurt Lewin's Change Theory.

Literature Synthesis

Once the literature search method was complete, several articles were reviewed for inclusion in this project. Those articles and their findings are discussed in the next topics of provider knowledge through COVID19.

Provider Knowledge

The American Academy of Family Physicians (AAFP) does not recommend testing individuals for vitamin D deficiency even for those at-risk populations. The researchers determined that the AAFP reported this attitude in screening for vitamin D deficiency due to a lack of insufficient evidence revealing the benefits and harms of screening for vitamin D deficiency. Despite this finding, the researchers discovered that in New York, 40% of the serum vitamin D laboratory tests ordered were not medically indicated suggesting the lack of knowledge of guidelines in this region. In California, 3% of the serum vitamin D tests ordered were for those patients classified as “high-risk.” The researchers reported provider attitude when treating vitamin D management was not always the top priority during patient visits. The researchers also reported Upstate New York spent \$33 million on serum vitamin D tests in 2014 suggesting that physicians either did not understand recommended guidelines for testing or did not agree with them making their own clinical judgments. Another influence could have been recent research revealing the effects of low vitamin D levels in non-skeletal health conditions. At the conclusion of their study, the researchers were able to determine that lack of inconsistency in clinical practice varied among physicians’ knowledge, attitudes, and behaviors in testing vitamin D levels. It was recommended that better clinical guidelines and encouragement of following evidence-based management practices be implemented. (Rockwell et al., 2018).

Bone Health

One of the most important roles of Vitamin D in the human body is its contribution to bone health. Vitamin D deficiency is known to cause a chronic condition called osteoporosis. One of the larger at-risk populations for osteoporosis is in

postmenopausal women. A recent cross-sectional study was performed in Sri Lanka from January 2018 to December 2018. After this study, it was revealed that of the 105 postmenopausal participants, 44% were Vitamin D insufficient with 19% being deficient in their Vitamin D levels. Bone density assessments were performed on 71 of the participants revealing 38% who completed the test had osteoporosis. This finding was directly correlated with the level of 25(OH) Vitamin D level (Suganthan, 2020).

A separate study performed by reviewing medical records of 136 postmenopausal women with current fractures revealed that 61.8% of the participants had vitamin D deficiency with 14.7% having vitamin D insufficiency. The researchers based their results on vitamin D levels as <20 ng/ml for deficiency and 20-30 ng/ml as insufficient. They further separated their fracture groups into high-energy injury versus low-energy injury. The researchers defined low-energy injury as a fracture that results from a fall at less than one meter in height. No definition was provided for high-energy injury. After their study, the researchers determined there was a high prevalence of fractures among the participants who had vitamin D deficiency. They further determined the prescription rate for vitamin D supplementation was lower in those participants with high-energy fractures than those with low-energy fractures (Lee & Kim, 2018).

Depression

Another chronic health condition to evaluate is the impact of vitamin D impairment and the symptoms of depression. According to a National Institute of Mental Health report dated from the year 2017, there were approximately 17.1 million adults aged 18 and older who have suffered from major depressive episodes. Major depression is a leading cause of mental health disorders that can lead to the interruptive social, work,

and personal lives of individuals who suffer from the condition. There are several at-risk populations including military personnel. In 2019, Kelly Schaad, et al. performed a retrospective chart review of those military patients with a diagnosis of depression to determine if there is a correlation with vitamin D deficiency. The study population consisted of 318,818 participants with a diagnosis of vitamin D deficiency and/or depression. The researchers reported that vitamin D plays a role in the synthesis of dopamine and serotonin in the brain which impacts mood, motivation, pleasure, and drive. After their study, it was revealed that 20.4% of those military participants who suffered from depression were also vitamin D deficient as compared to the 4.2% of the participants who were not deficient. The researchers noted that military personnel are often reluctant to address possible depression concerns, and further standardizing of vitamin D screenings could help with the recognition of depression in this population. The limitations of their study included the exclusion of demographics of skin tone, BMI, and vitamin D nutritional intake of those participants which could have limited the analysis of the data collected. Despite this, the researchers still strongly believed that the risk of vitamin D deficiency is correlated with a depression diagnosis (2019).

In a separate study, the researchers' goal was to identify an association between the status of vitamin D levels with a diagnosis of depression in female participants. This study was performed by a self-administered questionnaire given to 770 female teachers in Kuala Lumpur, Malaysia. At their conclusion, the researchers determined that approximately 72% of the female participants were vitamin D deficient based on serum levels of vitamin D <20 ng/ml with 68% reporting that depression was independently associated with the status of vitamin D levels (Moy, et al., 2016). Because of the

prevalence of both vitamin D deficiency and depression disorders in the US, it should be considered plausible to screen at-risk populations for vitamin D deficiency.

Breast Cancer

Recent research has been published discussing a link between vitamin D deficiencies and its impact on certain cancers like breast cancer. A 2017 research study performed by Manar Atoum and Foad Alzoughool revealed that there is an inverse relationship between vitamin D levels and the risk of breast cancer. They performed systematic literature reviews about vitamin D deficiency and the increased risk of breast cancer. One research study revealed that low levels of vitamin D were not only at the time of diagnosis but also associated with a poorer prognosis showing that 94% of the participating women with vitamin D levels less than 20ng/ml developed metastases and 73% died from advanced disease.

A second research performed by Katie O'Brien et al. associated risk between vitamin D impairment and breast cancer over five years. They utilized a study called the Sister Study which enrolled 50,884 women from the years 2003 to 2009 without breast cancer but who had a sister with the disease. Of those participants with low vitamin D serum results, they concluded that 1,611 women with low vitamin D levels later developed breast cancer compared to 1,843 randomly selected cohort participants with normal ranges of vitamin D serum levels. At the conclusion of their study, the researchers revealed that those participants with high serum vitamin D levels greater than 38 ng/ml combined with regular use of vitamin D supplementation had decreased rates of breast cancer incidents by an astounding 21% over a five-year follow-up period (2017).

Dementia

Another important chronic health condition impacted by vitamin D deficiency is cognitive impairment like dementia. A cross-sectional study published in the year 2020 revealed that there is a correlation between developing increased severity of cognitive impairment in those patients with low serum vitamin D levels. Their study included patients enrolled in the Department of Neurology of the General Hospital of Wanbei Coal and Electrical Group that was studied from the years 2017 to 2018. Two methods in their study included obtaining MRI imaging of the brain and serum vitamin D test results. A mini-mental state examination (MMSE) was also used to evaluate participants' cognitive status. There was a total of 226 eligible participants in their study. The researchers evaluated the MRI results and discovered that as the number of participants with cases of white matter lesions of the brain increased so did the proportion of patients with vitamin D deficiency. Further results expressed were that 69.2% of the participants with vitamin D levels of <20 ng/ml have severe white matter lesion disease as compared to approximately 31% of those with sufficient levels of vitamin D. As a result, they concluded that there is a direct link between vitamin D deficiency and cognitive impairments (Wang, et al, 2020).

In 2019, a group of researchers performed literary searches seeking a link between vitamin D deficiency and the development of Alzheimer's Disease (AD) and dementia. The role of vitamin D in neutrophils, neurotransmission, neuroprotection, and neuroplasticity suggests that vitamin D plays an important impact on cognitive health. After their study, they revealed that of the participants with vitamin D deficiency, 32% were at an increased risk for dementia while 34% were at risk for AD (Chai, et al., 2019).

COVID19

Most recently concerns have arisen regarding the severity of COVID19 virus infections and a possible link to vitamin D serum impairments. Alireza Abrishami, et al, performed a medical chart review of patients diagnosed with COVID19 and were inpatients from February 28, 2020, to April 19, 2020. Of the chart reviews, 73 subjects were included in their study. As noted by the researchers, vitamin D plays a significant role in the development and persistence of inflammation in the lungs. Previous studies revealed that higher serum concentrations of vitamin D showed a reduced risk of influenza progression during winter months. Therefore, the researchers' goal in their study was to identify if vitamin D levels play a key role in the severity of COVID19 symptoms. The results of their study revealed that those patients with low serum vitamin D levels and COVID19 were significantly associated with increased lung involvement including poor outcomes. They further reported that those with vitamin D deficiency also had a higher death rate revealing a 34.6% probability of death compared with 6.4% of those patients with sufficient levels of vitamin D (2021).

A separate study done by Kaufman et al which included 191,799 patients with positive COVID19 tests as well as serum vitamin D levels revealed that those participants with deficient serum vitamin D levels (<20ng/ml) equated to higher positive COVID tests in 39,190 patients as compared to a total of 40,191 patients who had serum levels ranging from 30 to >55 ng/ml. As a result of their study, the researchers suggest a strong correlation between vitamin D serum levels and the rate of infection by the COVID19 virus (2020).

Project Implementation/Methodology

After receiving approval from the Mississippi University for Women Institutional Review Board (see Appendix A for IRB approval), the researcher began implementation of this practice improvement project. Convenience sampling was utilized for data collection with the recruitment of participants by social media requests made through the Mississippi APRNs Facebook page, by email, and by in-person invitation requests. A brief PowerPoint presentation was provided on a virtual platform at the request of each participant. Current guidelines for screening, diagnosing, and treating vitamin D deficiency were included in the educational session. Participants were provided two separate links to answer both questionnaires (see Appendix B and C for Questionnaires 1 and 2), which were both linked in the PowerPoint presentation. Before participating, consent statements were included with the questionnaires. Completion and submission of the questionnaires implied their voluntary consent to participate in this study. The participants were asked to complete the first questionnaire before watching the presentation to ensure the accuracy of the data collected. The first questionnaire was utilized to assess provider demographics and knowledge of screening, diagnosing, and treating vitamin D deficiency. The second questionnaire addressed the same provider demographic questions along with knowledge questions relating to vitamin D deficiency but also included assessing if providers planned to change their current practice to improve vitamin D deficiency treatment. The purpose of the second questionnaire also allowed the researcher to evaluate if the educational session was effective in improving providers' knowledge and practice confidence level related to this condition.

Tools/Instrumentation

The researcher developed an educational PowerPoint presentation which was comprised of evidence-based data reviewed in the literary research previously discussed. The two questionnaires were developed by the researcher and reviewed by the project advisor before application submission to IRB for approval (see Appendix B and C for Questionnaires 1 and 2). The researcher also developed a screening and treatment algorithm (see Appendix E for the algorithm) that was provided to the participants within the PowerPoint presentation to assist as a clinical decision guideline.

Evaluation Methods

Statistical analysis was performed for each questionnaire to evaluate the effectiveness of the project implementation. The researcher completed descriptive statistics and compiled the data in an Excel spreadsheet. This information was then forwarded to a professional statistician to assist in statistical analysis using inferential statistics. There were three project goals: improving provider knowledge regarding vitamin D deficiency, increased provider confidence level, and increasing provider clinical practice of screening, diagnosing, and treating vitamin D impairment.

Project Timeline

The original proposal was completed in the fall semester of 2020. The researcher performed an ongoing review of the literature and developed the questionnaires during the spring semester of 2021. Once approval from the IRB committee was granted, the researcher began recruiting providers in June 2021 to participate in the educational session receiving. The researcher obtained 82 email addresses from willing participants.

The timeline for participants to complete both the educational session and questionnaires lasted over six months ending in February 2022. Reminder messages to complete the educational session and questionnaires were sent on January 24, January 28, and February 1 in the year 2022 to participants with a total of 28/82 pre-questionnaire responses and 26/82 post-questionnaire responses received by the deadline. Once data collection was completed, the researcher forwarded the compiled results to a statistician to assist in the interpretation of the findings. Results were compiled in March and April of 2022 with the final defense of the project occurring during the spring semester of 2022.

Results

The goal of this quality improvement project was to increase the knowledge of healthcare providers regarding the impact of vitamin D deficiency in chronic health conditions. Two other goals was to increase healthcare providers' practice confidence levels and clinical practice of screening, diagnosing, and treating vitamin D impairment. The educational session was executed using a PowerPoint platform. One questionnaire was administered before the participation in the educational session with the second questionnaire administered immediately following completion of the presentation.

Participants

Nurse practitioners, physicians, specialists, and other providers attended the educational session. The first questionnaire was completed by 23 (85.2%) nurse practitioners, 2 (7.4%) physicians, and 3 (10.7%) specialties (see *Figure 1*). Of these 28 participants, 15 (53.6%) reported working in primary care, 3 (10.7%) in pain

management, 7 (25%) in other specialties, and 3 (10.7%) in orthopedic specialties (see *Figure 2*). Years' experience of participants was reported as 12 (35.7%) for 0-5 years, 10 (35.7%) for 6-10 years, 4 (14.3%) for 11-15 years, and 2 (7.1%) for 15 plus years (see *Figure 3*). Each questionnaire was evaluated as an independent sample without matching responses. One participant did not complete the post-questionnaire survey.

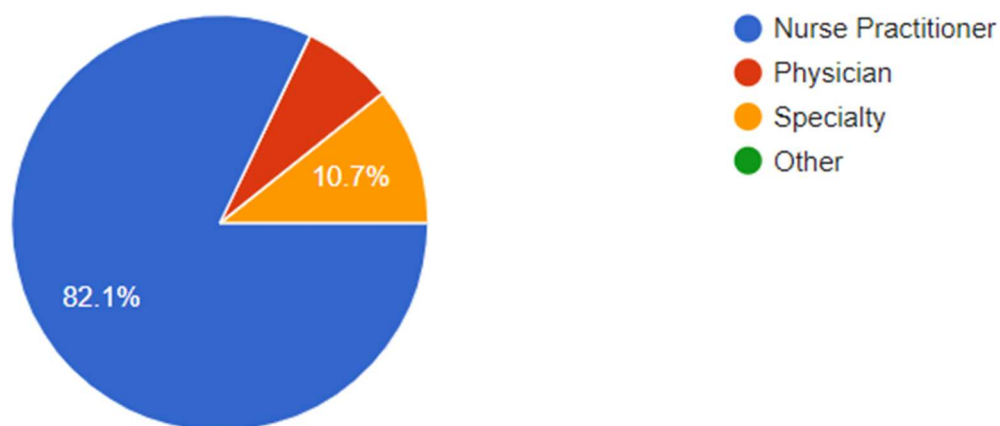


Figure 1, Questionnaire 1: Profession of participant

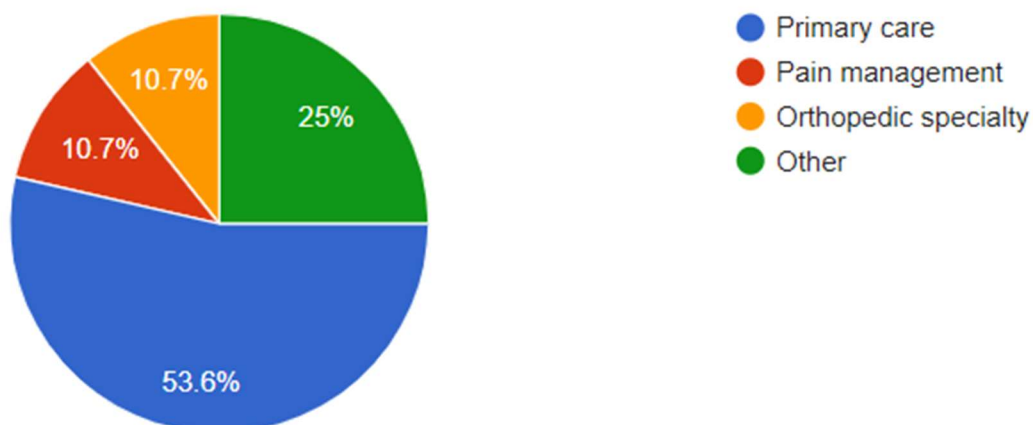


Figure 2, Questionnaire 1: Practice type

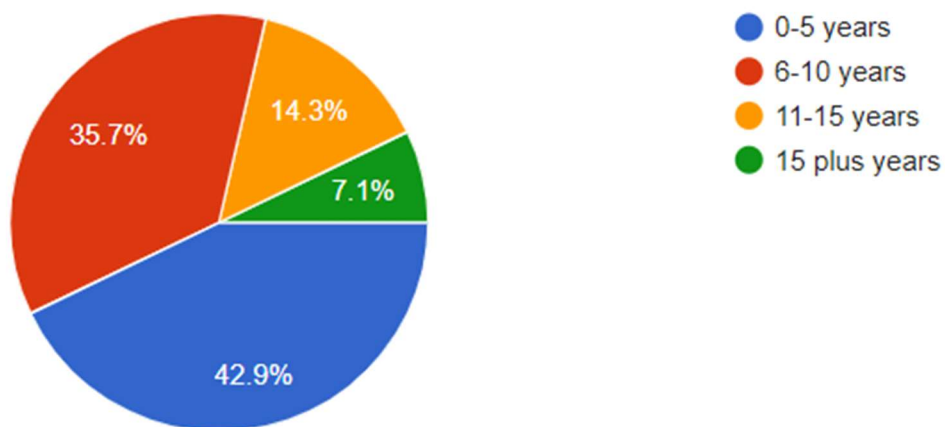


Figure 3, Questionnaire 1: Years in practice

Outcomes

At the beginning of the educational session, at-risk populations for vitamin D deficiency were discussed. Before education, approximately 4% of the participants correctly answered. Following education, however, this number increased to approximately 22% (see *Figures 4 and 5*). Participants were asked at what serum vitamin

D level to initiate pharmacological therapy. Pre-education responses were answered correctly at 85.7% when choosing '<30.' Post-education, this question was correctly answered at 100% (see *Figures 6 and 7*). Another question posed to the participants was to identify which serum level of vitamin D was considered deficient and insufficient with the correct answer choice being "<20 deficient, <30 insufficient.' Before the educational session, 78.6% of the participants chose the correct answer with this number improving to 100% after education was provided (see *Figures 8 and 9*). Participants were asked if vitamin D is the number one nutritional deficit in the world with answer options of 'true' or 'false.' Pre-education results revealed 71.43% chose 'true' with 100% of the respondents choosing 'true' after education was provided (see *Figures 10 and 11*). Per clinical guidelines, the pharmacological supplement of choice is cholecalciferol to supplement vitamin D. The participants were asked to identify the correct supplementation. Only 50% identified cholecalciferol as the correct answer before education. Once education was provided, the correct answer choice increased to approximately 74% (see *Figures 12 and 13*). Another knowledge question posed to participants was to identify symptoms of vitamin D toxicity. Before the educational session, approximately 61% of the participants chose 'kidney stones' as the correct answer. Once education was provided, the correct answer percentage increased to approximately 88% (see *Figures 14 and 15*). The recommended dietary intake of vitamin D for most adults is 600IU per day. Pre-education results revealed approximately 43% correctly answered; however, after education was provided, this number increased to approximately 89% identifying the correct answer choice (see *Figures 16 and 17*). Statistical analysis was performed on the seven knowledge questions of the pre-and

postquestionnaires. Each was evaluated as independent samples by a professional statistician. Prior to the educational session, 3.53% or 55% of the 7 questions were correctly answered. Following the educational session, 5.83% or 80% of the participants correctly answered those knowledge questions. Therefore, it was determined to be of statistical significance with a *p-score* of less than 0.001. The prequestionnaire and postquestionnaire each contained a question regarding the confidence level of the participant in screening and treating vitamin D deficiency. Prior to the educational session, 10.7% of the participants reported being 'very confident' in treating the disorder with 60.7% reporting somewhat confident. Not confident was reported at 7.1% and confident was reported at 21.4%. Following the educational session, it was noted that the participants reported a significant increase in their confidence levels with 77.8% reporting very confident, 18.5% reporting confident, and 3.7% reporting somewhat confident (see *Figures 18 and 19*). No participant reported not being confident on the post questionnaire as was reported on the prequestionnaire. Statistical analysis was also performed on the likelihood that participants were addressing vitamin D deficiency before and after the educational session to determine if there was statistical significance in the data results. A chi-square test of association was performed to determine if the responses in the pre-questionnaire were associated with responses in the post-questionnaire. The test found no statistical association with how participants answered either questionnaire with a resulting *p-score* of 0.274 (see *Figures 20 and 21*).

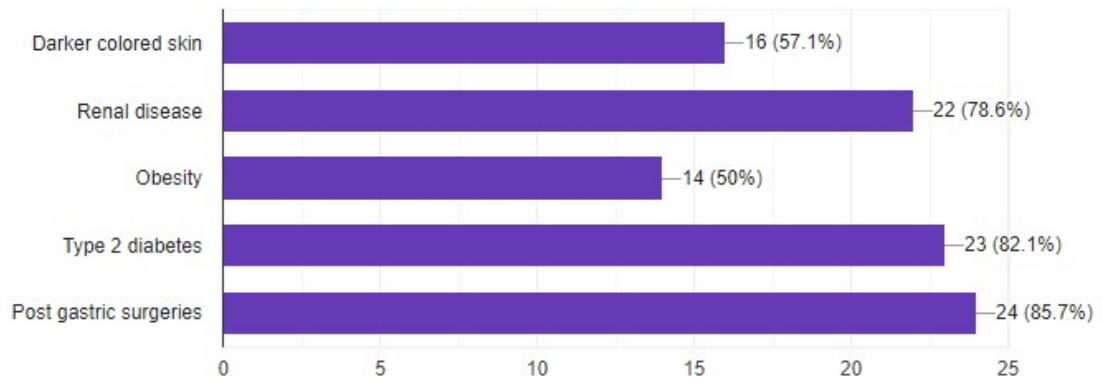


Figure 4, Questionnaire 1: At-risk populations

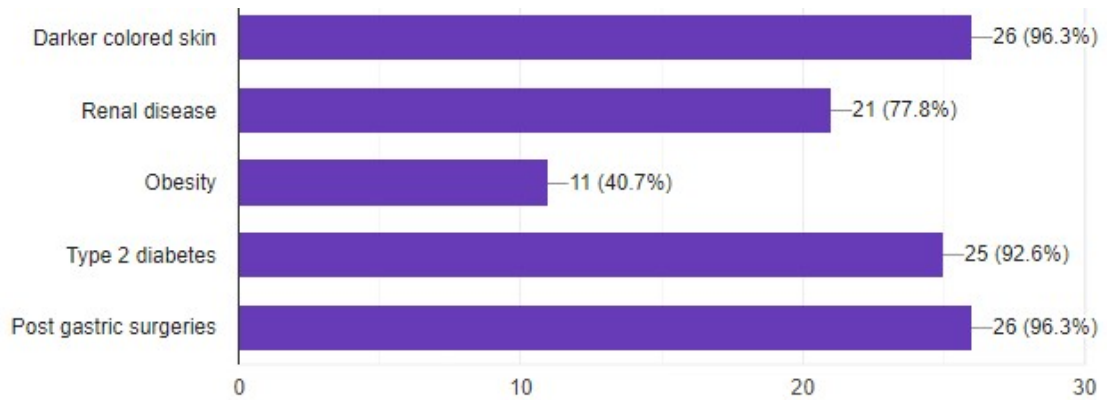


Figure 5, Questionnaire 2: At-risk populations

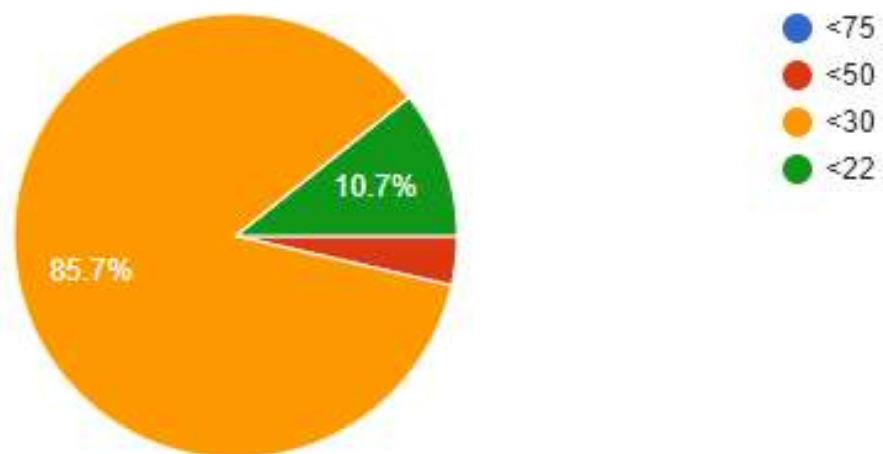


Figure 6, Questionnaire 1: Vitamin D serum level to initiate pharmacological therapy

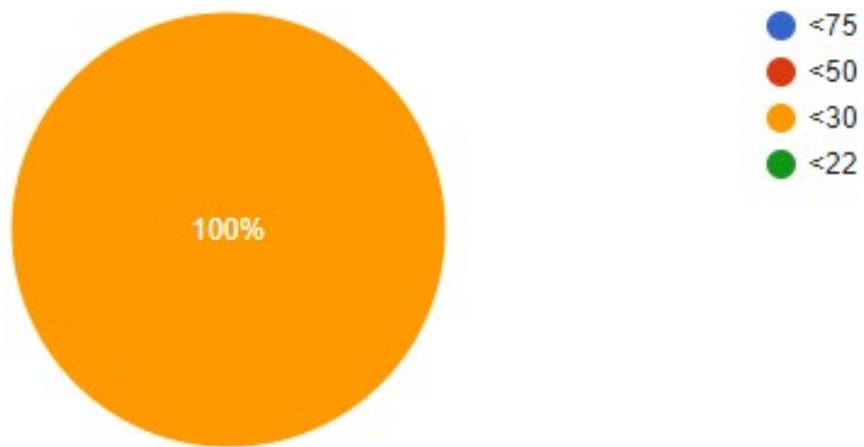


Figure 7, Questionnaire 2: Vitamin D serum level to initiate pharmacological therapy

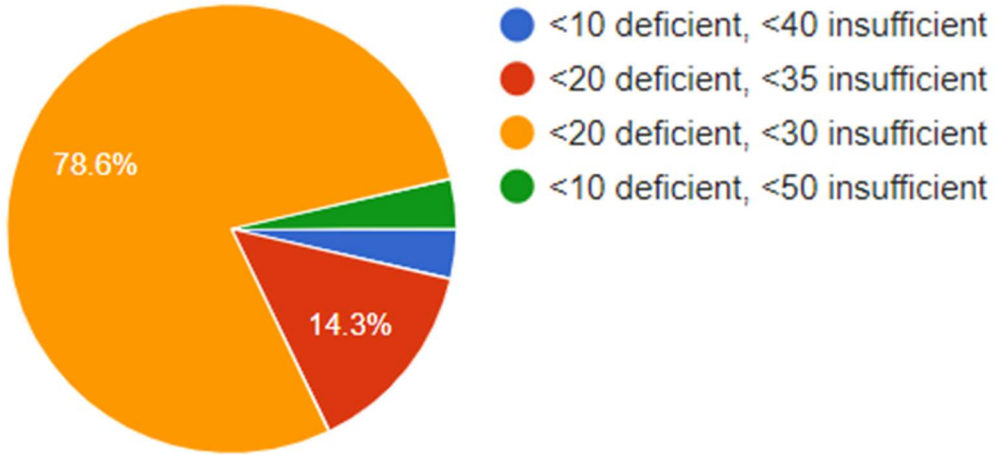


Figure 8, Questionnaire 1: Serum level considered deficient and insufficient

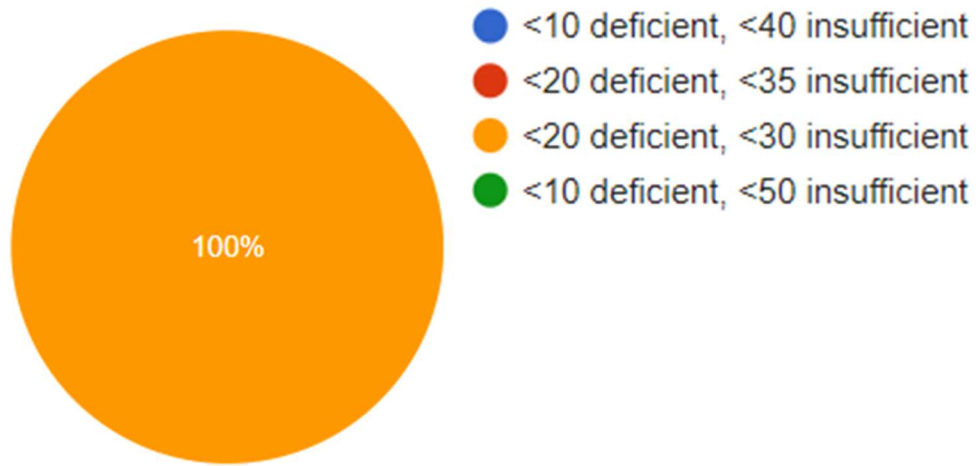


Figure 9, Questionnaire 2: Serum level considered deficient and insufficient

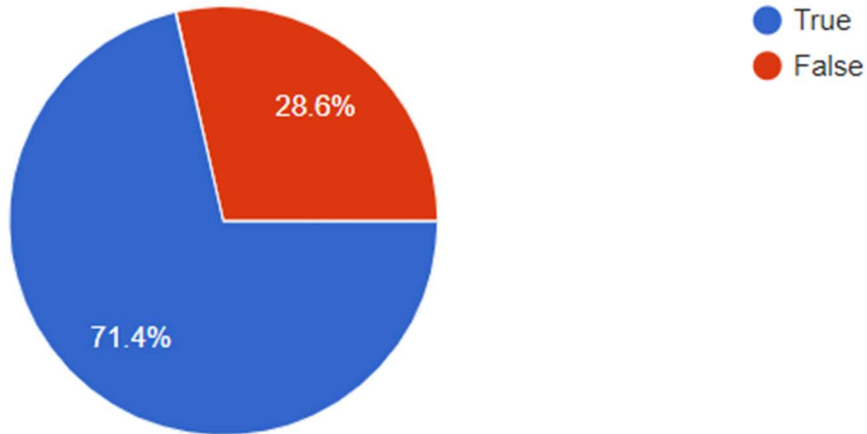


Figure 10, Questionnaire 1: Vitamin D number one nutritional deficient worldwide

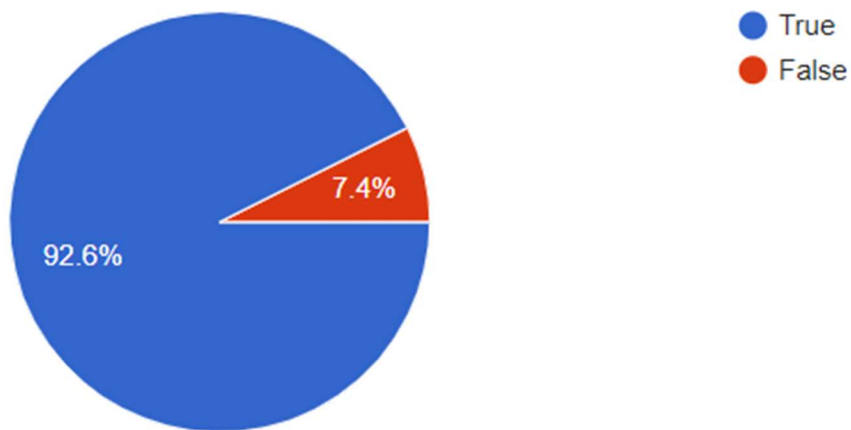


Figure 11, Questionnaire 2: Vitamin D number one nutritional deficient worldwide

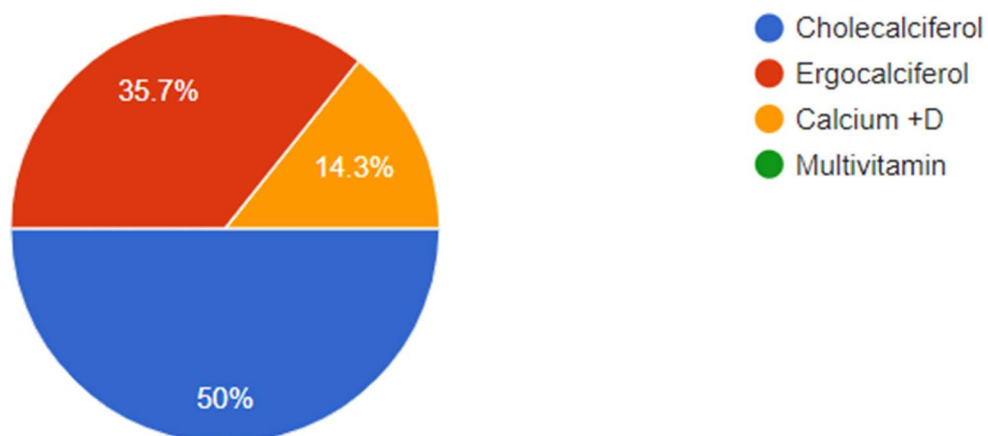


Figure 12, Questionnaire 1: Recommended pharmacological supplement

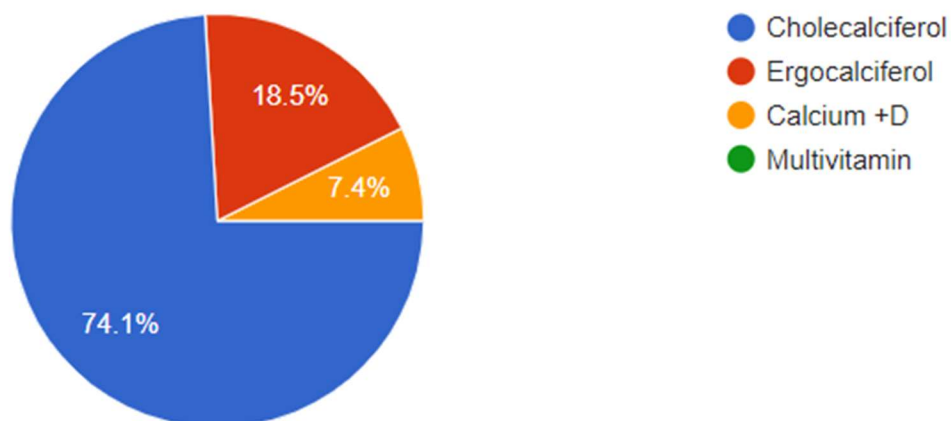


Figure 13, Questionnaire 2: Recommended pharmacological supplement

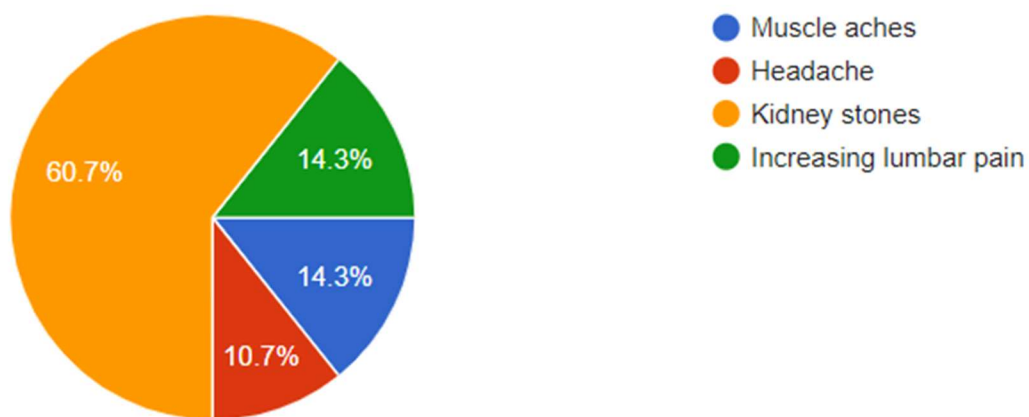


Figure 14, Questionnaire 1: Vitamin D Toxicity Symptoms

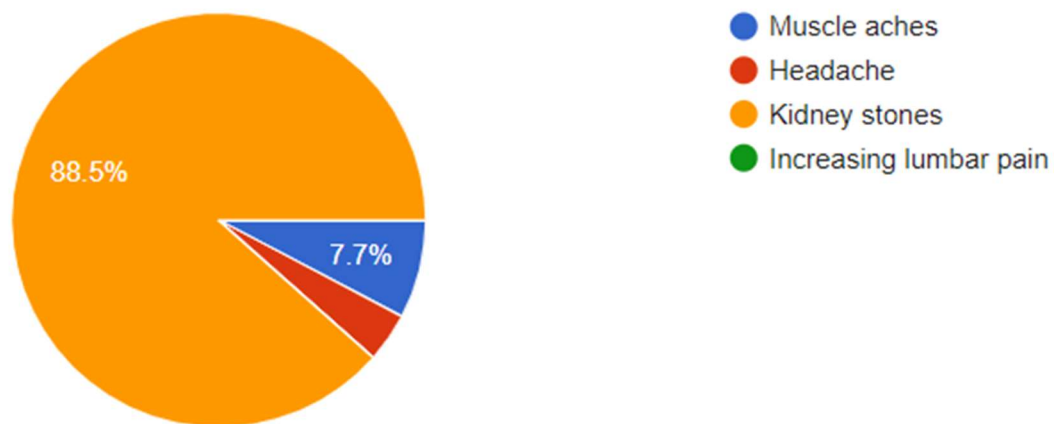


Figure 15, Questionnaire 2: Vitamin D toxicity symptoms

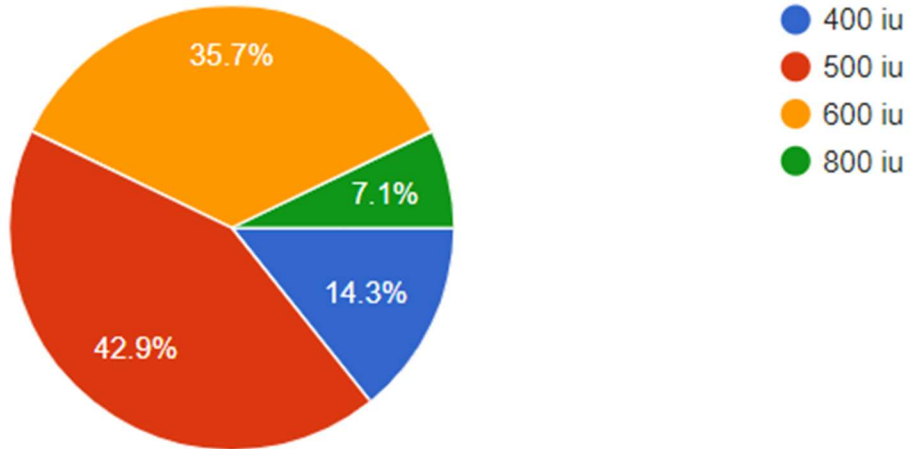


Figure 16, Questionnaire 1: Recommended daily dietary intake for adults

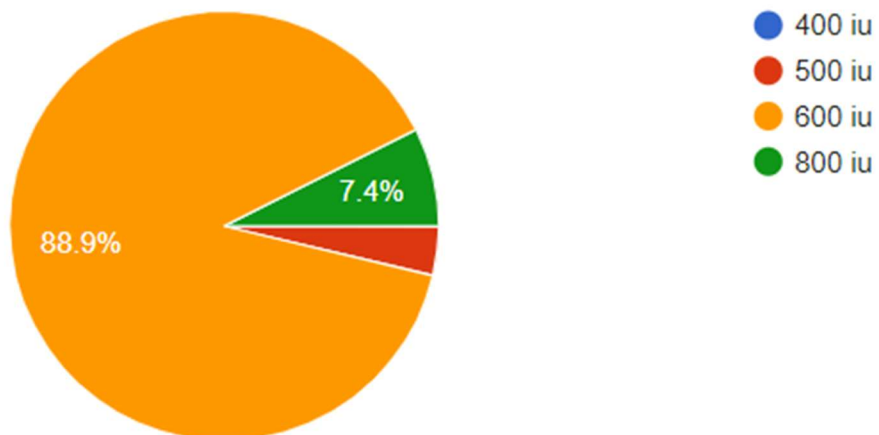


Figure 17, Questionnaire 2: Recommended daily dietary intake for adults

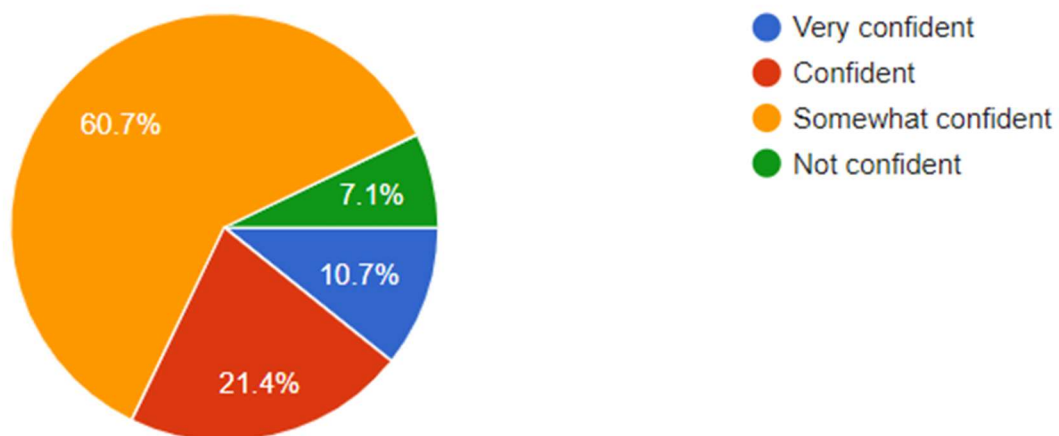


Figure 18, Questionnaire 1: Confidence level of participants

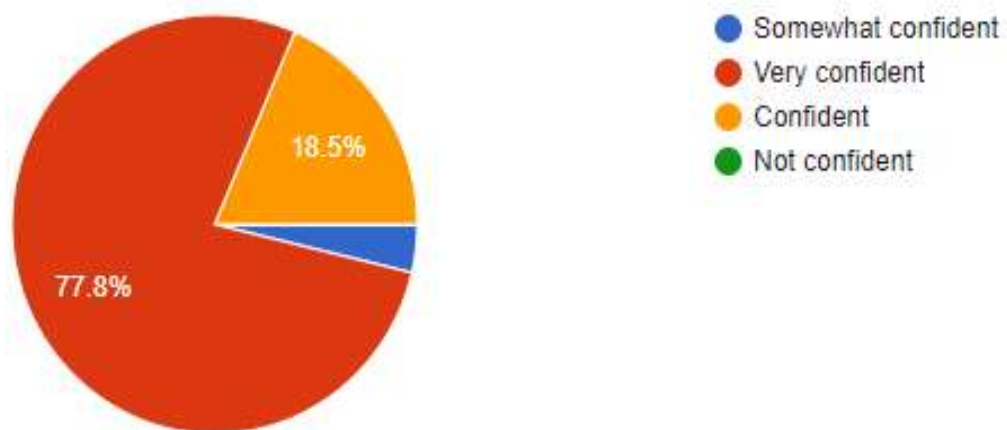


Figure 19, Questionnaire 2: Confidence level of provider

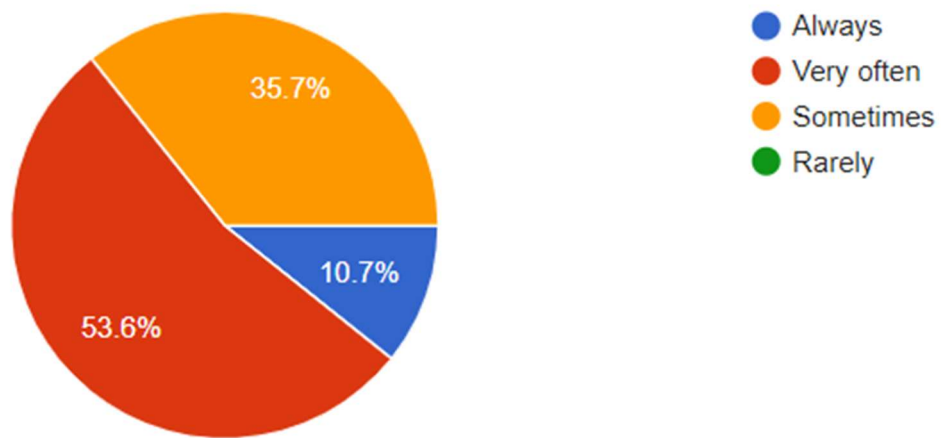


Figure 20, Questionnaire 1: Likelihood to address vitamin D deficiency

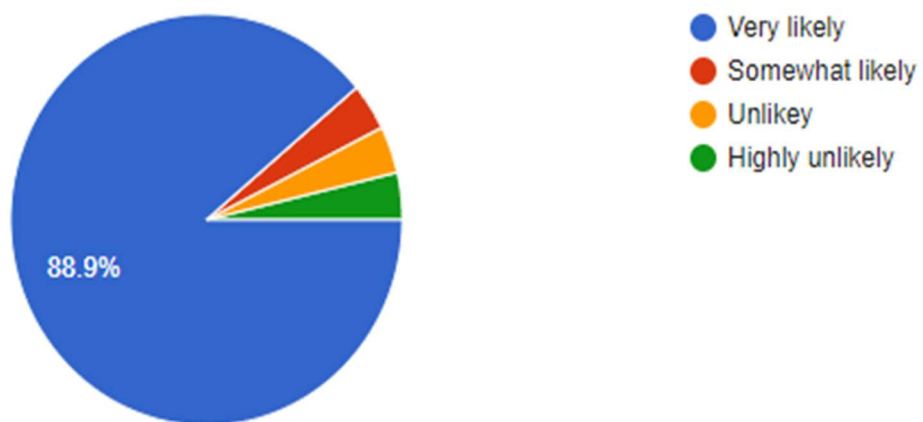


Figure 21, Questionnaire 2: Likelihood to address vitamin D deficiency

Project Limitations

There have been a few limitations of this project recognized by the researcher. The first limitation was the small sample size. Despite numerous attempts to obtain more participation from the emailed invitation requests, participants were not responsive. A second limitation is that the questionnaires were developed by the researcher and only had face validity. A third limitation of this project was that the participants requested only virtual presentations instead of in-person presentations due to the ongoing COVID19 pandemic.

Project Significance

Vitamin D deficiency and its impact on chronic health conditions continue to be researched today. The role of vitamin D is well known for its function of improving bone health to help prevent osteoporosis and osteopenia. However, recent research also targets vitamin D as playing an important role in immunity preventing worsening infections like COVID19 and healthy cell growth which could play a role in the prevention of certain cancers like breast cancer. Further research reveals the function of vitamin D in decreasing the symptoms of depression and dementia. Due to poor nutritional choices or access to healthy foods, decreased sun exposure, increased metabolism of vitamin D secondary to certain medication usage, or poor gastrointestinal absorption, vitamin D deficiency will continue to be a global issue. Recommendations are now forthcoming to begin identifying those at-risk populations, evaluate vitamin D serum levels, and implement treatment accordingly. Healthcare providers must continue to educate themselves on the ongoing research of vitamin D deficiency and its impact on chronic health conditions. It is also important that those at-risk populations be identified, screened

by serum laboratory studies, diagnosed according to the most recent guidelines, and treated accordingly.

Implications and Recommendations

Despite its small sample size, this project's results were statistically significant in reaching all three goals of improving provider knowledge of vitamin D deficiency, increasing practice confidence level of participants, and increasing clinical practice in screening, diagnosing, and treating vitamin D deficiency. Implications and recommendations for nursing, nursing research, nursing education, and community are discussed below.

Nursing

After participants attended the educational session that improved knowledge and confidence levels in practice, it is recommended that all healthcare providers continue utilizing the recommendations of screening and diagnosing vitamin D deficiency. It is also recommended to utilize the treatment algorithm to aid in increasing compliance with treating vitamin D deficiency in clinical practice.

Nursing Research

As valuable information continues to come forth about the impact of vitamin D on healthcare outcomes, this project could be utilized for future research. The researcher does recommend that a larger sample size be obtained. Also, it is recommended that participants be recruited from different regions of the country as well as nationally. The researcher also recommends that question pertaining to the level of confidence in

addressing and managing vitamin D deficiency on the postquestionnaire should match in both question format and answer choices on the pre-questionnaire for more cohesiveness.

Nursing Education

It is recommended by the researcher that nursing professionals continue to learn the impact of vitamin D deficiency and follow recommended treatment guidelines as outlined in this project. The results of this project do reveal successful improvement in knowledge and practice confidence in the participants' ability to screen, diagnose, and treat this disorder. The researcher does feel these results must be shared among larger groups of healthcare professionals either through education in classroom settings or at continuing education events. Another recommendation is that continued research on any updates to this project be available to all healthcare professionals, particularly providers like nurse practitioners.

Community

Following this educational presentation, the healthcare providers did report improved confidence levels and knowledge in the management of vitamin D deficiency. As a result, these providers plan to make a change in the current clinical practice that ultimately impacts the healthcare outcomes of their patients and the community.

Budget/Cost

There were minimal costs incurred while performing this project. This research was performed for academic purposes only, and there was no reimbursement of costs to the researcher for time spent on this project. The researcher did spend personal time away from work while performing this project. However, this was not calculated with the

budget costs. Gross estimates for use of a statistician and project materials are calculated below.

Expense	Estimated Cost
Statistician	\$100
Printing materials	\$100

Conclusion

The purpose of this research project was to provide education on the impact of vitamin D deficiency in chronic health conditions in the hopes of improving provider knowledge and improving their current clinical practices of screening, diagnosing, and treating this disorder while simultaneously improving the confidence levels of healthcare providers. Evidence-based guidelines along with a treatment algorithm were utilized in this project to educate healthcare providers in the state of Mississippi. A prequestionnaire was completed before the educational session with a postquestionnaire provided immediately following the session. Statistical analysis was performed and determined that the project goals were met. Questions from both the pre-questionnaire and post-questionnaire were independently sampled. The results determined that participant knowledge improved following the educational session ($p = <.001$). Practice confidence levels of participants reported as 'very confident' improved from 10.7% to 77.8% following the educational session, and approximately 89% of the participants reported a likelihood of changing their current clinical practice when screening, diagnosing, and treating vitamin D deficiency. Because of the positive outcome of this research study, it is imperative that continued education for healthcare providers located in Mississippi as well as nationally should continue to improve patient healthcare outcomes.

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Appendix A

To: Shelly Parker and Dr. Laura Turner

From: Irene Pintado, IRB Chair *I.P.*

Date: 5/17/2021

Project: Evaluating provider knowledge on the impact of Vitamin D deficiency in chronic health conditions

The Mississippi University for Women IRB committee has determined that your project is exempt under 45 CFR 46.101 (b)(4). If any changes are made to the study, the Committee must be notified. If the project is still running twelve months after the date of this memo, please be advised that we will need an update for our files.

Good luck with your work!

Appendix B

Dear Participant:

This questionnaire is the first of two questionnaires regarding the presentation you attend on assessment, diagnosis, and treatment of vitamin D deficiency. Responses to this questionnaire will be utilized to determine the effectiveness of my practice improvement project for completion of my Doctor of Nursing (DNP) degree. Participation is strictly voluntary. Completion and submission of this questionnaire will imply your consent to participate in this study. You may choose to withdraw from the study at any time prior to submission. All submissions will be anonymous; therefore, I ask that you do not enter any personal identifiers including name on this questionnaire. Thank you for your time and your participation.

Pre-questionnaire

Demographics of participants:

1. Profession of participant
 - a. Nurse Practitioner
 - b. Physician
 - c. Specialty
 - d. Other
2. Years in practice
 - a. 0-5 years
 - b. 6-10 years
 - c. 11-15 years
 - d. 15 plus years
3. Practice type
 - a. Primary Care
 - b. Pain Management
 - c. Orthopedic Specialty
 - d. Other

Knowledge questions regarding vitamin D:

4. The recommended daily dietary intake of Vitamin D for most adults is?
 - a. 400 iu
 - b. 600 iu
 - c. 500 iu
 - d. 800 iu
5. Who is at highest risk for Vitamin D deficiency? SELECT ALL THAT APPLY.
 - a. Darker colored skin
 - b. Renal disease

- c. Obesity
 - d. Type 2 diabetes
 - e. Post gastric surgeries
6. Vitamin D deficiency is the number one nutritional deficit worldwide.
- a. True
 - b. False
7. Symptoms that can be associated with Vitamin D Deficiency. SELECT ALL THAT APPLY.
- a. Falls
 - b. Decreased physical functioning
 - c. Headaches
 - d. Lower back/pelvic pain
 - e. Muscle weakness/aches
 - f. Dizziness
 - g. Fatigue
8. What chronic illnesses are affected by vitamin D deficiency? SELECT ALL THAT APPLY.
- a. Depression
 - b. IBS
 - c. GERD
 - d. Osteomalacia
 - e. Certain cancers
 - f. Cognitive disorders
9. At which serum vitamin D level is recommended to initiate Vitamin D supplementation?
- a. <75
 - b. <50
 - c. <30
 - d. <22
10. Which is the preferred vitamin D supplementation for patients?
- a. Cholecalciferol
 - b. Ergocalciferol
 - c. Calcium +D
 - d. Multivitamin
11. At which serum level is it considered vitamin D deficient and vitamin D insufficient?
(ng/ml)
- a. <10 deficient, <40 insufficient
 - b. <20 deficient, <35 insufficient
 - c. <20 deficient, <30 insufficient
 - d. <10 deficient, <50 insufficient
12. Which of the following signs and symptoms indicates possible vitamin D toxicity?
- a. Muscle aches
 - b. Kidney stones
 - c. Weight loss
 - d. Increasing lumbar pain

Personal Practice Questionnaire

13. How often do you educate your patients regarding Vitamin D deficiency?
 - a. Always
 - b. Very often
 - c. Often
 - d. Sometimes
 - e. Never
14. Which of the following serum laboratory studies is the one you most routinely order for testing of vitamin D?
 - a. 25-hydroxyvitamin D—25 (OH)D
 - b. Previtamin D
 - c. 1,25 dihydroxyvitamin—D_{1,25}(OH)
 - d. I do not screen for vitamin D.
15. Which of the following choices would you recommend for dietary supplementation of vitamin D?
 - a. Fatty fish, fortified milk
 - b. Beets, potatoes
 - c. Peas, sweet potatoes
 - d. Pork meats, peaches
16. Prior to this presentation, how likely were you screening, diagnosing, and treating patients for Vitamin D deficiency or insufficiency?
 - a. Always
 - b. Very often
 - c. Sometimes
 - d. Rarely
 - e. Never
17. Prior to this presentation, how confident were you in appropriately screening, diagnosing, and treating patients for vitamin D deficiency or insufficiency?
 - a. Very confident
 - b. Confident
 - c. Somewhat confident
 - d. Not confident

Appendix C

Dear Participant:

This questionnaire is the second of two questionnaires regarding the presentation you attended on assessment, diagnosis, and treatment of vitamin D deficiency. Responses to this questionnaire will be utilized to determine the effectiveness of my practice improvement project for completion of my Doctor of Nursing (DNP) degree.

Participation is strictly voluntary. Completion and submission of this questionnaire will imply your consent to participate in this study. You may choose to withdraw from the study at any time prior to submission. All submissions will be anonymous; therefore, I ask that you do not enter any personal identifiers including name on this questionnaire. Thank you for your time and your participation.

Post-questionnaire

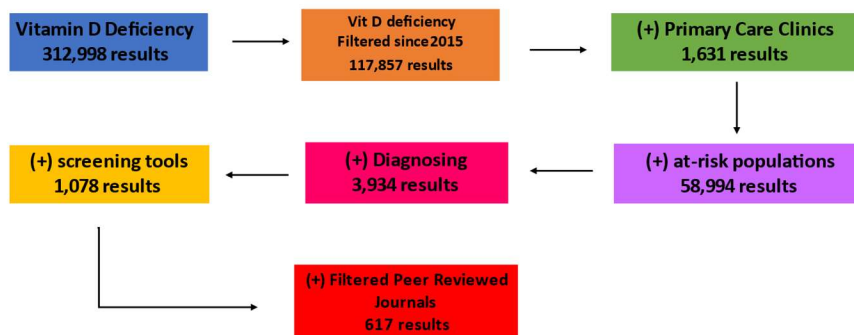
1. Profession of participant
 - a. Nurse Practitioner
 - b. Physician
 - c. Specialty
 - d. Other
2. Years in practice
 - a. 0-5 years
 - b. 6-10 years
 - c. 11-15 years
 - d. 15 plus years
3. Practice type
 - a. Primary Care
 - b. Pain Management
 - c. Orthopedic Specialty
 - d. Other
4. The recommended daily dietary intake of Vitamin D for most adults is?
 - a. 400 iu
 - b. 600 iu
 - c. 500 iu
 - d. 800 iu
5. Who is at highest risk for Vitamin D deficiency? SELECT ALL THAT APPLY.
 - a. Darker colored skin
 - b. Renal disease
 - c. Obesity
 - d. Type 2 diabetes
 - e. Post gastric surgeries
6. Vitamin D deficiency is the number one nutritional deficit worldwide.

- a. True
 - b. False
7. Common symptoms that can be associated with Vitamin D Deficiency. SELECT ALL THAT APPLY.
- a. Falls
 - b. Decreased physical functioning
 - c. Headaches
 - d. Lower back/pelvic pain
 - e. Muscle weakness/aches
 - f. Dizziness
 - g. Fatigue
8. What chronic illnesses are affected by vitamin D deficiency? SELECT ALL THAT APPLY.
- a. Depression
 - b. IBS
 - c. GERD
 - d. Osteomalacia
 - e. Certain cancers
 - f. Cognitive disorders
9. At which serum vitamin D level is recommended to initiate Vitamin D supplementation?
- a. <75
 - b. <50
 - c. <30
 - d. <22
10. Which is the preferred vitamin D supplementation for patients?
- a. Cholecalciferol
 - b. Ergocalciferol
 - c. Calcium +D
 - d. Multivitamin
11. At which serum level is it considered vitamin D deficient and vitamin D insufficient? (ng/ml)
- a. <10 deficient, <40 insufficient
 - b. <20 deficient, <35 insufficient
 - c. <20 deficient, <30 insufficient
 - d. <10 deficient, <50 insufficient
12. Which of the following signs and symptoms indicates possible vitamin D toxicity?
- a. Muscle aches
 - b. Kidney stones
 - c. Weight loss
 - d. Increasing lumbar pain

13. Following this presentation, how confident do you feel your knowledge has increased regarding the effect vitamin D deficiency can have on patients' health status?
 - a. Somewhat confident
 - b. Very confident
 - c. Confident
 - d. Not confident
14. Following this presentation, how confident do you feel you will be able to better identify those at-risk populations and increase vitamin D screenings of your patients?
 - a. Somewhat confident
 - b. Very confident
 - c. Confident
 - d. Not confident
15. Following this presentation, how likely are you to increase your frequency in addressing and treating Vitamin D deficiency?
 - a. Very likely
 - b. Somewhat likely
 - c. Unlikely
 - d. Highly unlikely
16. How likely are you to utilize what you learned during this presentation to make change(s) in your current clinical practice?
 - a. Very likely
 - b. Likely
 - c. Unlikely
 - d. Highly unlikely

Appendix D

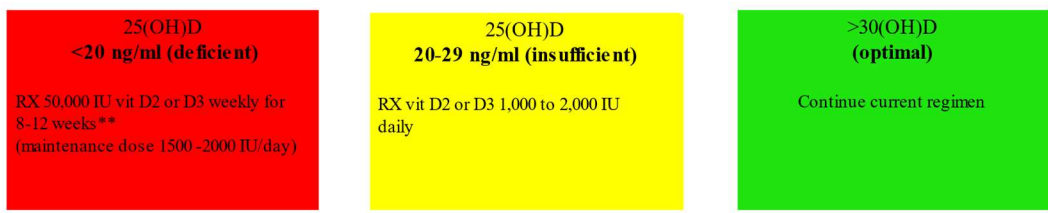
Search Strategy Map



Appendix E

Vitamin D Screening Guide

At risk populations :
BMI >30, darker skin tone, little/no sun exposure, poor nutrition, malabsorption disorders (Chron's, ulcerative colitis, celi ac disease, etc.), weight loss surgery, diabetes*



↓
Recheck serum 25(OH)D level in 3 months

↓
Recheck serum 25(OH)D level in 3 months

References:
NIH (2019). Vitamin d fact sheet for health professionals. Retrieved from [Vitamin D-Health Professional Fact Sheet \(nih.gov\)](https://ods.od.nih.gov/factsheets/VitaminD-HealthProfessional/)

*This may not be a complete list of at risk populations but rather those commonly listed
**Obese patients, those with malabsorption disorders, and those on certain medications like antiepileptic drugs, glucocorticoids may need higher dosing to achieve optimal level