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Micronutrient deficiency after bariatric surgery

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Walden University

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Walden University

College of Nursing

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Naitté P. Jordan

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the review committee have been made.

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Walden University
2022

Abstract

Micronutrient Deficiencies After Bariatric Surgery

by

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MS, Sonoma State University, 1987

BS, Sonoma State University, 1984

Project Submitted in Partial Fulfillment
of the Requirements for the Degree of
Doctor of Nursing Practice

Walden University

May 2022

Abstract

Bariatric surgery is the most clinically efficacious treatment for obesity and obesity-related comorbidities. Many patients undergoing bariatric surgery have preexisting levels of nutritional deficiencies. The prevalence of micronutrient deficiencies may increase after surgery, and long-term nutritional monitoring and follow-up are essential factors for postoperative patient care; yet advanced practice nurses may not be accustomed to caring for patients or treating micronutrient deficiencies. The purpose of this systematic literature review was to collect and analyze clinical evidence to determine what can the APN with the best available evidence do for implementing protocols and procedures to prevent, detect, and monitor for nutritional deficiencies after surgery in the clinical setting? The data sources were from PubMed, Embase, CINAHL, and Medline. A PRISMA diagram was used to identify 1121 articles including randomized control trials, systematic reviews, and clinical guidelines; of these 17 articles met the criteria. The Johns Hopkins nursing evidence-based model was used as the guiding framework. Analysis of the evidence revealed inconsistent recommendations and guidelines drawn from the leading three bariatric experts as well as limited studies conducted in the United States, United Kingdom, Italy, Germany, India, Brazil, and China for what constitutes deficiencies and supplementation dosages. However, recommendations can be made for a nurse-driven protocol which calls for lifelong routine monitoring based on symptom or type of procedure; daily vitamin and mineral supplementation; and identifying deficiency versus insufficient levels of micronutrients, particularly vitamin B12 and D serum levels. Using the best evidence to guide practice is a start to fostering a positive social change.

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Dedication

The completion of this project is dedicated to my deceased mother, my brother, Charles, son, William, daughter's Tomiye, Nadja and Aunt Judy, who believed in me. And, to God who provided the strength to continue this journey.

Acknowledgments

I want to thank my project committee members Dr. Rachel Pitman, Dr. Eric Anderson and Dr. Hahn, Dr. Rose, and Dr. Jill, the librarian, for their professional guidance and support. Dr. Pitman, thank you, for providing emotional support and reassurance when I needed it desperately. You are an astonishing mentor, and I truly appreciate your extraordinary mentorship of me. I would like to especially thank Bridgette Malchow, my academic advisor, for the opportunity to share my feeling and, for always being there to answer my questions. The success of my achievement would not have been possible without your contributions.

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Section 1: Nature of the Project

Introduction

During the Renaissance period, obesity was viewed as a symbol of beauty, wealth, and prosperity. Many centuries have passed, and our views on obesity have changed. Now, obesity is seen as a health hazard. Obesity rates remain high among adults 20-64 years of age in the United States and rose steadily from 19.4% in 1997 to 31.4% for the period between January and September 2017. According to the World Health Organization, obesity is characterized as having a body mass index (BMI) ≥ 35 kg/m², and classified into class I (BMI 30-34.9), class II (BMI 35-39), and class III (BMI ≥ 40).

Obesity remains a preventable disease and a worldwide problem, and its prevalence is growing exponentially. In 2017, the number of obese adults in the United States was 42.4% and 42.8 % among older adults aged 60 and over. The prevalence of severe obesity among U.S. adults was 9.2 % in 2017-2018 (Hales, 2020). Obesity is a worldwide disease due to its related comorbidities and due to its association with high morbidity and mortality.

Obese individuals often go through many failed attempts to lose weight by traditional methods such as behavioral modification, diet, and exercise to no avail. After many failed attempts to lose weight, the obese individual has one last option: weight-loss surgery. Weight-loss surgery procedures have proven to resolve or improve weight and obese-related comorbidities. Different surgical procedures can exacerbate or contribute to nutritional deficiencies post-operatively (Zimmermann, 2018). Micronutrient deficiencies, especially vitamin D, folate, B12, and iron deficiencies are commonly

observed before surgery. Consequently, micronutrient deficiencies and their complications can result in undeniable irreversible metabolic and neurologic dysfunctions (Lewis et al , 2018). Vitamin/mineral deficiency continues to go undetected and underdiagnosed post-operatively.

Problem Statement

Local Nursing Practice Problem

Despite bariatric surgery benefits, this doctoral project focused on the high prevalence of micronutrient complications after bariatric surgery and the advanced nurse practitioner's (ANP) role central to establishing standardized protocols to significantly impact patient care and outcomes. ANPs working in bariatrics play a key role in educating patients, families, and staff about bariatric surgery patients and care management.

The current local practice problem exists with the treatment of vitamin/mineral deficiency postoperative. The nursing management of postoperative bariatric care is often based on the surgeon's clinical practice and the individual practitioner's decision-making process. Consequently, the advanced practice nurse (APN) struggles to make clinical decisions for the bariatric postoperative patient based on personal knowledge and practice skills.

Currently, the practice site attempted to adhere to the nutritional recommendations provided by the American Society for Metabolic and Bariatric Surgery (ASMBS); however, not all providers were eager to follow through with these

recommendations. The nursing staff is often left lost in the struggle making the right clinical decisions to assess, treat, and manage post-operative bariatric patients.

The need to address this problem is evident that bariatric surgery procedures contribute to or exacerbate patients' susceptibility to nutritional deficiencies after surgery. This systematic review examined articles about the current nursing practice guidelines and translated the findings to impact patient care and post-operative management for micronutrient deficiencies.

Local Relevance

Post-operative patient management practices vary among bariatric centers, partly because of surgeons' practices and skills set. The fact that postoperative vitamin/mineral therapy can vary due to the clinical practice and patient needs. The absence of an evidence-based nursing protocol to prevent, detect, treat, and manage patients has led to ineffective patient care, even death.

Data have shown that a lack of clear guidelines/protocols for patient management in nursing often leads to poor health outcomes and neurological complications such as Wernicke's encephalopathy (Cabral et al., 2016). A nurse-driven, comprehensive protocol implemented to treat nutritional deficiencies following surgery includes early monitoring for signs and symptoms of all bariatric procedures.

Significance

This systematic literature review provides an understanding of various bariatric procedures and the after effect on vitamin/mineral absorption within the gastrointestinal tract. This systematic review will support implementing the nurse-driven protocol in

caring for patients after bariatric procedures and the theories employed in these studies' potential role for the ANP to develop nursing competence.

Practice-Focused Question

This doctoral project's practice-focused question: "What can the APN with the best available evidence do for implementing protocols and procedures to prevent, detect, and monitor for nutritional deficiencies after surgery in the clinical setting?"

Addressing the Gap in Practice

Currently, the nursing practice documentation of patients pre/postsurgery bariatric surgery for micronutrient deficiencies has been insufficient or limited due to lack of research on standardized guidelines. Addressing this gap may encourage team members to engage in evidence-based research and positively impact the multidisciplinary team, surgeons, who may guide nursing practice. Based on protocols, patients are underdiagnosed or under detected by this practice. I am addressing the knowledge gap by providing a systematic literature review that may improve nursing practice, improve patient outcomes, and reduce unnecessary emergency department visits.

Nature of the Doctoral Project

Source of Evidence

The nature of this project was to collect the highest level of evidence contributing to the knowledge gap in nursing practice. All articles were retrieved from Walden University online databases: Google Scholar, Embase, Medline, Cochrane, and PubMed. In addition, official websites such as the ASMBS, Center for Disease Control and

Prevention, American College of Surgeons, and the Obesity Society were accessed for additional resources.

Approach

I conducted a systematic literature review of peer-reviewed articles and studies relevant to nutritional deficiencies following bariatric surgery procedures associated with micronutrient deficiencies using the following terms: bariatric surgery, micronutrient deficiencies, guidelines/protocols, vitamin and minerals, obesity, nutrition absorption, and metabolic complications. For inclusion, articles were published within the past 5 years. Exclusion of articles included adolescents, pregnancy, maternal, revisions, bleeding, leaks bowel obstruction, and dumping syndrome. The strategy included using the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) flowchart. This tool assisted in the examination of articles, allowing for a visual display of relevant topics to reflect findings and identify existing nursing protocols. The Johns Hopkins Nursing Evidence-Based research and critical appraisal of evidence was used to gather, evaluate, grade and record evidence.

Significance

Gaining a greater understanding of the literature supported the implementation of a protocol when caring for post-operative bariatric surgery patients with micronutrient deficiencies to minimize readmissions and long-term nutritional complications. Nurse practitioners can educate and instruct patients on self-help practices to improve outcomes. This systematic literature review will identify research gaps and improve patient care of

post-operative bariatric patients by providing evidence-based research applied in outpatient clinical settings.

The literature review is relevant to the nursing practice by contributing research of surgery-related micronutrient deficiencies and the malabsorption components secondary to bariatric surgery procedures. This literature review will reveal the lack of nursing knowledge within bariatric clinics and the lack of clinical attention to enable early detection and proper patient management. The literature review will provide clinical knowledge for practitioners to deliver quality care. This doctoral project may decrease health cost and enhance the medical care nurses deliver to their patients.

Stakeholders

The main stakeholders are the patients, surgeon, ancillary staff, nurse practitioners, physician assistance, family members, specialists, and suppliers. Additional stakeholders that might be affected include dietitians, patient advocates, and the community. In bariatric surgery centers, most obese patients seeking to undergo bariatric surgery require mandatory perioperative assessment with a licensed dietitian or nutritionist for their initial nutritional screening. Following the bariatric surgery, patients are seen on a need to be seen basis. It has been documented that obesity remains a challenge for patients and their healthcare providers. This systematic review will provide the local institution with the potential to improve patient care outcomes and data tracking.

Contribution of the Doctoral Project

This project will contribute to nursing practice by improving nurses' knowledge and understanding of the major metabolic and nutritional deficiencies associated with the

anatomical rearrangement of the gastrointestinal tract. The outcome of this review might improve overall care after bariatric surgery procedures and how nurses deliver care to this population of patients.

This project can contribute to reducing hospital readmissions, reducing the risk of micronutrient deficiency complications both related short/long, and serving as a foundation for developing methods to prevent vitamin and mineral deficiency following bariatric surgery.

Transferability

A bariatric evidence-based practice (EBP) protocol might provide early detection and improved management of patients diagnosed with micronutrient deficiency. This systematic literature discusses vitamin/mineral deficiency and factors contributing to vitamin homeostasis with other outpatient bariatric clinics within the community. This DNP project might provide for EBP used to identify early signs and symptoms of micronutrient deficiencies after bariatric surgery procedures. This project's findings could apply to nursing practice in a broader sense for publication in nursing practice journals.

Social Change Implication

As APNs play an important role in primary care, they must be well educated in various health conditions. Micronutrient deficiency is a metabolic condition with which there is particularly low awareness in both the primary care community and the nursing profession. This DNP project can provide an overview of micronutrient deficiency nurse-driven protocol for monitoring and management after bariatric surgery procedures.

Adopting a nurse-driven protocol can improve patient outcomes, including nurse empowerment, when collaborating with the multidisciplinary understanding of treating vitamin/mineral deficiency after bariatric procedures. A literature review can also improve patient care, improve nurses' knowledge, and improve post-operative patient outcomes at the site and in the community.

This new protocol can be used locally in caring for bariatric surgery patients. The adoption of new EBPs will facilitate change in decision-making and clinical treatment. The family nurse practitioner will provide quality care by monitoring patient outcomes after implementing changes that will improve patient care and outcomes.

Summary

In summary, most obese patients' nutrition remains at higher risk for various vitamin/mineral deficiencies than normal-weight individuals. Underdiagnosing and under detecting signs and symptoms of micronutrient deficiencies can lead to irreversible mental and physical damage in this population of patients. The need for evidence-based nursing protocols is critical to establish standardized care with targeted interventions and guidelines. This protocol will play a critical part to enhance clinical performance through the quality of successful patient care.

This systematic literature review can facilitate the use of an evidence-based protocol for micronutrient deficiencies following bariatric procedures. The second section of this project will provide an overview of the concepts, models, and theories that guided the research relevance of this problem to nursing practice and the perspective promoting the review of this problem.

Section 2: Background and Context

Introduction

Nursing is changing its practices to include EBP, which will impact workflow and clinical knowledge. Evidence-based nursing practice is an offshoot of the evidence-based medicine approach to evaluate nursing practice (Stannard, 2019). The practice problem at the practicum site involved the lack of standardized protocols to manage patients after bariatric surgery.

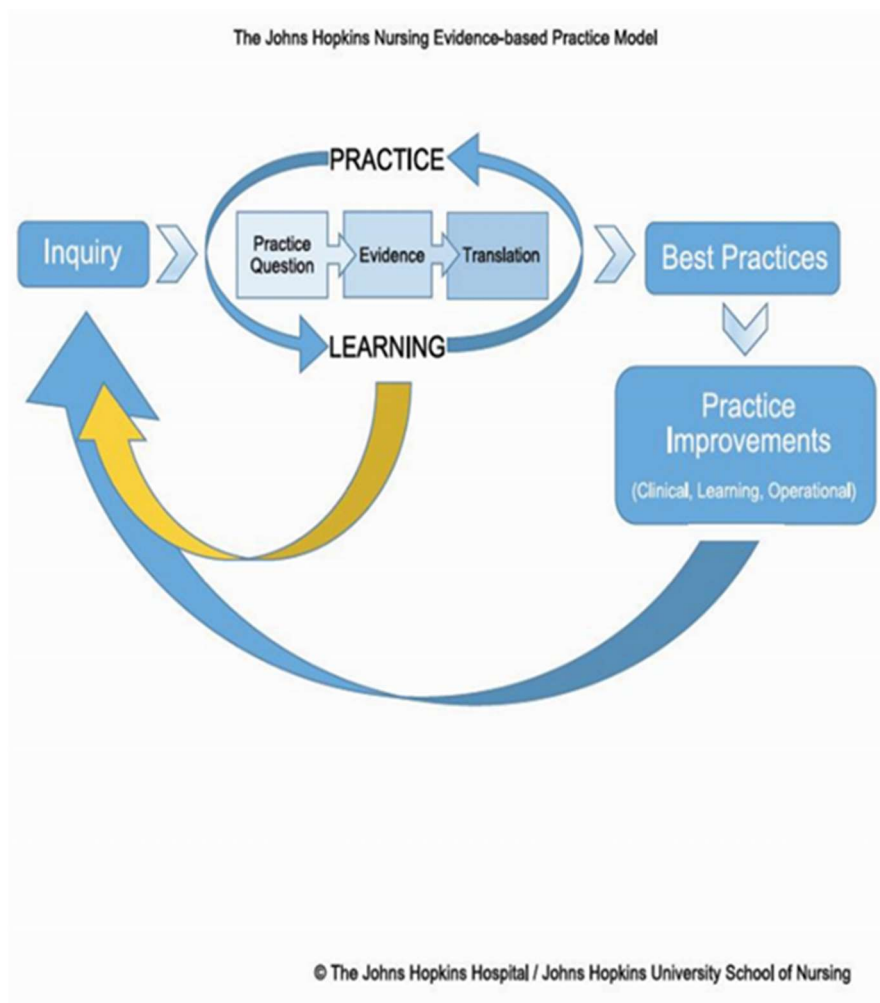
The focused practice question for this doctoral project: “What can the APN with the best available evidence do for implementation of protocols and procedures to prevent, detect, and monitor for nutritional deficiencies after surgery in the clinical setting?” The purpose of this project is to examine and summarize EBP protocols/guidelines to understand the clinical manifestation of micronutrient deficiency following bariatric surgery procedures.

This section describes the models used in this literature review of nurse-driven protocol for post-operative bariatric patients. The EBP protocol will provide knowledge and research evidence to assist the APN in clinical decision-making. This Doctor of Nursing Practice (DNP) project used the Johns Hopkins Nursing Evidence-based Practice Model (JHNEBPM) guide the practice protocol (see Figure 1). The JHNEBPM also identifies internal and external factors that influence practice, education, and research, such as legislation, standards, and environment (Newhouse, 2007). I chose the JHNEBPM for this DNP project due to its detailed guidelines, which provide a process

for creating a practice question, appraising research, and evidence, and making recommendations for practice (Dearholt, 2007).

Figure 1

Johns Hopkins Nursing Evidence-Based Model



Post-operative bariatric patients will face many physiological challenges after surgery, such as food restriction, nausea and vomiting, and reduced tolerance for certain foods. The nurse-driven protocols will serve as an intervention to improve the diagnosis of micronutrient deficiency, resulting in lower visits to the emergency department.

This section also includes a discussion of the importance of this project for the nursing practice, the local background, and the context of the problem in the current practicum site, the role of the student in the project, and clarification of terms.

Concepts, Models, and Theories

Rationale for Models

The JHNEBPM was selected to promote the development of an evidence-based protocol that synthesizes the best evidence about the prevention and management of micronutrient deficiencies after all bariatrics procedures. The JHNEBP model provides the framework needed to guide this project through the research process due to its detailed guidelines in appraising research evidence and translating that information into the practice setting.

The JHEBPM is used to explore the best evidence-based clinical, administrative, and educational decision-making for improving patient care and outcomes. The selected model provides a framework for the translation of the best evidence into patient care and guides this protocol to improve patient outcomes. The model offers a process for facilitation of the execution of a practice protocol in the clinical setting. The model includes three significant steps: (1) development of a practice question, (2) review of the evidence-based literature, and (3) translation of research findings into practice (Dearholt, 2007).

Related Synthesis

The model explains which studies identify strategies for condensing large quantities of clinical knowledge useable to practice promoting the DNP project. The next

step includes assessing the research and how knowledge is applied in clinical practice.

Finally, clinical decision-making is used to close the gap between scientific research and its use in clinical practice to impact patient care.

Classification of Terms

The following terms provide clarity to this project:

Bariatric Surgery

Bariatric surgery, a surgical procedure in the treatment of obesity to promote weight loss, involves alterations of the gastric volume or diversion away from the proximal intestine (Wright, 2015).

Restrictive Bariatric Surgery

In *adjustable banding (AGB)*, a band is adjusted around the proximal stomach and upper portion of the fundus, creating a temporary gastric pouch of 30 ml (Hakim, 2011).

Vertical sleeve gastrectomy (VSG) is a surgery that involves making a longitudinal resection of the greater curvature of the stomach to reduce it to a narrow tube and eliminate the gastric fundus 150 milliliters (Torquati, 2015).

Micronutrients

Micronutrients are vitamin D, iron, vitamin B 12, fat-soluble vitamins (A, D, E, K), thiamine, and folate (Hakim, 2011).

Deficiency

Deficiency is a shortage of a substance (such as a vitamin or mineral) needed by the body (Oxford Languages Dictionary, n.d.)

Weight-Loss Surgery (WLS) is used synonymous with bariatric surgery to reflect the impact of these procedures and their ability to treat obesity (American Society for Metabolic and Bariatric Surgery , 2021).

Roux-en-Y gastric bypass (RYGB) is a weight loss surgery procedure that reduces the volume (20-30ml) of the upper stomach to a small pouch in obese patients.

Biliopancreatic diversion (BPD) with duodenal switch (DS) is a weight loss surgery procedure that consists of creating a 300 cc gastric pouch proximal to the ileocecal valve, anastomosing the distal stomach is removed forming to a small pouch and dividing the upper part of the small intestines forming two limbs extending from the pylorus to the jejunum (Ballesteros, 2016).

Vertical sleeve gastrectomy. (VSG) is a surgical weight loss procedure that removes a portion of the stomach to 15% (size of a small banana) of its normal size.

Evidence-based practice (EBP) is a problem-solving approach to the delivery of health care that integrates the highest quality of evidence from research studies and expert clinical data to achieve the quality of care and best patient outcomes (Stillwell, 2010).

Obesity is a person's body mass index (BMI > 30) as an indicator of body fatness subdivided into three classes 1, 2, and 3 (Center for Disease Prevention and Control [CDC], n.d.).

Relevance to Nursing Practice

EBP is critical to clinical decision-making and the quality of care and patient outcomes. The growing interest in nursing research improves knowledge and skills that

integrate studies and patient data in nursing. Implementing a nurse-driven protocol can improve the care and management of patients by reducing emergency room visits and hospital readmissions.

Many APNs working in bariatric surgery rely on their existing nursing knowledge and skills. The absence of evidence-based protocols for diagnosing and treating patients leads to poor nursing management and outcomes. Evidence has shown that the use of protocols to supplement clinical decision-making can improve patient outcomes and prevent long-term complications such as beriberi (Parrott, et al., 2018). The continued rise in cases of micronutrient deficiency may be contributing to the negative effect of the lack of evidence-based protocols to adequately diagnose and manage this population of patients. A lack of protocols in the facility may be contributing to the increased number of new cases (Malnick, 2020). Research data have demonstrated a high prevalence of micronutrient deficiency in obesity preoperatively and emphasized adequate vitamin supplementation as well as post-operative screening and monitoring (Schiavo, 2018). Currently, the site chosen for this project does not use standardized protocols to screen, manage, and treat patients after bariatric surgery.

Local Background and Context

Summary of Local Background

Many bariatric surgery sites serve as the pivotal point in providing care in Northern California. Bariatric surgery is gaining notoriety as the most efficacious treatment for obesity and its associated comorbidities. However, nursing knowledge is lacking in this arena. As the number of bariatric surgeries rise, the APN and other general

practice clinicians continue to struggle with their management of micronutrient deficiency among obese patients undergoing bariatric surgery.

The current staff practice to manage micronutrient deficiency after bariatric surgery relies on the nurses' general knowledge and skills. Bariatric surgery patients are unique in their need for ongoing surveillance and education to improve nursing management outcomes. The urgent need to implement nurse-driven protocols for micronutrient management post-operatively improves clinical skills and clinical decision-making to improve healthcare outcomes.

Institution Context

The local bariatric office serves hundreds of patients living in Northern California with obesity, morbid obesity, and comorbid conditions. The local site is a certified bariatric center. Their goal is to continue to serve the community and surrounding areas with the best EBP leading to effective long-term treatment for morbid obesity.

The clinic provides a wide range of surgery options, including biliopancreatic diversion with duodenal switch (BPD/DS), duodenal loop switch (SADI-S), and revisions. The team of surgeons with over 50 years of combined experience is equipped to handle the most challenging and complicated cases. The clinic performs bariatric surgery on morbidly obese individuals with chronic renal disease, liver disease, and other complicated cases that other centers have denied.

State/Federal Context

In California, bariatric centers must achieve accreditation following a rigorous standard of practice regulated by the American College of Surgeons and the ASMBS. All

bariatric centers also receive a review by the Metabolic and Bariatric Quality Improvement and Patient Safety Committee to maintain and improve care standards and care pathways in all bariatric centers. Also, unlike metabolic and bariatric organizations, the nursing practice licensing agency provides practice guidelines for nurses to abide by at all nursing levels, not specific to bariatric surgery (Wellness, 2020).

According to Carrie-Anne (2018), metabolic and nutritional complications among those undergoing bariatric surgery procedures continue to increase. However, the lack of education for clinicians remains underused outside the surgery centers. These procedures' success continues to provide optional treatment for obesity, providing weight loss and improved quality of life. Nevertheless, the clinical management of the patient undergoing bariatric surgery requires long-term monitoring and nutritional supplementation post-operatively (Carrie-Anne, 2018).

Role of the DNP student

Student Professional Context

I currently practice as an APN practitioner in bariatric surgery/family practice in a private surgeon's office. My role includes consultation, evaluation, and treatment of an obese individual who seeks bariatric surgery, either by self-referral or by their doctor. In my role, I get to witness firsthand the micronutrient deficiencies after bariatric procedures. I am responsible for the patient and their family's postoperative teaching, early detection of signs and symptoms of deficiency, ordering medication or drug and laboratory testing needs, and recording signs and symptoms exhibited by the patients.

Student Role in the DNP project

My goal in this DNP project was to research the best practices available in the literature and translate these findings into the workplace to improve my knowledge and increase my nursing confidence in caring for my patients. Based on my findings obtained from the research, I summarized this information and translated my findings into a new protocol for all APNs. In this DNP project, I make recommendations to improve nursing practice. I strive to gain the support of the surgeons and the staff to implement change in the clinic.

Student Motivation

As an APN, my goal is to improve the healthcare of all patients and their health outcomes. I have tried to act as a role model to my coworkers and motivator for others in my field. Also, I seek to advance my knowledge and those around me. Six years ago, I started on a journey to incur knowledge beyond my current knowledge base. As a DNP student, I can change how I practice and improve patient care. The work I put into DNP has been challenging to follow, but I have continued to grow and succeed in my endeavor.

Potential Bias

In research, biases can present at any phase of a research project. According to FitzGerald (2017), bias among healthcare professionals exists at the same level as the public. For example, a potential bias for this DNP project may come from nurses, surgeons, family practitioners, and other stakeholders' opinions and values about this project (FitzGerald, 2017).

Summary

APNs hold the explicit role of health educator and caregiver when it comes to caring for patients- best practices to come to mind. The EBP model facilitated the systematic review of the nurse-driven protocol of bariatric patients postoperatively. The DNP project might result in the implementation of an evidence-based guided protocol to improve practice and patient care. This next section will include the sources of evidence used to guide, analyze, and synthesize the literature review.

Section 3: Collection and Analysis of Evidence

Introduction

The need to address the problem of obesity in the community is a challenge for patients and clinicians. Today, bariatric surgery is the most efficacious treatment for obesity and morbid obesity worldwide. The obese patient seeking bariatric surgery procedures enters the unknown territory, resulting in the patient's bariatric surgery procedures providing rapid weight loss and amelioration of comorbid diseases such as, Type 2 Diabetes Mellitus.

While the APN faces many challenges in providing care and management to those obese individuals seeking bariatric surgery, working with bariatric patients requires surgical knowledge about the different procedures, risks, and complications associated with each surgery. To provide evidence-based patient care and management, the role of the APN requires knowledge, skills, and training in the field of bariatrics.

With proper knowledge in bariatrics, the APN must rely on evidence-based research to bridge the knowledge gap and practice. To provide the necessary care to this population, establishing a nurse-driven protocol would bridge the practice gap.

Purpose of This DNP Project

The purpose of this systematic review project is to improve patient care and management for post-operative bariatric patients. This approach aligns itself with the practice-focused question. The APN will be pivotal to recognizing micronutrient deficiency risks and management after bariatric surgical procedures. With the rise in bariatric procedures performed in the United States, clinicians other than the surgeon

need to detect micronutrient deficiencies with associated complications. This project has the potential to improve outcomes and quality of care in this population.

Significance to Nursing Practice

This DNP project holds significance to the field of nursing practice, as it may inspire the local site to implement nursing protocols to improve health outcomes for all bariatric surgery patients post-operatively. There is developing evidence of risks from micronutrient deficiency after bariatric surgery procedures despite the growing popularity of bariatric procedures as the number one successful treatment for obesity.

Bariatric surgery adversely affects iron metabolism, including absorption, transport, release, and use of micronutrients and the quality of life. For example, vitamin B₁₂ deficiency has been recognized as a worldwide public health issue that can evolve into various neurological and hematological disorders. Unlike fat-soluble vitamin deficiency (A, D, E, and K), it can be difficult to diagnose vitamin B₁₂ deficiency until it is too late (Muhuri, 2016). The combined restrictive and malabsorptive procedures have caused more nutritional complications.

The ASMBS published guidelines for nutritional and metabolic support for bariatric patients recommend clinical guidelines for pre-postoperative bariatric surgery. However, these guidelines or reference tools have not been adequately addressed. The implementation of a nurse-driven protocol for patients after bariatric procedures will reduce healthcare costs and use of resources visits and improve quality of life.

This DNP project produced an evidence-based protocol to improve management and preventable metabolic and neurological symptoms significantly; if early treatment is

not initiated, it could result in irreversible damage. Developing a nurse-driven protocol reduces the risks of micronutrients and associated complications.

Addressing the Gap in Practice

Presently, the nursing practice of managing patients' postoperative bariatric surgery is guided by individual clinical judgment and experience. The APN in the clinic determined micronutrient deficiency was a clinical issue due to the number of patients seen with signs and symptoms of micronutrient deficiency. The rising rate of surgical intervention treatment revealed a gap in knowledge in the scientific field. Due to a lack of evidence-based protocols, patients are negatively affected by this practice. To address this gap, EBP guidelines/protocols answering the question would provide new knowledge to APN for the assessment and treatment of postoperative bariatric patients.

Nature of the Doctoral Project

Source of Evidence

For this systematic review, I conducted a detailed literature search using the online databases from Walden University. This literature review used a three-step strategy to extrapolate studies. The first step involved a limited search of Google Scholar, Embase, Medline, and PubMed, followed by an analysis of the abstract and title for key works to add to the list of search terms. Next, I conducted a search in other databases using all identified keywords to ensure appropriate translation across search concepts. Finally, I reviewed official websites such as Disease Control and Prevention, Obesity Surgery, and Bariatric Times.

Approach

The PRISMA matrix provides an overview of the research relevant to the project topic. It is a tool that supports the critical examination of articles and resources, gaps in knowledge, and articles identified, included, and excluded. This visual tool also displays article analysis in chart form for ease of reference (Moher et al., 2009).

Despite the lack of data available to advanced practice nursing on postoperative care and managed care, bariatric patients require evidence-based clinical intervention to reduce or prevent long-term nutritional deficiencies. The collection and analysis of evidence will assist with clinical decision-making in evidence-based nursing. I selected articles by searching keywords such as *micronutrient deficiencies, vitamins, protocols and guidelines, post-operative management, and evidence-based guideline for nutritional supplementation.*

Practice-Focused Question

The nursing problem at the practice for managing postoperative bariatric patients relied on experience, judgment, and nursing skills level. Patients may be negatively affected by the lack of standardized nurse is protocol. The practice-focused question of this doctoral project is “What can the APN do with the best available evidence for implementing protocols and procedures to prevent, detect and monitor for nutritional deficiencies after surgery in the clinical setting?”

Clarifying the Purpose

The purpose of this doctoral project is to conduct a literature review to evaluate and synthesize the literature to develop an evidence-based protocol for APNs to detect,

assess, and treat micronutrient deficiency among post-operative bariatric patients. I conducted this literature review within the context of the JHNEBP model to answer the question: “What can the APN do for implementing protocols and guidelines to treat micronutrient deficiency after bariatric surgery?” Micronutrient deficiencies should be considered during all phases of bariatric surgery to avoid potentially irreversible complications.

This approach aligns with the practice-focused question. The evidence can be collected to provide information that supports a recommendation for EBP guidelines in clinical nursing practice postoperative management in caring for bariatric patients. The research data will review the mechanism that causes impairment of vitamin/mineral status for developing a nurse-driven protocol in this population. This review can be applied and used as the best approach to care management in communities and nationally.

Sources of Evidence

EBP is a framework for clinical practice that integrates the best available research evidence provided and patients’ values and preferences to make decisions about health care recommendations. EBP has been developed for a specific practice situation or agency to reduce cost and improve outcomes. The nature of this project is to gain an overview of information about micronutrient deficiency after bariatric surgery the best available evidence relevant to nursing care and management.

The nature of this project is to collect published articles from current EBP protocols/guidelines to support the need to implement an EBP for postoperative bariatric patients with micronutrient deficiency. The sources included peer-reviewed articles from

Walden University's online databases. A synthesis matrix grouping to find gaps in the literature and relevant concepts by categories related to the management of vitamin/mineral deficiencies. The information will be synthesized and analyzed to recommend the integration of an evidence-based protocol for knowledge transfer in bariatric clinics locally and throughout the state of the project site.

Relationship of the Evidence to the Purpose

The purpose of this doctoral project is to evaluate and synthesize the highest evidence that can be used to develop a nurse-driven protocol/guideline. The evidence gathered from this research review provided the data needed to develop recommendations for the protocol. There has been limited documentation of nursing strategies to manage bariatric care after surgery. It is essential to exhaust the search for evidence of best practices.

Evidence to Address the Practice-Focused Question

Analyzing and synthesizing the evidence was crucial to answer the focused-practice question. Research indicates obesity rates are rising, causing an increased burden on the public healthcare system. Bariatric surgery is the most effective treatment available for individuals who are obese or morbidly obese with comorbid conditions such as sleep apnea and hypertension. Although, most studies indicate bariatric surgery induces significant weight loss and ameliorates cardiometabolic problems of obesity, evidence shows an increase in incidence in micronutrient deficiencies after surgery (Wright, 2015). Bariatric surgery procedures encourage weight loss by altering the gastrointestinal tract to promote food restriction and malabsorption of vitamins and

minerals. Therefore, bariatric procedures, including restrictive, combined restrictive, and malabsorptive, promote micronutrient deficiency, including the trace elements. Evidence-based protocols are needed to bridge the knowledge gap about bariatric surgery procedures' effects and the nutritional complications that ensue. Implementing a nurse-driven protocol may serve as a tool for APNs to prevent, assess, treat, and manage micronutrient deficiency following bariatric surgery.

Databases and Search Engines

The first step involved a search of Joanna Briggs Institute, EMBASE, MEDLINE, CINAHL, and Cochrane Library. Studies were published between January 1, 2015, and September 30, 2020. Next, I analyzed the titles and abstracts for keywords to add to the list of search terms. Additional databases National Guidelines Clearinghouse were searched using identified critical words, including the synonym terms and MeSH terms (*trace elements*, bariatric surgery [all], and vitamin deficiency). Inclusion search terms included age > 18 years of age, bariatric procedures, micronutrient deficiency, and protocols. Exclusion filters for all searches included maternity, pregnant women, and minors, under 18 years of age.

Key Search Terms and Combinations of Search Terms

The Walden librarian assisted with a wide variety of database searches for all relevant research. The search keyword terms included vitamins, micronutrients, protocols, guidelines, vitamins (A, B, B1, B12, C, D, E, K, thiamine, iron, zinc, calcium), trace elements and vitamin deficiency, micronutrient deficiency, bariatric surgery (all), weight-loss surgery, bariatric protocols, treatment of vitamin deficiency, mineral

deficiency, treatment of vitamin deficiency, bariatric surgery and vitamin deficiency and micronutrient complications used that focused on bariatric surgery and micronutrient deficiencies to research the database.

Search Exhaustive and Comprehensive

The search was exhaustive by using various terms and a combination of phrases and terms that include the practice-focused question. The selective articles and abstracts were read to ensure the search was exhaustive. All articles in the search process generate a bibliography of studies that includes abstracts and titles of relevant studies. It is essential to exhaust the literature for the best EBP. Finally, I collated, combined, and summarized the collected data. The evidence found included articles using mixed methods and qualitative and quantitative studies. The findings and recommendations of evidence are discussed in Section 4.

Institutional Review Board

This doctoral project aligns with Walden University's systematic literature review. An application for full approval of the Institutional Review Board was obtained from Walden University to proceed with this DNP project. This DNP project was a systematic review and did not include any human subjects. The approval number is 07-07-21-0484723.

Analysis and Synthesis

The evidence was collected manually and recorded in a literature matrix table. The articles were divided into sections according to year, authors, title, purpose, sample size, design, and findings into the matrix table. The search began using CINAHL, search

words, and protocols and guidelines about bariatrics and vitamin deficiencies. The PRISMA flowchart was used to show an illustration for the article' selection procedure. The collected articles were arranged by the year published, authors, title, purpose, sample design, and findings in each appropriate column in the matrix.

Systems Used for Recording, Tracking, Organizing, and Analyzing the Evidence

Analysis Procedure

The analysis procedure involved categorizing articles based on a grade scale of 1-5. The evidence's highest strength was selected to recommend findings to produce a nursing protocol for micronutrient deficiency management after bariatric surgery procedures. The data analysis provided an evidence-based protocol used in various clinical settings in their managed care and treatment of bariatric patients.

Summary

This project provides recommendations that can address the gap in evidence-based knowledge the APN can use to facilitate collaborative change in current clinical practice surrounding screening, diagnosing, and managing micronutrient deficiencies after bariatric surgery procedures. The APN can then address the implementation of nurse-driven protocols with the best available evidence to change nursing practice, which will improve patient outcomes. The next section will include findings and recommendations from the systematic literature review and their implications for the focused-practice question.

Section 4: Findings and Recommendations

APNs are trained to assess patients' needs, diagnose disease, and formulate treatment plans for obese patients undergoing bariatric surgery procedures pre- and postoperatively. Since the onset of bariatric surgery procedures, postoperative management has expanded to include APNs. The postoperative management of bariatric patients can be affected by the type of surgery (restrictive, malabsorptive, or combination) as well as the skill level of the nurse and patients' compliance with the plan of care.

Laparoscopic bariatric surgeries can disrupt the absorption and metabolism of water-soluble and fat-soluble vitamins and minerals. Consequently, patients are at higher risk of developing deficiencies in one or more micronutrients can develop after surgery, including thiamin, A, B1, B12, D, E, iron, ferritin, and calcium (Chakhtoura, 2015). For example, a thiamin deficiency can lead to a neurological condition called Wernicke encephalopathy. Wernicke encephalopathy can take weeks to years after surgery to develop and requires early interventions for best outcomes (Story, 2020). The non-existence of nursing protocols to aid nurses in screening, assessing, and monitoring patients at each follow-up visit has led to many metabolic conditions that, if detected early, could have been avoided. It was found that micronutrient deficiency is more common in morbid obese patients than patients of normal body weight.

The practice-focused question used to facilitate this DNP project was: "What can the APN do to implement protocols and guidelines to detect, treat and manage micronutrient deficiencies after bariatric surgery?" To answer this question, I conducted a

systematic literature review. The articles identified to answer the practice-focused question were full-text peer-reviewed and evidence-based. I retrieved them electronically from PubMed, Embase, Cumulative Index of Nursing and Allied Health Literature, and Medline. The articles were selected for review if they met these inclusion criteria. The keywords used included micronutrient deficiencies, bariatric surgery, weight-loss surgery, Roux-en-Y gastric bypass, laparoscopic sleeve gastrectomy, bilio-pancreatic with or without the duodenal switch, guidelines, protocols, interventions, and nurse-driven protocols. The data analysis matrix included, author, year, title, sample size/setting, findings that help answer the practice-focused question, limitations, evidence level, and quality of the articles. The summary and findings are included in the analysis table in Appendix C.

Search Outcome

The literature review resulted in a total of 1,121 articles. Of these, 1,029 articles were retrieved from CINAHL, ProQuest, and Allied Health, and 92 articles came from other sources such as Google Scholar. After removing duplicate articles, 778,343 were screened for the relevance of information by title and abstracts. Of these, 177 were excluded because the data were not relevant to the review. This resulted in 166 meeting the eligibility criteria, including a 5-year publication timeframe. These were further narrowed by topic within the publication timeframe.

The inclusion criteria for this systematic literature review included a) articles addressing screening, management, and follow-up, b) patient care guidelines for common vitamins/mineral deficiencies, c) recommendations for lifelong vitamin supplementation

therapy, and d) full-text articles accessible through Walden library electronic database. The analysis resulted in (n=17) full-text articles meeting the inclusion criteria for this systematic literature review related to nursing protocols, recommendations, algorithms, or guidelines addressing micronutrient deficiency, treatment, monitoring, or follow-up (See PRISMA diagram Appendix D).

The approach to organized and synthesizing the evidence gathered included a matrix synthesis that arranged the relevant concepts by categories related to diagnosing, screening, guidelines related to vitamin/mineral deficiency management. The information was used to recommend a nurse-driven protocol. A matrix methodology was used to categorize the information from the literature review. The sources were organized to reveal current data on the focused question.

Systematic Reviews

Cabral (2015) examined the impact of vitamin D and calcium deficiency on the bones of patients undergoing bypass the Roux-en-Y gastric (RYGB). In the review, RYGB patients showed higher levels of vitamin D and calcium level (RYGB), with a focus on the type of administration, doses, and effects after surgery. This review included five articles from the last 10 years. The reported results that all bariatric surgeries can lead to poor absorption of fat-soluble vitamins and other micronutrients such as calcium. Though not significant vitamin D at a dosage between 1000mg-1800mg /day, and 500mg of calcium daily revealed no relationship or relevance over time to the postoperative bone loss after the RYGB.

Weng (2015) analyzed iron and vitamin B12 deficiencies between 100 cases who received laparoscopic RYGB. The patients were evaluated preoperatively at 6, 12, 24, and 36 months. Preoperatively, 12% showed iron and vitamin B12 deficiencies. Postoperatively, 24% were deficient in iron and vitamin B12. These results provide evidence of the need for comprehensive nutrient follow-up after RYGB.

Dix (2017) evaluated the effects of laparoscopic sleeve gastrectomy (LSG) on vitamin D status and the effectiveness of vitamin D supplementation. 15-200 patients who had undergone LSG surgery received a vitamin D supplementation dose of 3000 IU daily and found that the current guidelines recommend initial vitamin D supplementation of 3,000 IU daily. The study showed that LSG did not require any follow-up testing.

Lewis et al. (2018) investigated the prevalence of vitamin A, B1, C, or E levels after gastric bypass surgery. The review included 21 articles; all studies were of level IV grade and inconclusive in quality. This review highlighted the inconsistency in defining micronutrient deficiency and what constitutes deficiency levels in some studies. Lewis et al. reported a lack of information on micronutrient supplementation including adherence to the administration of prescribed supplements. It was concluded that clinics should make their own decision to decide what defines deficiency.

Li et al. (2018) investigated the effectiveness of vitamin D supplementation on preventing postoperative vitamin D deficiency after LSG. There were 1,285 patients in this study. The study found that vitamin D at 800 IU/day, for 1 year was effective in preventing vitamin D deficiency after the LSG, which can vary due to sun exposure or the lack of sun exposure.

Mahawar (2018) compared the use of vitamin B12 injections for RYGB patients versus orally vitamin B12 of 1000 as prophylactic treatment for RYGB patients. The group of patients received vitamin B12 1000 µ daily after surgery. Despite the current guidelines, prophylactic B12 injections were not considered in the data and there is still need for long-term studies to understand the impact of vitamin B12 injections after RYGB.

Lewis et al. (2018) investigated the prevalence of vitamin A, B1, C, and E levels after gastric bypass surgery systematic review of experimental and epidemiological study designs, intervention trials, randomized and nonrandomized controlled trials, and retrospective and prospective studies for adult individuals undergoing bariatric (RYGB or SGAGB) who reported on one or more micronutrient deficiencies (vitamin A, vitamin B1, and vitamin E). Lewis et al. concluded future research is needed to investigate micronutrient risks with a focus on confounders to serum micronutrients, as there is a link between postoperative inflammation or infection and micronutrient deficiency.

Randomized Control Trials

Luger et al (2017) conducted a randomized control trial evaluated the efficacy and safety of a forced vitamin D dosing regimen and intervention after loop-gastric bypass. Both groups experienced a higher increase of 25(OH), which indicates that a high vitamin D level after receiving a loading dose with subsequent maintenance dose in the first month after surgery.

Lewis et al. (2018) investigated the prevalence of vitamin A, B1, C, and E levels after RYGB or SGAGB surgery in patients who reported on one or more micronutrient

deficiencies (vitamin A, vitamin B1, and vitamin E). Even though the metabolic sequelae are not known, patients were given 100 μ daily of multivitamins after the first 12 months of surgery, which is not in line with the ASMBS guidelines (Heusschen, 2020).

Guidelines

Dagan (2020) addressed the current nutritional recommendations in managing adult bariatric surgery patients to ensure long-term postoperative success based on evidence. The nutritional recommendations were divided into three sections: 1) pre-surgery nutritional evaluation and pre-surgery diet and supplementation; 2) post-surgery diet progression, eating-related behaviors, and nutritional therapy for common gastrointestinal symptoms; and 3) recommendations for lifelong supplementations and advice for nutritional follow-up. The evidence supports the need to identify and correct nutritional deficiencies, which should include complete blood counts, electrolytes, lipid panel, glucose, and liver and kidney function. It should also monitor vitamin and mineral assessment every 3 months for the first year, every 6 months in the second year, and then annually to optimize long-term success and prevention of complications (Dagan, 2017).

O'Kane (2020) focused on The British Obesity and Metabolic Surgery Society perioperative and postoperative guidelines for biochemical monitoring and micronutrient replacement for adults and adolescents undergoing bariatric surgery in the United Kingdom. The study focused on the adjustable gastric band (AGB), LSG, RYGB and the biliopancreatic duodenal switch (BPD/DS). It recommended long-term postoperative nutritional and metabolic support for safe clinical practice and patient care.

Chakhtoura (2016) investigated the Endocrine Society, the American Association of Clinical Endocrinologists, The Obesity Society, and the ASMBS's various guidelines and recommendations on vitamin D supplementation to guide physicians and patients. The Endocrine Society recommends that postoperatively, bariatric patients should routinely be supplemented with vitamin D daily, 3,000 IU/day to 50,000IU-1-3 times weekly orally. There is still the need for long-term high-quality randomized trials to be developed based on recommended standards on nutritional guidelines.

Parrott (2017) reviewed the ASMBS's update from 2008 with key micronutrient screening for preoperative and postoperative bariatric surgery. Unfortunately, surgery can exacerbate preexisting nutrient (vitamin B1, B12; folate; iron; vitamins A, E, K, calcium, vitamin D; copper; and zinc) deficiencies. To this date, no guidelines have examined micronutrient deficiencies after bariatric surgery using a scientific approach that optimizes patient outcomes and safety.

Di Lorenzo (2020) reviewed the European Association for Endoscopic Surgery 2020 guidelines to inform physicians for postoperative nutritional and metabolic support to inform for providers. Despite the guidelines, vitamin D (25(OH)) was higher among men (60%) versus women (38,1%) in Italy. They recommend scheduled multidisciplinary postoperative follow-up and daily micro and/or macronutrient supplementation according to the type of the procedure and to the deficiencies documented during follow up.

Remedios et al. (2016) reviewed the bariatric nutritional guidelines for the Indian population. They found that nutritional deficiencies in India exist because the country is economically poor and that such deficiencies are more likely to occur due to the cultural

practices and habits of the Indian population because of poverty. The Center for Obesity and Digestive Surgery recommends that all patients undergo compulsory preoperative and postoperative nutritional counseling and vitamin supplementation lifelong, irrespective of the type of surgery. Mechanick et al. (2019) examined the 2019 update on clinical practice guidelines for perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric endorsed by the American Association of Clinical Endocrinologists, the American College of Endocrinology, the Obesity Society, and the American Society for Metabolic and Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists. They found common deficiencies of fat-soluble vitamin deficiencies (vitamin A, D, E, K, folic acid, iron, and calcium) found in 82% to 90% of patients. They recommend vitamin supplementation with 1 to 2 tablets of a chewable multivitamin with 800 to 1,000 µg daily of fortified folic acid, 5,000 -10,000 IU daily Vitamin A, 400 IU daily of vitamin E, 1 mg daily of vitamin K, and up to 150-300 mg of elemental iron daily with vitamin C. Anemia is likely to occur as a result of the malabsorption of iron. Postoperatively biochemical surveillance of nutritional status included CBC, platelets, electrolytes, glucose, iron studies, ferritin, vitamin B 12 (MMA, Hcy optional), liver function (GGT optional), lipid panel, 25 Hydroxyvitamin D other optional tests intact PTH, thiamine and RBC folate. Despite the current guidelines, serum levels need to be monitored carefully for both under-replacement and the various vitamins. It is understood that restrictive and malabsorptive procedures lead to metabolic and nutritional complications, although it is unclear exactly which micronutrient

deficiency occurs. However, professional guidance remains essential because of the risk of nutritional deficiencies.

Algorithm

Bazuin et al. (2017) reviewed the Catharina Hospital algorithms aimed to evaluate any of the postoperative bariatric patients for nutritional deficiencies to improve laboratory spending at the clinic. They identified substantial cost savings using algorithms to detect early vitamin A, B, B1, B6, B12, D, folate, ferritin, zinc, and magnesium deficiencies. Their algorithm resulted in a 14% to 42% cost savings in their clinic. Despite using the algorithm, not all patients develop deficiencies. This led to less screening and reduced laboratory costs.

Findings

This systematic literature review aimed to synthesize current evidence on the detection, treatment, and management of micronutrient deficiencies after bariatric surgeries. The findings included:

- Bariatric surgery patients are more susceptible to one or more micronutrient deficiencies after surgery during the 1st year after the operation.
- There are inconsistent recommendations and guidelines by the top three bariatric experts for what constitutes vitamin B12 and vitamin D deficiencies verses insufficiency serum level.
- Recommended guidelines using the best evidence-based findings to improve clinical practices and patient outcomes in primary care

- The best practices for micronutrient deficiency management were endorsed by an international and national panel of experts working in the field of metabolic and bariatric surgery.
- Studies conducted in the United Kingdom, Italy, Germany, India, Brazil, China. Studies conducted in the United States were limited.

Recommendations

Built on the analysis and synthesis of this review, numerous studies confirmed the insufficient evidence on micronutrient deficiencies after bariatric surgery. This review concluded that the evidence demands that more research to be done on this topic, and especially that more population-specific evidence-based practice protocols for nursing practice be investigated to improve patient management and outcomes. Future research is needed in this area to improve practice in the primary care setting. The purpose of this systematic literature review was to identify evidence-based data to facilitate developing a nurse-driven protocol at the practice site. The recommendations are as follows:

- Implement a universally accepted protocol to manage micronutrient deficiencies that includes lifelong routine monitoring based on symptom or the type of procedure, daily vitamin, and mineral supplementation.
- Identify what constitutes deficiency versus insufficient levels of micronutrients at the clinic site.
- Adjust frequency and serial monitoring of micronutrients with emphasis on vitamin B12 and vitamin D serum levels.

- Treat patients with signs and symptoms of micronutrient deficiency based on clinical findings; do not wait for laboratory confirmation because results can take days.
- Foster further research on bariatric surgeries and nutritional complications conducted in the United States to advise best clinical practice and improve patient outcomes and safety.

Strengths and Limitations of Project

The strength of the project includes an exhaustive literature search for improving patient care for this population on this often-overlooked important clinical issue for patients. This systematic review included searching articles related to guidelines or algorithms addressing treatment and the management of micronutrient deficiencies as well as full-text articles within a 5-year timeframe, including randomized controlled trials and systematic reviews. A possible limitation of undertaking an exhaustive search of nurse-driven evidence-based protocols, guidelines, and treatment recommendations for micronutrient deficiencies post bariatric surgery in nursing.

This systematic literature review ($N = 17$) supports the need for an accessible evidence-based nurse-driven protocol to improve APN's ability to monitor for micronutrient deficiencies after surgery. Addressing micronutrient deficiencies based on evidence will bridge the knowledge gap to improve patient outcomes and facilitate safer outcomes. APNs can align their critical thinking with this new clinical evidence to improve patient assessment and treatment. The findings in this systematic literature review are in line with findings that bariatric surgery patients might ~~thus~~ benefit from an

additional nursing assessment after surgery to decrease nutritional complications. Future studies should assess whether nutritional strategies targeting vitamin supplementation before surgery might lead to more minor micronutrient deficiencies after surgery.

Section 5: Dissemination Plan

Plan to Extend Beyond DNP Project

The plan for this DNP is to share the results of this project to nursing schools, community health fairs, and private doctors' offices and clinics in nearby regions. I hope to share this information by participating in the Sigma Theta Tau International Nursing Research Congress which facilitates and encourages nursing research to collaboration within the global nursing community

Audience for Dissemination

The primary audience for this project dissemination is the nursing staff at the outpatient bariatric surgery center and primary care clinics. The stakeholders concerned in supporting this project include the surgeons, APNs, physician assistants, psychologists, vendors, and dietitians/nutritionists at the practice site and around the region. The findings of this project will promote changes to our current clinical nurse practice care of patients after bariatric surgery.

This project will impact ~~ed~~ APNs' awareness about the prevalence of micronutrient deficiency after bariatric surgery. The recommendations from this systematic review provide current evidence-based data to develop a nurse-driven protocol for micronutrient deficiencies after bariatric surgery.

Analysis of Self

Challenges, Solutions, and Insights Gained

The greatest challenge as a DNP student has been staying motivated to complete the program. My journey to the DNP program started in 2016 as a professional self-

improvement project. In 2018, I saw an opportunity to share with other staff members ways to improve nursing practice of patients after bariatric surgery. The clinic was reviewing a new preoperative guideline called ERAS. This new protocol became implemented within weeks of introducing it to our nursing practice. I realized that I had become a better nurse leader and that EBP had improved clinical practice processes and patient outcomes at the practice site. My leadership experience has enabled the opportunity to implement EBP successfully.

Scholar

My professional role as an APN has been a steady climb upwards for the past decade, but one with trials and tribulations. I have learned to integrate my research into practice. I learned to remove the barriers to implementing EBP. The strategies included sharing research articles and leaving articles for other nurses to review in the workplace.

This evidence-based DNP project has increased my knowledge about bariatric surgery and the complications of nutritional deficiencies associated with that type of surgery. I have learned to think out of the box when caring for bariatric surgery patients and the need for continuous evaluation of their nutritional status. I have learned the importance of EBP and how providers' knowledge and clinical practice impact patient outcomes and quality of life.

Summary

Bariatric surgery is becoming increasingly popular in the United States and worldwide. Research over the past 5 years has associated bariatric surgery with micronutrient deficiencies. Adequate vitamin and mineral supplementation have also

improved nutritional and metabolic outcomes. Exactly which micronutrient deficiencies are likely to occur is not fully known. Furthermore, long-term studies about micronutrient deficiencies are needed to create appropriate prevention and treatment strategies for patients after bariatric surgery for the nutritional and metabolic complications that may follow these surgeries.

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Appendix A: Permission Letter From John Hopkins

From: Kim Bissett
Sent: Tuesday, December 22, 2020 8:41 AM
To: Naitte Jordan
Subject: JHNEBP permission

Hello Naitte,

You have permission to use the JHNEBP model and diagram in your doctoral dissertation.
Best of luck with your DNP project.

Thank you,
Kim

Kim Bissett, PhD, MBA, RN
Director, [The Johns Hopkins Center for Evidence-based Practice](#)



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Appendix B: Table of Evidence

Table 1*Analysis and Synthesis of Evidence*

Author and date	Title	Evidence type	Sample size and setting	Study findings that help answer the EBP question	Limitations	Evidence level & quality
1. Cabral, J. A. V., DeSouza, G. P., de Almeida, Nascimeto, J., Simoneti, L. F., Marchese, C. & Sales-Peres, S. H de Carvalho (2016)	Impact of vitamin D and calcium deficiency in the bones of patients undergoing bariatric surgery	Systematic review	n= not reported /University of São Paulo, Brazil	The study showed high deficiencies in vitamin D and calcium after Roux-en-Y surgery. All patients' post-operative calcium should be between 1000-1800 mg/day and vitamin D should be 500 IU /day to prevent or minimize bone metabolic complications.	Only restrictive surgery types; did not identify bone fractures; limited timeframe to 22 months	LII/C
2. Weng, T. C., Chang, C. H., Dong, Y. H., Chang, Y. C. & Chuang, L. M. (2015)	Anemia and related nutrient deficiencies after Roux-en-Y gastric bypass surgery:	Systematic review and meta-analysis	n=5909/some where US	The study found the proportion of patients with anemia was 12.2% at baseline to 20.9% and 25.9 % at 12 and 24 months postoperatively; ferritin deficiency increased from 7.9% at baseline. 13.4% and 23.0% at 12 and 24 months . RYGB is associated with deficiencies in vitamin B12 and iron.	Only RYGB surgeries; the missing rate for each outcome at 12, 24, and 36 months	LII/B
3. Dix, C. F., Bauer, J. D. & Wright, O. R., York, L. (2017)	Vitamin D status and sleeve gastrectomy	Systematic review	n=15-200// Queensland Health and the Royal Brisbane and Women's Hospital, Australia	The studies reporting 14 and 72 % of patients were vitamin D deficient 1 year post-surgery	Only sleeve gastrectomy patients; monitoring timeframe	LII/C
4. Lewis, C. A., de Jersey, S., Hopkins, G., Hickman, I. & Osland, E. (2018)	Does bariatric surgery cause vitamin A, B1, C or E, deficiency	Systematic review	n=not reported	The study identified current limitations is needed to further investigate the risk of deficiency for these procedures with a specific focus on confounders to serum vitamin A, B1, C, and E.	There were inconsistent findings in the literature regarding the presence of vitamin A, B1, C, and E deficiency following SG, GB, and AGB Surg; limited first year after GB, SG, and AGB bariatric surgery	LI/C

5. Li, Z., Zhou, X. & Fu, W. (2018)	Vitamin D supplementation for the prevention of vitamin D deficiency after bariatric surgery:	Systematic review and meta-analysis	n=41-309/ United States (5); Norway (2), Italy (2), Netherlands (2), and Spain (2)	The study revealed the prevalence of vitamin D depletion was 54.0 and 31.0%. The study demonstrated that vitamin D supplementation significantly reduced the prevalence of vitamin D depletion and improved the 25-OHD level 1 year following surgery.	The different surgery types; six were observation studies.	LIB
6. Mahawar, K. K., Reid, A., Graham, Y., Callejas-Diaz, L., Parmar, C., Carr, W. R. J., . . . Small, P. K. (2018)	Oral vitamin B12 supplementation after Roux-en-Y gastric bypass	Systematic review	n= not reported/Bariatric Unit, Department of General Surgery, Sunderland Royal Hospital, Sunderland, UK	The study revealed for Roux-en-Y gastric bypass revealed oral supplementation doses of $\leq 15 \mu\text{g}$ vitamin B12 daily are inadequate for prophylaxis of vitamin B12 deficiency in adult RYGB patients. Suggests doses of 1000 μg vitamin B12 daily or higher may deliver better outcomes	Roux-en-Y gastric bypass patients; a study conducted in the UK	L1/B
7. Lewis, C.-A., de Jersey, S., Seymour, M., Hopkins, G., Hickman, I., & Osland, E. (2020)..	Iron, vitamin B12, folate and copper deficiency after bariatric surgery and the impact on anaemia: a systematic review	Systematic review	n=not reported/US	The study focuses on the prevalence of these nutritional deficiencies and the impact on anemia in the first 12 months after surgery	Results on the prevalence of nutritional anaemias	L1/C
8. Luger, M., Kruschitz, R., Kienbacher, C., Traussnigg, S., Langer, F., Prager, G., Schindler, K., Kallay, E., Hoppichler, F., Trauner, M., Krebs, M., Marculescu, R., & Ludvik, B. (2017)	Vitamin D3 loading is superior to conventional supplementation after weight loss surgery in vitamin D-deficient morbidity obese patients: a double-blind randomized placebo-controlled trial	Randomized control study	n=50/Vienna	This study aimed to examine the efficacy and safety of forced vitamin D dosing regimen and intervention effects in liver fibrotic patients. The found vitamin D3 deficiency among 50-96% of bariatric patients. The results in the first month postoperatively, oral vitamin D3 (≤ 3 doses of 1000,000 IU; intervention group) with subsequent maintenance dose (3420 IU/day) in both groups until 6-month follow-up	Limited timeframe of 6-months; restricted to omega-loop gastric bypass patients; small sample size	L1/B
9. Heussen L., Schijns, W., L., Ploeger, N., Deden, L. N., Hazebroek, E. J., Berends, F. &	The true story on deficiencies after sleeve gastrectomy: Results of a double-blind randomized controlled trial	Double-blind randomized control trial	n=139/ Rijnstate hospital, Arnhem, Rotterdam, Netherlands	The study revealed nutritional deficiencies (iron, folic acid, vitamin B1 (7.3%), and vitamin D (76.1 %,	Only patients living in Rotterdam; only pre-operative screening for	L1/B

Aarts, E. O. (2020)				zinc (13%) are highly common post-operatively after laparoscopic sleeve (LSG); routine multivitamin supplementation should contain elementary zinc, iron, folic acid, vitamin B12, D, B1 to prevent deficiency to prevent deficiencies and need long-term nutritional follow-up	vitamin B12 & D deficiency; only biliopancreatic diversion with duodenal switch	
10. Dagan, S., Goldenshulger, A., Globus, I., Schweiger, C., Tel Aviv, I., Sandbank, G.K., Ben-Poosoorat, T. & Sine, T. (2017)	Nutritional recommendations for adult surgery patients: Clinical practice	Clinical guidelines	N=468,609, 45% were RYGB, 37 % LSG, and 10% LAGB/ Tel Aviv, Israel	Nutritional recommendations are divided into 3 main sections: 1) pre-surgery 2) post-surgery and 3) recommendation for lifelong vitamin and mineral supplementation to enhance the quality of care, set uniform guidelines, and ensure safe practices	Tel Aviv, Israel	LIV/B
11. O'Kane, M., Parretti, H. M., Pinkney, J., Welbourn, R., Hughes, C. A., Mok, J., Pinnock, G., et al (2020)	British Obesity and Metabolic Surgery Society Guidelines on perioperative and postoperative biochemical monitoring and micronutrient replacement for patients undergoing bariatric surgery-2020 update	Clinical guidelines	N= did not report/ Centre for Obesity Research Rayne Institute, Department of Medicine University College London, London, UK	Most common deficiencies include vitamin D, A, B12, ferritin, folate, trace elements, thiamine, calcium, anemia. Postoperative nutritional screening and/or monitoring after surgery; vitamin and mineral supplementation to prevent nutritional deficiencies post-operative; treatment of nutritional deficiencies before/after bariatric surgery	Wales, U. K.	LIV/B
12. Chakhtoura, M. T., Nakhoul, N., Akl, E. A., Mantzoros, C. S. & Fuleihan, G. A. E. H. (2015)	Guidelines on vitamin D replacement in bariatric surgery: Identification and systematic appraisal	Clinical guidelines	N=not reported, all bariatric patients /Beirut, Lebanon	Recommendations: Vitamin D varying from 3,000IU daily to 50,000 IU 1-3 times weekly, or based on serum remarks and bone density; use of algorithm produced cost-savings up to 42%	Variable follow-ups: inconsistency in the definition of the deficiency; vitamin D supplementation on differ between societies	LIV/B
13. Parrott, J. M., Frank, L., Rabena, R., Craggs-Dino, L. & Isom, K. A. (2017)	American Society for Metabolic and Bariatric Surgery Integrated Health Nutritional	Clinical guidelines	n= not reported/ United States	The purpose of this study was to provide evidence-based guidelines based on a review of clinical	Lack standardization	LIV/A

	Guidelines for the Surgical Weight Loss Patient 2016 Update Micronutrients			evidence the existence of micronutrient deficiencies (vitamins B1, and B12; folate, iron, vitamins A, E, K, and D; copper and zinc) are increasing, and the goal is to facilitate high-quality care using a scientific approach to management that optimizes patient outcomes and safety.		
14. Di Lorenzo, N., Antoniou, S. A., Batterham, R. L., Busetto, L., Godoroja, D., Iossa, A., et al (2020).	Clinical practice guidelines of the European Association for Endoscopic Surgery (EAES) on bariatric surgery: update 2020 endorsed by IFSO-EC, EASO, and ESPCOP	Clinical guidelines	n= 58/ Iran	The study purpose to provide recommendations evidence-based to encourage practitioners to apply these guidelines in conjunction with their clinical judgment to individual patient circumstances at 10 days, 1, 3, 6, and 12 months after surgery; including daily nutritional supplementation of (vitamin D 200 IU, Calcium 400 mg, magnesium 100mg, Zinc 4 mg per tablet for 1 year.	Iranian patients; malabsorptive procedures not included in the study	LIV/B
15. Remedios, C., Bhasker, A. G., Dhar, S. & Lakdawala, M. (2016)	Bariatric nutrition guidelines for the Indian population	Clinical guidelines	n= not reported /India	The positive change occurred post-operative after the introduction of nutritional recommendations for bariatric and metabolic surgery specific to patients from India.	Exclusive to patients living outside India;	LIV/C
16. Mechanick, Jeffrey I, Caroline Apovian, Stacy Brethauer, W. Timothy Garvey, Aaron M. Joffe, Julie Kim, Robert F. Kushner, et al. (2019)	Clinical practice guidelines for the perioperative nutrition, metabolic, and nonsurgical support of patients undergoing bariatric procedures-2019-update: Cosponsored by American Association of Clinical Endocrinologists/American College of Endocrinology, the Obesity Society, American Society	Guidelines, expert opinion	-n=not reported /Lebanon	The purpose of this study screened all patients, LRYGB or LSG one pre/post-operatively for vitamins A, B1, B6, B12, D, folate, ferritin, zinc, and magnesium at 6,12,18,24,36,48, and 60 months. post-operative most common deficiencies were vitamin D (82%-90%) zinc, ferritin, folate, and vitamin B12, and follow-up ranged	Limited to Lebanon	LIV/A

	For Metabolic & Bariatric Surgery, Obesity Medicine Association, and American Society of Anesthesiologists			from 3-84 months. The algorithm provided efficient screening based on observations recommendations was to provide evidence-based update clinical decision-making	
17. Bazuin, I., Pouweis, S., Houterman, S., Nienhuijs, S. W., Smulders, J. F. & Boer, A. K. (2017)	Improved and more effective algorithms to screen for nutrient deficiencies after bariatric surgery- algorithms	Algorithms	n= 2055/ Catharina Hospital Eindhoven, Germany	The study screened all patients, LRYGB or LSG one pre/post-operatively for vitamins A, B1, B6, B12, D, folate, ferritin, zinc, and magnesium at 6,12,18,24,36,48, and 60 months. post-operative most common deficiencies were vitamin D (82%-90%) zinc, ferritin, folate, and vitamin B12, and follow-up ranged from 3-84 months. The algorithm provided efficient screening based on observations	Only focused on vitamin D deficiency and supplementation LIV/B

Appendix C. Levels of Evidence and Quality Guides

Table 2

Johns Hopkins Levels of Evidence

<p>Level I Experimental study, randomized controlled trial (RCT) Systematic review of RCTs, with or without meta-analysis</p>	<p>A <u>High quality</u>: Consistent, generalizable results; sufficient sample size for the study design. adequate control; definitive conclusions; consistent recommendations based on comprehensive literature review that includes thorough reference to scientific evidence</p>
<p>Level II Quasi-experimental study Systematic review of a combination of RCTs and quasi experimental, or quasi-experimental studies only, with or without meta-analysis</p>	<p>B <u>Good quality</u>: Reasonably consistent results; sufficient sample size for the study design. some control, definitive conclusions; reasonably consistent recommendations based on comprehensive literature review that includes some reference to scientific evidence</p>
<p>Level III Non-experimental study Systematic review of a combination of RCTs, quasi-experimental and non-experimental studies, or non-experimental studies only, with or without meta-analysis Qualitative study or systematic review with or without a meta-synthesis</p>	<p>C <u>Low quality or major flaws</u>: little evidence with inconsistent results; insufficient sample size for the study design; conclusions cannot be drawn</p>
<p>Level IV Opinion of respected authorities and/or nationally recognized expert committees/consensus panels based on scientific evidence</p> <p>Includes: Clinical practice guidelines Consensus panels</p>	<p>A <u>High quality</u>: Material officially sponsored by a professional, public, private organization, or government agency; documentation of a systematic literature search strategy; consistent results with sufficient numbers of well-designed studies; criteria-based evaluation of overall scientific strength and quality of included studies and definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years</p> <p>B <u>Good quality</u>: Material officially sponsored by a professional, public, private organization, or government agency; reasonably thorough and appropriate systematic literature search strategy; reasonably consistent results, sufficient numbers of well-designed studies; evaluation of strengths and limitations of included studies with definitive conclusions; national expertise is clearly evident; developed or revised within the last 5 years</p> <p>C <u>Low quality or major flaws</u>: Material not sponsored by an official organization or agency; undefined, poorly defined, or limited literature search strategy; no evaluation of strengths and limitations of included studies, insufficient evidence with inconsistent results, conclusions cannot be drawn; not revised within the last 5 years</p>

<p>Level V Based on experiential and non-research evidence</p> <p>Includes: Literature reviews Quality improvement, program or financial evaluation Case reports Opinion of nationally recognized experts(s) based on experiential evidence</p>	<p>A High quality: Clear aims and objectives; consistent results across multiple settings. formal quality improvement, financial or program evaluation methods used. definitive conclusions; consistent recommendations with thorough reference to scientific evidence</p> <p>B Good quality: Clear aims and objectives; consistent results in a single setting; formal quality improvement or financial or program evaluation methods used; reasonably consistent recommendations with some reference to scientific evidence</p> <p>C Low quality or major flaws: Unclear or missing aims and objectives; inconsistent results; poorly defined quality improvement, financial or program evaluation methods; recommendations cannot be made</p> <p><u>Literature Review, Expert Opinion, Case Report, Community Standard, Clinician Experience, Consumer Preference:</u> A High quality: Expertise is clearly evident; draws definitive conclusions; provides scientific rationale; thought leader(s) in the field</p> <p>B Good quality: Expertise appears to be credible; draws fairly definitive conclusions; provides logical argument for opinions</p> <p>C Low quality or major flaws: Expertise is not discernable or is dubious; conclusions cannot be drawn</p>
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Note. Dang, D., & Dearholt, S. (2017). *Johns Hopkins nursing evidence-based practice: model and guidelines*. 3rd ed. Sigma Theta Tau International. www.hopkinsmedicine.org/evidence-based-practice/ijhn_2017_ebp.html

Appendix D: PRISMA Diagram



PRISMA 2009 Flow Diagram

