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Evaluating the Effects of a Total Joint Education Class on Patient Outcomes

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Walden University
2020

Abstract

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MHA, University of South Carolina, 2006

BS, Clemson University, 2002

Dissertation Submitted in Partial Fulfillment

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Abstract

As the population ages and as people live longer, there is a growing demand for total hip and total knee procedures. Possible outcomes for these procedures is a postoperative joint infection (PJI) that can cause long postoperative lengths of stay (LOS) in the hospital. The PJIs can also negatively impact the quality of life for the patient. Using the roadmap of the continuous quality improvement theory, the purpose of this quantitative study was to examine the relationship between the independent variables (joint education class participation, body mass index [BMI], A1c, and smoking) and dependent variables (PJI and LOS). To evaluate the relationship with PJI, a logistical regression analyzed the sample population of 1,216 patients and indicated a relationship between joint education class attendance and PJI among total hip patients, but not total knee patients when controlling for the other variables. The regression also indicated a significant relationship between BMI and smoking and PJIs, but it did not show a relationship between A1c/diabetes and PJI. To evaluate the relationship between joint class education and LOS a Poisson regression indicated that those who did not attended the joint education class, whether they had total hips or total knees, had a longer postoperative LOS. The implications for positive social change involve providing information to physicians and administrators regarding the effectiveness of the total joint education class in improving outcomes. This information could be used to justify the need for patient compliance with the class and/or the possible need for additional resources to support the total joint education program.

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Acknowledgments

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Chapter 1: Introduction to the Study

Many variables can cause patients undergoing total hip and total knee arthroplasty procedures that can affect postoperative joint infections (PJIs). A PJI is an outcome of patients undergoing total hip or total knee arthroplasty procedures, and it can cause increased length of stay (LOS) in the hospital following surgery. In this study, I explored the relationship between patients who attend a total joint education class prior to surgery and those patients' postoperative outcomes in a hospital in South Carolina. Using the results of this study, I may create needed positive social change by providing information to physicians and administrators regarding the effectiveness of the total joint education class in improving outcomes. This information could be used to justify the need for patient compliance with the class and/or the possible need for additional resources to support the total joint education program.

Throughout Chapter 1, I present information about the background of this study, the problem statement, and my purpose. I also present items more closely tied to the methodology, data, and analysis of the study because this discussion will outline the research question and hypothesis; theoretical framework; the nature of the study; and the assumptions, limitations, and challenges. I then conclude the chapter with a summary of all of the components of Chapter 1.

The total joint education class focuses on variables such as body mass index (BMI), A1c, and smoking. Alvi et al. (2015) found direct correlation between elevated BMI levels of patients prior to surgery and their postoperative LOS. Furthermore, Kremers et al. (2015) evaluated A1c levels on postoperative outcomes. Smoking is another variable that has been studied to determine its relationship to outcomes for total joint patients. Gonzalez et al. (2017) found smokers had an increased risk of postoperative infections than those patients who did not smoke. Therefore, a hospital in South Carolina has created a total joint education class with curriculum that encompasses these variables to improve the outcomes of patients having total hip or total knee arthroscopies. In this study, I sought understand the relationship between patients who did and did not attend the joint education class with independent variables (smoking, BMI, and A1c levels) on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina. The relationship between these variables may indicate the effectiveness of the total joint class and could, again, give physicians and administrators a better understanding of the need for this education class, as well as the need for resources to sustain the program.

Background

PJIs are severe health complications that can mean prolonged stays in the hospital, and they sometimes cause death. Many variables can cause PJIs for patients having total hip or total knee arthroscopies. Due to the severity of these outcomes (infection rates and postoperative LOS) and the importance of gaining understanding of the factors that have influence, there has been a significant amount of research surrounding the topic, and these researchers have evaluated relationships among variables that may influence surgical outcomes such as preoperative classes, A1c, BMI, and smoking.

Alvi et al. (2015) completed a study that stratified patients by BMI who were having total hip arthroscopies (THAs) and evaluated the relationship between BMI and complications. Their purpose of the study was to determine whether increasing BMIs affect overall complications, surgical complications, medical complications, and deep wound complications. The authors also evaluated variations in time from the operating room to discharge and whether BMI influenced the patient in returning to the operating room. Meller et al. (2016) also completed a study related to BMI and postoperative outcomes that evaluated BMI and the surgical risks and costs with complications after a THA in patients who were morbidly obese and super obese. Their purpose of the study was to evaluate the populations of morbidly and super obese patients and the effects of their BMI on complications; costs during the 90 days following surgery; and outcomes, such as readmission, renal failure, and wound dehiscence. They found that morbidly obese patients were at increased risk for complications than the patients of normal weight. They also found a strong dose response between increasing BMI and an increased likelihood of PJI, readmission, renal failure, and wound dehiscence. Not only has BMI been shown to influence postoperative outcomes, but smoking has been studied as well.

Gonzalez et al. (2017) evaluated the incidence of PJIs after primary joint replacement according to smoking status. The smoking status was classified into never, former, and current smoker. Incidence rates and hazard ratios for PJI according to smoking status were assessed within the first year after surgery and beyond. The authors found that smoking increased the risk of infection by approximately 1.8 times after primary hip or knee arthroplasty procedures in both current and former smokers and beyond the first year of quitting smoking the infection rate was similar to those who had never smoked. Along with BMI and smoking, another factor that may influence outcomes are the A1c levels.

Kremers et al. (2015) evaluated diabetes mellitus as a risk factor for infections in total hip and knee replacement procedures. Their purpose was to evaluate the relationship between the hemoglobin A1c value preoperatively on PJIs. They found a significantly higher risk of PJIs among patients with a diagnosis of diabetes mellitus, patients using diabetes medications, and patients with perioperative hyperglycemia; however, the effects were attenuated after adjusting for BMI, type of surgery, and the American Society of Anesthesiologist (ASA) score, which evaluates overall health, and operative time. The data were limited, but there was no association with hemoglobin A1c values and PJIs.

The researchers that I have referenced evaluated patients who have had total joints and some of the variables such as smoking, A1c, and BMI that may affect outcomes. However, these studies leave a gap in understanding of the relationship between attendance in a joint education class and independent variables, such as smoking, BMI, and A1c on PJI rates and LOS. When considering my study, I needed to better understand the relationship between the joint education class and outcomes so that administrators and physicians can be better informed regarding the need for resources to support the program.

Problem Statement

According to McCann-Spry, Pelton, JoAnne, Grandy, and Newell (2016), the demand for total hip and knee arthroplasty is rising rapidly in the United States. This increase in demand is straining hospital resources to provide care for these patients. Due to government-mandated programs, bundled payments and accountable care organizations (ACOs) stakeholders must provide high-quality coordinated care to control costs. Therefore, both payers and providers are increasingly interested in the study of outcomes, which would include decreasing prosthetic joint infections and LOS (Arana, Harper, Qin, & Mabrey, 2017).

PJIs can significantly affect a patient's quality of life following surgery. Nunez et al. (2015) found that the health-related quality of life (HRQOL) decreased significantly for patients with PJIs. Kremers et al. (2015) found that patients with diabetes and perioperative hyperglycemia (elevated blood glucose) were more likely to develop PJI when compared with patients with normal glucose levels. Meller et al. (2016) found that morbidly obese patients were more likely to have a PJI following a total hip or total knee procedure compared with those of normal weight. These findings indicate that a focus on BMI could influence PJI and subsequently LOS. Gonzalez et al. (2017) found that patients who had a total hip or knee procedure and smoked were 1.8 times more likely to develop a PJI than nonsmokers. Therefore, factors such as A1c/blood glucose, BMI, and smoking have shown to have an influence on PJIs in previous studies, but the next study specifically discusses the influence of a joint education class on postoperative outcomes.

Jordan et al. (2014) performed two studies that analyzed preoperative education and found a decrease in preoperative expectation and improvement in knowledge, flexibility, and regularity of exercise among the patients, but alone there were no significant differences in validated joint specific patient reported outcomes. However, when the study was combined with treatment by a physiotherapist, there was a reduction in costs and LOS.

In this study, I evaluated the effects of a joint education class on reducing LOS and PJI rates within a health care facility in South Carolina. The joint education class covered factors that influence PJIs such as A1c, BMI, and smoking. A joint education class has not always been in place at this health system and the compliance with the program by patients and surgeons since implementation has not been 100%. Therefore, I have attempted to determine the relationship between patients who participated in the joint education class and those who did not based on their PJI rates and LOS. The joint education class within the orthopedic service line at a health system in South Carolina has been implemented to help prepare patients for their upcoming total hip or total knee arthroplasty.

Purpose

My purpose in this study was to determine the effects of a joint education class on reducing PJI rates and LOS among patients who received total hip or total knee arthroplasty procedures at a hospital system in South Carolina. The dependent variables were PJI rates and LOS and the independent variables were components related to the joint education class (A1c, BMI, and smoking).

Research Questions

RQ1: Among total hip arthroplasty patients, is there a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina?

H_0: There is no relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

H_1: There is a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

RQ2: Among total knee arthroplasty patients, is there a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina?

H_0: There is no relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

H_1: There is a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

RQ3: Among total hip arthroplasty patients, is there a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

H_0: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

H_1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

RQ4: Among total knee arthroplasty patients, is there a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

H_0: There is no relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

H_1: There is a relationship among attendance of a joint education class and independent variables (smoking, BMI, A1c levels) on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

Theoretical Framework

I based my study on the theory of continuous quality improvement (CQI). According to HHS (2017), CQI is the systematic process of identifying, describing, and analyzing strengths and problems and then testing, implementing, learning from, and revising solutions. CQI focuses on constant innovation and creative thinking to improve quality. The theory of CQI is rooted in the work of Deming and Shewart and their theories on quality and statistical control. Deming and Shewart (1939) discussed the three steps in quality control and the three senses of statistical control as it relates to manufacturing. The three steps in quality control involve the specification of what is wanted or the end-product, the production of things to satisfy the specification, and the inspection of things produced to determine whether they satisfy the specification. The three senses of statistical control that play an important part in attaining the uniformity or consistency in the quality of a manufactured product are (a) the concept of a statistical state constituting a limit to which one may hope to go in improving uniformity of quality, (b) as an operation or technique of attaining that uniformity, and (c) as a judgement.

The theory of CQI and the concepts of quality and statistical control relate to my study because this theory involves constant inspection and reevaluation of a process to determine the most effective method that yields the best outcomes/product (Deming & Shewart, 1939). In the case of my study, the variable of joint education class participation has been evaluated through statistical analysis to determine how this variable affects PJI rates for patients having a total hip or total knee joint arthroplasty. To improve the preoperative program by determining the significance of the joint education class, I used this theory in my study to focus on the importance of CQI.

Nature of the Study

My approach to this study was quantitative, and I sought information to address the research questions for this study. This logistic regression and Poisson regression modules helped me to evaluate the relationship among the attendance of a joint education class and associated independent variables (A1c, BMI and smoking) on the dependent variables, PJI rates and LOS, for total hip and total knee arthroplasty patients. The study was retrospective in nature and the information that I gathered was secondary data that I collected from various data sources at a health system in South Carolina.

Assumptions, Scope, Limitations, and Challenges

Assumptions

My assumption in this study that cannot be demonstrated as true is that the data produced by the health care facility were reported and recorded accurately. There are good processes in place at the facility for reporting data; however, it must still be assumed that the data reported is accurate.

Scope and Delimitations

I established delimitations to limit the scope of my study. I included only total hip and total knee arthroplasty patients from the selected health care facility in South Carolina. I included only those patients who attended and did not attend the joint education class at this facility within a specified timeframe. The last delimitation is the sample size, because it included only the population that fits the aforementioned criteria that are in the data registry at the health care facility in South Carolina.

Limitations/Challenges

The data for this study were not difficult to obtain; however, one limitation or challenge was obtaining the data in a timely manner because those providing the data were busy with their everyday work. I had already built relationships with those who provided the data, so I overcame this challenge. Another limitation was the number of patients with A1c values. A1c values may be obtained only from patients who have diabetes; therefore the lack of data for this independent variable created the definition of the category for those who did not have an A1c as not diabetic. The definition of this category as *not diabetic* versus omitting the data that was missing A1c levels did not limit the size of the sample population. Other than these challenges, there were no data issues, such as storage or associated fees.

Significance

In this study, I uniquely addressed the need to determine how statistically significant participation in a joint education class is in predicting the PJI and LOS of patients having a total hip or total knee arthroplasty. The assessment of quality of care and outcomes provided by hospitals has become increasingly important in the United States (Lichtman et al., 2018). Kremers et al. (2015) observed in a cohort of 20,171 total hip and knee arthroplasty procedures that there was a significantly higher risk of PJIs among patients with a diagnosis of diabetes mellitus, patients using diabetes medications, and patients with perioperative hyperglycemia, but the effects were further influenced after adjusting for BMI. This is the reason why a health system in South Carolina has implemented a preoperative joint education class to improve these measurements and lab values to improve outcomes, decrease LOS, reduce 30-day readmission, reduce costs, and decrease infection rates. In this study, I evaluated the relationship between patients that have participated in the preoperative joint education class, and those who have not, by evaluating PJI rates and LOS. The effects of positive social change will provide hospital administrators, providers, and patients with information regarding the effectiveness of this class and the importance of participation/compliance for the candidates of total hip and knee arthroplasty procedures. Compliance by the orthopedist to participate in the program, to include the joint education class, has not been 100%; therefore, the relationships between having completed the preoperative program and those who have not could provide insight into the effectiveness of the program and create the social change needed for physicians to see the importance of their patient's participation.

Summary

Chapter 1 was an introduction to the study in which I presented the background of the problem; purpose of the study; significance of the study; research questions and variables; theoretical framework; and assumptions, scope, limitations, and possible challenges with the study. In Chapter 2, I review the literature with a thorough analysis of studies evaluating postoperative joint and postoperative LOS. In Chapter 3, I detail the research methodology and design of the study. In Chapter 4, I indicate the results of the statistical analysis. Chapter 5 is a discussion and interpretation of the findings from my study.

Chapter 2: Literature Review

Introduction

The demand for total hip and knee joint replacements continue to rise steadily. An estimate for 2050 is 1,859,553 cases for total hip arthroplasties (THAs) and 4,174,554 cases for total knee arthroplasties (TKAs) (Arana et al., 2017). THAs and TKAs have become increasingly popular orthopedic procedures, with expected increases of 174% and 673% by the year 2030 (Kurtz et al., 2014). TKA has experienced a 231% growth in volume between 2000 and 2010, with an estimated 680,886 cases performed in 2014 in the United States (Boddapati et al., 2018). The demand for THA and TKA procedures is rising rapidly due to the aging population and the prevalence of arthritis (McCann-Spry et al., 2016). As these numbers increase, insurers continue to push for lower costs and better outcomes (Arana et al., 2017). PJIs and LOS are two of the outcomes that I evaluated in this study. PJIs can have a significant effect on a patient’s quality of life following surgery. Nunez et al. (2015) found that the health-related quality of life (HRQOL) decreased significantly for patients with PJIs. Many variables may influence outcomes (PJIs, LOS), including BMI, A1c, and smoking status. Smoking, diabetes mellitus, and obesity are among the most common modifiable conditions within the TJA patient population, and there is a growing body of literature on their associated risks as well as potential preoperative and perioperative management strategies (Boylan, Bosco, & Slover, 2018). Throughout this chapter, I will discuss these variables to assess the relationships that have been found between these factors and the outcomes of PJI and extended LOS in TJA patients. Next, I will briefly overview these factors, evaluating first

BMI, then diabetes/A1c, followed by smoking, as well as a discussion surrounding total joint education classes.

The Centers for Disease Control (CDC) has estimated that 48% of the U.S. adult population would be considered obese by 2018 (CDC, 2016). Adhikary et al. (2018) found that higher BMI has been associated with postoperative complications in TKA and THA. Meller et al. (2016) found that morbidly obese patients were more likely to have a PJI following a total hip or total knee procedure compared with those of normal weight. These findings indicate that a focus on BMI could influence PJI and subsequently postoperative LOS. A1c or A1C levels have also been a focus of researchers and how it can influence outcomes for THA and TKA patients.

Diabetes is an independent risk factor for PJI (Godshaw, 2018). Mraovic et al. (2011) demonstrated that postoperative hyperglycemia greater than 200 mg/dL in patients with diabetes undergoing TJA was at more than 2 times the risk of PJI than those with better glycemic control. Godshaw et al. (2018) found that patients undergoing a TJA experienced the most rapid change in complications when A1c was between 6.5% and 7.5% and, therefore, found that the magnitude of the preoperative A1c decrease was more important than achieving an arbitrary cutoff. Furthermore, Harris et al. (2013) concluded that preoperative glycemic optimization was more effective with a greater magnitude of A1c reduction than to achieve a specific cutoff. For example, a reduction of A1c from 8.5% to 7.2% decreased complication risk more than A1c reduction from 7.2% to 6.9%. In addition, the authors found that using an A1c cutoff of 7.0% would have led to unnecessarily delaying surgery in 31.89% but would have prevented complication in only

3.04% of patients. Therefore, it is apparent that preoperative A1c and/or blood glucose levels can possibly have an influence on postoperative outcomes and influence complication rates. Another variable that may affect postoperative infections in TA or TJK patients is smoking.

Smoking has been linked to postoperative infections across many types of surgery. Many complications, including surgical site infections, are more prevalent in smokers because smoking has a detrimental effect on all phases of wound healing (Krantz & Dunivan, 2018). Gonzalez et al. (2017), in a study on patients with primary hip or knee arthroplasty procedures, found that current and former smokers were 1.8 times more likely to have postoperative infections, and former smokers beyond the first year of quitting had similar infection rates than those who had never smoked. Therefore, BMI, A1c/blood glucose, and smoking may influence postoperative outcomes for both THA and TKA patients.

A health care entity in South Carolina has created a joint education class to educate potential THA or TKA patients on the risk factors such as BMI, A1c/blood glucose, smoking, and others that may influence PJIs and postoperative LOS. Those running this educational program hope to limit the number of PJIs for this patient population by giving them the information they need to prepare for their surgery.

Literature Search Strategy

The search for literature was conducted using the Walden University library system and Google Scholar. The search engine that I used in the Walden University Library was Thoreau, a multidatabase search engine. The search terms that I used were related to the total joint arthroscopy surgical procedures and other associated factors, such as BMI, A1C/blood glucose, smoking, and total joint education class. Some of the searches related directly to health sciences were conducted in PubMed and MEDLINE. The date range for most of the sources used in this study ranges from 2013 to the present; however, some of the references that I used in explanation of the theoretical concepts and framework are from earlier dates to help explain the origins of these concepts. All of the references used from the Walden library were peer reviewed. The key search terms included *total joint arthroscopy, body-mass index (BMI), blood glucose/A1C, smoking cessation, total joint education class, postoperative joint infection, prosthetic joint infection, outcomes, length of stay,* and *continuous quality improvement,* or *CQI.*

Theoretical Foundation

The theoretical foundation that I used in this study was based on the theory of CQI. *CQI* is defined by HHS (2017) as the systematic process of identifying, describing, and analyzing strengths and problems and then testing, implementing, learning from, and revising solutions. CQI was the backdrop of this study and correlates with efforts to improve outcomes for THA and TJA patients including PJI rates and postoperative LOS. Through intervention with the patient from attendance at a joint education class, the effectiveness of the class was evaluated by analyzing participants who did or did not attend the class, as well as other variables previously mentioned, such as BMI, A1C, and smoking.

CQI Theory

The CQI theory is rooted in the studies of Deming and Shewart and their work regarding quality and statistical control from a manufacturing standpoint. Deming and Shewart (1939) described the three steps in quality control and the three senses of statistical control in manufacturing. CQI relies heavily on performance measurement and analysis and on the involvement of leadership and front-line staff in decision making processes (Price et al., 2017). This theory consists of three steps in quality control that involve specification, the production of things to satisfy the specification, and the inspections of things that are produced to determine whether they satisfy specification. The CQI theory and the concepts of quality and statistical control relates to this study as this theory involves constant inspection and reevaluation of a process to determine the most effective method that yields the best outcomes/product (Deming & Shewart, 1939). This theory and its concepts can be applied to the constant pursuit to improve outcomes for patients receiving THA and TKA procedures. My study, sought to determine possible causes for outcomes such as PJI and a longer than normal postoperative LOS.

The three senses of statistical control that play an important part in attaining the uniformity or consistency in the quality of a manufactured product is (a) the concept of a statistical state constituting a limit to which one may hope to go in improving uniformity of quality, (b) as an operation or technique of attaining that uniformity and (c) as a judgement. One study by Price et al. (2017) described the four dimensions of CQI within an organization as seen in Figure 1.

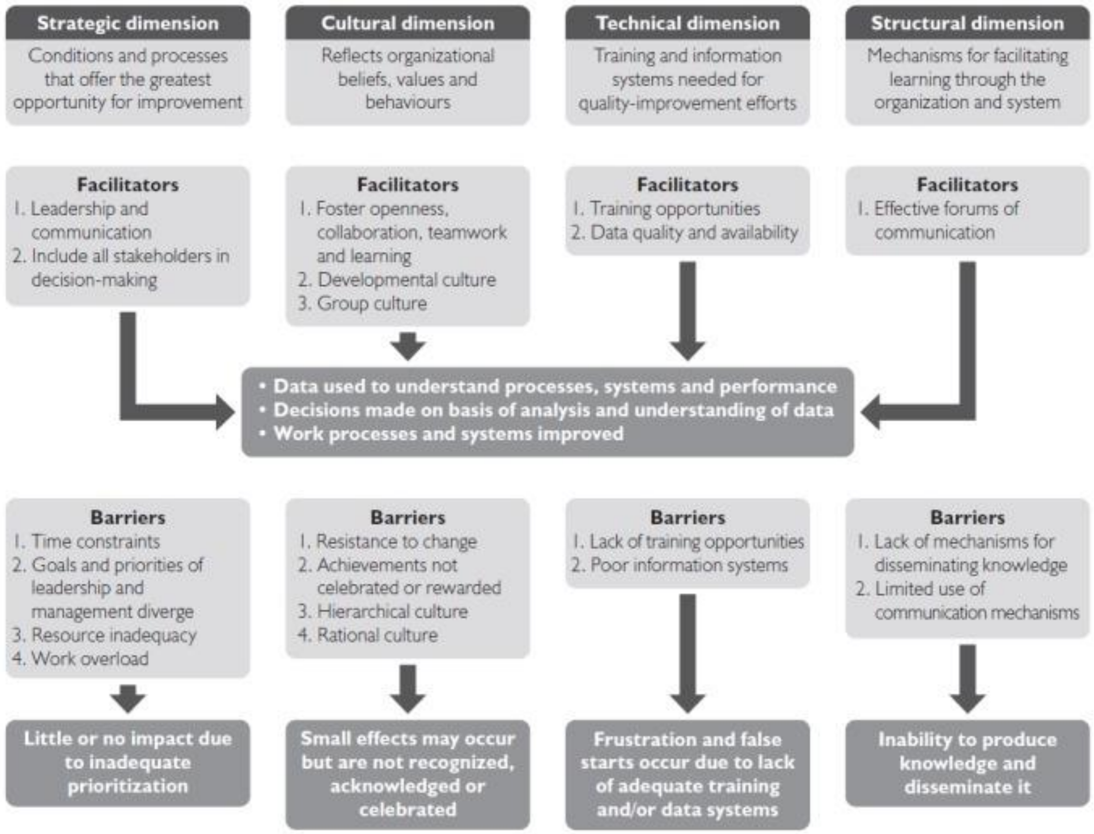

Figure 1. Four dimensions of continuous quality improvement.

Figure 1 demonstrates the dimensions of strategic, cultural, technical and structural within an organization that need to be understood to implement CQI. It shows the factors that need to exist to facilitate such a process and the barriers that exist within each dimension that can hinder to ability of the CQI process to be effective. Within clinical health research fields, these four dimensions of CQI have received empirical validation, indicating that the when these four dimensions of CQI were applied, the compliance to the process was greater (Price et al., 2017).

The theory of CQI and the concepts of quality and statistical control relates to this study, because this theory involves constant inspection and reevaluation of a process to determine the most effective method that yields the best outcomes/product (Deming & Shewart, 1939). In the case of this study, the variable of joint education class participation was evaluated through statistical analysis to see how this variable effects PJI rates for patients having a total hip or total knee joint arthroplasty. In an effort to improve the preoperative program by determining the significance of the joint education class, this theory will focus the study on the importance of CQI. The CQI theory was applicable to this study in that CQI parallels the process and culture within the preoperative program of constantly evaluating processes within the total joint program and determining factors that may influence outcomes. Therefore, the program and this study offer guidance to administrators, providers and other facilitators within this program as to what needs to be a focal point, whether it is the joint education class and/or a combination of focus on the possible independent factors such as BMI/obesity, diabetes/A1c, or smoking, which patients are educated about during the joint education class.

Literature Review of Key Concepts

This literature review will discuss total joint arthroplasty surgery, particularly total hip and total knee arthroplasty procedures. It will also discuss PJIs and longer than expected LOS in the hospital, which are adverse outcomes for these procedures. In addition to a discussion surrounding these procedures and possible outcomes, there will be a discussion surrounding the different variables that can possibly lead to adverse outcomes. These variables include BMI, A1c, smoking, and in particular a joint education class which was the focus of this study and is offered to candidates of these procedures.

Total Joint Arthroplasty

This section will review the two types of surgery this study involves, the total hip arthroplasty (THA) and the total knee arthroplasty (TKA). Alvi et al. (2014) mentioned the total joint arthroplasty (TJA) is an effective means to surgically treat pain and disability related to degenerative conditions of the hip and knee with measurable beneficial effects in overall health, quality of life and physical function. The total joint arthroplasty (TJA) is considered one of the most successful surgical innovations of the 20th century. It is definitive treatment for patients who suffer from advanced joint degeneration due to arthritis. The total knee and total hip arthroplasties have proved to be extremely effective in relieving pain, as well as improving the function of these joints in a durable cost-effective manner (Belatti et al., 2014).

The effectiveness and popularity of THA and TKA procedures has shown in recent trends and projections. Over 800,000 total hip and total knee arthroplasties are performed each year in the United States and the prevalence of arthritis, which is one of the main causes for this procedure, will only continue to increase as the American population continues to age and gain weight, further driving the demand for these procedures (Belatti et al., 2014). The THAs and TKAs have become increasingly popular orthopedic procedures, with expected increases of 174% and 673% by the year 2030 (Kurtz et al., 2014). An estimate for 2050 is 1,859,553 cases for THAs and 4,174,554 cases for TKAs (Arana et al., 2017).

Postoperative Joint Infection and Length of Stay

PJI is a significant cause of morbidity and even mortality among patients undergoing TJA (Tarabichi et al., 2017). The incidence of PJI following primary THA is 1% to 2% and the incidence after a TKA is 1% to 4% (O'Toole, 2017). The THA and TKA are the fastest growing and among the costliest procedures in the United States with over 1.2 million procedures performed annually. Although these procedures are considered relatively safe, the PJI are rare but can be a devastating complication for the patients having these procedures. (Kremers, 2014). The diagnosis-related group code for hip and knee arthroplasty is the highest hospital inpatient short-stay cost for Medicare, and complications and subsequent longer lengths of stay can add to these costs (McCann-Spry, 2016). Due to these outcome issues of infection and longer LOS, there have been a number of studies attempting to identify the causes of these negative outcomes.

The PJI is one of the most challenging complications associated with total joint arthroplasty procedures. Appropriate diagnosis and management is essential to prevent excessive morbidity and restore adequate function (Marazzi et al., 2017). Therefore, there is a significant number of studies surrounding the PJI. One study by Arana (2014) found through a quality improvement project when an outcomes manager-led inter-professional team utilizes a collaborative care model (CCM) approach in the care of patients with total joint replacement, a meaningful decrease in LOS and direct cost can be achieved. A CCM is a multi-disciplinary team made up of physicians, floor nurses, pharmacists, dieticians, chaplains, physical therapists, occupational therapists, social workers, care coordinators, home health coordinators, and perioperative nursing staff. The CCM helps to promote patient- and family-centered focus, interprofessional communication, coordination of care, and the measurement of team-based outcomes. There have also been studies that have evaluated variables thought to have an effect on postoperative outcomes, such as BMI, A1c, and smoking. The next sections will focus on studies that have evaluated PJI, the variables that may influence PJI rates, and discuss how and why they may have an influence on outcomes.

Body Mass Index (BMI) and Obesity

One method used to measure body weight is BMI. This method has a formula that is utilized to determine a healthy weight, normal body weight, or ideal weight of an individual. The BMI formula includes an individual height and weight. Worldwide the obesity rate has tripled since the 1970s. Obesity, as well as its related illnesses and diseases, have increased in the last 50 years (WHO, 2016). The BMI formula calculates the BMI score by dividing weight in pounds by height in inches (in) squared and multiplying by a conversion factor of 703 (i.e. Weight = 150 pounds, Height = 5’5″ (65″) Calculation: $[150 \div (65)^2] \times 703 = 24.96$). The CDC estimated that 48% of the U.S. adult population would be considered obese by 2018 (CDC, 2016). According to Alvi et al. (2014), one-third of the overall U.S. population is overweight or obese and the association between obesity and degenerative joint disease requiring arthroplasty is well documented.

Obese patients may be at increased risk of PJI due to longer operative times, increased need for allogeneic blood transfusion, and the presence of other medical comorbidities. The obese patient population is also at an increased risk of wound dehiscence due to increased surface tension at the surgical site, as well as postoperative surgical wound complications such has hematoma formation and prolonged wound drainage that may increase the risk of PJI. Obese patients undergoing TJA are also at increased risk of developing an infection due to "paradoxical malnutrition", as these patients are often malnourished despite their obesity (O'Toole, 2017). Patients with morbid obesity, defined as a BMI greater than 40 kg/m2, and super obesity, defined as a BMI greater than 50 kg/m2, increasingly present for total hip replacement. There is disagreement in the literature whether these individuals have greater surgical risks and costs for the episode of care, and the magnitude of those risks and costs. There also is no established threshold for obesity as defined by BMI in identifying increased complications, risks, and costs of care (Meller et al., 2016). Recently, analysis of higher BMI data was limited to small cohorts from hospital-based data banks, based on BMI or height and weight only, often as part of a multivariate analysis. Patients who are super obese are at increased risk for serious complications compared with patients with morbid obesity, whose risks are elevated relative to patients whose BMI is less than 40 kg/m^2. Costs of care for patients who were super obese, likewise, were increased (Meller et al., 2016). Therefore, this study showed that as BMI increases to more moderately obese and super obese levels risk of serious complications, such as PJI and extended LOS increase.

Diabetes and A1c

The association between diabetes and PJI after TJA is well documented, and current projections show a steep increase in the burden of PJI in the future as a direct consequence of the rising rate of diabetes in the TJA population (Tarabichi et al., 2017).

Diabetic patients undergoing total joint arthroplasty (TJA) with postoperative hyperglycemia >200 mg/dL have increased the risk of prosthetic joint infection (PJI) (Godshaw, 2019). The CDC guidelines will state that patients with a fasting blood glucose level >200 mg/dL should be considered as uncontrolled diabetics and optimized before elective surgery. However, owing to the lack of adequate publications and high level of evidence, the CDC is not able to determine the most optimal threshold for HbA1c that may be predictive of subsequent surgical site infections (Tarabichi et al., 2017). The recent World Health Organization guidelines that were released in November 2016 were not able to set a threshold for fasting glucose or HbA1c as a measure of proper glycemic control (Capozzi et al., 2017). In addition, the evidence for blood glucose/A1c or diabetes as a risk factor for a PJI has been conflicting. However, diabetes mellitus has been considered a well-established risk factor for surgical site infections (SSIs), following many surgical procedures. The evidence is conflicting as to whether or not the disease itself, or perioperative hyperglycemia (elevated A1c levels) control, or diabetes mellitus management around the time of surgery modifies the risk of SSIs following THA or TKA. There have been studies in patients having orthopedic procedures that suggest both the presence of diabetes mellitus and perioperative hyperglycemia have been associated with an increased risk of SSIs (Kremer et al., 2014). One study found that perioperative hyperglycemia is a risk factor for PJI in arthroplasty patients, as blood glucose values greater than 200 mg/dL double the risk of PJI (Eka & Chen, 2015). So, therefore there are studies that suggest controlling blood glucose/A1c during surgery may help reduce infection rates. Next will be a discussion on controlling diabetes, blood glucose/A1c preoperatively.

Tarabichi et al. (2017) conducted a multicenter study designed to evaluate the potential association between preoperative A1c and also determine the optimal threshold for A1c for patients undergoing TJA. The study identified A1c level of 7.7% as the critical threshold that is associated with subsequent PJI. This study determined the threshold of 7.7% for the HbA1c may explain the inability of prior studies to demonstrate an association between A1c levels and subsequent infections, as prior studies used the 7% threshold. The finding of this study were valuable in that it provided the opportunity for the medical community to optimize glycemic control for patients undergoing TJA without unnecessarily depriving those with HbA1c between 7% and 7.7%. Another study by Chastil et al. (2015) identified a cutoff of 7.6% for A1c to minimize PJI risk; however, this cutoff was not found to be statistically significant. They did, however, find that elevated A1c was correlated with increased mortality after TJA.

Smoking and Surgical Outcomes

In this section the effect of smoking and its possible effect on PJI will be discussed, as well as the effectiveness of smoking cessation classes on PJI rates. Smoking represents a major concern in surgery overall, where smokers in comparison to nonsmokers are more liable to have perioperative complications, postoperative healing complications, and surgical site infections, regardless of the type of surgical procedure performed (Gonzalez et al., 2017). Studies have shown that smoking is associated with adverse outcomes after total joint arthroplasty (TJA), including periprosthetic or PJI

(Boylan et al., 2019). As mentioned prior, smoking has been linked to postoperative infections across many different types of surgical procedures. These complications, including surgical site infections, are more prevalent in smokers because smoking has a detrimental effect on all phases of wound healing (Krantz & Dunivan, 2018). Throughout these studies, smoking status is evaluated in a number of ways. Studies evaluate the never smoker, former smoker, the 1-year past smoker, 90 day past smoker, and a current smoker. The following discussion evaluates how these various statuses of smoking effect outcomes, particularly PJI and LOS for TJA patients.

Gonzalez et al. (2017) found that a current smoker or smoker within the past year is 1.8 times more likely to have a PJI when compared to a never smoker. This study also found that after a year of not smoking the infection rate was similar to the never smoker after a mean follow-up of 55 months. One study by Kapadia (2014) evaluated patients in a number of categories based on the number of packs smoked a year. There was a less than 20 pack-year group of 57 THA patients, a 20 to 40 pack-year, which included 39 THA patients, and a more than 40 pack-year group that included 14 THA patients. The data obtained from these groups was used to determine the potential influence of tobacco quantity on survivorship, clinical and radiographic outcomes and complication rates. Additionally, the study sub-stratified patients who reported as current smokers (68 hips) or former smokers (42 hips) and compared the differences between these two groups. Patients were also stratified by age (less than or greater than 65 years), BMI of less than or greater than 35kg/m^2, and by gender. These patients were then evaluated post-surgically at 6 weeks, 3 months, 6 months, 12 months and annually. The results showed that at the time of the most recent follow-up the survivorship of the nonsmoker group was 99% and for the smoker group it was 92%. The surgical complication rate for smokers was 3.6% versus 0% for the nonsmoker and the medical complication rate was 0.9% for the smoker and 0% for the nonsmoker. The higher surgical complication rate in smokers was significant (p = .0119) and there was no significant difference in medical complications between the two groups (p =.3333). The stratification based on pack-year history showed no significant difference in medical complication rates, surgical complication rates, or revision rates (P > 0.3082). For primary TKA, at a mean follow-up of 47 months, survival was 90% for ever smokers and 99% for never smokers (Kapadia, 2014). While this study evaluated postoperative surgical and medical complication rates, another study by Sahota et al. (2017) evaluated postoperative readmission rates.

Sahota et al. (2017) studied the impact of smoking on 30-day readmissions and found that smokers that had smoked within the year prior to surgery were three times as likely as nonsmokers to be admitted within 30 days after TJA. It was also found that adjusted odds ratio showed those patients that smoked were almost twice as likely to be associated with 30-day surgical complications that could include PJI. It needs to be mentioned, that complication rates as it relates to smoking, must be adjusted based on patient risk factors, as smoking predisposes patients to a large variety of health complications, such as cardiopulmonary disease, diabetes and other conditions that can also be linked to complications after arthroplasties. Given the number of these other potential confounders, understanding the impact of smoking independently can prove to be elusive (Sahota et al., 2017).

Total Joint Education Class

The next topic that will be discussed is the total joint education class. Preoperative education has been proposed as a way to improve outcomes postoperatively. This type of class can offer the opportunity to provide patients with the information and address realistic expectations of possible outcomes, as the patients expectation is known to have an impact both on functional outcomes and the quality of life after the joint replacement (Jordan et al., 2014). These classes may vary in content, but for example, a study by Pelt et al. (2017) described a joint education class in their hospital as 9 short videos about what the patient should be learning prior to surgery, what they need to expect the day of surgery, during the hospital stay, and when they go home.

A study found that the impact of preoperative education is effective in reducing preoperative anxiety, however the affects were only small and the findings were not universal. (Jordan et al., 2014). The study by Pelt et al. (2017), found that efforts to improve patient education and management led to a decrease in patients being discharged to post-acute care (PAC) facilities. Therefore, the education class may have impacted the preoperative care. Along with this education program decreasing the number of patients being discharged to PACs, it also found that when controlling for age and medical co-morbidities, the frequency of 30-day readmissions was greater in patients who underwent a TJA prior to the pathway changes that included the education class. This study also found when evaluating the influence of discharge disposition as an independent risk factor for readmission that those discharged to PACS were 2.4 times more likely to experience a 30-day readmission. They found the most the optimal place for patients to be discharged following a total joint procedure is to home. There was also a study that referred to the education program as joint camp.

Dehorney and Ashcraft (2018) did a study that evaluated a Joint Camp which was introduced in a rural north Texas medical center which was a 300-bed for-profit hospital., in May of 2015. The target population for this joint camp were patients 50 years and older undergoing an elective joint replacement surgery. All patients that met then inclusion criteria at this facility were enrolled in the program. The camp consisted of preoperative education classes, interprofessional collaboration among health care team members, and postoperative follow-up. The study evaluated retrospectively by tracking LOS and 30-day readmission rates. A total of 1,425 patients participated in this study over an 18-month period. Based on review of literature, it was expected this program would decrease LOS and readmissions, however the initial findings were not evident of these decreases. The study found initially that the LOS increased from 5.87 days before implementation to 7.9 days during the first quarter of the year of 2016. Readmissions also increased from 6.2% at the beginning of the project to 7.2% the next quarter. One variable was the registered nurse (RN) turnover. During the 3rd quarter of the project RN turnover increased from 11.7% to 32.2%. This caused the director to have to rely on agency nurses that were not familiar with either the Joint Camp or the implemented orthopedic processes. There was a significant relationship established between LOS and RN turnover, with LOS increasing .48 days for each 1% in RN turnover. Once the orthopedic unit staffing stabilized LOS began to decrease and the average LOS among program participants decreased to 2.7 days. A staffing vacancy at the Joint Camp coordinator position also resulted in negative outcomes with readmission rates increasing by 13.9% while the position was vacant. However, once a new coordinator was in place, the readmission rate decreased to 2.8%. At the beginning of the study nurse turnover rates increased from 11.7% to 32.2%. Therefore, although the results initially did not show positive outcomes for the TJA patients due to other variables, there was much improvement once those variables stabilized and did not impact the program.

Summary and Conclusion

The themes in this literature review were related to total hip and total knee joint arthroplasty surgery, the outcomes, such as PJI or extended LOS, the risk factors or variables that may influence these outcomes, as well as initiatives implemented by health care institutions in attempt to improve outcomes for these patients. As mentioned before, the demand for these total joint arthroscopies is growing with the aging population as well as with the obesity epidemic. By 2050, the estimate is 1,859,553 cases for total hip arthroplasties (THAs) and 4,174,554 cases for total knee arthroplasties (TKAs) (Arana et al., 2017).

Although this chapter discussed the total joint arthroscopy procedure and the variables, such as BMI, blood glucose/A1c and smoking, that may influence negative outcomes, such as PJI and extended LOS, additional research was needed to understand the effect of a total joint education class and its ability to improve the knowledge of the patient. This knowledge may better equip the patients with the understanding of the importance of controlling the variables preoperatively and postoperatively in order to improve outcomes. The research problem, purpose and question of this study was intended to provide results that may help educate health care professionals, administrators and others of the benefits of not only having a joint education class, but in controlling the variables (BMI, A1c and smoking) on the outcome of the patient.

Chapter 3: Research Method

Introduction

My purpose in this study was to determine the effect of a joint education class on reducing (PJI) rates and (LOS) amongst patients who received total hip or total knee arthroplasty procedures at a hospital system in South Carolina. The dependent variables were PJI rates and LOS, and the independent variables were components related to the joint education class (A1c, BMI, and smoking). The results may provide administration, orthopedic surgeons and other staff with a better understanding of the influence the independent variables have on the outcomes of total hip and total knee arthroplasty cases.

In this chapter, I will review the research methodology for this study. First, I will review the research questions/hypothesis, research design, and rationale, which will include both the independent and dependent variables. In this section, I will also discuss the research design and its connection to the research questions. Then I will review the methodology for this study including the target population, the sampling strategy, the procedures for data collection, and the operationalization of constructs. Finally, prior to the summary of the chapter, I will discuss surrounding the threats to validity, where both internal and external threats are discussed, as well as possible threats to construct or statistical conclusion validity. In this section, ethical procedures are going to be discussed, along with any concerns that may exist.

Research Questions and Hypothesis

I used four research questions to guide this study. The first is: Among total hip arthroplasty patients, is there a relationship with attendance of a joint education class;

independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina? Therefore, this question focuses solely on total hip arthroplasty patients and the relationship between the independent variables and one of the dependent variables (PJI).

The hypothesis associated with this research questions is as follows:

Ho: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

The next research question focuses on the total knee arthroplasty patients and is as is as follows: Among total knee arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina?

The hypothesis associated with this research questions is as follows:

Ho: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

This research question focuses on total hip patients and the relationship between the independent variables and the second dependent variable (LOS) in this study and is as follows: Among total hip arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

The hypothesis associated with this research questions is as follows:

H0: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

Finally, the fourth research question in this study evaluated the total knee arthroplasty patients and the relationship the independent variables have with LOS and is as follows: Among total knee arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

The hypothesis associated with this research questions is as follows:

H0: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

Now that the research questions and hypothesis have been reviewed, the research design and rationale will be evaluated. This next section will describe the variables involved in the study, the type of study, the design of the analysis and some of the assumptions involved. It will then discuss some of the assumptions and tests needed to ensure the accuracy of the analysis.

Research Design and Rationale

Variables

The independent variables that tested in all four research questions were joint education class participation, smoking, BMI, and A1c. I controlled the independent variables of smoking, BMI, and A1c to determine the true effect of the joint education class on the outcomes of the patient.

The dependent variables for this study were PJI and LOS. *PJI* is defined as any infection following the procedure that occurred in the joint in which surgery was performed. *LOS* is defined as the number of days, using midnight census, the patient stayed in the hospital following the procedure. The PJI will be evaluated in RQs 1 and 2, and the LOS is tested in RQs 3 and 4.

Design

This study was a quantitative study that will seek to understand the relationships outlined in the research questions. Creswell (2009) noted that a quantitative study is a means of testing a theory by examining the relationship between variables. This quantitative study was a logistic regression and Poisson regression that evaluated the relationship in the attendance of a joint education class and associated independent variables (A1c, BMI and smoking) on the dependent variables or outcomes (PJI rates and LOS) for total hip and total knee arthroplasty patients. Due to having multiple independent variables and dependent variables the logistical regression and Poisson regression analysis was the most appropriate fit for the study. In contrast to a one-variable-at-a-time approach, logistical regression results allow a researcher to account for relationships between predictors and thereby estimate their relative contributions to variance in the dependent variable (Plonsky & Oswald, 2017). Therefore, the independent variables (joint education class attendance, A1c, BMI and smoking) were all evaluated at one time for their contribution to variances in the outcome (PJI and LOS), while also being able to determine the relationship the independent variables have on each other and the effect on outcomes. Select independent variables (BMI, A1c, and smoking) would be controlled variables for determining relationships between joint education class participation and outcomes (PJI and LOS). The sample population will be all total hip and total knee patients over a 2-year period at a hospital in South Carolina. The study will therefore be retrospective in nature and the data collected will be secondary data.

In conducting a logistical and Poisson regression analysis there are assumptions that will naturally be involved. The testing of assumptions is an important task for those utilizing these regression analyses. There are four assumptions the researcher should test to prevent bias or untrustworthy information. The four assumptions are normality, linearity in the parameters, independence of errors, and measurement error (Williams et al., 2013). Normality requires that the predictor and/or response variables be normally distributed, as in reality only the assumption of normally distributed errors is relevant in a multiple regression. The linearity in the parameters assumes the independent variable is a linear function of the dependent variable and the relationships between the independent variables and the dependent variables do not have to be linear (Williams et al., 2013). The independence of errors assumes the estimates of standard errors and test significance is done without bias. Finally, the fourth assumption is homoscedasticity which assumes a constant variance for each of the independent variables that are measured (Williams et al., 2013). It is important these measures are taken to ensure the accuracy and trustworthiness of the information.

Methodology

Population

According to Belati et al. (2014) over 800,000 total hip and total knee arthroplasties are performed each year in the United States. By the year 2050 that number is estimated to rise to 1,859,553 annually (Arana et al., 2017). The target population for this study will be any patient that had total hip or total knee arthroplasties during a 2-year time frame at a hospital system in South Carolina. If the patient had an infection after this 2-year timeframe, the data for those instances will be included in the study.

A power analysis was performed prior to the data analysis. See Table 1 for results.

Table 1 Tests for the Odds Ratio in Logistic Regression With One Binary X and Other Xs (Wald Test)

Power	*N*	Pcnt *N* X=1	PO	P1	*OR*	R^2	Alpha	Beta
0.51309	1200	50	0.017	0.005	0.291	0	0.05	0.48691
0.47225	1200	50	0.017	0.005	0.291	0.1	0.05	0.52775
0.4294	1200	50	0.017	0.005	0.291	0.2	0.05	0.5706
0.38468	1200	50	0.017	0.005	0.291	0.3	0.05	0.61532
0.18147	1200	50	0.017	0.01	0.584	0	0.05	0.81853
0.1676	1200	50	0.017	0.01	0.584	0.1	0.05	0.8324
0.15369	1200	50	0.017	0.01	0.584	0.2	0.05	0.84631
0.13975	1200	50	0.017	0.01	0.584	0.3	0.05	0.86025
0.0461	1200	50	0.017	0.015	0.881	0	0.05	0.9539
0.04474	1200	50	0.017	0.015	0.881	0.1	0.05	0.95526
0.04335	1200	50	0.017	0.015	0.881	0.2	0.05	0.95665
0.0419	1200	50	0.017	0.015	0.881	0.3	0.05	0.9581

The power analysis in Table 1 was completed with a basic understanding of the data set. A logistic regression of a binary response variable (Y) on a binary independent variable (X) with a sample size of 1200 observations (of which 50% are in the group X=0 and 50% are in the group X=1) achieves 51% power at a 0.050 significance level to detect a change in probability (Y=1) from the baseline value of 0.017 to 0.005. This change corresponds to an odds ratio of 0.291.

Operationalization of Constructs

The independent variables include smoking status, BMI, and A1c. The variable sources, research questions numbers and value labels independent variables are listed below.

Table 2 Independent Variables

Variables/ IV	Variable source	Research questions	Value label	Score/Degree
Smoking status	Secondary data	RQ1 RQ2 RQ3 RQ4	Smoker or nonsmoker	
BMI	Secondary data	RQ1 RQ2 RQ3 RQ4	BMI score	
A1c	Secondary data	RQ1 RQ2 RQ3 RQ4	A1c value	

The dependent variables were PJI and LOS. The variable sources, research questions numbers and value labels dependent variables are listed in Table 3.

Table 3 Dependent Variables

Variables/ DV	Variables sources	Research question	Value label	Score/Degree
PJI	Secondary data	RQ1 RQ2	Yes/No	
LOS	Secondary data	RQ3 RQ4	LOS value	

Data Analysis Plan

The statistical software R will be used to analyze the data to test the hypotheses and describe the sample. The secondary data collected from the hospital system will be imported into R. The researcher will screen the data for errors related to missing entries.

This study includes different statistical strategies to examine results from the sample obtained for this study. The research study also provided a statistical analysis related to the research questions to determine if the null hypothesis should be retained or rejected. A logistical regression was used to evaluate the relationship between joint class attendance and PJI and a Poisson regression was used to analyze the relationship between joint class attendance and LOS. The logistic regression was a two-tailed test with an alpha of 0.05, so therefore the confidence interval was 95%. The Poisson was only one-tailed and again had the alpha set at 0.05 with a confidence interval of 95%. In these analysis other independent variables or predictor variables were held constant, such as smoking, BMI and A1c. Also, in order to evaluate the relationships among the categorical variables such as smoking and the effect on outcomes, one of the variables, such as nonsmokers were used as a reference variable with a value of 1. There were also categorical variable analysis done to look more in-depth at the relationships between the variables. These multiple tests were performed in order to reduce Type 1 and Type 2 errors and develop an understanding of all of the relationships. The research questions and hypothesis analyzed through these regressions are as follows:

RQ1: Among total hip arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina?

Ho: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total hip arthroplasty patients within a health care facility in South Carolina.

RQ2: Among total knee arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels);

on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina?

Ho: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates among total knee arthroplasty patients within a health care facility in South Carolina.

RQ3: Among total hip arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

H0: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total hip arthroplasty patients within a health care facility in South Carolina.

RQ4: Among total knee arthroplasty patients, is there a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) within a health care facility in South Carolina?

H0: There is no relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

H1: There is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing overall patient LOS (dependent variable) among total knee arthroplasty patients within a health care facility in South Carolina.

Threats to Validity

Validity and reliability of the data is needed to ensure the data collected is accurate and trustworthy (Frankfort-Niachimias et al., 2015). This study used secondary data and therefore the collection process and the measurements used in collecting the data had to be precise. The secondary data was obtained from the hospital database and contained some self-reported data, such as smoking status and possible self-reported outcomes following the total hip or total knee arthroplasty.

Ethical Procedures

To ensure full compliance with ethical procedures, this study followed Walden University Institutional Review Board (IRB) ethical guidelines. I did not collect secondary data without full approval from the (IRB). I also did not contact individuals within the secondary data. All precautions were taken to ensure patient information was protected in accordance to the Health Insurance Portability and Accountability Act of 1996 (HIPPAA). This study did not require any identifying information which eliminates the ability for information to identify specific individuals. The statistical data was obtained from the health system and inputted into R to interpret and analyze. All data will be personally destroyed by the researcher after five years of completion of the study.

Summary

This study examined the relationship between the joint education class using controls for BMI, A1c and smoking status with the outcomes of PJI and LOS. The research design was guided by the CQI model. Secondary data was gathered for two years from all total hip and total knee arthroplasties at a hospital system in South Carolina. This data was then used for extensive data analysis using multiple logistic regression analysis to evaluate the relationship of joint education class participation with the PJIs and postoperative LOS. Chapter 4 contains the data collection overview, description of the study sample, and the results of data analyses using chi-square tests and multiple logistic regression. Chapter 5 concludes with the overview of the study, the summary of the findings, and the implications for social change by indicating the relationship between joint education class participation and patient outcomes following the procedure.

Chapter 4: Results

Introduction

The study site for this project was an acute care hospital system, in South Carolina, involving three hospitals at Prisma Health. My objective for the project was to evaluate the effectiveness of a total joint class and the relationship between class attendance and outcomes, specifically PJIs and LOS. My focus in this study was on total joint arthroplasty patients who received total knee and total hip arthroplasties. It was a retrospective cohort using secondary data for total joint (total hip and total knee arthroplasty) patients in the course of an approximately 2-year timeframe at Prisma Health Baptist Parkridge, Baptist and Richland hospitals in Columbia, South Carolina. All data collection was performed from the Prisma Health hospital system, specifically from the orthopedic service line database. The research questions for this study question the relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) and reducing overall patient LOS (dependent variable). In this chapter, we will review a summary of the findings of the study, discuss the data collection methods, and review the statistical analysis and results of the study. There will then be a summary of the answers to the research questions and key findings from the study.

Data Collection

The data that I collected included all total knee and total hip patients between January 1, 2017 and October 31, 2018, at Palmetto Health. Follow-up data on the patients was provided through April 30, 2019, to document if a PJI occurred. The sample that I used for this study consisted of 1,216 patients. Of these patients, there were 752 females and 464 males. The procedural mix included 406 total hip procedures and 810 total knee joint procedures. Of these patients, 535 did not attend the preoperative total joint class and 681 did attend. Also, of the 1,216 patients who had a total joint procedure, there were 41 who had a PJI and 1,175 who did not have a joint infection within the timeframe of the study. With regard to smoking status, the sample consisted of 31 current smokers and 1,185 noncurrent smokers. The sample had 84 recent (within the year) former smokers and 1,101 who stated that they have never smoked. The A1c patients were grouped into three categories. These categories were “diabetes not well controlled,” “diabetes with reasonable control,” and “not diabetic.” The distribution in these categories were as follows. There were 46 patients in the “diabetes not well controlled.” The patients in this category had a recorded A1c of 7 or higher. The next category, “diabetes with reasonable control,” included 397 patients and were classified in this category because they had a recorded A1c and the A1c value was less than 7. Finally, the last group was “not diabetic” and included 773 patients who did not have an A1c recorded due to them being identified by their physician as not needing an A1c due to not being diabetic or having a medical history or indication of diabetes. Finally, the last variable was BMI. Patients were categorized into four categories for BMI. The first category was “underweight,” which consisted of 3 patients. The “underweight” category included any patient with a BMI less than 18.5. The next category was “normal” and consisted of 141 patients. The “normal” category included patients with a BMI greater than or equal to 18.5 and less than 25. The "overweight" category included 311 patients, which included any patient with a BMI greater than or equal to 25 and less than 30. Finally, the fourth category was obese and included 761 patients and this category was defined as anyone with a BMI greater than 30. However, testing for linearity in BMI resulted in treating this variable as continuous for the logistical regression and merging the groups as they proved to be linear.

Results

My goal in this study was to determine the effectiveness of the total joint class on postoperative outcomes. The first analysis performed used a logistic regression to evaluate the effect of the total joint class, as well as smoking status, A1c/diabetes, and BMI on PJIs. See Table 4 for the results.

Table 4 Logistic Regression Model – Logistic GEE Shows O.R. for joint class in hip patients and joint in class patients, outcome is readmitted for PJI

	OR	95% CI	*p* value
BMI Merged (Linear)	1.085	(1.045, 1.126)	<.001
Current Smoker	10.383	(2.800, 38.497)	<.001
Recent-Former Smoker	15.653	(5.834, 41.995)	<.001
A1c Diabetes with reasonable control	0.620	(0.448, 0.858)	<.004
A1c Diabetes not well controlled	1.523	(0.925, 2.507)	<.098
Hip - Total Joint Class (no attendance)	4.448	(1.958, 10.103)	<.001
Knee - Total Joint Class (no attendance)	0.665	(0.536, 0.825)	<.001
Knee - Total Joint Class (attended)	1.298	(1.013, 1.663)	<.039

Estimate of common correlation parameter is 0.0086. Calculated dispersion parameter = 0.972. CIC = 8.89. For the outcome variable, Y=1 when Readmitted for PJI = 1.

Table 4 illustrates the results from the logistic regression performed on my data. I will first address the results directly related to my research questions and will then discuss other significant results related to the independent variables. To determine the relationship between the total joint class and PJIs in total hip patients (RQ1), I needed to create a reference variable as a value of 1. The reference value I used were the patients that had a total hip procedure, attended the joint class and had a PJI. Using this as the reference value and evaluating the total hip patients that did not attend class, I found a *p* value $<.001$, so therefore there was significance. In evaluating the odds ratio, the regression indicated an odds ratio of 4.45, so for patients that had a total hip procedure and did not attend the class, they were 4.45 times more likely to develop a PJI than those that did attend. Therefore, for my first research question evaluating the relationship of total joint class attendance for total hip patients and PJI, I would reject the null hypothesis as the results indicate there is a relationship between total joint class attendance and reduced PJI rates. Another notable result from Table 4 is that among patients attending the joint class, the odds of a total knee patient being readmitted for a surgical site infection are 1.30 times the same odds in a hip patient, with the remaining predictor values held constant. This odds ratio is statistically significantly different from 1 (the null value), with a p value of 0.039. In Table 5 are results of another logistic regression that focuses on the relationship among patients that did not attend the joint class and were readmitted with a PJI.

Table 5 Logistic Regression Model – Logistic GEE Shows O.R. for joint procedures that did not attend joint class, outcome is readmitted for PJI

	OR	95% CI	*p* value
BMI Merged (Linear)	1.085	(1.045, 1.126)	<0.001
Current Smoker	10.383	(2.800, 38.497)	<0.001
Recent-Former Smoker	15.653	(5.834, 41.995)	<0.001
A1c Diabetes with reasonable control	0.620	(0.448, 0.858)	0.004
A1c Diabetes not well controlled	1.523	(0.925, 2.507)	0.098
Hip - Total Joint Class (no attendance)	6.69	(2.383, 18.789)	<0.001
Knee - Total Joint Class (attended)	1.95	(1.257, 3.033)	0.003
Hip - Total Joint Class (attended)	1.50	(1.213, 1.866)	0.003

Estimate of common correlation parameter is 0.0086
Calculated dispersion parameter = 0.972
CIC = 8.89. For the outcome variable, Y=1 when Readmitted for PJI = 1

The results from the logistic regression in Table 5 indicates that among patients not attending the joint class, the odds of a hip patient being readmitted for a surgical site infection are 6.69 times the same odds in a knee patient, with the remaining predictor values held constant. This odds ratio is statistically significantly different from 1 (the null value), with a p value <0.001. Next, I will continue to evaluate the results of the logistic regression as it pertains to my research questions, particularly the question (RQ2) related to patients that had total knee procedures and the relationship between joint class attendance and reduced PJI rates.

Referring back to Table 4, among patients attending the joint class, the odds of a total knee patient being readmitted for a surgical site infection are 1.30 times the same odds in a hip patient, with the remaining predictor values held constant. This odds ratio is statistically significant different from 1 (the null value), with a p value of 0.039. The next table displays data that looks into the total knee patients further and the relationship between joint class attendance and PJIs. It uses the reference variable of knee patients that attended the joint class.

Table 6 Logistic Regression Model – Logistic GEE Shows O.R. for joint class in knee patients and joint in class patients, outcome is readmitted for PJI	OR	95% CI	*p* value
BMI Merged (Linear)	1.085	(1.045, 1.126)	<0.001
Current Smoker	10.383	(2.800, 38.497)	<0.001
Recent-Former Smoker	15.653	(5.834, 41.995)	<0.001
A1c Diabetes with reasonable control	0.620	(0.448, 0.858)	0.004
A1c Diabetes not well controlled	1.523	(0.925, 2.507)	0.098
Hip - Total Joint Class (no attendance)	3.427	(2.383, 18.789)	<0.001
Knee - Total Joint Class (attended)	0.512	(1.257, 3.033)	0.003
Hip - Total Joint Class (attendance)	0.771	(1.213, 1.866)	<0.001

Estimate of common correlation parameter is 0.0086
Calculated dispersion parameter = 0.972
CIC = 8.89. For the outcome variable, Y=1 when Readmitted for PJI = 1

In Table 6, the results can be interpreted as among knee patients, the odds of those who did not attend the total joint class being readmitted for a surgical site infection are 0.51 times the same odds in a patient who did attend the joint class, with the remaining predictor values held constant. This odds ratio is statistically significantly different from 1 (the null value), with a p value of 0.003. Therefore, for my second research question that focused on total knee patients sought to determine if there is a relationship with attendance of a joint education class; independent variables (smoking, BMI, A1c levels); on reducing postoperative prosthetic joint infection (PJI) rates (dependent variable) within a health care facility in South Carolina? The answer would be that I would fail to reject the null hypothesis, as there was no significance in the relationship that joint class attendance reduced PJI rates. These results somewhat tie back to literature reviewed. As mentioned previously, Jordan et al. (2014) performed two studies that analyzed preoperative education and found a decrease in preoperative expectation and improvement in knowledge, flexibility and regularity of exercise among the patients, but alone there was no significant differences in validated joint specific patient reported outcomes. However, when the study was combined with treatment by a physiotherapist, there was a reduction in costs and LOS. While my results did indicate a relationship between the class and reduced PJI rates for total hip patients, the relationship for total knee patients was the inverse of what may have been expected. Now, that I have addressed the results directly related to the research questions, I will review the other results as they related to my independent variables, BMI, smoking, and A1c.

In Table 4, BMI was determined to have linearity. Therefore, in evaluating the results and treating BMI as a continuous variable, there was a p value of 0,003, which was less than 0.05, indicating significance. The odds ratio for BMI was 1.085. This indicates that for every 1 unit increase in BMI, the patient had an 8.5% increased likelihood of having a PJI. These results did coincide with results in other research reviewed. Meller et al. (2016) found that morbidly obese patients were more likely to have a PJI following a total hip or total knee procedure compared to those of normal weight. These findings indicate a focus on BMI could influence PJI and subsequently LOS. Now that the results of the independent variable BMI have been reviewed, the results for smoking will be evaluated.

In evaluating the results of smoking, whether the patient was a current smoker, recent smoker, or a nonsmoker, the regression once again used a reference variable and it was placed at a value of 1. The reference variable used for smoking was the nonsmoker. Evaluating the results of the current smoker, the *p* value of <0.001 indicated the results were significant. Therefore, with an odds ratio of 10.383, the results showed that for those patients that are current smokers, they are 10.4 times more likely to develop a PJI than those that are nonsmokers. As for the recent-former smokers, the *p* value <0,001 indicated significance as well, and with an odds ratio of 15.653, these patients have 15.7 times the likelihood of having a PJI than those that are nonsmokers. These results not only agree with literature supporting smoking as being a factor in PJI, but the odds ratios are actually much higher than research reviewed. Gonzalez et al. (2017) found that patients that had a total hip or knee procedure and smoked were 1.8 times more likely to develop a PJI than nonsmokers. This ratio is much less than the 10.4 and 15.7 odds ratios my results found for current and former smokers respectively. Next, I will review the results of the A1c data.

The A1c patients were categorized into 3 categories. The first category, which was the reference variable for this regression was nondiabetic patients. The other two categories include A1c/diabetic patients well controlled and A1c/diabetic patients that are not well controlled. With nondiabetics as the reference variable, the A1c/diabetic patients with reasonable control had a *p* value of 0.004. Therefore, there was significance in the relationship between nondiabetic patients and diabetic patients with reasonable control and the development of a PJI. The odds ratio of 0.620, however indicates that the

A1c/diabetic patients well controlled, actually have less of a chance of developing a PJI than nondiabetics. As for the A1c/diabetics not well controlled, there was a *p* value of 0.098, therefore indicating there is no significance in the relationship of nondiabetic patients and diabetic patients not well controlled and the development of a PJI. These results did not relate to the results I found in my research. Other studies have found that A1c levels and diabetic status have contributed to PJIs. Kremers et al. (2015) found that patients with diabetes and perioperative hyperglycemia (elevated blood glucose and A1cs) were more likely to develop PJI when compared to patients with normal glucose levels. In order to further explore the variables and to test for Type 1 and Type 2 errors, the following analysis was also performed.

Table 7 Categorical Variables by Readmitted for PJI – (Columns add to 100%)

	All Subjects	False	True	Estimate	p value
Gender - Female	752(61.8%)	729(62.0%)	23(56.1%)	0.593	0.441c
Gender – Male	464 (38.2%)	446(38.0%)	18(43.9%)		
Procedure-Hip	406(33.4%)	383 (32,6%	23(56.1%)	9.839	0.002c
Procedure Knee	810(66.6%)	792(67.4%)			
Joint Class – No	535(44.0%)	510(43.4%)	25(61.0%)	4.964	0.026c
Joint Class-Yes	681(56.0%)	665(56.5%	16(39.0%)		
Current Smoker-False	1185(97.5%)	1149(97.8%)	36(87.8%)	NA	0.003f
Current Smoker-True	31(2.5%)	26(2.2%)	5(12.2%)		
Recent/Former Smoker-False	1132(93.2%)	1108(94.3%)	24(58.5%)	NA	0.000f
Recent/Former Smoker-True	84(6.9%)	67(5.7%)	17(41.5%)		
A1c Not Diabetic	773(63.6%)	746(63.5%)	27(65.9%)	-0.038	0.810g

A1c Diabetes w/reasonable control	397(32.6%)	385(32.8%)	12(29.3%		
A1c Diabetes not well controlled	46(3.8%)	44(3.7%)	2(4.9%)		
BMI underweight	3(0.2%)	3(0.3%)	0(0.0%)	0.214	0.161g
BMI normal	141(11.6%)	137(11.7%)	4(9.8%)		
BMI overweight	311(25.6%)	304(25.9%)	7(17.1%)		
BMI obese	761(62.6%)	731(62.2%)	30(73.2%)		

f - Fisher's exact test; descriptive statistics are count (percent). The estimate is the odds ratio in the case of a 2x2 table.

c - Chi-square test; descriptive statistics are count (percent). The estimate is the chi-square statistic.

g - Goodman-Kruskal gamma test; descriptive statistics are count (percent). The estimate is gamma.

Table 7 shows the evaluation of the independent variables independent of one another; therefore, there were no controls. The analysis evaluated each group of categorical variables and tested for a relationship with readmission for PJI. The notable categorical variables are the procedural variables (hip and knee) and both smoking variables (current and recent/former). The p value for the procedural variables was 0.002 and had an odds ratio of 9.839, which was a significant relationship and indicated that patients that had total hip procedures were 9.8 times more likely to have a PJI than total knee patients. As for the current smokers, the p value of 0.003 indicated a significant relationship between current smokers and nonsmokers and whether or not they were readmitted with a PJI. The categorical variables of recent/former smokers and non-recent/former smokers was 0.000, which also indicated a significant relationship between recent/former smokers, non-recent/former smokers and whether or not they were readmitted with a PJI.

Table 8 Categorical Variables by Joint Class Attendance – (Rows add to 100%)

	No	Yes	Estimate	p value
Gender - Female	322(42.8%)	430(57.2%)	1.109	0.292
Gender – Male	213(45.9%)	251(54.1%)		
Procedure-Hip	183(45.1%)	223(54.9%)	0.287	0.592c
Procedure Knee	352(43.5%)	458(56.5%)		
Current Smoker-False	511(43.1%)	674(56.9%)	14.422	<.001c
Current Smoker-True	24(77.4%)	7(22.6%)		
Recent/Former Smoker-False	491(43.4%)	641(56.6%)	2.574	0.109c
Recent/Former Smoker-True	44(52.4%)	40(47.6%)		
A1c Not Diabetic	335(43.3%)	438(56.7%)	-0.048	0.407g
A1c Diabetes w/reasonable control	174(43.8%)	223(56.2%)		
A1c Diabetes not well controlled	26(56.5%)	20(43.5%)		
BMI underweight	2(66.7%)	1(33.3%)	-0/129	0.161g
BMI normal	54(38.3%)	87(61.7%)		
BMI overweight	124(39.9%)	187(60.1%)		
BMI obese	355(46.6%)	406(53.4%)		

f - Fisher's exact test; descriptive statistics are count (percent). The estimate is the odds ratio in the case of a 2x2 table.

c - Chi-square test; descriptive statistics are count (percent). The estimate is the chi-square statistic.

g - Goodman-Kruskal gamma test; descriptive statistics are count (percent). The estimate is gamma.

The second table of categorical variables analyzed the independent variables and whether or not they were predictors of joint class attendance. The analysis evaluated each group of categorical variables and tested for a relationship with joint class attendance. The notable categorical variables are the current smokers and noncurrent smokers and the BMI categorical variables. The p value for the current smokers and noncurrent smokers was <0.001 and had an odds ratio of 14.422, which was a significant relationship and indicated that patients that were current smokers were 14.4 times more likely not to attend joint class. As for the BMI categorical variables, the p value of 0.016 indicated a significant relationship between what BMI category the patient was categorized and whether or not they attended joint class. Now that the questions related to the relationship between joint class attendance and reduced PJI rates with the other independent variables have been reviewed, I will now move on to my last two research questions. The following Poisson regression was used to evaluate the relationship between joint class attendance, including the independent variables of smoking, A1c/diabetes and BMI and reducing postoperative LOS of the patients that had a total hip or total knee arthroplasty.

Table 9 Poisson GEE, Outcome Is LOS

	I.R.R.	95% CI	*p* value
Total Joint Class (no attendance)	1.165	(1.005, 1.350)	0.043
Recent-Former Smoker	0.849	(0.785, 0.918)	<0.001
Current Smoker	1.152	(0.886, 1.497)	0.291
A1c Diabetes with reasonable control	1.031	(0.936, 1.137)	0.535
A1c Diabetes not well controlled	1.129	(1.093, 1.167)	0.098
BMI - Underweight	0.561	(0.507, 0.621)	<0.001
BMI - Overweight	0.998	(0.969, 1.009)	0.258
BMI - Obese	1.049	(1.000, 1.101)	0.049
Procedure - Hip	1.091	(0.998, 1.192)	0.054

The correlation structure is exchangeable, and the ID variable is Surgeon.
The estimate of the common correlation parameter is 0.0286
Calculated dispersion parameter = 1.147
CIC = 7.63

In the following paragraphs, I will describe the results of the data listed in the Table 9. First, I will review the results that are associated with my 3rd and 4th research questions. The results from the Poisson, showed that patients not attending the total joint class are expected to stay in the hospital 16.5% more days than those attending the class, with the remaining predictor values held constant. This is true whether the patient had hip or knee surgery. This association is not likely due to chance (p=0.043). Therefore, for research questions 3 and 4 regarding the relationship between joint class attendance and reducing postoperative LOS, I determined that there was a relationship and therefore reject the null hypothesis. Therefore, whether the patient had a total hip or total knee procedure, there was a relationship between joint class attendance and a reduced postoperative LOS. As with the logistic regression I also evaluated the impact of the other variables on postoperative LOS. The first results are regarding smoking and the relationship with postoperative LOS.

The results for smoking were somewhat conflicting with what I have seen in other research. Recent/former smokers are expected to stay in the hospital 15.1% fewer days than nonsmokers, with the remaining predictor values held constant. This association is not likely due to chance ($p<0.001$). As for current smokers, they are expected to stay in the hospital 15.2% more days than nonsmokers, with the remaining predictor values held constant. This association may be due to chance ($p=0.291$). The results for the next variable discussed will be for A1c/diabetes.

The results of the relationship between patients who had their diabetes under control and nondiabetics, was also different from what I've seen in other research. Patients with diabetes under reasonable control (HgbA1c $\leq$ 7.0) are expected to stay in the hospital 3.1% more days than nondiabetics (no record of HgbA1c), with the remaining predictor values held constant. This association may be due to chance ($p=0.535$). However, patients with diabetes not well controlled (HgbA1c $>$ 7.0) are expected to stay in the hospital 12.9% more days than nondiabetics (no record of HgbA1c), with the remaining predictor values held constant. This association is not likely due to chance ($p<0.001$). The next and final variable results were for BMI, and for the Poisson regression, this variable was not evaluated in linearity, but instead evaluated from a categorical standpoint of underweight, overweight and obese, with normal weight set as the reference variable. Underweight patients (BMI $<$ 18.5) are expected to stay in the hospital 43.9% fewer days than patients of normal weight ($18.5 \leq$ BMI < 25), with the remaining predictor values held constant. This association is not likely due to chance ($p<0.001$). Overweight patients ($25 \leq BMI < 30$) are expected to stay in the hospital 1.1% fewer days than patients of normal weight ($18.5 \leq BMI < 25$), with the remaining predictor values held constant. This association may be due to chance ($p=0.258$). The obese patients ($BMI \geq 30$) are expected to stay in the hospital 4.9% more days than patients of normal weight ($18.5 \leq BMI < 25$), with the remaining predictor values held constant. This association is not likely due to chance ($p=0.049$). One last notable result indicated that total hip patients are expected to stay in the hospital 9.1% more days than knee replacement patients, with the remaining predictor values held constant. This association may be due to chance ($p=0.054$).

Summary

Included in Chapter 4 was the analysis of the results of this quantitative, retrospective cohort. A logistic regression was used to answer the first two research questions and determined the relationship between the independent variables (joint class attendance, BMI, smoking, and A1c/diabetes) and the dependent variable PJI for the total hip and total knee population used for this study. Based on the analysis there was a statistically significant relationship between total hip patients and their joint education class attendance and reduced PJI rates, but results did not show a significant relationship among total knee patients. There was also a relationship between BMI and smoking, on PJI rates. However, there was no relationship between patients A1c levels and PJI. As for the last two research questions, a Poisson regression was used to determine the relationship between the independent variables (joint class attendance, BMI, smoking, and A1c/diabetes) and the dependent variable LOS. This regression indicated that for those total hip or total knee patients that did not attend the joint education class, they were expected to stay in the hospital 16.5% more days than those attending the class, with the remaining predictor values held constant. This indicated that for both research questions 3 and 4, there was a relationship between joint class attendance and reduced postoperative LOS, so therefore I rejected the null hypothesis. Chapter 5 describes the interpretation of the findings, the limitations of the study, recommendations for future research, implication for social change and conclusion.

Chapter 5: Discussion, Conclusion, and Recommendations

Introduction

In this study, I generated significant results that will be used by administrators to make decisions surrounding the joint education class at my hospital system. My purpose in this study, and my four research questions, allowed me to evaluate the population of total hip and total knee patients to determine whether there was a relationship between their joint class attendance including other independent variables (smoking, BMI, and A1c levels) and the outcomes or the dependent variables, which were PJI rates and postoperative LOS. In brief, my key findings from the logistic regression that addressed my first two research questions were that for patients who had a total hip procedure and did not attend the joint education class, they were 4.45 times more likely to develop a PJI, than those who did not. With regard to total knee patients, there was no significance in the findings, so I did not determine a relationship with their joint class attendance and reducing PJIs. Regarding the last two questions that I used to evaluate the relationship on joint education class and postoperative LOS using a Poisson regression, results indicated that for those total hip or total knee patients who attended the joint education class were expected to stay in the hospital 16.5% more days than those attending the class, with the remaining predictor values held constant. This indicated that for RQs3 and 4, there was a relationship between joint class attendance and reduced postoperative LOS.

Interpretation of Findings

Among total knee patients, there was no relationship between joint class attendance and reduced PJI. However, there was significance in the relationship in total hip patients. The results for total hip patients had a *p* value < .001 and with an odds ratio of 4.45, indicating that patients who had a total hip procedure and did not attend the joint education class were 4.45 times more likely to have a PJI than those who attended. Using this same logistic regression, there were also some findings related to the other independent variables, such as BMI and smoking.

The relationship between BMI, when treating the variable as linear, and PJI was significant with *p* value of .003, which was less than .05, indicating significance. The odds ratio for BMI was 1.085; therefore, the patient had an 8.5% increased likelihood of having a PJI for every 1 unit increase in BMI. Unlike the BMI variable, which was treated with linearity, the smoking variable was categorized as current smoker, recent/former smoker, and nonsmoker. The reference variable used for smoking was the nonsmoker. Evaluating the results of the current smoker, the *p* value of <.001 indicated that the results were significant. Therefore, with an odds ratio of 10.383, the results showed that for those patients who were current smokers, they have 10.4 times the likelihood of developing a PJI than those that are nonsmokers. As for the recent-former smokers, the *p* value <.001 indicated significance as well, and with an odds ratio of 15.653, these patients have 15.7 times the likelihood of having a PJI than those who are nonsmokers. These results were significant, indicating with all other variables controlled, both BMI and smoking have significant effect on PJI rates. As for A1c, the results were not as consistent with the expected.

As I mentioned previously, the A1c patients were categorized into 3 categories: A1c/diabetic patients not well controlled, A1c/diabetics well controlled, and nondiabetics. Using nondiabetics as the reference variable the results showed with significance that A1c/diabetic patients well controlled have less of a chance in the development of a PJI than nondiabetic patients. Also, in A1c/diabetic patients not well controlled there was a *p* value of .098, indicating that there was no significance in the relationship of nondiabetic patients and diabetic patients not well controlled and the development of a PJI. These results were surprising, because it would seem that diabetics and even diabetics whose health is well controlled would have a more likely chance of developing a PJI than nondiabetics. However, there may be some limitations in the data that could have contributed to this discrepancy from the expected. I will discuss these limitations in more detail in the limitations section of this chapter, but nondiabetics were categories as nondiabetics due to the lack of an A1c lab value within the data. According to the physicians, the lack of this lab is due to the patient not having the history or indications of diabetes, but the patients could have still been at risk. Now that the findings related to RQs 1 and 3 have been discussed, I will interpret the results of the Poisson regression and significant findings discovered.

The most significant results from the Poisson regression, showed patients not attending the total joint class are expected to stay in the hospital 16.5% more days than those attending the class and this is true whether the patient had hip or knee surgery. These results alone answered my third and fourth research questions related to the relationship of joint class attendance on LOS reduction, indicating there is a relationship for both total hip and total knee patients between joint class attendance and the reduction of LOS. However, this analysis also yielded other significant results. In the following paragraphs, I will discuss the results from the Poisson regression for the independent variables, BMI, smoking and A1c.

I will start by discussing BMI, as there were some significant results that were expected from what has been seen in other research. BMI was treated as a categorical variable in the Poisson regression versus a linear variable, as it was in the logistic regression, with normal weight set as the reference variable. The results of the regression indicated that underweight patients (BMI < 18.5) are expected to stay in the hospital 43.9% fewer days than patients of normal weight ($18.5 \leq$ BMI < 25). This association is not likely due to chance ($p<0.001$). Overweight patients ($25 \leq$ BMI < 30) are expected to stay in the hospital 1.1% fewer days than patients of normal weight ($18.5 \leq$ BMI < 25). This association may be due to chance ($p=0.258$). The obese patients (BMI ≥ 30) are expected to stay in the hospital 4.9% more days than patients of normal weight ($18.5 \leq$ BMI < 25). This association is not likely due to chance ($p=0.049$). Aside from the relationship between overweight patients and normal weight patients, these results are consistent with other research, indicating that obese patients have not only an increased likelihood of developing a PJI, but also have a longer postoperative LOS.

As mentioned before, the results for smoking were somewhat unexpected. The results for the recent/former smokers LOS as it relates to nonsmokers was the unexpected result. Recent/former smokers are expected to stay in the hospital 15.1% fewer days than nonsmokers, and this result was not likely due to chance ($p<0.001$). A theory for this result may be that this group of patients was pushing to be discharged earlier due to the desire to smoke. However, as for current smokers, they are expected to stay in the hospital 15.2% more days than nonsmokers, and this association may be due to chance ($p=0.291$). This possible relationship between current smoking and nonsmokers and postoperative LOS was more consistent with other research. Now, finally I will discuss the results of the last independent variable, A1c, and some of the findings surrounding diabetic patients.

The results of the relationship between patients who had their diabetes under control and nondiabetics, was different than recent literature. Patients with diabetes under reasonable control (HgbA1c ≤ 7.0) are expected to stay in the hospital 3.1% more days than nondiabetics (no record of HgbA1c), with the remaining predictor values held constant, but this association may be due to chance ($p=0.535$). However, patients with diabetes not well controlled (HgbA1c > 7.0) are expected to stay in the hospital 12.9% more days than nondiabetics (no record of HgbA1c and this association is not likely due to chance ($p<0.001$). Therefore, the relationship between diabetic patients not well controlled and nondiabetic patients was consistent with other research, however the results regarding the relationship between A1c/diabetic patients well controlled and nondiabetics and LOS, was not as expected. Therefore, much like the logistic regression that evaluated the relationship of A1c levels and PJI, the relationship with LOS also showed inconsistencies with recent literature. Once again, these inconsistencies could be due to limitations and the categorization of patients without an A1c level documented as diabetics, which leads me to the next session, where I will discuss the limitations of the study.

Limitations

The data for this study was not difficult to obtain, however there were some delays in obtaining the data due to those providing it being busy with their everyday work. There were also some issues with missing values that I had to obtain in order to make my data set as complete and accurate as possible. Over the years, I have built working relationships with those pulling and delivering the data to me, so the issues obtaining the data were minimal. Another expected limitation was the number of patients with A1c values, which totaled 443 patients. A1c values were only obtained from patients who are diabetic, so therefore the lack of data for this independent variable created the definition of the category for those who did not have an A1c as not diabetic. The definition of this category as not diabetic versus omitting the data missing A1c levels did not limit the size of the sample population. Defining this group as not diabetic could have generalized this population and some of these patients may still have been diabetic, but not tested, but this was the most reasonable solution versus eliminating a large portion of the data set. Other than these challenges, there were no data issues, such as storage or associated fees.

Implications

When I chose this topic, I hoped it would be one that could have significant impact to social change and help to support policy, funding and overall acceptance of the benefits the joint education class has on the total hip and total knee patients in my hospital system. Now that I have completed the study, the results are hopefully going to provide hospital administrators, providers and patients with information regarding the effectiveness of this class and the importance of participation/compliance for the candidates of total hip and knee arthroplasty procedures. The compliance of orthopedist and their patients to participate in the joint education class, have not been 100%. Therefore, the relationships between joint class attendance and postoperative outcomes will hopefully indicate the effectiveness of the program and will hopefully lead to the decisions that will affect the entire population of patients having total hip and total knee procedures going forward. The Chief Executive Officer (CEO) of my organization has been waiting to see my results and will make a decision of whether or not to make this class mandatory for all patients that are going to have these procedures. I believe with these results, the CEO will decide to make this class mandatory or at the very least share the results with the orthopedic surgeons, so that they can see the effectiveness of the program. The results of this study could also help support future funding for the total joint class, which will be critical in a time where resources are scarce.

Recommendations

Throughout this study there were indications that there may be opportunities for further research. As with any quantitative study with multiple variables, there are a number of different ways to look at the data and evaluate independent variables that could influence the dependent variables. Therefore, I have a few recommendations for future research that apply to the other independent variables collected in my study.

The first recommendation is for further analysis surrounding the recent smoker variable. The negative effects that smoking can have on someone’s physical health can last for years. This study classified a recent smoker as someone that smoked within a year of their consultation. Future research could evaluate PJI rates for patients that have smoked as recently as 2, 3, 4 or more years to see if there is a relationship dependent upon how many years patients have gone without smoking and their PJI rates. Another independent variable that may yield important information with additional research is related to demographics.

My second recommendation for further research involves a more in-depth look at the relationship between gender and PJI rates. I think it would be interesting to see if whether or not the patient is a male for female has an influence on PJI rates. This analysis could then take into consideration other independent variables, such as diabetes, smoking, joint class attendance, and so on, in conjunction with gender to see if there are PJI risk factors associated. Another recommendation would be to evaluate the data based on race. It may be interesting to see if African Americans, Caucasians, Latin Americans, and other demographic groups have a higher prevalence of PJIs when controlled for other various independent variables.

Conclusion

This study evaluated the effect of a total joint education class on patient outcomes to include PJI and postoperative LOS. The total joint class had a statistically significant effect on total hip patients in reducing PJIs as well as postoperative LOS. The class attendance also had a statistically significant relationship among total knee patients and reducing postoperative LOS. Although these results were the most significant, there was also useful information provided regarding the other independent variables such as BMI, smoking and A1c/diabetes. The results of this study will be used by administrators and physicians at the hospital from which the data was obtained. They will either use this information for further support and funding of the total joint class or use it in support of making the total joint class mandatory for all potential patients having these procedures. These decisions could impact social change at my hospital and in my community by improving future outcomes for the total hip and total knee patient population.

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