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Dietary Fiber Education for Diverticular Disease and Hospital Readmission Rates

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Dietary fiber education for diverticular disease and hospital readmission rates

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Hospital readmission rates are being used to indicate quality of care by healthcare facilities in recent years. Increase in incidence and hospitalizations of patients with diverticular disease (DD) has caused burden to hospital resources. High fiber diets have been a part of the recommended therapy for patients to reduce symptoms and complications of DD. Analysis of the effect of high fiber diet education on hospital readmission of patients with a diagnosis of DD (N=68) was conducted. Chi-square analysis determined that high fiber diet education was not associated with readmission (x^2=0.567, P=0.452). T-tests determined that men were more likely to be readmitted than women (P=0.029). A higher BMI was also observed in patients who were readmitted compared to those not readmitted (P=0.006). While high fiber diet education was not associated with readmission, males and patients with a higher BMI were significantly associated with hospital readmission.

Keywords: Diverticular disease, high fiber diet education, readmission

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CHAPTER I

INTRODUCTION

Diverticular disease (DD) has become an increasing burden to healthcare costs and resources with admission rates on the rise in the last 25 years (Talabani, Lydersen, Endreseth & Edna, 2014). It was estimated that DD was responsible for approximately 313,000 hospital stays and over $2.5 billion to hospitals in the United States in 2004 (Milenkovic, Russo, & Elixhauser, 2006). In 2009, over 2.5 million people were sean in outpatient clinics for DD, with diverticulitis listed as one of the top discharge diagnoses from hospitals in the same year, costing hospitals an even higher $2.7 billion (Peery et al., 2012a). Cost analysis from a United Kingdom hospital showed significant burden to hospital and facility resources as a result of DD, with 70% of the total cost attributed to just bed-day expenses (Papagrigoriadis, Debrah, Koreli, & Husain, 2004). The prevalence of DD is noted to be highest in elderly populations, with approximately two-thirds of persons aged 80 years or older estimated to have the condition (Aldoori & Ryan-Harshman, 2002). While most prevalent in the elderly, recent studies identify a growing incidence of the disease in patients younger than 45 years (Etzioni, Cannom, Ault, Beart, & Kaiser, 2009; Nguyen, Sam, & Anand, 2011).

In addition to increases in overall prevalence and hospitalizations for the disease, increases in readmission have been identified, furthering the burden of disease. Hospital readmission rates for patients treated for DD are also high with rates of 30% (Elliot, Yego, & Irvin, 1997) to 35.3% (Moreno & Wille-Jergensen, 2007). Hospital readmissions within 30 days of discharge from a hospital for treatment of DD are also being noted. Approximately 9.6% of patients treated for DD are readmitted within 30 days (Jeyarajah et al., 2009), and total cost to hospitals for patients readmitted within 30 days are more than twice as high when compared to patients not readmitted (Damle et al., 2014).

Readmission rates within 30 days have begun to be an important indicator of quality among hospitals since the Centers for Medicare and Medicaid Services (CMS) began publicly reporting hospital readmission rates in 2009. At first, CMS began reporting 30-day readmission and mortality rates on patients with acute myocardial infarctions, heart failure, and pneumonia. CMS reports have now expanded to include all unplanned 30-day readmissions. Through the Hospital Readmission Reduction Program, implemented in 2012, hospitals with higher-than-average readmission rates for certain diagnoses would be penalized up to 1% of Medicare reimbursement for claims from July 2008 to June 2011. Now in its third year, some hospitals are penalized up to 3% for excess readmissions (CMS, 2014). A report by Jencks, Williams, and Coleman (2009) sheds light on the prominence of readmission rates among Medicare patients and the estimated cost to CMS sparked discussion in health care reform. Approximately 19.6% of Medicare patients were being readmitted, costing CMS over $17 billion annually (Jencks et al., 2009). The Healthcare Cost and Utilization Project (HCUP) reported that 2011 saw an estimated $41.3 billion in costs to hospitals for all-cause 30-day hospital readmissions (Hines, Barrett, Jiang, & Steiner, 2014). Since the implementation of the Hospital Readmission Reduction Program, the policy’s effectiveness in improving overall quality and safety has been called into questions due to its narrow focus. A number of factors have been determined to lead to readmission, some of which are difficult for hospitals to change, or even out of hospital control (Joynt & Jha, 2012)

During its initial year in 2012, hospital readmission rates were noted to decrease nationally from an average of 19% from 2007-2011 to 18.4% in 2012 (Gerhardt et al., 2013). Kaiser Health News reported nearly 18 percent of Medicare patients who had been hospitalized in 2013 were readmitted within a month (Rau, 2014). While this estimate is lower than past years, roughly 2 million patients continue to return every year, costing CMS $26 billion annually. Under the new fines, three-quarters of hospitals that are subject to the Hospital Readmissions Reduction Program are being penalized. Over the course of the year, the fines will total about $428 million (Rau, 2014). CMS reported that 56% of Mississippi hospitals were penalized an average of 0.7% for readmission in the 2013-2014 fiscal year (Kaiser Health News, 2014).

Diverticular disease is a term that defines the presence of one or more diverticulum in the colon. Diverticula develop when the mucosal membranes of the colon herniate though the various layers of the colon (Jun & Stollman, 2002; Kang, Melvin, & Maxwell, 2004). Diverticular disease is mostly present in the sigmoid region of the colon (Jun & Stollman, 2002); however, it is found on the right side of the colon in most Asian populations, giving rise to a possible genetic etiology (Heise, 2008). Although the etiology is still fairly unknown, most epidemiological research suggests that a combination of dietary fiber deficiency, colonic pressure and motility changes, and structural alterations to the colon may be responsible (Heise, 2008). While it is reported that only 10-25% of patients with DD present with symptoms (Shahedi et al., 2013), patients with DD experiencing symptoms most commonly complain of fever, left lower quadrant pain, and changes in bowel habits (Parra-Blanco, 2006). A clinical diagnosis of DD has a low specificity, and clinical symptoms of DD are also found in other gastrointestinal disorders (Laurell, Hansson, & Gunnarsson, 2007). Physicians now rely on computerized tomography (CT) as the primary diagnostic tool to identify DD in patients (Kang et al., 2004). There are two different classification systems for the staging of DD utilized by physicians, both providing guidance to the appropriate treatment modality (Hinchey, Schaal, & Richards, 1978; Kohler et al., 1999).

Low dietary fiber intake was first hypothesized as an etiology for the disease in 1971 when Painter and Burkitt (1971) identified a high prevalence of the disease in industrialized nations when compared to rural African populations. Calling it "a disease of Western civilization," Painter and Burkitt (1971) noted a low incidence of disease prior to 1900 and cited the consumption of a low fiber diet through refined grains as a possible factor to the disease's development. Since this initial hypothesis, large cohort studies have been conducted to identify the relationship, with most finding a lower risk of developing DD in those who consume high fiber diets (Aldoori et al., 1994; Crowe, Appleby, Allen, & Key, 2011). The Health Professionals Follow-Up Study, which began in 1986, garnered insight into other possible associations and the development of DD. Obesity was noted to increase the risk of developing DD (Strate, Liu, Aldoori, Syngal, & Giovannucci, 2009), as well as increase the risk of recurrent complications (Aldoori et al., 1995a). Smokers in the Health Professionals Study also showed an increase in risk for the development of complications related to DD (Aldoori et al., 1995b).

The present study evaluated the effect of inpatient high fiber diet education instruction provided by clinical dietitians at North Mississippi Medical Center in Eupora, Mississippi, on the incidence of readmission among patients admitted with a primary or secondary diagnosis of diverticulitis. The purpose of this study was to investigate the effect of high fiber diet education in the prevention of hospital readmission among patients hospitalized for DD. The primary objective of this retrospective study was to identify differences between the prevalence of readmission post discharge when patients admitted with DD were instructed on maintaining a high fiber diet for prevention and those who were not instructed. A secondary objective was to investigate the ability of age, sex, ethnicity, body mass index (BMI) level, serum erythrocyte sedimentation rate, and high fiber diet education to predict readmission among patients hospitalized for DD.

CHAPTER II

LITERATURE REVIEW

Prevalence of Diverticular Disease

In 2002, diverticular disease (DD) was suggested to be a very common disorder of the civilized world. It was estimated that only 10% of those aged 40 and younger were afflicted with the condition, while up to 66% of those aged over 80 years were affected (Aldoori & Ryan-Harshman, 2002). From 2001-2005, DD represented the most common finding on colonoscopies and sigmoidoscopies, with 71.4% of participants over the age of 80 presenting with DD (Everhart & Ruhl, 2009).

While prevalence of DD is high, it is only estimated that 10-25% of patients will develop diverticulitis over the course of their lifetime. It is to be noted that the estimated incidence of 10-25% is found throughout literature and is suspected to have been established from data that were collected in the early 20th century. A lower incidence of only 4% was demonstrated in retrospective analysis of 2222 patients with DD based on clinical criteria, and it was estimated that an occurrence of diverticulitis following an incidental diagnosis of diverticulosis from CT was only 1% (Shahedi et al., 2013).

Impact to Healthcare

Diverticular disease was responsible for 254,179 inpatient discharges and 1,493,865 outpatient clinic visits in 2002 (Reddy & Longo, 2013), with an estimated increase of 16.4% in hospitalizations for the disease between 1996 and 2004 (Everhart & Ruhl, 2009). Higher reports of a 26% increase in hospital admissions for DD annually were also noted (Etzioni et al., 2009). More recently, diverticulitis was noted to be the most common gastrointestinal diagnosis among patient hospitalizations in 2009, comprising 219,133 discharges and was noted to be a 41% increase from 2000. In combination, diverticulitis and diverticulosis represented 283,355 discharges and cost hospitals an estimated $2.7 billion (Peery et al., 2012a).

Although DD is seen more in older adults, the incidence among younger patients is increasing. Rates of hospital admissions for DD in patients aged 18-44 years rose 82% from 1996-2004 (Etzioni et al., 2009). Using data from the Nationwide Inpatient Sample, as part of the Healthcare Cost and Utilization Project (HCUP), a 150% and 70% increase in patient hospitalizations in the United States for DD in those aged 15 to 24 years and 25 to 44 years, respectively, was reported. There was an overall increase in hospital admissions for DD across gender, age, and geographical location. The study showed an increase in age-adjusted hospitalizations from 61.8 to 75.5 per 100,000, with the sharpest increase in DD admissions noted to be between the ages of 25 and 44. Geographically, more hospitalizations were noted in the South and Midwest regions of the United States, as compared to that of the Northeast and Western regions (Nguyen et al., 2011). In 2002, it was estimated to cost between $9,742 and $11,729 per hospitalization for DD (Reddy & Longo, 2013).

In addition to increase in the United States, European nations are also experiencing an increase in hospital admissions related to DD. In the United Kingdom, Hospital Episode Statistics (HES) data showed hospital admissions more than doubled in rate between the years 1996 and 2006. The rate went from 0.56 to 1.20 per 1000 persons per year from 1996 to 2006, with 41.4% resulting in inpatient admissions (Jeyarajah et al., 2009). Admissions were examined again using HES data from 1989-1990 and 1999-2000, again demonstrating English hospitals increased DD admissions by 16% and 12% amongst men and women, respectively (Kang et al., 2003). While in Norway, the incidence of DD was estimated to have more than doubled (2.56-fold) over the course of 25 years. The rate of hospital admissions for DD increased from 17.7 per 100,000 to 51.1 per 100,000 (Talabani et al., 2014).

Although DD is well-documented and seen in many populations, compared to other gastrointestinal disorders, it remains lower on the list in regards to mortality. In 2009, DD was 16th in a list of gastrointestinal causes of death with a crude death rate of 1.0 per 100,000 (Peery et al., 2012a). In a five year study of patients with DD, those who underwent surgery for DD had a mortality rate of 17.7% (Elliott et al., 1997).

Etiology and Pathophysiology

Diverticular disease is a term that defines the presence of one or more diverticulum in the colon. The colon is made of multiple layers: mucosa, submucosa, muscularis mucosa, an area of circular muscle, a longitudinal muscle layer, and the serosa. Diverticula occur when the mucosal membrane herniate though the various layers of the colon (Jun & Stollman, 2002; Kang et al., 2004); however, most diverticula are considered “false” in that they do not herniate through all layers of the bowel wall (Heise, 2008). The layer of longitudinal muscle in the colon usually remains and is not penetrated. It is thought that increased intraluminal pressures will cause the herniations at weak points in circular muscle layers where blood vessels pass. Most commonly, they are found in the sigmoid and left-sided colon (Jun & Stollman, 2002); however, many Asian populations demonstrate predominance for diverticula on the right-side, suggesting the possibility of genetics in its development (Heise, 2008). Kang et al. (2004) explains that thickening of the circular muscle and the taenaie coli, a long strip of muscle along the colon, causes narrowing of the lumen, and cites the law of La Place, which states that tension in the wall of a hollow cylinder is proportional to its radius multiplied by the pressure within the cylinder. Intraluminal pressure is, therefore, increased where the lumen is narrowed most, which is in the sigmoid colon (Kang et al., 2004).

Although DD has been well-documented and observed in many patients, its etiology and pathophysiology still remain fairly unknown. Evidence suggests that a combination of dietary fiber deficiency, colonic pressure and motility changes, and structural alterations to the colon may be responsible (Heise, 2008). Much evidence is also apparent that there is a great correlation with the development of DD and age (Mimura, Emanuel, & Kamm, 2002). In histological studies of the aged human gut, decreased nerve density has been found, indicating suspected impaired colorectal motility. In addition, further studies have shown reduced prostaglandin immunoreactivity and smaller individual nerve fibers in the older tissue of subjects with DD (Commane, Arasaradnam, Mills, Mathers, & Bradburn, 2009). In the 1980s, researchers observed increases in elastin deposits within the colonic wall, which causes highly contractile muscle. Collagen may also play a factor in the development of the disease. Collagen present in the submucosa of the colon has been examined in patients with DD. Cross-linking of the collagen causing the tissue to become less soluble in weak acid was determined to increase in patients older than 40 years. Collagen present in other parts of the body, such as skin and heart valves, has also demonstrated an inverse relationship between acid solubility and age. This cross-linking of collagen makes the tissue more rigid (Wess, Eastwood, Wess, Busuttil, & Miller, 1995), and less likely to tolerate the increased pressures (Touzios & Dozios, 2009). Ultimately, the colon becoming shorter and thicker due to the elastin and collagen deposits appears to be the confounding factor that is associated with age and increased risk (Commane et al., 2009).

Arwidsson, Knock, Lehman, and Winberg (1964) first observed increased luminal pressures in patients with DD using a 30 cm sigmoidoscopy, which showed increased segmentation within the colonic wall. It was when Painter and Burkitt (1971) described the disease as one of "Western civilization" and postulated that decreases in dietary fiber intake led to increased colonic segments or "bladders," and would eventually make herniation and development of diverticula highly favorable. Increased luminal pressures also occur when the muscle tissue is attempting to move insufficient fecal bulk, often from low fiber intake, through the colon. With less bulk, the colon must produce stronger contractions to move the bulk through (Aldoori & Ryan-Harshman, 2002; American Dietetic Association, 2008). Colonoscopy examinations extending 55 cm into the colon also observed the presence of higher intraluminal pressures in symptomless patients with DD (Trotman & Misiewicz, 1988).

Changes in gut motility has also been examined closely as a possible contributor to the development of DD. Twenty-four-hour examinations of colonic motility in patients with DD were measured and results showed significant abnormalities in the motor response to eating in patients with DD. Patients were observed to have an excessive state of activity described as "spastic." In addition, prior to meals, colonic motility was higher than controls (Bassotti, Battaglia, Spinozzi, Pelli, & Tonini, 2001). Pathological studies into the cell types and impact on motor function have determined that interstitial cells of Cajal are important in generating the electrical activity and motility in the colon. They act as "pacemaker cells" in controlling the contractions within the colon that facilitate motility. These cells of Cajal are significantly decreased in patients with DD, which might also explain abnormal colonic motility (Bassotti et al., 2005).

Finally, immunological and neural changes are also shown to be present in patients with DD. Increased sensitivity of acetylcholine and upregulation of M3 receptors were found to be present in the musculature of the colon. In addition, a decrease in choline acetyltransferase activity in the circular, smooth muscle layer has been demonstrated in DD when compared to controls. The combination of an increase in sensitivity to acetylcholine, upregulation of M3 receptors, and a decrease in choline acetyltransferase activity led the researchers to suggest that hypersensitivity related to denervation could be taking place (Golder et al., 2003).

Diagnosis

The presence of diverticula allows for the diagnosis of DD; however, there are many people who remain asymptomatic (Shahedi et al., 2013), which is likely the reason that incidence may be underreported (Fearnhead & Mortensen, 2002). It is estimated that only 20% of the population with DD will present with symptoms such as diverticulitis, abscesses, perforation, or bleeding (O'Neill, Ross, McGarry, & Yalamarthi, 2011). There have been changes in the past century that have allowed for diagnosis of DD to be confirmed. Patient history, clinical signs, biochemical analysis, and radiological investigations have all been a part of the diagnosis process in DD (Buckley, Geoghegan, O'Riordain, Lybum, & Torreggiani, 2004). Clinical diagnoses are also used to determine DD within a patient, but it shows a low sensitivity of only 64% when used alone during admission (Laurell et al., 2007). In addition, clinical symptoms for DD can also be present in other gastrointestinal conditions such as irritable bowel syndrome (IBS), ischemic colitis, and inflammatory bowel disease (Kang et al., 2004). Diagnoses were largely found using contrast enemas until the use of CT was introduced (Snyder, 2004).

Since CT was introduced as a method for diagnosing DD, it is now used as the primary diagnostic tool by physicians due to its high sensitivity (Buckley et al., 2004; Snyder, 2004) and relatively quick, non-invasive technique (Lawrimore & Rhea, 2004). CT scanning has reported sensitivity of up to 95% and specificity of 77% (Kang et al., 2004). Kang et al. (2004) describes the normal colon to have thin walls and clear haustrations. When used with oral contract, CT can identify diverticula by the appearance of pockets or "out-pouchings" which may fill with air or contrast dye. Additionally, thickening of the bowel wall greater than 5 mm, pericolic fat streaking, and inflammatory changes are features attributable to complicated DD, such as diverticulitis (Kang et al., 2004). In recent years, magnetic resonance imaging (MRI) has become popular in the use of diagnosing DD. It has similar sensitivities and specificities to CT; however, MRI remains limited in availability and at a higher cost, making it the lesser preferred method of diagnosis between the two (Snyder, 2004).

Patients usually present with clinical symptoms when inflammation and complications of DD occur. In sigmoid diverticulitis, left lower quadrant pain is the most common complaint. Constipation is noted to be present in approximately 43-60% of patients; however, overall changes in bowel habits are noted. Fever is also a clinical symptom seen often in patients with DD (Parra-Blanco, 2006). In a five year study of 163 patients with DD, 95% presented with a change in bowel habit, 75.5% with rectal bleeding, 41.1% with abdominal pain, 6.1% with mucus discharge, 6.7% with abdominal distention, 4.9% with weight loss, and 3% with incontinence (Salem, Molloy, & O'Dwyer, 2007).

Stages of Diverticular Disease

Classification of DD was first examined in the 1970s as a guide to treat perforated DD, and varied from a diagnosis of diverticulitis with the presence of a pericolic abscess, Stage I, to advanced infection or fecal peritonitis, Stage IV (Table 2.1) (Hinchey et al., 1978; O'Neill et al., 2011). A modified version of the Hinchey classification was developed to include advances and changes in symptoms. Stage I was divided into phlegmon, Stage Ia, and pericolic abcess, Stage Ib (Kaiser et al., 2005; O'Neill et al., 2011. Stage II was also divided further into Stage IIa, abscesses amenable to percutaneous drainage, and Stage IIb, complex abscess with or without fistula (Sher et al., 1997; O'Neill et al., 2011). This classification system has been used to guide physicians to appropriate treatment, and can provide prognostic information (O'Neill et al., 2011).

Table 2.1 The Hinchey Classification of Perforated Diverticulitis

Hinchey Stage	Features of disease
I	Diverticulitis with pericolic abscess
II	Diverticulitis with a distant abscess (this may be retroperitoneal or pelvic)
III	Purulent peritonitis
IV	Fecal peritonitis

Source: O'Neill et al., 2011

In addition to the Hinchey classification, a clinical classification was also developed by the European Association for Endoscopic Surgeons (EAES), which divides the disease into three categories of symptomatic or complicated states based on severity of symptoms (Table 2.2, Kohler et al., 1999; O'Neill et al., 2011). In the first grade, patients would present with symptoms such as abdominal pain and fever, and a subjective patient evaluation would be considered. In addition, CT results must present with diverticulitis and further examination via colonoscopy or barium enema is suggested to rule out other conditions. In recurrent symptomatic, uncomplicated disease, grade II, presentation of clinical symptoms continues, at which point, patients may become candidates for surgical intervention. Finally, grade III includes complicated diverticulitis that includes bleeding, perforation, and abscess formation, which require more immediate medical attention. At grade III, physicians may begin to use the Hinchey Classification to direct treatment modalities. The two different methods for classification of disease are widely used; however, neither of the two have been validated (Kohler et al., 1999). Although the EAES classification is available to determine clinical stages of DD, there continues to be no consensus as to the definition of "uncomplicated diverticulitis."

Researchers describe uncomplicated diverticulitis as symptomatic DD with signs of inflammation, but without complications visualized on CT scans (Tursi et al., 2008).

Table 2.2 The European Association for Endoscopic Surgeons Classification System

Grade of disease	Clinical explanation of grade	Clinical state of the patient
I	Symptomatic, uncomplicated disease	Pyrexia, abdominal pain, CT findings consistent with diverticulitis
II	Recurrent symptomatic disease	Recurrence of Grade I
III	Complicated disease	Bleeding, abscess formation, phlegmon, colonic perforation, purulent and fecal peritonitis, structuring, fistula and obstruction

Source: O'Neill et al., 2011

Risk Factors for Diverticular Disease

Demographics

Based on a study published in 1969, a review of over 500 cases demonstrated that 60% of patients with DD were comprised of women (Parks, 1969); however, more recent reviews have determined an equal incidence of DD across both genders (Stollman & Raskin, 2004). A review of patients being admitted for flexible sigmoidoscopy in 1999 showed an overall incidence rate of 14.3% of patients presenting with diverticula, and a male-to-female ratio of 1.2:1. Men were shown to exhibit a higher incidence of bleeding, and women were more likely to present with complications of a colonic stricture or colonic obstruction (McConnell, Tessier, & Wolff, 2003).

Diverticular disease has been found to have great correlation with age. It is estimated that more than 40% of patients over the age of 60, and more than 60% of patients over the age of 80 acquire diverticula (Touzios & Dozois, 2009). The prevalence of diverticulosis in patients aged 80 has also been reported as high at 80% (Peery & Sandler, 2013). The average age of patients being admitted for surgical resection in 1999 was 64 years (McConnell et al., 2003). However, younger (under age 50) patients, particularly male, presenting with DD, have been documented to show more complications, often requiring emergent surgery or intervention. Males younger than 50 years with DD were also more likely to require surgical intervention for fistulas than older patients (McConnell et al., 2003).

Smoking, Caffeine, and Alcohol

In the Health Professionals Follow-Up Study, there was no association between smoking and symptomatic DD; however, it was estimated that the participants who smoked the most would have a 21% greater risk of symptomatic DD than those that never smoked (Aldoori et al., 1995b). Smokers have more than twice the incidence of complications, such as recurrent acute diverticulitis, colonic strictures and a higher rate of perforations (Turunen et al., 2010). Alcohol and caffeine were also examined to identify possible correlations between consumption and incidence or risk of DD in the Health Professionals Follow-Up Study. There was no increased risk of DD in participants who consumed caffeine, regardless of the source. Alcohol did show a somewhat positive association in those consuming spirits; however, when factoring in research bias, the association was considered weak, at best (Aldoori et al., 1995b).

Physicial Inactivity and Obesity

Obesity has become a more prevalent indicator of the severity of DD, particularly in the younger population (Schauer, Ramos, Ghiatas, & Sirinek, 1992). Results from the Health Professionals Follow Up study indicated that higher BMI, higher waist circumference, and high waist-to-hip ratio all increased relative risk for diverticulitis and diverticular bleeding. Participants with a BMI greater than 30 kg/m^2 had a multivariable relative risk of 1.78 and 3.19 for diverticulitis and diverticular bleeding, respectively, when compared to participants with a BMI less than 21 kg/m^2 (Strate et al., 2009).

Although the etiology between obesity and DD is unclear, increased perforations and recurrent episodes of diverticulitis have been seen in participants from the Health Professionals Follow-Up Study with higher BMI. Relative risk also increased significantly as BMI increased in the study. In addition to increased BMI, the study indicated that physical activity, in general, and vigorous activity reduced the risk of symptomatic DD (Aldoori et al., 1995a). In an analysis of patients from the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP), morbid obesity was determined as an independent risk factor for emergency surgery in patients with diverticulitis. According to ACS NSQIP data, morbidly obese patients admitted for surgery for diverticulitis were almost 10 years younger than patients with a normal BMI between 18.5 and 24.9 kg/m^2 (Bailey, Davenport, Proctor, McKenzie, & Vargas, 2013).

The Centers for Disease Control and Prevention (CDC) (2014) reports that more than one third (34.9%) of adults in the United States are obese. In 2013, 41 states had a prevalence of 25% or more and no state had a prevalence of obesity less than 20%

(Figure 2.1). The southern regions had the highest prevalence of obesity, 30.2%, and Mississippi was one of 18 states that had an obesity prevalence of 30% or more. Obesity prevalence was highest in Mississippi and West Virginia (35.1%) and lowest in Colorado (21.3%) (CDC, 2014). Obesity and overweight are determined by one's BMI. An adult with a BMI of 25.0-29.9 kg/m^2 is considered overweight, and an adult that has a BMI of 30 or greater is classified as obese (Table 2.3, National Heart, Lung and Blood Institute [NHLBI], 2000).

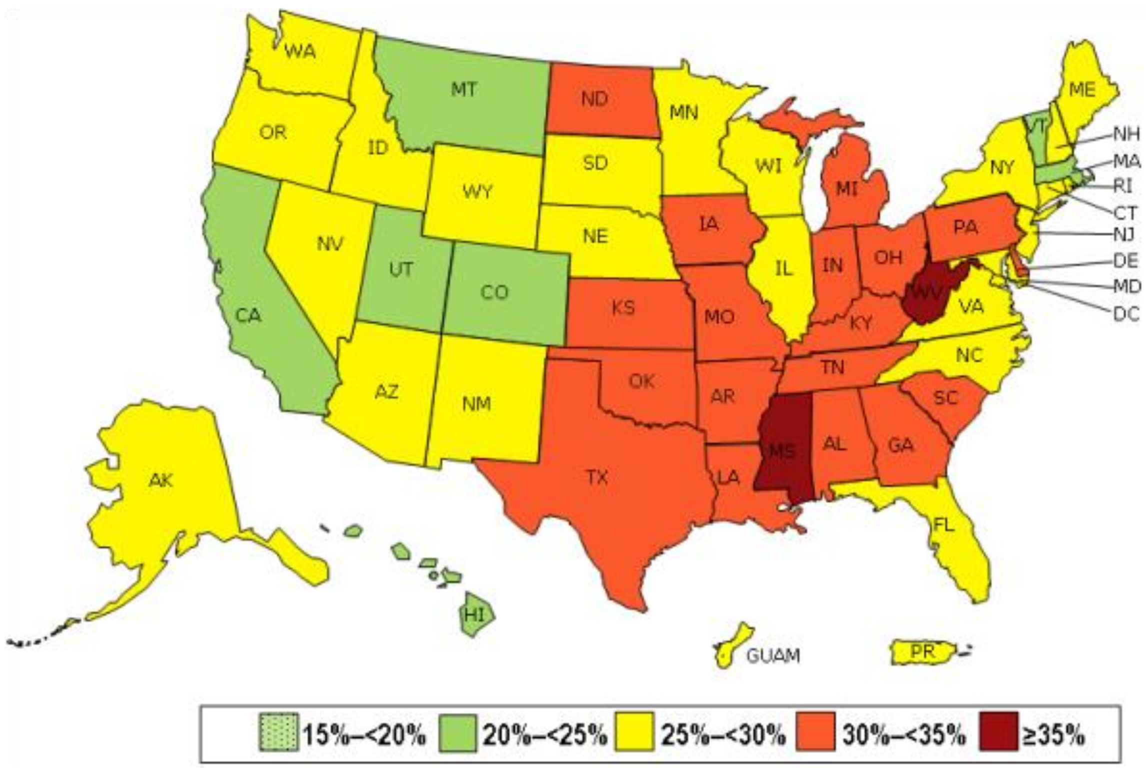

Figure 2.1 Prevalence of Self-Reported Obesity among U.S. Adults by State and Territory, BRFSS, 2013

Source: Behavioral Risk Factor Surveillance System, CDC, 2014

Table 2.3 Body Mass Index Classifications and Associated Ranges

Classification	Body Mass Index
Underweight	< 18.5 kg/m^2
Normal Weight	18.5-24.9 kg/m^2
Overweight	24.9-29.9 kg/m^2
Obesity (Class 1)	30-34.9 kg/m^2
Obesity (Class 2)	35-39.9 kg/m^2
Extreme obesity (Class 3)	>40 kg/m^2

Source: NHLBI, 2000

Constipation and Irritable Bowel Syndrome

Patients with DD may present with diagnoses of other gastrointestinal disorders, some of which might be associated with increased risk of developing DD. In particular, population-based studies have shown that subjects with IBS are at increased odds of developing colonic diverticulosis, suggesting a positive correlation between the two (Jung et al., 2010). However, more recent analysis has suggested that symptomatic, uncomplicated DD may be diagnosed in patients with IBS who have diverticula found incidentally during colonoscopy (Peery & Sandler, 2013).

In research examining colonic transit times, it has been shown that patients with DD have higher intraluminal pressures, in contrast to those with IBS, who have lower intraluminal pressures. However, when comparing the intraluminal pressures in patients with IBS and DD, studies have reported conflicting results, and one review of the symptoms related to DD suggests that because both conditions are common, coincidental occurrence is likely (Simpson, Scholefield, & Spiller, 2003).

In addition to IBS, constipation has been considered another confounding factor related to the development of DD. Constipation and DD have both exhibited longer transit times (Kirwan & Smith, 1977), but it is thought that constipation may be more likely a symptom or complication of DD rather than part of its etiology (Eastwood, Smith, Brydon, & Pritchard, 1978). Constipation is more prevalent in patients with diverticulitis than uncomplicated DD (Tursi et al, 2008); however, many times this can be in conjunction with other common gastrointestinal conditions such as IBS or colitis (Salem et al., 2007).

Nonsteroidal Anti-inflammatory Drugs

Considering that few patients develop complications related to the DD, evidence of what leads to symptomatic disease is important. Nonsteroidal anti-inflammatory drugs (NSAIDs) are not shown to increase the risk of developing DD, but have been suggested to increase the risk of bleeding and perforation in those already presenting with DD. A prospective analysis of the Health Professionals Follow-Up Study examined the acetaminophen, NSAIDs, aspirin, and steroid use of 35,615 men (Aldoori, Giovannucci, Rimm, Wing, & Willett, 1998a). The age-adjusted relative risk for the development of symptomatic diverticular disease in regular NSAID users (2 or more times per week) was 1.52, which demonstrated an increased risk over non-users. Regular NSAID users showed increased risk for abdominal pain, change in bowel habits, and bleeding (Aldoori et al., 1998a). This research was supported by additional case-control studies showing increases in perforation and/or peritonitis (Morris et al., 2003; Wilson, Smith, & MacIntyre, 1990).

Dietary Fiber

Painter and Burkitt (1971) hypothesized that DD developed as a result of a diet low in fiber, and called it “a disease of Western civilization.” The low fiber diet is thought to increase luminal pressure causing the formation of the diverticula. This was suggested by Painter and Burkitt (1971) after review of necropsy studies in patients of rural Africa. More developed countries in North America and Europe showed a high incidence rate, where there were virtually no cases to be observed in African populations. These researchers observed very little incidence of the disease prior to 1900, and believed reduced dietary fiber from refined grains in industrialized countries may be the likely cause of the rise in cases (Painter & Burkitt, 1971). Further research showed positive results with unprocessed bran and its therapeutic use in treatment of DD. A majority of patients in the case-control study found symptom relief from varying ranges of unprocessed bran and dietary fiber (Painter, Almeida, & Colebourne, 1972).

Since these studies were first published, the methodology has been called into question; and some studies cite the findings of Painter and Burkitt (1971) to be weak (Commane et al., 2009). A double-blind controlled trial was conducted using fiber supplementation in 58 patients with DD. Aside from relief of constipation, no significant improvements or changes were shown among the placebo and treatment groups. Much speculation has arisen regarding the role of dietary fiber in the development or prevention of DD (Ornstein et al., 1981). Further, Peery et al. (2012b) published new evidence obtained from 2104 participants from the Diet and Health Studies suggesting that a high fiber diet was associated with an increased risk of diverticulosis, rather than a decreased risk, as previously thought. The study used colonoscopy results of patients from 1998 to 2010 (Peery et al., 2012b). Predominating data, however, continue to show the benefit of a high fiber diet in the prevention of DD. Using data from over 47,000 men and women in the EPIC-Oxford Study in Great Britain, those who consumed the highest amount of fiber (greater than 25.5 gm/day for women and less than 26.1 gm/day for men) were at a 41% lower risk of DD compared with those in the lowest quintile of less than 14 gm/day for both women and men (Crowe et al., 2011).

In a prospective case-control study using the Health Professionals Follow-up Study, results showed an increased risk of developing DD in patients with the lowest dietary fiber intakes. Adjusted for age and total energy intake, participants with the highest total dietary fiber, crude fiber, vegetable fiber, and fruit fiber were significantly less likely to develop DD that those with the lowest intakes of all types of fiber. However, there was no statistical significance among participants consuming cereal fibers (Aldoori et al., 1994). Further investigations into varying types of fibers were also conducted in the cohort from the Health Professionals Follow-Up Study. Insoluble fibers were the most protective against development of DD; in particular, cellulose demonstrated the lowest multivariate relative risk of 0.57 when compared to hemicelluloses and lignin at 1.26 and 0.80, respectively (Aldoori et al., 1998b). Earlier case-control studies used bran compared to other substances such as ispaghula and lactulose to determine appropriate treatment. Bran in amounts of 20 gm/day was shown to significantly reduce overall transit time (Eastwood et al., 1978), and lower intraluminal pressures (Findlay, Mitchell, Smith, Anderson, & Eastwood, 1974).

The amount of dietary fiber needed to provide a protective benefit against the onset of DD remains uncertain. The American Dietetic Association (2008) has observed limited evidence to support the use of whole foods and dietary fiber supplements in their protection or improvement of gastrointestinal disorders, citing lack of data. The 2010 Dietary Guidelines for Americans from the United States Department of Agriculture

(USDA) and the United States Department of Health and Human Services (USDHHS) recommends obtaining dietary fiber from a variety of plant foods (USDA & USDHHS, 2010). The Dietary Reference Intakes recommends 14 gm of dietary fiber per 1,000 kcal consumed per day or 25 grams for adult women and 38 grams for adult men for cardiovascular protection (Institute of Medicine of the National Academies, 2005). It is estimated that Americans only receive about 15 gm of dietary fiber on average per day (American Dietetic Association, 2008; USDA & USDHHS, 2010).

Nuts, Seeds, Corn, and Popcorn

It has previously been advised by physicians that once diverticula developed within the colon, they could become obstructed or lead to trauma with intake of high-residue foods such as nuts, seeds, corn, and popcorn, thus these foods should be avoided (Strate et al., 2008). Using the 47,228 men from the Health Professionals Follow-Up Study, nut, corn, and popcorn consumption and rate of diverticulitis and diverticular bleeding were examined. There was no increased risk of DD or diverticular complications shown with consumptions of nuts, corn, or popcorn (Strate et al., 2008). Literature from the American Dietetic Association also reported no scientific evidence suggesting that undigested particles such as nuts, corn, seeds, or popcorn should be avoided (Marcason, 2008).

Right-Sided Diverticular Disease

Right-sided DD has been found in mostly Eastern countries, as opposed to the more common left-sided condition found in Western populations. Diagnosis of right-sided DD has proven difficult as the clinical symptoms appear similar to those of acute appendicitis; however, radiologic evaluations, such as CT, have made identification and diagnosis of right-sided DD much easier. In studies of right-sided DD, treatment remains to be more conservative in more mild or uncomplicated cases. However, evidence shows that risk factors for the recurrence of diverticulitis in right-sided cases differ from left-sided cases. The presence of multiple diverticula in the ascending colon or caecum has shown to increase the risk of recurrent diverticulitis (Park, Kim, Lee, Kim, & Lee 2014). In recent studies of Korean populations, right-sided diverticulosis was seen in younger populations, with older patients presenting with left-sided DD (Kim et al., 2013). Japan has also seen an increase in left-sided DD, citing more Western influences in their diet. Obesity was measured in Japanese patients with both left- and right-sided DD, and while only 22.8% of patients within the study presented with left-sided DD, there were positive correlations between obesity, visceral obesity, and increased age with an increased risk of left-sided DD (Yamada et al., 2013).

Erythrocyte Sedimentation Rate

The erythrocyte sedimentation rate is a common laboratory indicator for the diagnosis of inflammatory processes in adults. Historically, the Westergren method has been used to determine the range for the appropriate erythrocyte sedimentation rate for adults; however, many facilities utilize their own ranges for normal values. The upper limit for a normal erythrocyte sedimentation rate usually does not exceed 30 mm/hr in reference ranges. Elevations in the erythrocyte sedimentation rate often denotes an inflammatory condition or infection (Brigden, 1999). Elevated erythrocyte sedimentation rates above 60 mm have been associated with poor prognosis in acute inflammatory responses such as rheumatoid arthritis, acute infection, and malignancies (Ford et al., 1979).

As the most common clinical complication of DD, diverticulitis is characterized by acute inflammation of the mucosal tissue around the diverticula. Increases in inflammatory indices, such as erythrocyte sedimentation rate, have been increasingly popular in determining the diagnosis of diverticulitis. Elevated erythrocyte sedimentation rates are seen in patients presenting with both complicated and uncomplicated diverticulitis, with higher values seen in those with complicated disease (Tursi et al., 2008). Over 57% of patients with acute uncomplicated diverticulitis were demonstrated to have elevations in erythrocyte sedimentation rate and was significantly associated with histologic damage on CT scans (Tursi et al., 2008). Although using clinical parameters, including erythrocyte sedimentation rate, is discouraged in determining a diagnosis of diverticulitis, high specificities of 97% (Laurell et al., 2007) and 98% have been observed (Toorenvliet, Bakker, Breslau, Merkus, & Hamming, 2010).

Hospital Readmission Rates

Readmission rates within 30 days have begun to be an important indicator of quality among hospitals since the CMS began publicly reporting hospital readmission rates in 2009. At first, CMS began reporting 30-day readmission and mortality rates on patients with acute myocardial infarctions, heart failure, and pneumonia. CMS reports have now expanded to include all unplanned 30-day readmissions (Figure 2.2). Through the Hospital Readmission Reduction Program implemented in 2012, hospitals with higher-than-average readmission rates for certain diagnoses would be penalized up to 1% of Medicare reimbursement for claims from July 2008 to June 2011. Now in its third year, some hospitals are penalized up to 3% for excess readmissions (CMS, 2014). Jencks et al. (2009) shed light on the prominence of readmission rates among Medicare patients and the estimated cost to CMS sparked discussion in health care reform. Approximately 19.6% of Medicare patients were being readmitted, costing CMS over $17 billion annually (Jencks et al., 2009). The Healthcare Cost and Utilization Project (HCUP) reported that 2011 saw an estimated $41.3 billion in cost to hospitals for all-cause 30-day hospital readmissions (Hines et al., 2014). Since the implementation of the Hospital Readmission Reduction Program, the policy's effectiveness in improving overall quality and safety has been called into question due to its narrow focus. A number of factors have been determined to lead to readmission, some of which are difficult for hospitals to change, or even out of hospital control (Joynt & Jha, 2012).

During its initial year in 2012, hospital readmission rates were noted to decrease nationally from an average of 19% from 2007-2011 to 18.4% in 2012. Many hospital referral regions in the United States reported a decrease in readmission rates in the 2011-2012 fiscal year, with only few increases noted (Figure 2.3, Gerhardt et al., 2013). Kaiser Health News reported nearly 18% of Medicare patients who had been hospitalized in 2013 were readmitted within one month (Rau, 2014). While this estimate is lower than past years, roughly two million patients continue to return every year, costing CMS $26 billion annually. Under the new fines, three-quarters of hospitals that are subject to the Hospital Readmissions Reduction Program are being penalized. Over the course of the year, the fines will total about $428 million (Rau, 2014). CMS reported that 56% of Mississippi hospitals were penalized an average of 0.7% for readmission in the 2013-2014 fiscal year (Kaiser Health News, 2014).

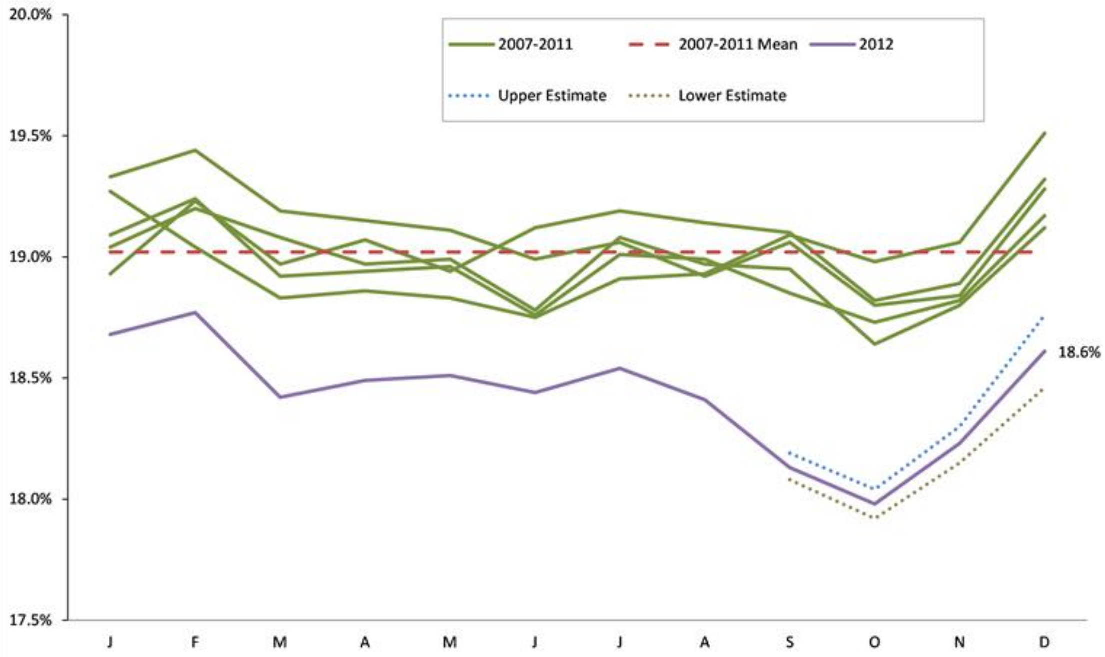

Figure 2.2 30-Day Hospital Readmission rates in the United States, 2007 – 2012

Source: Gerhardt et al., 2013

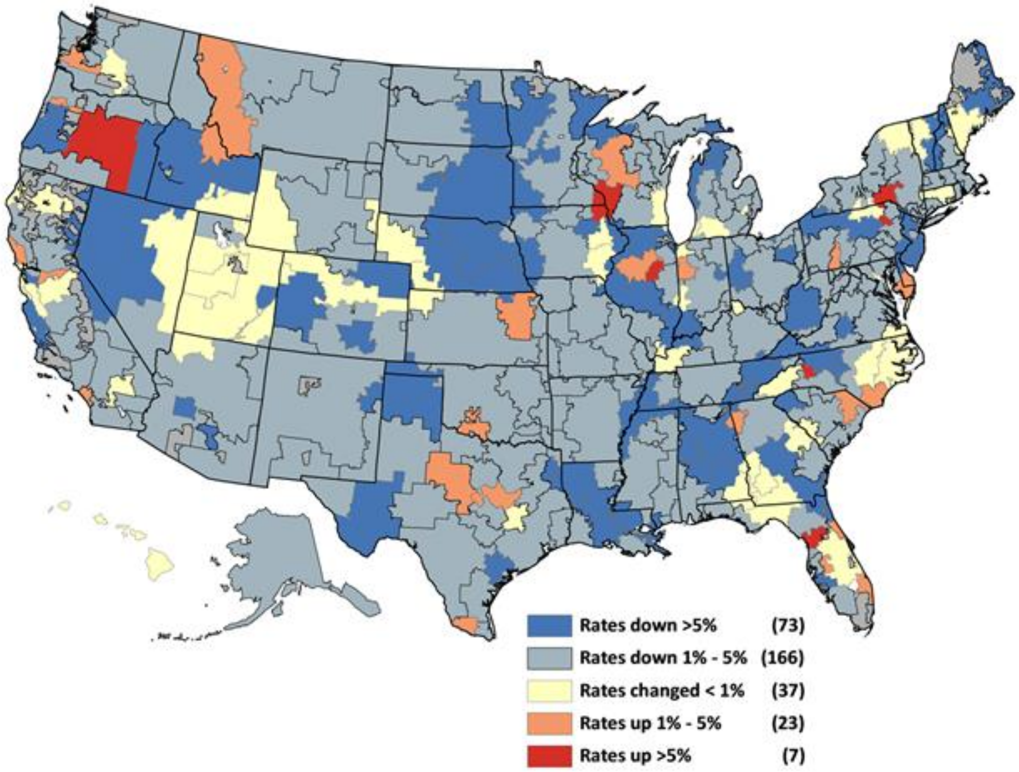

Figure 2.3 Changes in Readmission Rates by Hospital Referral Region, 2011-2012
Source: Gerhardt et al., 2013

Readmission among Patients with Diverticular Disease

Estimates for the readmission to hospitals for DD have shown to be similar across several studies. In a five-year audit of admissions for DD, there was a 30% chance of readmission with a complication of DD. The median interval between first and second admissions for acute diverticulitis and acute hemorrhaging were 18 and 15 months, respectively (Elliott et al., 1997). A readmission rate of 35.3% over six years was observed in a cohort of 445 Danish patients originally admitted with DD from 1989-1995 (Moreno & Wille-Jergensen, 2007). A smaller cohort of 72 hospitalized patients with diverticular bleeding who were admitted from 2004 to 2008 was assessed for recurrence of bleeding. At a median interval of 1535 days, 38% of patients showed recurrence of bleeding. Incidence of recurrent bleeding at two years was 33% (Niikura et al., 2012). Estimates of readmission rates in the United Kingdom have been higher than those seen elsewhere. Between 1996 and 2006, HES data revealed a 28-day readmission rate of 9.6% (Jeyarajah et al., 2009). In a review of studies examining outcomes of treatment options, readmission rates varied widely among the study populations. However, in most of the studies, patients who were treated conservatively (without surgery) were more likely to be readmitted to the hospital that those treated with surgery, 18.6% and 6.1%, respectively. Readmission rates for patients treated conservatively were as high as 55% in the studies that were reviewed (Peppas, Bliziotis, Oikonomaki, & Falagas, 2007).

Patients with complicated DD sometimes undergo surgery or colonic resection. In a recent report, patients undergoing colorectal resection between 2008 and 2012 for gastrointestinal conditions, including DD, were assessed to determine predictors for readmission (Damle et al., 2014). Fifty percent of patients were readmitted within seven days following discharge for colon resection, and these patients were more likely to undergo another surgery, be admitted to the ICU, and have a longer length of stay during the readmission. Total cost to the hospital for patients readmitted within 30 days was more than twice as high when compared to patients not readmitted, $26,917 and $13,817 respectively, leading researchers to suggest more targeted interventions to reduce readmissions and financial burden to hospitals (Damle et al., 2014).

Diverticular disease continues to be highly correlated with age in multiple epidemiological studies. In a study using HES data from the United Kingdom, multivariate regression models adjusting for age, gender, ethnicity, Charlson index score, category of admission, and surgical patients determined that those readmitted within 28 days of discharge for DD were statistically more likely in patients that were over 80 years old. However patients under 50 years of age were more likely to be readmitted one year following initial admission than older age groups (Jeyarajah et al., 2009).

Increases in the number of co-morbidities have also been shown to increase the risk of readmission for patients with DD. The Charlson index is a tool used to determine the degree of comorbidity in study populations (Charlson, Pompei, Ales, & MacKenzie, 1987), and has been used in readmission studies. In the HES study from the United Kingdom, an increasing Charlson index score of up to six was positively and significantly related to 28-day readmission and 1-year readmission (Jeyarajah et al., 2009).

CHAPTER III

METHODOLOGY

Purpose

The primary objective of this study was to examine the effect of high fiber diet education on the prevention of hospital readmission for patients admitted to North Mississippi Medical Center-Eupora with a primary or secondary diagnosis of DD. Sex, age in years, race, and BMI were all collected as these characteristics have been examined as potential risk factors for incidence of DD. The secondary objective of the study was to investigate the ability of age, sex, race, BMI, erythrocyte sedimentation rate, and high fiber diet education to predict readmission among patients hospitalized for DD.

Research Questions

The following research questions were investigated: (1) Will there be a difference in the incidence of hospital readmission among patients admitted with a primary or secondary diagnosis of DD who received high fiber diet education and those who did not? (2) Will there be a difference in the incidence of readmission among patients who identify as current or previous smokers and those who do not? (3) Will there be a difference in the incidence of readmission among patients who identify as consuming alcohol and those who do not? (4) Will there be a difference in the incidence of readmission among patients who identify as consuming caffeine and those who do not?

(5) Will there be differences in age, sex, race, BMI, and erythrocyte sedimentation rate between participants who are readmitted and those who are not? (6) Can age, sex, race, BMI, erythrocyte sedimentation rate, and high fiber diet education predict the likelihood of hospital readmission among patients admitted with a primary or secondary diagnosis of DD?

Participants

The participants for this study consisted of inpatients at North Mississippi Medical Center-Eupora who were admitted with a primary or secondary diagnosis of DD between the years 2012 and 2014 according to their ICD-9 code. The medical center began using electronic medical charts for documentation in April of 2012. Prior to implementation of the electronic medical chart program, education given to patients was documented and stored in paper format. This study period provides consistent documentation of high fiber diet education for the participants. Participants who received high fiber diet education were instructed by a registered dietitian prior to discharge from acute care. North Mississippi Medical Center-Eupora is located in the rural town of Eupora, Mississippi.

Institutional Review Board

Project approval was obtained prior to starting this study from the Institutional Review Board (IRB) through the Mississippi State Regulatory Compliance Office, Mississippi State University (Appendix A), and the IRB through North Mississippi Health Services located in Tupelo, Mississippi (Appendix B). All data collection occurred at North Mississippi Medical Center-Eupora in Eupora, Mississippi. Approval and permission for the study to be conducted at North Mississippi Medical Center-Eupora was obtained from the hospital's IRB and the Chief Executive Officer (Appendix C) and was contingent on approval obtained from the university's IRB. All ethical and HIPAA guidelines pertaining to the use of healthcare information were adhered to in this study.

Procedure

This study focused exclusively on participants who were inpatients and admitted with a primary or secondary diagnosis of DD. Patients admitted to North Mississippi Medical Center-Eupora with a primary or secondary diagnosis of DD receive diet education counseling upon physician consult or referral to a dietitian. All instructional education sessions include written client education materials for high fiber medical nutrition therapy provided from the National Institute of Diabetes, Digestive, and Kidney Diseases (2013).

The staff that provided diet instruction consisted of two registered dietitians. All education sessions were conducted individually in the patient's hospital room with or without family members and/or a caregiver present. Education materials were developed by the National Institute of Diabetes, Digestive, and Kidney Diseases (2013) and included an overview of the disease, symptoms of the disease, dietary fiber recommendations, and a list of common foods consisting of fiber and their fiber content per serving. The registered dietitian introduces the patient to the disease, if unfamiliar, and proceeds to discuss symptoms and suspected causes of the disease, including insufficient dietary fiber intake. A high fiber diet is recommended upon discharge to prevent further complications of DD. Specifically, foods and food groups known to have higher fiber content are identified and patients are advised to increase consumption of these foods. Patients are instructed that nuts, seeds, and popcorn are not associated with increased risk of disease, and that avoiding these foods is unnecessary. Increased fruit, vegetables, and whole grain consumption is encouraged, and specific strategies for increasing dietary fiber are discussed with each patient based on food preferences and lifestyle. Written materials used during education sessions and the dietitian's contact information are left with patients, family members, or caregivers to take home upon discharge. A summary of the patient's education, including materials given, location, type of education given, and patient's response is then documented in the electronic medical record by the dietitian who completed the instruction.

Data Collection

Height, weight, sex, race, age in years, BMI, CT results, erythrocyte sedimentation rate, documentation of high fiber diet education, smoking, alcohol, and caffeine use, and if the patient was readmitted into the hospital, were entered into a Microsoft Excel spreadsheet for analysis using information in the patients' electronic medical records. No personal information or identifiers were used or recorded. Patients were selected for this study if they had a primary or secondary diagnosis of DD during hospitalization. The BMI of each patient was calculated using the following equation: BMI = kg/m^2. Serum erythrocyte sedimentation rate was analyzed in the facility's laboratory and recorded in each patient's medical record during the hospitalization. The first recorded serum erythrocyte sedimentation rate, if any, was recorded for the purpose of this study as laboratory values are not consistently collected and analyzed on the same day during the patient's course of treatment. Computerized tomography scans of the abdomen/pelvis areas were taken for each patient for diagnostic and treatment purposes.

The radiologist interprets the images and submits a report in the patient's electronic medical record. The reports were reviewed for evidence of DD.

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software, version 22 (SPSS, Inc., Chicago, IL). Descriptive statistics summarized demographic, social, and laboratory values. Chi-square tests were performed to test for significant relationships between high fiber diet education and incidence of readmission among patients with DD. Correlation coefficients were used to investigate relationships between continuous variables. Independent samples t-tests were conducted to compare differences between those who were readmitted and those not readmitted. A control group, patients admitted with a primary or secondary diagnosis of DD and did not receive high fiber diet education, was available. Logistic regression was performed with the dichotomous categorical dependent variable of (0) not being readmitted and (1) being readmitted to the hospital following discharge for treatment of DD, and the independent variables of high fiber diet education, sex, age, race, BMI, and sedimentation rate. All available data were used for analysis. Categorical variables are reported as frequencies and continuous variables are reported as means ± standard deviations (SD). Significance was set at $P < 0.05$.

CHAPTER IV

RESULTS AND DISCUSSION

Abstract

With hospital admission rates for diverticular disease (DD) on the rise in the last 25 years, it has become an increasing burden on healthcare cost and resources. Although the pathogenesis of DD continues to be poorly understood, it is hypothesized that a diet low in fiber, commonly found in Westernized diets, increases the risk. High fiber diets have been a part of the recommended therapy for patients to reduce symptoms and complications of DD. Analysis of the effect of high fiber diet education on hospital readmission at 30 days post discharge of patients (N = 68) with a diagnosis of diverticulitis was conducted. In addition, other variables were examined such as age, sex, race, and body mass index (BMI). Chi-square analysis determined that high fiber diet education was not associated with hospital readmittance ($\chi^2 = 0.567$, P = 0.452). However, t-tests determined that men were more likely to be readmitted than women (P = 0.029). A higher BMI was also observed in the group of patients who were readmitted compared to those not readmitted, BMI of 35.8 ± 15.5 standard deviation (SD) and 27.4 ± 6.4 SD, respectively (P = 0.006). Other variables not associated with higher incidence of readmittance for DD were use of tobacco, alcohol, or caffeine, and sedimentation rate and computerized tomography results. Logistic regression determined that higher BMI and being male were the only significant predictors of readmission for DD in this study.

While high fiber diet education was not associated with readmission, males and patients with a higher BMI were significantly associated with readmission. Further research into the association between obesity and symptomatic DD disease may be recommended to help uncover its etiology.

Introduction

Diverticular disease (DD) has become an increasing burden to healthcare costs and resources with admission rates on the rise in the last 25 years (Talabani, Lydersen, Endreseth, & Edna, 2014). Diverticular disease was responsible for approximately 313,000 hospital stays and over $2.5 billion in health care costs in the United States in 2004 (Milenkovic, Russo, & Elixhauser, 2006). In 2009, over 2.5 million people were seen in outpatient clinics for DD, with diverticulitis listed as one of the top discharge diagnoses from hospitals, with a cost to hospitals of $2.7 billion (Peery et al., 2012a). Cost analysis from a United Kingdom hospital showed significant burden to hospital and facility resources as a result of DD, with 70% of the total cost attributed to bed-day expenses (Papagrigoriadis, Debrah, Koreli, & Husain, 2004). The prevalence of DD is noted to be highest in elderly populations, with approximately two-thirds of persons aged 80 years or older estimated to have DD (Aldoori & Ryan-Harshman, 2002). While most prevalent in the elderly, studies have identified a growing incidence of DD in patients younger than 45 years (Etzioni, Cannom, Ault, Beart, & Kaiser, 2009; Nguyen, Sam, & Anand, 2011).

In addition to increases in overall prevalence and hospitalizations for DD, increases in readmission rates have been identified, furthering the burden of disease. Hospital readmission rates for patients treated for DD were reported as high with rates of

30% (Elliot, Yego, & Irvin, 1997) to 35.3% (Moreno & Wille-Jergensen, 2007). Hospital readmissions within 30 days of discharge from a hospital for treatment of DD are also being noted. Approximately 9.6% of patients treated for DD were readmitted within 30 days (Jeyarajah et al., 2009), and total costs to hospitals for patients readmitted within 30 days were more than twice as high when compared to patients not readmitted (Damle et al., 2014).

Readmission rates within 30 days are now recognized as an important indicator of quality among hospitals since the Centers for Medicare and Medicaid Services (CMS) began publicly reporting hospital readmission rates in 2009. At first, CMS began reporting 30-day readmission and mortality rates on patients with acute myocardial infarctions, heart failure, and pneumonia. CMS reports have now expanded to include all unplanned 30-day readmissions. Through the Hospital Readmission Reduction Program, implemented in 2012, hospitals with higher-than-average readmission rates for certain diagnoses would be penalized up to 1% of Medicare reimbursement for claims from July 2008 to June 2011. Now in its third year, some hospitals are penalized up to 3% for excess readmissions (CMS, 2014). A report by Jencks, Williams, and Coleman (2009) sheds light on the prominence of readmission rates among Medicare patients, and the estimated cost to CMS sparked discussion in health care reform. Approximately 19.6% of Medicare patients were being readmitted, costing CMS over 17 billion dollars annually (Jencks et al., 2009). The Healthcare Cost and Utilization Project (HCUP) reported that 2011 saw an estimated 41.3 billion dollars in cost to hospitals for all-cause 30-day hospital readmissions (Hines, Barrett, Jiang, & Steiner, 2014). Since the implementation of the Hospital Readmission Reduction Program, the policy's effectiveness in improving overall quality and safety has been called into question due to its narrow focus. A number of factors have been determined to cause readmission, some of which are difficult for hospitals to change, or even out of hospital control (Joynt & Jha, 2012).

Diverticular disease is a term that defines the presence of one or more diverticulum in the colon. Diverticula develop when the mucosal membranes of the colon herniate though the various layers of the colon (Jun & Stollman, 2002; Kang, Melvin, & Maxwell, 2004). Diverticular disease is mostly present in the sigmoid region of the colon (Jun & Stollman, 2002); however, it is found on the right side of the colon in most Asian populations, giving rise to a possible genetic etiology (Heise, 2008). Although the etiology is still fairly unknown, most epidemiological research suggests a combination of fiber deficiency, colonic pressure and motility changes, and structural alterations to the colon may be responsible (Heise, 2008). While it is reported that only 10-25% of patients with DD present with symptoms (Shahedi et al., 2013), patients with DD experiencing symptoms most commonly complain of fever, left lower quadrant pain, and changes in bowel habits (Parra-Blanco, 2006). A clinical diagnosis of DD has a low specificity, and clinical symptoms of DD are also found in other gastrointestinal disorders (Laurell, Hansson, & Gunnarsson, 2007). Physicians now rely on computerized tomography (CT) as the primary diagnostic tool to identify DD in patients (Kang et al., 2004). Low dietary fiber intake was first hypothesized as an etiology for the disease in 1971 when Painter and Burkitt (1971) identified a high prevalence of DD in industrialized nations compared to rural African populations. Calling it “a disease of Western civilization,” Painter and Burkitt (1971) noted a low incidence of disease prior to 1900 and cite the consumption of a low fiber diet through refined grains as a possible factor to the disease’s development.

Since this initial hypothesis, large cohorts have been conducted to identify the relationship, with a lower risk of developing DD in those who consume high fiber diets (Aldoori et al., 1994; Crowe et al., 2011). The Health Professionals Follow-Up Study, which began in 1986, garnered insight into other possible associations and the development of DD. Obesity was noted to increase the risk of developing DD (Strate et al., 2009), as well as increasing the risk of recurrent complications (Aldoori et al., 1995a). Smokers in the Health Professionals Study also showed an increase in risk for the development of complications related to DD (Aldoori et al., 1995b).

The present study evaluated the effect of inpatient high fiber diet education instruction provided by clinical dietitians at North Mississippi Medical Center in Eupora, Mississippi, on the incidence of readmission among patients admitted with a primary or secondary diagnosis of diverticulitis or DD. The purpose of this study was to investigate the effect of high fiber diet education in the prevention of hospital readmission among patients hospitalized for DD. The primary objective of this retrospective study was to identify differences between the prevalence of readmission post discharge when patients admitted with DD are instructed to consume a high fiber diet for prevention and those who are not instructed. A secondary objective was to investigate the ability of age, sex, ethnicity, BMI level, serum erythrocyte sedimentation rate, and high fiber diet instruction to predict readmission among patients hospitalized for DD.

Methods

Participants and Institutional Review Board Approval

Participants consisted of those admitted with a primary or secondary diagnosis of diverticulitis or DD. All participants were identified within 24 hours of admission through the nutrition screening process initiated by nursing staff. Those who received high fiber diet education were instructed by a licensed, registered dietitian at a northeast Mississippi community hospital. Approval and permission for this study was obtained from the hospital's Institutional Review Board (IRB) and the Chief Executive Officer and was contingent on approval obtained from the university's IRB prior to beginning the study. All ethical and HIPAA guidelines pertaining to the use of healthcare information were adhered to in this study.

Procedure

High fiber diet education was conducted with patients who were admitted to the hospital with a primary or secondary diagnosis of DD or diverticulitis. These patients received nutrition education and counseling on a dietary fiber intake of at least 25 gm/day. All sessions included written client educational materials for high fiber medical nutrition therapy provided by the National Institute of Diabetes, Digestive, and Kidney Diseases (2013). High fiber diet education was administered by one of two full-time registered dietitians employed by the hospital. All education sessions were conducted individually in the patient's hospital room with or without a family member and/or caretaker present. Education materials were developed by the National Institute of Diabetes, Digestive, and Kidney Diseases (2013) and included an overview of the disease, symptoms of the disease, dietary fiber recommendations, and a list of common foods consisting of fiber and their fiber content per serving. The registered dietitian introduced the patient to the disease, if unfamiliar, and proceeded to discuss symptoms and suspected causes of the disease, including insufficient dietary fiber intake. A high fiber diet is recommended upon discharge to prevent further complications of DD.

Specifically, foods and food groups known to have higher fiber content were identified and patients were advised to increase consumption of these foods. Patients are instructed that nuts, seeds, and popcorn are not associated with increased risk of disease, and that avoiding these foods is unnecessary. Increased fruit, vegetables, and whole grain consumption is encouraged, and specific strategies for increasing dietary fiber are discussed with each patient based on food preferences and lifestyle. Written materials used during education sessions and the dietitian's contact information are left with patients, family members, or caregivers to take home upon discharge. A summary of the patient's education, including materials given, location, type of education given, and the patient's response is then documented in the electronic medical record by the dietitian who completed the instruction.

Research Questions

The purpose of the study was to investigate the following research questions: (1) Will there be a difference in the incidence of hospital readmission among patients admitted with a primary or secondary diagnosis of DD who received high fiber diet education and those who did not? (2) Will there be a difference in the incidence of readmission among patients who identify as current or previous smokers and those who do not? (3) Will there be a difference in the incidence of readmission among patients who identify as consuming alcohol and those who do not? (4) Will there be a difference in the incidence of readmission among patients who identify as consuming caffeine and those who do not? (5) Will there be differences in age, sex, race, BMI, and erythrocyte sedimentation rate between participants who were readmitted and those who were not? (6) Can age, sex, BMI, race, erythrocyte sedimentation rate, or high fiber diet education predict the likelihood of hospital readmission among patients admitted with a primary or secondary diagnosis of DD?

Statistical Analysis

Data were analyzed using the Statistical Package for Social Sciences (SPSS) software, version 22 (SPSS, Inc., Chicago, IL). Descriptive statistics were used to summarize demographic, social, and laboratory values of participants. Chi-square tests were performed to test for significant relationships between high fiber diet education and incidence of readmission among patients with DD. Correlation coefficients were used to investigate relationships between continuous variables. Independent t-tests were conducted to compare differences between those who were readmitted and those not readmitted. Logistic regression was performed with the dichotomous categorical dependent variable of (0) not being readmitted and (1) being readmitted to the hospital within 30 days post discharge, and also over the study period, and the independent variables of high fiber diet education, sex, age, race, and BMI. All available data were used for analysis. A control group, patients admitted with a primary or secondary diagnosis of DD and did not receive high fiber diet education, was available. Categorical variables are reported as frequencies and continuous variables are reported as means ± standard deviations (SD). Significance was set at $P < 0.05$.

Results

The study included 68 participants (54 females, 14 males) with a mean age of 70.2 ± 13.7 years (range = 42 to 94 years old). Over half of the participants were 65 years or older (n = 47) with six aged 90 to 94 years. Participants were mostly Caucasian (n =

60) and the remainder were African-American/Black (n = 8). The mean weight of the participants was 79.9 ± 24.4 kilograms. Forty-two participants had an erythrocyte sedimentation rate available during their hospital stay. The mean erythrocyte sedimentation rate was 33.4 ± 25.6 mm/hr and the values ranged from 0 mm/hr (n = 1) to 104 mm/hr (n = 1) with 18 patients exceeding 30 mm/hr. The characteristics of the participants including alcohol, tobacco, and caffeine use are shown in Table 4.1. Only 25 (36.7%) patients in the study had diverticulitis confirmed via CT. For the remaining patients, 14 had a confirmed visualization of diverticulosis on CT, while the final 29 did not have visualization of diverticula noted on CT analysis.

The mean BMI was noted to be 28.4 ± 8.3 kg/m^2, which according to the Clinical Guidelines on the Identification, Evaluation, and Treatment of Overweight and Obesity in Adults indicates overweight (NHLBI, 2000). The range of BMI's was 15.0 to 73.3 kg/m^2 and five participants were considered underweight, 17 had normal BMI values, 23 were classified as overweight, and the remaining 23 were considered obese. There were two participants who were classified as Obese, Class III with BMIs of 51.9 and 73.3 (Table 4.2).

Table 4.1 Characteristics of Participants

Characteristic	Participants (N = 68)
Age (yrs)	70.1 ± 13.4 (42-94)[a]
Height (cm)	167.4 ± 8.6 (152.4-193.0)
Weight (kg)	79.9 ± 24.4 (43.6-202.0)
BMI[b] (kg/m^2)	28.4 ± 8.3 (15-73.3)
Erythrocyte Sedimentation Rate (mm/hr) (n = 45)	33.4 ± 25.6 (0-104)
Sex	14 men 54 women
Race	8 African Americans 60 Caucasians
Alcohol use	14 yes 54 no
Tobacco use	11 yes 57 no
Caffeine use	47 yes 21 no

[a]Mean ± standard deviation (range)
[b]Body mass index

Table 4.2 Body Mass Index Classification of Participants

BMI[a] Category	Men		Women	
	Caucasian	African American	Caucasian	African American
Underweight (Less than 18.5)	1	0	4	0
Normal (18.5-24.9)	2	0	13	2
Overweight (25-29.9)	4	2	16	1
Obesity, Class I (30-34.9)	4	1	11	0
Obesity, Class II (35-39.9)	0	0	3	2
Obesity, Class III (40 or higher)	0	0	1	1

[a]Body mass index, calculated as kg/m^2

An independent samples samples t-test was calculated comparing BMI, age, and sedimentation rates between those readmitted and those not readmitted. There was a significant difference in BMI ($t (66) = -2.822$, $P = 0.006$) between those readmitted and those not readmitted. The mean BMI of the patients readmitted was significantly higher (35.8 ± 15.5 kg/m^2) than the mean for those not readmitted (27.4 ± 6.3 kg/m^2). There were no significant differences between readmission and age or erythrocyte sedimentation rates, $P = 0.364$ and $P = 0.128$, respectively (Table 4.3).

Chi-square analysis determined that men were more likely to be readmitted than women ($\chi^2 = 4.797$, $P = 0.029$, Table 4.3). Only 7.4% of the women were readmitted, whereas 28.5% of men were readmitted. There were no significant differences among races for participants readmitted. It should be noted that a total of eight patients were readmitted during this retrospective study. Of the eight patients readmitted, four were readmitted multiple times for treatment of DD, with one patient readmitted within 30 days of a previous discharge on two occasions.

Thirty-four of the 68 patients received high fiber diet education from a registered dietitian, while the other 34 did not. Some patients did not receive dietary fiber education due to short lengths of hospital stay or weekend admissions, initial diagnosis was different than DD, or the dietitian did not receive a consult or referral for diet education. Chi-square analysis determined that high fiber diet education did not affect readmittance ($\chi^2 = 0.567$, $P = 0.452$). Alcohol, tobacco, and caffeine consumption were also analyzed. Only 14 of the participants were noted to consume alcohol, 11 consumed tobacco in some form, and 47 reported they consumed caffeine. Chi-square analysis determined no significant relationships between alcohol, tobacco, or caffeine consumption and readmission. Of those that consumed alcohol, 10 were female, and four were male. Eight females reported using tobacco, while only three males reported tobacco use. Thirty-four of the 54 females in the study reported using caffeine, while 13 males reported doing so. Only one male reported he did not consume caffeine. Chi-square analysis revealed that males were significantly more likely to consume caffeine ($\chi^2 = 4.655$, $P = 0.031$) than females. A significant negative correlation was observed between age and BMI ($r = -0.430$, $P < 0.001$). There was a significant trend for BMI to decrease as age increased.

Table 4.3 Results Comparing Participants Not Readmitted and Those Readmitted

Variable	Not readmitted (n = 60)	Readmitted (n = 8)	P value
Age (yrs)	70.7 ± 13.6[a]	66 ± 14.2	0.364
BMI[b]	27.4 ± 6.4	35.8 ± 15.5	0.006*
Sex	10 men[c] 50 women	4 men 4 women	0.029*
Race	6 African Americans 54 Caucasians	2 African Americans 6 Caucasians	0.216
Erythrocyte sedimentation rate (mm/hr)	31.2 ± 25.1 (n = 38)	49.8 ± 25.9 (n = 5)	0.128
Received high fiber diet education	31 no 29 yes	3 no 5 yes	0.452

[a]Continuous data compared by Independent t-tests
[b]Body mass index, as kg/m^2
[c]Categorical data compared by chi-square tests
*Significance between groups ($P < 0.05$)

Logistic regression was conducted to predict readmission to the hospital for DD using age, sex, BMI, race, erythrocyte sedimentation rate, and high fiber diet education as predictors. A test of the full model against a constant model (Omnibus tests of model coefficients) was significant, which indicated that the predictors, as a set, distinguished between those readmitted and those not readmitted ($\chi^2 = 16.068$, $P = 0.013$ with $df = 6$). Cox and Snell R^2 value of .312 and Nagelkerke R^2 value of .608 suggested a moderate relationship between prediction and grouping into readmitted and not readmitted; this indicated that between 31.2% and 60.8% of the variability was explained by the set of variables. The Wald criterion demonstrated that male sex (P = 0.032) and BMI (P = 0.035) were the only significant contributions for predicting readmittance or not being readmitted (Table 4.4).

Table 4.4 Results from Logistic Regression

		B	S.E.	Wald	*df*	Sig.	Exp(B)
Step 1[a]	BMI	.211	.098	4.594	1	0.032*	1.235
	Sex (male)	-5.422	2.576	4.430	1	0.035*	.004
	Age	.116	.080	2.087	1	0.149	1.123
	Race	1.762	1.934	.830	1	0.362	5.824
	Received diet education	.778	1.434	.295	1	0.587	2.178
	Erythrocyte sedimentation rate	.047	.033	2.055	1	0.152	1.048
	Constant	-16.264	8.447	3.707	1	0.054	.000

[a]Variables entered on step 1: Body mass index (BMI), sex, race, received diet education, erythrocyte sedimentation rate. *P < 0.05.

Discussion

Participants readmitted had a significantly higher BMI than those not readmitted and men were more likely than women to be readmitted. There is no definitive evidence to support a variation in incidence of DD amongst genders, with multiple studies providing conflicting results. However, obesity has been determined to be associated with higher incidence of disease, and obese men are more likely to develop more severe symptomatic DD than men with a lower BMI (Aldoori et al., 1995a; Strate et al., 2009). As ACS NSQIP results demonstrated, young obese patients were also more likely to develop complications related to DD and require emergency surgery (Bailey et al., 2013).

It is of note that while not statistically significant, the average age of patients readmitted were approximately four years younger than those not readmitted in the present study.

Among the participants in the study, there was a negative correlation between BMI and age. This correlation has also been observed in a longitudinal analysis of Croatians over 24 years. Between ages 45 and 55, BMI would begin to increase in the population; however, beginning at age 55, participants in the study showed a significant decrease in BMI. Although there was a significant decline, most of the participants in the study were classified as overweight (BMI 25-29.9 kg/m^2) (Pavlovic, Milkovic-Kraus, Jovanovic, & Hercigonja-Szekeres, 2012). In addition, other longitudinal studies, as well as studies from tribal populations in India demonstrated a decline in BMI associated with age (Guo, Zeller, Chumlea, & Siervogel, 1999; Mungreiphy, Kapoor, & Sinha, 2011). An average BMI of 28.4 kg/m^2 was seen in the present study, indicating an overweight classification.

While the mean erythrocyte sedimentation rate was not significantly elevated in the present study, Tursi et al. (2008) evaluated the elevation in inflammatory indices, including erythrocyte sedimentation, as a predictor and diagnostic tool for DD. It was noted that in clinical practice, DD is recognized by increased elevated erythrocyte sedimentation rate. Tursi et al. (2012) also stated that it would be reasonable to treat a patient for diverticulitis with an elevated erythrocyte sedimentation rate. Erythrocyte sedimentation rates were available in the present study for 43 of the 68 participants and ranged from 0 to 104 mm/hr.

Li et al. (2014) assessed risk factors for readmission among patients that were treated conservatively after their first diagnosis of diverticulitis. Patients with complicated DD were at a significantly higher risk for readmission that those with uncomplicated DD. The incidence of readmission, overall, was low, but patients younger than 50 had a higher incidence of readmission at 10.4% (Li et al., 2014). DD is thought to be age-related in nature; however, with recent observations of increased prevalence among younger populations.

The present study observed that high fiber diet education did not affect the rate of readmission when comparing participants who were readmitted and those not readmitted. Advancements in pharmacological and non-pharmacological treatment of DD patients have made the DD therapeutic regimen complex. Poor dietary fiber intake and obesity are recognized as problems in patients with DD, which can result in increased complications related to DD, often leading to hospitalization or surgery. Expert opinion and research support high dietary fiber intake as a standard therapy for managing DD, but preventing future complications of diverticulitis is still unclear (American Dietetic Association, 2008). The current Dietary Reference Intake for dietary fiber is at least 25 grams for women and 38 grams for men per day (Institute of Medicine of the National Academies, 2005). Unlu, Daniels, Vrounenraets, and Boermeester (2012) aimed to identify if treatment of symptomatic DD with a high fiber diet was effective. His review of three randomized controlled trials and a case-control study determined that all but one study indicated that a high fiber diet was an effective treatment (Unlu et al., 2012). It was noted, however, that high quality studies continues to be lacking. The American Dietetic Association (2008) also reported limited evidence to support high dietary fiber intake as a protective therapy for gastrointestinal disorders. Nevertheless, expert consensus suggests that a diet high in fiber is the best recommendation for treatment of DD. Currently, the present study represents the first study to examine the effect of high fiber diet education on readmission of DD.

Limitations

There are limitations that should be noted in the present study. This study was conducted with a small sample size in a single acute care facility located in the southern region of the United States; therefore, findings are not reflective of the entire United States population. Also, participants for this study were selected based on a primary or secondary diagnosis of DD per hospital screening policy; a patient's discharge diagnosis may have differed from the admitting diagnosis. Therefore, admitting diagnosis may not be the most accurate way to identify this patient subset for intervention within the acute care setting. Additionally, this study addressed instances of readmission based on occurrence of previous high fiber diet education. Compliance to a high fiber diet was not measured. Future research may also investigate differences in knowledge, beliefs, and behaviors regarding fiber consumption pre- and post-education. Recommendations for DD patients regarding dietary fiber intake are based on general consensus and not conclusive scientific evidence; therefore, further research is also needed regarding the effect of increased dietary fiber consumption on clinical outcomes in DD patients.

Implications

The results of this study indicated that high fiber diet education had no effect on the likelihood of readmission post discharge from the hospital in patients with DD. However, this study did observe that men were more likely than women to be readmitted to the hospital in which they were discharged for an admission of DD. Also, the average

age of participants who were readmitted was, on average, four years younger, but it was not statistically significant. In addition, the average BMI of patients readmitted was significantly higher than patients not readmitted.

This study suggests that inpatient high fiber diet education may not be effective in reducing hospital readmissions for patients with DD. Additional research may be needed to determine evidence-based interventions outside of general expert opinion regarding dietary fiber intake as an intervention for uncomplicated DD. The development of a theory-based education program on dietary fiber consumption may also be a more effective tool to increase compliance with dietary fiber guidelines. Testing the program in comparison with severity of DD or readmission rates could provide insight into appropriate intervention. Dietitians may need to take a more comprehensive approach and readdress particular interventions in this population. For example, obesity and high intake of red meat have also demonstrated increased risk of disease, and are considered risk factors for a number of other conditions that may threaten the overall health of patients. Dietitians may need to focus primarily on education regarding weight management and providing overall diet adequacy, emphasizing appropriate consumption of all food groups.

In addition, more research should investigate relationships between inflammatory indices in hospitalized DD patients and readmission rates. Currently, there is little research available to determine the relationship between the two, but research conducted on other inflammatory processes, such as rheumatoid arthritis, and risk of readmission have shown positive correlations. Research into developing evidence-based multidisciplinary interventions to prevent readmission in patients with DD is also needed.

Use of medications, particularly NSAIDs and steroids, have been associated with increased risk of complicated DD. Other than dietary fiber intake, recommendations and prescriptions for alternative analgesics might need to be considered to prevent complications.

CHAPTER V

CONCLUSION

The purpose of this study was to evaluate the effect of high fiber diet education in the prevention of hospital readmission among patients hospitalized for DD. Additional information regarding age, sex, race, BMI, CT findings, erythrocyte sedimentation rate, if the patient received high fiber diet education, and alcohol, tobacco, and caffeine use were collected retrospectively for each patient with a diagnosis of DD to investigate the differences between those readmitted and those not readmitted within 30 days, and also over the course of the review period. The participants for this study consisted of those admitted to the hospital with a primary or secondary diagnosis of DD.

This study indicated that high fiber diet education did not have an effect on the likelihood of readmission within 30 days or over the course of the review period. However, men were more likely than women to be readmitted to the hospital following an admission for treatment of DD. Also, the mean BMI of those readmitted was higher than those not readmitted. Logistic regression determined that BMI and being male were the only significant predictors of readmission for DD.

This study suggested that inpatient high fiber diet education was not an effective intervention for reducing any-cause hospital readmission among DD patients. Further research is needed to establish evidence-based recommendations beyond current consensus regarding dietary fiber consumption for the nutritional management of DD.

Current evidence to suggest the role of a high fiber diet in preventing DD has been shown to be conflicting, and most information is older and may be outdated. In addition to dietary fiber intake, it would most likely be beneficial to suggest weight reduction in patients with obesity, as it has been identified as a risk factor for developing complicated DD. This, and research into the relationships between co-morbidities and readmission rates in patients with DD are needed in order to identify patients most at risk for readmission.

Although evidence from the study does not suggest high fiber diet education is an effective tool to prevent readmission, multiple studies have shown its protective benefit regarding symptoms. For example, inflammation, abdominal pain, diarrhea, and more serious symptoms of complicated DD are likely to threaten the health of patients. Adequate dietary fiber has also been suggested as part of a healthful diet and can have protective cardiovascular benefits. Further research into the genetic predisposition of patients to developing DD is also warranted. Left-sided and sigmoid DD continue to be the predominant form of DD for more Western nations; however, Asian populations report high incidences of right-sided DD, with minimal left-sided conditions. These findings and results from studies involving twins with the incidence of DD suggest a genetic role in the etiology of DD. Due to the lack of current, sufficient evidence to determine an etiology; it has been difficult to develop evidence-based multidisciplinary approaches to prevention and intervention in DD. Further research should focus on determining an etiology and developing evidence-based interventions to prevent readmission and decrease the burden of DD to healthcare facilities.

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APPENDIX A

MISSISSIPPI STATE UNIVERSITY INSTITUTIONAL REVIEW BOARD

APPROVAL

BULLY MAIL powered by Google

Shiloh Quintana <sq19@msstate.edu>

Study 14-031: The Effect of High-Fiber Diet Education on Hospital Readmissions in Adult Patients with Diverticular Disease

kmyhand@orc.msstate.edu <kmyhand@orc.msstate.edu> Thu, Mar 20, 2014 at 2:48 PM
To: sq19@msstate.edu
Cc: kmyhand@orc.msstate.edu, dtidwell@fsnhp.msstate.edu

March 20, 2014

Shiloh Quintana
Food Sci, Nutrition, & Health Promo
Mailstop 9805

RE: HRPP Study #14-031: The Effect of High-Fiber Diet Education on Hospital Readmissions in Adult Patients with Diverticular Disease

Dear Ms. Quintana:

This email serves as official documentation that the above referenced project was reviewed and approved via administrative review on 3/20/2014 in accordance with 45 CFR 46.101(b)(4). Continuing review is not necessary for this project. However, in accordance with SOP 01-03 Administrative Review of Applications, a new application must be submitted if the study is ongoing after 5 years from the date of approval. Additionally, any modification to the project must be reviewed and approved by the HRPP prior to implementation. Any failure to adhere to the approved protocol could result in suspension or termination of your project. The HRPP reserves the right, at anytime during the project period, to obs! erve you and the additional researchers on this project.

Please note that the MSU HRPP accreditation for our human subjects protection program requires an approval stamp for consent forms. The approval stamp will assist in ensuring the HRPP approved version of the consent form is used in the actual conduct of research. Your stamped consent form will be attached in a separate email. **You must use the stamped consent form for obtaining consent from participants.**

Please refer to your HRPP number (#14-031) when contacting our office regarding this application.

Thank you for your cooperation and good luck to you in conducting this research project. If you have questions or concerns, please contact me at kmyhand@orc.msstate.edu or call 662-325-3294.

Finally, we would greatly appreciate your feedback on the HRPP approval process. Please take a few minutes to complete our survey at http://www.surveymonkey.com/s/YZC7QQD.

Since! rely,

Katie Myhand
Assistant Compliance Administrator

cc: Diane Tidwell (Advisor)

APPENDIX B

NORTH MISSISSIPPI HEALTH SERVICES INSTITUTIONAL REVIEW BOARD APPROVAL

NORTH MISSISSIPPI
HEALTH SERVICES

INSTITUTIONAL REVIEW BOARD

May 8, 2014

Shiloh Quintana, RD, LD
103 Eudora Welty Drive, MI
Starkville, MS 39759

Dear Ms. Quintana:

The Institutional Review Board received and reviewed the following:

- IRB submission
- Project description
- Data collection form
- Letter from Eupora Hospital Administrator, dated January 31, 2014, acknowledging that the study will be conducted at the facility

These items were reviewed for the following project:

Title: High Fiber Diet Education and Hospital Readmission in Patients with Diverticular Disease

The IRB has determined that this project meets the criteria for exemption (45 CFR 46.101(b)(4). If significant revisions are made to this project, please re-submit it to the IRB, as it may require further review at that point. All of the information associated with this project will be kept in the appropriate IRB file.

Sincerely,

Jeannine Peters, PharmD, CIP
IRB Manager

APPENDIX C

APPROVAL TO CONDUCT RESEARCH AT NORTH MISSISSIPPI MEDICAL CENTER-EUPORA

NORTH MISSISSIPPI
MEDICAL CENTER
EUPORA

January, 31, 2014

Katie Myhand
IRB Compliance Administrator
Mississippi State University

Dear Ms. Myhand,

As Administrator of North Mississippi Medical Center-Eupora, I am aware that Shiloh Quintana, RD, LD will conduct research on hospital re-admissions in adult patients admitted to our acute-care facility with diverticular disease. Ms. Quintana will utilize patient records in this retrospective study; however, she will not use patient identifiers nor will she interact with patients as a part of her research. Ms. Quintana will report her findings to Medical Staff of North Mississippi Medical Center-Eupora at the end of her study. If you need any additional information, please don't hesitate to let me know.

Sincerely,

Bob Jones
Administrator