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Association Between Childhood Secondhand Smoke Exposure and Inflammatory Bowel Disease Development

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Walden University
2020

Abstract

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MS, Walden University, 2014

BS, Campbell University, 2012

Dissertation Submitted in Partial Fulfillment

of the Requirements for the Degree of

Doctor of Philosophy

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Abstract

Inflammatory bowel disease (IBD) is a group of diseases that affect the gastrointestinal tract. Environmental factors, such as smoking, have been shown to play a role in the development of IBD; however, minimal research regarding secondhand smoke (SHS) exposure and the development of IBD has been conducted. The purpose of this study was to examine whether there was a relationship between childhood SHS exposure and the development of IBD. Bronfenbrenner's ecological systems theory was used in this study as a basis that the environment can aid in the development of disease. The research questions addressed the potential association between childhood SHS exposure and IBD development as well as the association between childhood SHS exposure and the age at diagnosis. A quantitative, cross-sectional design was used to analyze secondary data collected by a government organization regarding childhood SHS exposure and IBD status as well as other demographic, genetic, and environmental factors. There were 74 participants who met the inclusion factors to be included in this study. Multinomial logistic regression was conducted to analyze the variables in the data. The results indicated no significant relationship between childhood SHS exposure and IBD development as well as no significant relationship between childhood SHS exposure and the age of diagnosis. The results of this research can be used to inform future studies regarding the association of SHS exposure and IBD and possibly increase knowledge regarding individual risk factors for IBD and how physicians diagnose and treat patients.

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Dedication

This study is dedicated to all individuals who have been diagnosed with IBD and who suffer from the effects of these diseases while researchers continue to search for a cure. Additionally, this study is dedicated to all the caregivers and family members of patients with IBD who have provided and continue to provide support and understanding to their family members suffering from these diseases. Lastly, this study is dedicated to researchers and physicians who have dedicated their life to finding cures and treatments for IBD and diagnosing and caring for patients with IBD, respectively.

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Chapter 1: Introduction to the Study

Introduction

Inflammatory bowel disease (IBD) is a group of autoimmune, inflammatory, digestive diseases that consist of ulcerative colitis (UC) and Crohn's disease (CD) (Crohn's and Colitis Foundation [CCF], 2014; Moran, 2017). UC can result in inflammation of the colon, while CD can result in inflammation throughout the entire digestive tract (CCF, 2014; Moran, 2017). The age of diagnosis for the development of UC and CD is between 15 and 35 years old, although disease diagnosis can occur at any age for either disease (CCF, 2014; Moran, 2017). The exact causes of UC and CD are not entirely known (CCF, 2014; Moran, 2017). Hereditary, genetic, and environmental factors can facilitate the development of CD, while genetics, the immune system, and the environment can play a part in the development of UC (CCF, 2014; Moran, 2017). These two types of IBD are common in families and affect males and females equally but affect Whites (including Jews of European descent) more than other ethnicities (CCF, 2014, 2019b; Moran, 2017). However, CD has been shown to have a higher chance of running in families than UC, especially if a first-degree relative has IBD (CCF, 2019a). Examination of environmental factors has shown that IBD occurs more in developed countries, urban areas, and northern climates when compared to undeveloped countries, rural areas, and southern climates (CCF, 2014). IBD might be associated with foreign substances in the environment that might trigger the immune response but not inactivate the immune response at the appropriate time (CCF, 2014). A combination of a viral or

bacterial infection and the immune system response not being correctly regulated may also cause IBD (CCF, 2014).

Smoking is an environmental factor that is associated with IBD. Smoking has been seen to be a protective factor for UC development in adults (Lunney et al., 2015). A protective factor is a characteristic that might help prevent the development of a disease (Substance Abuse and Mental Health Services Administration, 2018). This means that smokers are less likely to develop UC (Lunney et al., 2015). Conversely, smoking has been seen as detrimental to CD development in adults, meaning that smokers are more likely to develop CD (Lunney et al., 2015). The effect of secondhand smoke (SHS) exposure on the development of IBD has not been thoroughly analyzed. The published literature does not show the effect of SHS exposure during childhood on the development of IBD (Özbeyli et al., 2017). I conducted this study to fill in this gap by focusing on the development and diagnosis of IBD and the association with exposure to SHS during childhood.

The problem introduced above is meaningful because it will help fill a gap in the current literature. Researchers have examined the effect of smoking on the development of UC and CD. Logically, the next step might be to explore the possible effects that SHS exposure can have on the development of IBD since SHS exposure is known to be harmful to individuals. It is crucial to examine the effect of SHS exposure during childhood on the development of IBD to determine if the same effect exists when exposed to active smoking. The results of this study could help in the determination of additional factors that might cause IBD since the exact causes are still unknown even

though it is known that the causes are multifactorial. The findings of this study can positively affect public health by providing additional information regarding IBD that could be used to help promote better diagnostics and further research, which may one day lead to a cure.

In this chapter, I explain the background of IBD and smoke exposure as well as highlight the gap in the literature regarding the lack of research on childhood SHS exposure and IBD. The problem statement, purpose of the study, research questions, and hypotheses are discussed. The theoretical framework and the nature of the study are also introduced. Lastly, I address the assumptions, scope and delimitations, limitations, and significance of this study.

Background

IBD research remains an understudied topic, but the amount of research evaluating characteristics of IBD has increased over the years. However, some areas of IBD research, such as pediatric research, are limited, with few studies examining this group. Therefore, research on adults marks the possible outcomes within children, but more research needs to be conducted with IBD and children since they are more vulnerable than adults.

The literature has shown that cigarette smoking may have a protective effect on the development of UC because smokers are less likely to develop UC compared to nonsmokers (Daniluk et al., 2017; Özbeyli et al., 2017). However, smoking tends to have a detrimental effect or association with CD because smokers are more likely to development CD compared to nonsmokers (Daniluk et al., 2017). Smoking is also

associated with disease progression, determination of surgery, and its outcomes for both UC and CD (Lunney et al., 2015).

The experiences and environments that a child encounters and lives in during early life can have an impact on their risk of developing UC and CD; the environment includes exposure to smoke through SHS (Guo et al., 2014). The trend of pediatric cases of IBD has been increasing, so it is only logical that the environment (such as SHS exposure) would be a good starting point to assess for associations between SHS exposure and IBD development in children as well as with a variety of other factors (Benchimol et al., 2017).

The purpose of this study was to examine the association between childhood SHS exposure, the development of IBD, and the age of diagnosis. Earlier research did not focus on the association between childhood SHS exposure and the development and diagnosis of IBD. If the results are statistically significant, then there may be an association between childhood SHS exposure and the development of IBD as well as an association between childhood SHS exposure and the age of diagnosis for those diagnosed with IBD.

Problem Statement

The purpose of this study was to examine the association between childhood SHS exposure, the development of IBD, and the age of diagnosis. Smoking has decreased within the past decade; however, the number of younger individuals diagnosed with UC and CD have increased (Benchimol et al., 2017; Centers for Disease Control and Prevention [CDC], 2018c; Moran, 2017). Due to the decrease in the number of smokers,

the amount of SHS exposure has also decreased since active smoking leads to passive smoke exposure (CDC, 2017). Based on the associations of active smoking and IBD development, the literature has shown that UC and CD may have an inverse relationship with SHS exposure (Lunney et al., 2015). Specifically, active smoking has shown a decrease in UC cases and an increase in CD cases (Lunney et al., 2015). It is reasonable to believe that a similar inverse relationship exists between SHS exposure and IBD development. In this study, I further examined the relationship on the development of these two IBDs and SHS exposure since only minimal research has been conducted on this specific association.

Purpose of the Study

In this study, I evaluated this gap in public health concerning the relationship between childhood SHS exposure and IBD development using a quantitative approach. Secondary data with childhood SHS exposure and disease diagnosis of patients (i.e., UC, CD, or no IBD disease) were used to examine this association. This potential association was further addressed using the variable of age at diagnosis. The primary independent factor analyzed was childhood SHS exposure (i.e., exposed or not exposed). The dependent factors examined were disease diagnosis (i.e., UC, CD, or non-IBD) and age at diagnosis (i.e., grouped into three categories based on the Montreal classification: 16 years old and younger, 17–40 years old, and over 40 years old). I controlled for demographic variables (i.e., sex and race), genetic-related variables (i.e., relatives' IBD disease diagnosis), and environment-related variables (i.e., place of residence during childhood, were you breastfed as infant, daycare attendance as a child, having pets

growing up, were you born via C-section, were you born prematurely, and did you take antibiotics before age 1).

Research Questions and Hypotheses

RQ1: What is the association between childhood SHS exposure and the development of IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$1: There is no statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

H_a1: There is a statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

RQ2: What is the association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$2: There is no statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

H_a2: There is a statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

Theoretical Foundation

The theoretical framework for this study was Bronfenbrenner's ecological systems theory. This theory postulates that the environments in which a child lives, as well as the inherent qualities of that child, determine the growth and development of that child (The Psychology Notes Headquarters, 2013). This approach consists of examining the multiple environments (or systems) in which a child lives: microsystem (i.e., immediate environment), mesosystem (i.e., connections), exosystem (i.e., indirect environment), macrosystem (i.e., social and cultural values), and chronosystem (i.e., changes over time; The Psychology Notes Headquarters, 2013). The microsystem includes entities that are the most influential on the life of the child since the child interacts with these the most; these entities include, but are not limited to, school, daycare, and family (Paquette & Ryan, n.d.). The chronosystem consists of the element of time and how the development of the child can change over time based on the child's environment and their reaction to the environment (Paquette & Ryan, n.d.). While the theory itself consists of more environments, I focused only on the microsystem and the chronosystem in this study.

Nature of the Study

The nature of this study was quantitative. A quantitative research method allows for the comparison or correlation of population attributes and the generalization of results to populations (Creswell, 2013). I developed the research questions for this study to examine the associations between childhood SHS exposure, IBD development, and age of diagnosis. Secondary data from the National Institutes of Health Integrative Human

Microbiome Project: The Inflammatory Bowel Disease Multi'omics Database (IBDMDB) were used to examine this association. Multinomial logistic regression was used to determine the association between the independent and dependent variables. The independent variable was childhood SHS exposure, and the dependent variables were IBD diagnosis for RQ1 and age at diagnosis for RQ2.

Definitions

Age at diagnosis: The age (in years) at which an individual was diagnosed with IBD through the careful examination of signs, symptoms, exams/procedures, and tests (National Cancer Institute at the National Institutes of Health [NCI at NIH], n.d.).

Childhood secondhand smoke (SHS) exposure: Exposure during childhood to smoke in the environment that came from another individual using tobacco products (NCI at NIH, n.d.).

Crohn's disease (CD): A type of IBD that can affect the entire gastrointestinal (GI) tract, especially the small intestine and colon (CCF, 2014; NCI at NIH, n.d.).

Inflammatory bowel disease (IBD): A category of chronic inflammatory diseases that includes CD and UC that result in inflammation of the GI tract, which can lead to symptoms, such as abdominal pain, constipation, diarrhea, rectal bleeding, loss of appetite, weight loss, fatigue, urgency to use the restroom, etc.; the exact cause of IBD is unknown, and there is no known cure (CCF, 2019b; NCI at NIH, n.d.).

Ulcerative colitis (UC): A type of IBD that only affects the colon (CCF, 2014; NCI at NIH, n.d.).

Assumptions

I made a handful of assumptions that were essential for this study to be conducted. First, it was assumed that the data set being used followed the characteristics of a normal distribution due to the Central Limit Theorem, which states that a sample size of 30 or more can be assumed to be large enough to follow a normal distribution (Kwak, & Kim, 2017). The data set that was used contained 74 patients who met the inclusion criteria for this study. This assumption of a normal distribution was critical in the selection of the most appropriate statistical method to use for data analysis. There were also limited secondary data sources available that contained the necessary variables for the completion of this study.

Second, I assumed that the diagnosis of IBD was determined by a qualified physician (i.e., gastroenterologist) through the use of colonoscopy and analysis of histological samples, if relevant. This was important to assume because a self-diagnosis based on symptoms, a diagnosis by an unqualified physician, or a diagnosis without a colonoscopy cannot be definitive.

Scope and Delimitations

One delimitation of this study was participation in the IBDMDB. Patients also had to meet the inclusion criteria of childhood SHS exposure and patient IBD status. If information regarding childhood smoke exposure and development and diagnosis of IBD (or not) were not collected, then the patients were not included in the study due to these factors being the primary variables required for the research questions to be answered. Due to the limited patients involved in this data set, the results of this study have a

limited generalizability to the general population because results are only relevant (i.e., not statistically significant) to those individuals included.

Bronfenbrenner's ecological systems theory aided me in the development of this study because this theory has been used for a variety of studies regarding children and how their environments affect disease progression over time (see The Psychology Notes Headquarters, 2013). I considered using the concept nicotine replacement therapy for this study; however, this concept did not quite fit the needs of this study because most quantitative research is formed based on theory instead of a concept.

Limitations

I identified several limitations for this study. One limitation was the use of secondary data; this can be considered a limitation since the data were not necessarily collected for answering the specific research questions of this study, and I was not involved in the actual collection of the data, so I do not have a clear understanding of how the data collection process was conducted (Cheng & Phillips, 2014). Another limitation was that the specific geographic regions where the patients live are unknown, so I was not be able to control for the geographic area in this study. A third limitation was not being able to examine additional variables that might be of interest, such as SHS exposure during pregnancy, paternal versus maternal SHS exposure, and the length of time exposed to SHS during childhood. These variables could potentially be addressed in future research because they were not available for analysis within the chosen data set. A final limitation was the small sample size; this could not be prevented because there are limited data available that directly relates to the research questions. However, the Central

Limit Theorem states that the number of patients available is sufficient enough (Kwak & Kim, 2017).

Significance

Research for IBD has increased in the past years, but there is still less research being conducted for this disease when compared to some other conditions that may affect a greater percentage of the population, such as cancer. The findings of this study fill the gap in the literature regarding whether SHS exposure during childhood is associated with IBD development. The results from this study, partnered with those of previous researchers, may allow public health professionals to be able to predict whether IBD would develop based on childhood characteristics, such as the environment (i.e., SHS exposure, attending daycare, having pets, etc.) and other influences (i.e., breastfed as an infant, born via C-section, born prematurely, and treated with antibiotics before the age of 1). This knowledge could lead to better treatment methods and more significant preparation for treatment in individuals because the findings of this study may lead to future research that may pinpoint which individuals are at a higher risk for developing IBD.

The results of this study might also lead to future studies that evaluate additional risk factors for the development of IBD. The ability to determine an individual's risk for developing a disease is an essential aspect of epidemiology (CDC, 2006). At the individual level, knowing the personal risk of disease can lead to individuals taking preventive actions to eliminate or reduce their risk of developing the disease. At the community level, policies can be enacted, which may help prevent the development of

IBD and focus on increasing public health regarding GI diseases. At the clinical level, additional risk factors can be evaluated, which may help physicians better diagnose and treat the health of the public with IBD.

Summary

Even though research involving IBD has increased over the years, the association between childhood SHS exposure and the development and diagnosis of IBD has not been adequately examined. In this chapter, I provided the background of IBD and smoking to create a platform from which to expand research to childhood SHS exposure and IBD development and diagnosis. This critical research was introduced and supported by providing an overview of previous related literature. The problem statement and purpose of the study were discussed. I also presented the research questions and hypotheses as well as the theoretical foundation, nature of the study, essential definitions, assumptions, scope and delimitations, limitations, and significance.

In Chapter 2, I will provide a detailed review of current and previous literature related to the research questions and topic as well as specify the gap that this research study aimed to fill. Topics discussed will include a background of IBD development and diagnosis, the observed associations between active smoking and IBD development, research involving children and IBD, and analysis concerning the theoretical foundation of the study.

Chapter 2: Literature Review

Introduction

IBD is a group of chronic, autoimmune diseases that affect over 3 million people (CCF, 2014). Within the past decade, more children have been diagnosed with IBD than previous decades (Benchimol et al., 2017; Moran, 2017). Since smoking is associated with the development of IBD, it is crucial to examine the effects of SHS on the development of IBD in children (Lunney et al., 2015). Of what is known of the associations seen between IBD and smoking, it is reasonable to believe that SHS exposure will have the same effect on IBD, meaning that secondhand smoking will have a protective effect on UC and be detrimental to CD development (Lunney et al., 2015).

Because the number of younger individuals being diagnosed with IBD has increased while smoking has decreased, the purpose of this study was to examine the association between childhood SHS exposure, the development of IBD, and the age of diagnosis. There is limited research regarding the association of SHS exposure and the development of IBD in children; therefore, I examined this potential association in this study to try to gain some insight regarding these variables, which could lead to a better understanding of SHS and early life exposure and its potential role in the development of IBD in children. This study could be an essential step in determining possible causes of these diseases because their origins are not entirely known (see CCF, 2014).

In this literature review, I sought to examine the basis for the intended association for this research. In this chapter, I examine Bronfenbrenner's ecological systems theory and the reasoning behind why this theory is acceptable to use for this association. The

key factors that may play a role in the association between childhood SHS exposure and the development of IBD are also identified and explored. I expound upon what is known regarding IBD, including the relationship between smoking and IBD development in adults and other childhood or early-life exposures, in an attempt to provide the information needed to proceed with the current study.

Literature Search Strategy

I located the extant literature for this review through searches of the following databases: MEDLINE and CINAHL combined, EBSCO, PubMed, Science Direct, and Google Scholar. The focus was on literature published in the last 5 years, but some pertinent information had to be obtained from older documents. The keyword search terms used included *inflammatory bowel disease, IBD, ulcerative colitis, UC, Crohn's disease, CD, children, childhood exposures, smoking, secondhand smoking, Bronfenbrenner's ecological systems theory, disease,* and several combinations of these terms.

Theoretical Foundation

Since this study was involved with the development of a disease based on childhood exposures, I used Bronfenbrenner's ecological systems theory as the theoretical foundation. Bronfenbrenner first authored this theory in a book, *The Ecology of Human Development: Experiments by Nature and Design*, published in 1981. However, Bronfenbrenner developed the ecological systems theory mostly in 1979 with the addition of the chronosystem in 1986, partly based on the author's influence on and participation in the Head Start Program ("Ecological systems theory," 2018).

Bronfenbrenner (1981) stated that the environment plays a crucial role in the growth and development of a child, including the development of disease. There are five levels of the environment in which a child lives: microsystem, mesosystem, exosystem, macrosystem, and chronosystem ("Ecological systems theory," 2018).

Bronfenbrenner's ecological systems theory is based on the premise that the interaction of the child and these five environments influence the child's development ("Ecological systems theory," 2018). While this theory does not provide real solutions to health problems, the examination of these five different environmental systems can lead to determining the potential cause of a health problem since all possible variables are examined throughout all the systems ("Ecological systems theory," 2018). The microsystem consists of the child and all of his or her interactions with family members, friends, and other relevant individuals, such as teachers, who together encompass the child's immediate environment ("Ecological systems theory," 2018; Paquette & Ryan, n.d.; The Psychology Notes Headquarters, 2013). The microsystem can also affect the development of the child's habits and temperaments, which may stay with him or her for life ("Ecological systems theory," 2018). The mesosystem represents the connections or relationships between the child's different microsystems, such as parents and teachers interacting ("Ecological systems theory," 2018; The Psychology Notes Headquarters, 2013). The exosystem involves the child's indirect environment, which can affect the child and his or her microsystem, but the child does not influence it ("Ecological systems theory," 2018; The Psychology Notes Headquarters, 2013). The exosystem can include the neighborhood, the local community, and health and social services as well as local

businesses and media (“Ecological systems theory,” 2018). The macrosystem consists of the culture/subculture, social class, ethnic group, and religious affiliations that surround the child (“Ecological systems theory,” 2018; The Psychology Notes Headquarters, 2013). These entities may change over time, and the child may play a small part in these changes; the changes can affect the child’s values and beliefs (“Ecological systems theory,” 2018). The outermost level, the chronosystem, includes the element of time and how the development of the child can change over time based on the child’s environment and their reactions to and interactions with the environment (“Ecological systems theory,” 2018; Paquette & Ryan, n.d.; The Psychology Notes Headquarters, 2013).

This theory has been used previously in social work, education, psychology, policymaking, and public health (“Ecological systems theory,” 2018). Zhou and Cheah (2015) examined the possible health risks that may lead to obesity in Chinese American children using this theory since this population is typically left out of the obesity equation; the authors created a pathway that may help further research for this population. Graves and Sheldon (2017) used Bronfenbrenner's ecological systems theory to highlight the potential components that can lead to effective recruitment methods for African American youth as well as barriers that may stem from the youths’ interactions with these systems. Additionally, Kekoni, Miettinen, Häkälä, and Savolainen (2019) studied the factors affecting child development in foster care using this theory to determine why foster children tended to not succeed as well in adulthood compared to those not in foster care. However, I found no articles regarding one specific environmental factor, such as SHS exposure, and the development of the disease.

Bronfenbrenner's ecological systems theory focuses on how the environment on all levels can affect the growth and development of a child, including the development of disease or other health conditions (Paquette & Ryan, n.d.). In this study, I examined the relationship between childhood SHS exposure and the development of IBD due to this environmental exposure. This theory has also been used to highlight the importance of considering all potential environmental factors because any factor could have a possible effect on the child's life and, more specifically, health ("Ecological systems theory," 2018). I developed RQ1 to inquire whether childhood SHS exposure could be associated with the development of IBD. Additional environmental factors were taken into consideration as possible covariates to ensure that any association seen was from childhood SHS exposure alone. RQ2 addresses if there is a relationship between SHS exposure and age of diagnosis while also considering other environmental factors that could affect any potential associations. The levels of the environment that were examined in this study were the microsystem and chronosystem. Only these two levels were considered because any possible SHS exposure would only be relevant if it was continuous, meaning that it would have to happen around the child often, so it makes sense that the exposure would occur in the child's immediate environment (i.e., microsystem), and then the disease outcome is what happens over time (i.e., chronosystem).

Literature Review Related to Key Variables

Inflammatory Bowel Disease (IBD)

IBD is a type of classification for the two primary diseases it encompasses: UC and CD (CCF, 2014). Both of these diseases result from inflammation in the GI tract (CCF, 2014). UC involves only inflammation of the colon and sometimes the rectum, whereas the inflammation involved in CD can appear in any part of the GI tract from the mouth to the anus (CCF, 2014; Gajendran, Loganathan, Catinella, & Hashash, 2018). UC tends to cause inflammation in a particular section, and it is continuous (CCF, 2014). In contrast, there can be alternating affected (i.e., inflamed) and nonaffected areas for CD (CCF, 2014). This difference between the appearance of UC and CD allows for doctors to evaluate and diagnose UC based solely on colonoscopy results partnered with symptoms and histological samples (if taken or if available).

Causes

Researchers do not entirely understand the mechanisms behind the development of IBD; the causes are understood to be a combination of hereditary factors, genetics, the immune system responses, and the environment (CCF, 2014). Gajendran et al. (2018) stated that CD risk factors include smoking, low fiber-high carbohydrate diet, altered microbiome, and medications such as nonsteroidal anti-inflammatory drugs.

Genetics play a role in the development of IBD; if an individual has a first-degree relative with IBD, then that individual is 10 times more likely to develop IBD compared to those individuals without a first-degree relative with IBD (Orholm et al., 1991). Five to 20% of IBD patients have a first-degree relative with IBD (CCF, 2014). Those

individuals with a second degree relative with IBD also have an increased risk of developing IBD, but it is a lot lower than with a first-degree relative (Orholm et al., 1991). Children who have mothers with CD have an increased risk of developing CD, especially if the mother was over the age of 35 years old and a smoker (Orholm et al., 1991). According to Mikhailov, Christensen, and Furner (2017), family history of UC is a risk factor for the development of CD, but a family history of CD is a protective factor for the development of CD.

Conflicting information regarding whether diet influences the development of IBD has been observed in research, but more research is needed to determine the exact contribution that diet may or may not have on the development and progression of IBD (CCF, 2014). Voutilainen et al. (2018) examined the relationship between early life exposures and the development of IBD later in life (within a 34-year follow-up period). Low high density lipoprotein cholesterol levels during childhood were correlated with the development of IBD; an inverse relationship between c-reactive protein concentrations during childhood and the development of IBD was also observed (Voutilainen et al., 2018). Diets high in sucrose before diagnosis have been associated with a higher risk of IBD development (Reif et al., 1997). An increase in the risk of UC was associated with high amounts of trans-unsaturated fats, while a decrease in the risk of UC was associated with high amounts of dietary long-chain n-3 polyunsaturated fatty acids (Ananthakrishnan et al., 2014).

IBD involves the patient's immune response continuing long after it should stop because it misclassifies food, bacteria, and other substances as foreign and, therefore,

proceeds to attack the healthy cells, which causes inflammation (CDC, 2018b). Changes in gut microbiota can lead to nonspecific gut inflammation, which can lead to IBD in those individuals with genetic susceptibility (Abegunde, Muhhamad, Bhatti, & Ali, 2016).

However, it is possible that medications can affect IBD development. Antibiotic exposure has been seen to be associated with new CD development but not UC (Ungaro et al., 2014). Disease activity is not altered by oral contraceptives (Cosnes, Carbonnel, Carrat, Beaugerie, & Gendre, 1999). A 3 times increase in flares was observed with CD patients who continued to take oral contraceptives, but smoking could also be a confounding variable (Timmer, Sutherland, & Martin, 1998).

Impact of IBD on Individuals' Lives

The age of diagnosis for UC and CD tends to correlate with the reproductive ages of 15 to 30 years old (CCF, 2014). However, more pediatric patients are being diagnosed with these diseases at even younger ages, which can have an extreme impact on their developmental stages (Benchimol et al., 2017; Moran, 2017). A child's height can be stunted or slowed as a result of developing one of these diseases during childhood; delayed puberty is also possible (CCF, 2014).

Symptoms of IBD include constipation, diarrhea, the urgency to use the bathroom, not knowing whether you will make it to the toilet in time, gas, abdominal pain, rectal bleeding, loss of appetite, fatigue, etc. (CCF, 2014). Childhood is such a critical time in an individual's life with their bodies growing and developing, and children are susceptible to other problems, such as emotional issues (i.e., embarrassment,

lack of understanding) associated with these diseases (CCF, 2014). There is no known cure for IBD, so a lifetime of care is needed; when this starts at such an early age, it can be detrimental to the quality of life of the child (Abegunde, Muhammad, & Ali, 2016). The length of time since diagnosis can also determine the probability that a patient will require surgery for the disease. For patients with UC, up to one third will require surgery after living with the disease for 30 years (CCF, 2014). For patients with CD, about 70% will require surgery at some point in their lifetime (CCF, 2014). Thirty percent of these CD patients who undergo surgery will have a recurrence of CD within 3 years because it is possible for CD to come back in parts of the digestive tract that were not removed during surgery (CCF, 2014).

In addition to living with IBD, some additional health concerns may accompany the disease. Mikhailov et al. (2017) found that patients with IBD were more likely to have other illnesses, respiratory diseases, or hospitalizations during infancy than non-IBD patients. IBD patients are also more likely to have the following chronic conditions: heart disease, lung disease, cancer, diabetes, arthritis, kidney disease, any liver disease, and ulcers compared to those without IBD (CDC, 2018a).

Anemia. Anemia is an extraintestinal manifestation that is very common in IBD patients (Hindryckx, Amininejad, Van De Vijver, & Bossuyt, 2014). Anemia in IBD patients can be caused by a multitude of mechanisms including blood loss from inflamed intestinal tissue, nutrient deficiency of iron and B12, chronic inflammation, hemolysis, and myelosuppression from medications (Dieleman & Heizer, 1998).

Venous thromboembolism. It was found that IBD patients are 3.5 times more likely to develop venous thromboembolism compared to sex- and age-matched controls (Novacek et al., 2010). This increased risk could result from a combination of malnutrition, heredity factors, surgery and hospitalization, and inflammation from the disease (Magro, Soares, & Fernandes, 2014; Novacek et al., 2010).

Heart conditions. The risk for developing hypertension correlates with an increase in obesity and metabolic syndrome as well as the use of medications such as corticosteroids and cyclosporine (Seminerio et al., 2015). IBD is also associated with increased risks for several heart conditions such as atrial fibrillation, stroke, myocardial infarction, heart failure, and cardiovascular-related death during a flare; there are no elevated risks for these heart conditions during remission (Kristensen et al., 2014). The risk of coronary artery disease is slightly higher for IBD patients (Singh, Kullo, Pardi, & Loftus, 2015; Singh, Singh, Loftus, & Pardi, 2014). In IBD patients, young adults (less than 50 years old) and women have a higher risk of cardiovascular disease compared to older adults (more than 50 years old; Singh et al., 2014).

Osteoporosis. Osteoporosis is another extraintestinal complication for IBD patients (CCF, 2014). The easiest way to prevent osteoporosis in patients is to reduce the number of glucocorticoids taken (Abegunde, Muhammad, & Ali, 2016).

Sleep deprivation/disturbances. Sleep problems have been associated with IBD (Dickstein & Moldofsky, 1999). Sleep disorders can greatly affect the quality of life for those with IBD (Abegunde, Muhammad, & Ali, 2016). Sleep disturbances can also be caused by the medications taken, such as corticosteroids (CCF, 2014). There is not

enough data to mandate treating sleep disorders in IBD patients, but IBD patients should be screened for sleep disorders (Abegunde, Muhhamad, Bhatti, et al., 2016).

Additional medical conditions. Other extraintestinal complications include redness, pain, and itchiness of the eyes; mouth sores; joint pain and swelling; tender bumps, painful ulcerations, and other sores/rashes of the skin; kidney stones; and primary sclerosing cholangitis, hepatitis, and cirrhosis of the liver (CCF, 2014).

Vaccination. Vaccination is another aspect of health that is even more important for individuals with IBD. Since IBD patients usually have compromised immune systems due to medications, these patients must be vaccinated to protect them against vaccine-preventable diseases (Chaudrey, Salvaggio, Ahmed, Mahmood, & Ali, 2015; Reddy, Beavers, Hammond, Lim, & FalckYtter, 2015). Live vaccines are not recommended as there is an increase in infection for immunocompromised IBD patients (Chaudrey et al., 2015; Reddy et al., 2015). All other vaccines should be given before beginning immunosuppressive therapy medications, if possible (Chaudrey et al., 2015; Reddy et al., 2015). Exposure to live vaccines through family members is also a concern as it places the patient at risk (Chaudrey et al., 2015; Reddy et al., 2015). However, there are some circumstances (such as traveling to foreign countries) when live vaccines may be required, or the benefits outweigh the risks, but it is crucial to speak with a doctor to determine the best time to receive a live vaccine (Chaudrey et al., 2015; Reddy et al., 2015).

Psychology and psychiatry. There may be a psychological component of IBD that can affect the patient's well-being and social life. This may be due to how an

individual perceives him or herself as being functionally disabled due to having this chronic disease (Irvine et al., 1994; Turnbull & Vallis, 1995). Also, the chronic nature of IBD with alternating stages of remission and flares, along with medication side effects, can lead to a person feeling alone and depressed (CCF, 2014). IBD patients are also more likely to experience higher amounts of psychiatric distress, anxiety, alexithymia, and somatosensory amplification (Becker et al., 2015). Due to this, relationships with friends, family members, or intimate partners can be negatively affected and result in a lower quality of life for the patients (Becker et al., 2015). Also, stress has been associated with an increase of flares in IBD but not an increase in risk for developing IBD (Gerbarg et al., 2016).

Treatments and Care

Unfortunately, there is no known cause for these diseases, but research shows that the causes of these diseases stem from genetic, environmental, and immune system components (CCF, 2019a, 2019c). Those individuals with an immediate family member with an IBD are more likely to develop IBD as well (5% to 20% with IBD have a first-degree relative with IBD) compared to individuals without a family history of IBD (CCF, 2014). Those individuals whose parents have been diagnosed with IBD have an even higher percentage of developing and being diagnosed with IBD (CCF, 2014).

Care for IBD patients is more focused on controlling symptoms rather than preventing further disease (Abegunde, Muhammad, & Ali, 2016). Including preventive measures may help make the individual's life more bearable, help plan for what might happen, and help catch new signs of disease or complications earlier than without

preventive health care. Preventive care could also lead to better options for patients since the disease could be detected earlier, and the disease may be in a less aggressive state.

Steroids are commonly used to try to induce remission in IBD patients, but they are not effective in maintaining remission (Abegunde, Muhammed, & Ali, 2016). Side effects of steroids can be adverse, so limiting the amount of steroid use in IBD patients is essential (Abegunde, Muhammed, & Ali, 2016). Probiotics, in general, have not been effective in managing IBD (Sokol, 2014). However, VSL#3 is effective at inducing remission in patients with mild-to-moderate active UC (Sokol, 2014). VSL#3 has also been seen to be beneficial in UC patients who have undergone ileal pouch-anal anastomosis (Singh, Stroud, Holubar, Sandborn, & Pardi, 2015). VSL#3 is a mixture of *Lactobacillus casei, L. plantarum, L. acidophilus, B. breve, B. infantis, Bifidobacterium longum L.delbrueckii subsp. bulgaricus, and Streptococcus salivarius subsp.thermophiles*, which tends to work better than only single agents/bacteria (Sokol, 2014). Additional medications used for the treatment of IBD include 5-aminosalicylic acids, thiopurines, methotrexate, anti-TNF-alpha agents, and anti-integrin antagonists. With all of these medications, routine lab testing should be conducted to ensure main body systems (liver, kidney, etc.) are not negatively affected by the medicines.

Smoking cessation can be seen as a treatment for those with CD as smoking worsens CD (Abegunde, Muhammad, & Ali, 2016). Smoking cessation reduces the risk of CD, disease flares, surgeries, and the number of treatments or medications needed for an individual (Nunes et al., 2016). Smoking cessation is not considered a treatment for UC since smoking is a protective factor for UC, but smoking cessation is considered

crucial due to the other disastrous effects smoking has on the human body and its position as a risk factor for a multitude of other diseases (Abegunde, Muhammad, & Ali, 2016). Nunes et al. (2016) stated that it is essential for gastroenterologists and primary care physicians to advise their IBD patients who smoke to quit smoking as the number of disease relapses (i.e., flares) is less in nonsmokers and those who quit smoking compared to current smokers.

Moderate exercise might help relieve some of the IBD symptoms as well as decrease the risk of obesity (Melinder et al., 2015). Exercise and physical fitness have been seen to have an inverse relationship with IBD activity, which points to a protective effect of exercise on IBD (Melinder et al., 2015). Physical activity can help improve the quality of life for IBD patients by reducing disease activity; this can make physical activity an essential part of therapy/treatment for advancing all facets of IBD patient health (Bilski, Brzozowski, Mazur-Bialy, Sliwowski, & Brzozowski, 2014; Klare et al., 2015). Diet-based interventions have not been successful in maintaining remission in IBD (Ballegaard et al., 1997; González-Huix et al., 1993).

Smoking and Health in General

Smoking is "the leading cause of preventable death" worldwide (CDC, 2019, para. 2). Smoking affects almost every system in the body and is well-known for its risks of cardiac, respiratory, and oncologic diseases (Abegunde, Muhammad, & Ali, 2016; Siquiera, 2017; CDC, 2019).

Smoking can result in appetite suppression and thus weight loss, but this can turn into smokers gaining weight with increased fat deposits and decreased metabolic rates for

chronic conditions (long-term smoking; Siquiera, 2017). Nicotine can negatively affect fertility for both men and women and possibly lead to erectile dysfunction; smoking also has been seen to have adverse reactions during pregnancy resulting in reduced weight, length, and head circumference of the fetus which can lead to long-term effects such as obesity, hypertension, Type 2 diabetes, respiratory dysfunction, neurobehavioral effects, and impaired fertility as well as "significant impairments in cognitive functioning, impulsivity, hyperactivity, an increased risk of developing an addiction disorder" (Bruin, Gerstein, & Holloway, 2010; Siquiera, 2017, p. e7).

Secondhand Smoking and Health in General

Nicotine (the addictive ingredient) is one of the significant components released through smoking and other tobacco products. Children can be introduced to nicotine through all types of tobacco products, including chewing tobacco, cigarettes, pipe tobacco, nicotine gum and patches, some insecticides, and now e-cigarettes (Siquiera, 2017). If vomiting is induced as a result of these products, then the effects are not severe due to the toxins exiting the body (Siquiera, 2017). However, e-cigarettes have nicotine in a liquid form which is more easily taken in a concentrated dose, and, if ingested, this can lead to death in children from nicotine poisoning (lethal at levels between 1 and 13 mg/kg for children and as little as 50 to 60 mg/kg in adults; Siqueira, 2017). Symptoms of nicotine ingestion range from vomiting and nausea to arrhythmias and coma (Siqueira, 2017).

Association Between Smoking and IBD Development

Research has been conducted regarding active smoking and its association with IBD development. Smoking has been seen to have a protective effect on the development of UC and a detrimental effect on the development of CD (Daniluk et al., 2017). This means that smokers are less likely to develop UC but more likely to develop CD; nonsmokers are at a higher risk of developing UC and a lower risk of developing CD. The protective factor of smoking on UC is very unusual as smoking is typically detrimental to all body systems. Also, smoking is usually a risk factor for the development of several diseases and health conditions. Patients with UC, who are current smokers, are more likely to experience a less severe disease course, require fewer steroids and other medications, and require fewer hospitalizations (Mokbel, Carbonnel, Beaugerie, Gendre, & Cosnes, 1998). Those individuals who quit smoking before disease onset had higher hospitalizations for colectomy (i.e., surgery; Boyko, Perera, Koepsell, Keane, & Inui, 1988). Current smokers have lower relapse rates and colectomy occurrences compared to nonsmokers (Boyko et al., 1988).

On the contrary, smoking can have a negative effect on the development of CD (Abegunde, Muhammad, & Ali, 2016). Mikhailov et al. (2017) evaluated several smoke exposures, with many of them acting as risk factors for the development of CD; a combination of all smoke exposures was continuously seen as a significant risk factor for the development of CD. Mikhailov et al. consistently found that any amount of smoke exposure was associated with the development of CD. The lack of research regarding SHS exposure and IBD development is what has led to this current research study.

Other Childhood Exposures and IBD Development

Environmental factors can also contribute to the development of IBD and can encompass a variety of avenues. For example, early-life indicators, such as the place where you were born or lived (in the United States or outside the United States; rural, urban, or suburban; hospital or not) could affect IBD development. Other early influences or factors such as breastfeeding can play a part in the immune response; this is still classified as an environmental exposure as it is a factor being introduced to the individual from outside of the body. Something as simple as whether the child was exposed to having a pet in the house could also affect the development or nondevelopment of IBD. There is a multitude of influences or factors that can impact the potential of future disease development. SHS exposure is an environmental factor for which I have not found any data, but it is possible that this could be associated with the development of IBD as well.

There are conflicting results regarding breastfeeding and association with IBD; some studies say that breastfeeding is protective while others say there is no association, and, still, others name breastfeeding as a risk factor for IBD development (Ekbom, Adami, Helmick, Jonzon, & Zack, 1990). Guo et al. (2014) found that those individuals with CD who were breastfed were less likely to have surgery related to their disease while those individuals who experienced childhood SHS exposure were more likely to have to undergo CD-related surgery. These associations were correct when controlling for age at diagnosis, disease duration, location of disease, disease behavior, the presence of perianal disease, and current smoking status (Guo et al., 2014). However, when

examining the influences of breastfeeding and SHS exposure simultaneously, only breastfeeding was found to be significant and associated with a decreased risk of disease-related surgery (Guo et al., 2014). On the contrary, Mikhailov et al. (2017) found no statistically significant association between being breastfed as an infant and the development of CD; however, a nonsignificant protective effect was observed with breastfeeding and the development of CD. Additionally, a longer duration of breastfeeding tended to have a more significant protective effect on the development of CD (Mikhailov et al., 2017).

Being diagnosed at an older age was associated with less risk of surgery for CD while having pets, growing up on a farm, or going to daycare were not associated with risk for CD-related surgery (Guo et al., 2014). Guo et al. (2014) found no association for risk of UC-related surgery when examining early life exposures.

Some research suggests that vitamin D may play an active role in disease activity for IBD (Basson, Swart, Jordaan, Mazinu, & Watermeyer, 2016; Del Pinto, Pietropaoli, Chandar, Ferri, & Cominelli, 2015; Holmes, Xiang, & Lucas, 2015). However, there are conflicting results about vitamin D and its potential effect on IBD development and disease course. Geographic location was suggested by some to be a factor of IBD development. Those living in more northern latitudes have a higher incidence of IBD compared to southern latitudes due to different amounts of exposure to UV light (Del Pinto et al., 2015; Holmes et al., 2015); others have not seen this relationship. While more information is needed to determine the extent of the association of vitamin D

deficiency and IBD, it is essential to test levels of vitamin D in IBD patients (Abegunde, Muhammad, Bhatti, et al., 2016).

Summary and Conclusions

The exact nature of IBD origins has not been identified. However, it is known that the environment, genetics, and immune system response all play a part in the development of IBD. The diagnosis of IBD forever changes the life of an individual; this includes the individual being more susceptible to other diseases or health conditions as well as the individual's social life. There is no known cure for IBD, although there is a wide range of treatments from antibiotics to immunosuppressants to biologics to surgery.

Smoking is an environmental factor that has been continuously examined with regards to IBD. Smoking has been associated with IBD development and disease progression, with smoking being detrimental for CD development but protective against UC development. However, SHS exposure on the development of IBD in children has not been thoroughly examined. This current study aims to lessen this gap by examining the relationship between disease diagnosis and childhood SHS exposure. Conducting this research may lead to more knowledge regarding early life exposures and IBD diagnosis. In Chapter 3, I will describe the research design and rationale, methodology, and threats to validity for this study.

Chapter 3: Research Method

Introduction

The cause of IBD is known to be multifactorial; even though the exact specifics are still unknown, the environment is one of the critical factors in IBD development along with genetics and the immune system response (CCF, 2014; Moran, 2017). With the environment factoring into the causal equation, it is crucial to investigate early life exposures, especially when individuals are diagnosed during childhood. One specific environmental, early-life exposure comes from the introduction to SHS during childhood. While research exists regarding smoking and IBD development in adults, little is known regarding childhood SHS exposure and the development of IBD in children. Evaluating this potential relationship could lead to insights regarding whether SHS exposure has the same effect on the development of IBD as smoking does. In this chapter, I describe the research design and rationale, methodology, and threats to validity for this study.

Research Design and Rationale

Quantitative research methods involve the gathering and managing of numerical data to describe a phenomenon and be able to generalize it to a broader population (USC Libraries, 2019). Quantitative research aims to evaluate the relationship between two or more variables using numerical data and statistical tests (USC Libraries, 2019). Quantitative research can be either descriptive/observational or experimental depending on what type of data are collected; observational studies aim to evaluate the relationship or associations between variables, while experimental studies aim to determine causality between the variables (USC Libraries, 2019). In this current study, I conducted an

observational study in which the relationship between childhood SHS exposure and IBD development was evaluated. The independent variable was childhood SHS exposure, while the dependent variable for RQ1 was the disease diagnosis of patients and the dependent variable for RQ2 was the age at diagnosis. Additional covariates in this study were demographic variables (i.e., sex, race), genetic-related variables (i.e., relatives' IBD disease status), and environmental variables (i.e., were you breastfed as an infant, daycare attendance as a child, having pets growing up, did you take antibiotics before age 1, were you born via C-section, and were you born prematurely).

I employed a cross-sectional research design in this study. The cross-sectional study design is frequently used in health promotion and when the researchers intend to observe the health conditions at one specific time (Salazar, Crosby, & DiClemente, 2015). A cross-sectional design can be used to detect differences between patients or phenomena, such as an exposure to a health risk or the presence of a health condition (Salazar et al., 2015). Additionally, a cross-sectional design can be useful for assessing the association between a risk or protective factor and a health-related outcome (Salazar et al., 2015). A cross-sectional design was appropriate for this study because the association between childhood SHS exposure and IBD diagnosis was evaluated.

Secondary data analysis can be used in quantitative research to gain knowledge regarding a similar yet unique topic for which the data were initially gathered (USC Libraries, 2019). I conducted a secondary data analysis in this study using data from the IBDMDB. Using secondary data for this study allowed me to review data already collected from patients with an IBD diagnosis. Use of this secondary data also supported

the examination of data from individuals of all ages and provided access to additional variables that may have been more difficult to collect. Using a cross-sectional design allowed me to investigate the relationship between childhood SHS exposure and disease diagnosis and possibly aid in the foundation of future intricate and complex studies (see Salazar et al., 2015).

Methodology

Population

The target population for this study was children and adults of all ages with and without an IBD diagnosis who were or were not exposed to SHS during childhood. I retrieved the data for this study from the IBDMDB. All races, sexes, and ages were accepted as participants, but these variables were controlled for within the statistical analysis along with other covariates.

Sampling and Sampling Procedures

I used a convenience sample sampling strategy in this study. Since the data were collected from a preexisting database, there was a limit to the amount of data from patients that could be gathered. This made a convenience sampling strategy appropriate for this study. Inclusion and exclusion factors determined the exact data that were able to be used from this database for this study.

Data from IBDMDB consists of 5,333 entries (some are duplicates). Inclusion and exclusion factors considerably lowered this number to 74 participants for this study. Inclusion criteria included the following: a response to a diagnosis of IBD (i.e., CD, UC, or non-IBD) and an answer to the question, “Were you exposed to cigarette smoke as a

child?" Additionally, age at diagnosis was an inclusion criterion for those individuals diagnosed with CD or UC. Individuals with a diagnosis of non-IBD but not an age at diagnosis were still included in analysis related to RQ1 (but not to RQ2). Exclusion criteria were nonresponses to the disease diagnosis and childhood SHS exposure variables. I also considered a nonresponse to age at diagnosis an exclusion factor for those individuals with UC or CD.

I performed a power analysis to determine the desired sample size for this study using G*Power Version 3.1.9.2. The selected parameters used to calculate the sample size were as follows: a power of 0.80 (80%), an alpha level of 0.05, and an odds ratio of 2.48. Given these parameters, the desired sample size for a two-tailed logistic regression test was 71. A power of 80% was chosen because this is a standard level of power used; also, 80% power means that there was an 80% probability that I would not commit a Type II error or fail to reject the null hypothesis when it should be rejected (see Statistics Solutions, 2019). An alpha level of 0.05 was chosen because this is the most commonly used alpha level; this means that there was a 5% chance of making a Type I error or rejecting the null hypothesis when I should have failed to reject the null hypothesis. I used an odds ratio of 2.48 because this is suggested as an appropriate odds ratio to obtain a large effect size for logistic regression (see Statistics Solutions, n.d.).

Archival Data

The data for this study came from IBDMDB. This database was formed by collecting data from the following established longitudinal cohorts: The Prospective Registry in IBD Study at Massachusetts General Hospital, The Pediatric Inception Cohort

at Cincinnati Children's Hospital and Emory University, The Mucosal-Luminal Interface (MLI) Cohort at Cedars-Sinai Medical Center, and The Swedish Twins (i.e., the Swedish Twin Cohort and Swedish Longitudinal Cohort). The Prospective Registry in IBD Study at Massachusetts General Hospital is a cohort within the Crohn's and Colitis Center at Massachusetts General Hospital that continually enrolls patients who are referred by their physicians; this cohort was used to recruit 24 adults (over the age of 18 years old) who were newly diagnosed with IBD and not familiar with treatments and six age-matched healthy controls into the IBDMDB (n.d.). The Pediatric Inception Cohort is a cohort that comes from the Crohn's and Colitis Foundation RISK study, which recruits pediatric patients with suspected IBD prior to colonoscopic examination and therapy; this cohort was used to recruit 24 children who were newly diagnosed with IBD and not familiar with treatments and six age-matched healthy controls (IBDMDB, n.d.). The MLI cohort is a cohort at the Cedars-Sinai IBD Center, which recruits patients who are about to undergo a clinically-indicated endoscopy; this cohort was used to recruit 24 adults who had been diagnosed with IBD more than 5 years before enrollment in the MLI cohort and six age-matched healthy controls (IBDMDB, n.d.). The Swedish Twin Cohort recruited twins of the same sex aged 18 years or older to use as a basis for proving the IBDMDB's principle, and the Swedish Longitudinal Cohort recruited both men and women (not pregnant or breastfeeding) with IBD; it was not stated how much data were gathered from these cohorts to use as a baseline (IBDMDB, n.d.).

I was able to access the database through the IBDMDB website (ibdmdb.org). I was then be able to click the "Download Data" link, which led me to the Results page

where I was able to download the data in an Excel sheet. This data are publicly available, so permission to access the data was not needed. Because the National Institutes of Health compiled this database, I considered the data to be reputable.

Data Analysis Plan

The software program I used for the statistical analysis in this study was IBM Statistical Package for the Social Sciences (SPSS) Statistics 25. SPSS was used to conduct multinomial logistic regression to assess the relationship between childhood SHS exposure (i.e., the independent variable) and the development of IBD (i.e., a dependent variable). SPSS was also used to conduct multinomial logistic regression to assess the relationship between childhood SHS exposure (i.e., the independent variable) and age at diagnosis (i.e., a dependent variable) for those with IBD.

Because I used a secondary data set for this study, some data cleaning and screening was needed. After the inclusion and exclusion factors were used to narrow down the data set, additional cleaning and screening were needed because there were multiple entries for the same patients (at different visits), so it looked like there were a greater number of patients than there was. Removing these duplicate entries was important because they would have provided duplicate data points and would have skewed the results. In addition, all missing data were coded as 999 in order for SPSS to be able to recognize this data as such.

The research questions and hypotheses for this study were:

RQ1: What is the association between childhood SHS exposure and the development of IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$1: There is no statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

H_a1: There is a statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

RQ2: What is the association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$2: There is no statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

H_a2: There is a statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

I performed descriptive statistics to define the characteristics of the sample. Frequencies and percentages were reported for categorical variables. All variables, including covariates, were categorical in this study. Childhood SHS exposure was defined as the individual being exposed to cigarette smoke as a child. I defined disease

diagnosis as the individual being diagnosed with UC, CD, or non-IBD. Age at diagnosis was the age at which the individuals with UC or CD were diagnosed. Sex was defined as an individual being male or female. I defined race as the race of an individual. Relatives' disease diagnosis was defined as having a relative (i.e., parent, sibling, grandparent, or distant relative) with IBD. I defined breastfed as an infant as an individual being breastfed as an infant. Daycare attendance was defined as an individual attending daycare as a child, while having pets growing up was defined as an individual growing up with a pet or not. I defined born via C-section as an individual being born via C-section or not and born prematurely as an individual being born prematurely. Antibiotics before the age of 1 was defined as being treated with antibiotics before the age of 1. These covariates have been researched in the literature and were shown to have some type of association with the development of IBD; therefore, it was important to have these variables as covariates to account for any interactions.

The statistical analysis test in this study included multinomial logistic regression analysis to evaluate the potential association between variables. For example, exposure to cigarette smoke during childhood was the independent variable for both research questions; this variable was measured on a binary scale where individuals were coded as exposed or not exposed (i.e., not exposed = 1; exposed = 2). Disease diagnosis was the dependent variable for RQ1; this variable was measured on a nominal scale where individuals were coded as having CD, UC, or non-IBD (i.e., non-IBD = 0; UC = 1; CD = 2). There were several covariates as well. Sex was measured on a binary scale where individuals were coded as male or female (i.e., male = 0; female = 1). Race was

measured on a binary scale where individuals were coded as White or Other (Black, more than one race, or other; i.e., White = 0; Other = 1); race had to be coded this way in order to include this variable in the analysis as it resulted in zeros in the crosstabulations when broken down further. Relatives' IBD status was measured on a binary scale where the relatives' disease status was coded as non-IBD or IBD (i.e., non-IBD = 0; IBD = 1). Breastfed as an infant was measured on a binary scale as being breastfed or not was coded (i.e., no = 1; yes = 2). Daycare attendance was measured on a binary scale as attending daycare as a child or not was coded (i.e., no = 1; yes = 2). Having pets growing up was measured on a binary scale as having a pet during childhood or not was coded (i.e., no = 1; yes = 2). Born via C-section was measured on a binary scale as being born via C-section or not was coded (i.e., no = 1; yes = 2). Born prematurely was measured on a binary scale as being born prematurely or not was coded (i.e., no = 1; yes = 2). Antibiotic treatment was measured on a binary scale as being treated with antibiotics before the age of 1 or not was coded (i.e., no = 1, yes = 2). All of these covariates were included in RQ1 except born via C-section as a crosstabulation with the independent variable resulted in zeros in some categories.

For RQ2, multinomial logistic regression was also conducted. Childhood SHS exposure was the independent variable measured on a binary scale as in RQ1. Age at diagnosis was the dependent variable measured on a nominal scale where individuals were coded into age groups based on the Montreal classification (i.e., 16 years or younger = 0; 17 to 40 years = 1; older than 40 years = 2). The covariates for RQ2 were sex, relatives' disease status, having pets growing up, born via C-section, and born

prematurely; the following variables were not included in RQ2 due to the crosstabulations resulting in zero individuals in some categories: race, breastfed as an infant, daycare attendance, and antibiotics before the age of 1.

The results were interpreted based on the odds ratios and *p* values calculated by SPSS.

Threats to Validity

External Validity

External validity involves the generalizability of the results of the study to the general population (San José State University, n.d.). The four main types of threats to external validity are selection biases; constructs, methods, and confounding; the real world versus the experimental world; and history effects and maturation (Laerd Dissertation, 2012b). In this study, selection bias could be a potential threat to external validity. Selection bias occurs when the sample in the study is not representative of the population (Laerd Dissertation, 2012b; San José State University, n.d). Selection bias can usually be prevented through random assignment of participants to groups (Laerd Dissertation, 2012b). However, this was not possible with this secondary data analysis as the participants have already been placed into their designated groups (Laerd Dissertation, 2012b). Selection bias was addressed by not limiting the sample to any one race or age to provide the best chance at having a representative sample (San José State University, n.d.). However, there was not much that could be done to prevent selection bias since a convenience sample was used for this study.

Internal Validity

Internal validity involves the conclusion from the research being an accurate portrayal of the association being studied (Laerd Dissertation, 2012c). Internal validity is also concerned with anything other than the independent variable that might affect the dependent variable from within the study (Western Oregon University, n.d.). The 14 main types of internal validity threats are history effects, maturation, testing effects, instrumentation, statistical regression, selection biases, experimental mortality, causal time order, diffusion (or imitation) of treatments, compensation, compensation rivalry, demoralization, experimenter effects, and subject effects (Laerd Dissertation, 2012c).

As with external validity, selection bias can also affect internal validity. However, as this study uses secondary data, the groups are already chosen; therefore, the random allocation of individuals was not possible. Causal time order may also be a threat to internal validity for this study as it was assumed that childhood SHS exposure occurred before the development of IBD. However, some of the data in the secondary data set were obtained by individuals who were diagnosed with IBD during childhood, so it is unclear if the SHS exposure occurred before, during, or after diagnosis. Therefore, for these individuals, it was difficult to ascertain whether the independent variable (i.e., childhood SHS exposure) preceded the dependent variable (i.e., IBD diagnosis; Laerd Dissertation, 2012c).

Construct Validity

Construct validity deals with making sure the measurement procedure that is used to measure the construct is valid (Laerd Dissertation, 2012a). The threats to construct

validity are inexact definitions of constructs, mono-operation bias, reducing levels of measurements of constructs, mono-method bias, treatment-sensitive factorial structure, and construct confounding (Laerd Dissertation, 2012a).

A potential threat to construct validity for this study was inexact definitions of constructs. This threat can be present if the definitions of constructs are too broad (not specific enough) or not completely thought out (Laerd Dissertation, 2012a). This can be reduced by having a clear and concise operationalized definition for the constructs (Laerd Dissertation, 2012a). By having a specific construct, the researcher can be more confident in the study and the results. Mono-operation bias could also be present in this study as mono-operation results from only having one measure for a construct (Laerd Dissertation, 2012a). In this study, childhood SHS exposure was measured as a nominal variable for exposed or not exposed to SHS as a child. However, this variable/construct could indeed be broken down even further to include additional information, such as duration of SHS exposure and the source of the SHS exposure (i.e., cigarettes, cigars, vaporizers). Reducing levels of measurements of constructs may also be a threat to construct validity in this study as the construct childhood SHS exposure could be measured more precisely if it was continuous (Laerd Dissertation, 2012a). However, as this study uses secondary data, reducing these threats was not possible as the data set enforces limitations that could not be overcome.

Ethical Procedures

There were not any required agreements needed to gain access to the data since the data were publicly available. Due to the nature of this secondary data set, there was

no human participation involved in my study, which negates the need for recruitment or data collection procedures. The secondary data set that was used for this study consists of de-identified participant information. There were no concerns regarding anonymity or confidentiality as the participants' identifying information (i.e., name, address, phone number, birth date, etc.) were not included in the version of the data set that I was able to access. For this study, I was the only one accessing this data; however, since it is made publicly available, anyone with Internet access can obtain the data. No specific protections were necessary for the data as it were de-identified, anonymous, and confidential. I had no conflicts of interest to report. This study met Walden University's ethical standards; the Institutional Review Board approval number for this study is 12-17-19-0372015.

Summary

In Chapter 3, I examined the appropriate research design and methods that were used in this study. Additionally, I highlighted the aspects of the data analysis plan, threats to validity, and ethical considerations for this study. This detailed explanation of the methods of how this study was executed was used to determine the relationship between childhood SHS exposure and the development of IBD. In Chapter 4, I will discuss the data collection and results of this study.

Chapter 4: Results

Introduction

The purpose of this study was to determine whether an association exists between childhood SHS exposure and IBD. Smoking is known to be associated with IBD, but the relationship between childhood SHS exposure and IBD has not been thoroughly researched; therefore, any potential relationship is not understood. In this study, I examined the relationship between childhood SHS exposure and IBD diagnosis as well as the relationship between childhood SHS exposure and the age of diagnosis for those diagnosed with IBD. The research questions and hypotheses in this study were:

RQ1: What is the association between childhood SHS exposure and the development of IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$1: There is no statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

H_a1: There is a statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors.

RQ2: What is the association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors?

$H_0$2: There is no statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

H_a2: There is a statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors.

In Chapter 4, I discuss the data collection process and the results of this study. G*Power 3.1.9.2 was used to calculate the sample size of this study using a power of 80%, an alpha of 0.05, and an odds ratio of 2.48. The statistical power of 80% and the alpha level of 0.05 were chosen because these are standard values for these parameters. The odds ratio of 2.48 was chosen because this is the value associated with a large effect size for logistic regression. Based on these parameters, the desired sample size for this study was 71. With the inclusion and exclusion criteria in mind, I was able to access data from a total of 74 individuals from the National Institutes of Health Integrative Human Microbiome Project: The IBDMDB.

Data Collection

As mentioned above, the data for this study were collected from the National Institutes of Health Integrative Human Microbiome Project: The IBDMDB; therefore, there was no time frame for data collection because all of the data were present upon accessing the data set. I first accessed this data set for statistical analysis on December 17, 2019 after receiving Institutional Review Board approval to proceed with my data collection and statistical analysis.

After evaluating the secondary data set, I assessed a total of 74 participants for this study. The participants consisted of both children and adults of all ages and sexes with an IBD diagnosis of UC, CD, or non-IBD and a SHS exposure classification of yes or no. Any individuals who did not have an IBD diagnosis response or a response regarding SHS exposure were excluded from the study. Additionally, any individuals who were categorized as having UC or CD were excluded if an age at diagnosis was not also available. A power analysis was conducted with an alpha level of 0.05, a sample size of 74, and an odds ratio of 2.48; this resulted in the true power of this study being 0.82.

The study consisted of data from 74 individuals of all ages and of different races and sexes. I considered these factors as covariates in the analysis to control for any potential differences in these characteristics regarding diagnosis of IBD. Generally speaking, IBD affects men and women equally; IBD is commonly diagnosed between the ages of 15 and 35 years old; and IBD affects Whites more than other races, but Blacks and Hispanics are more likely to experience extraintestinal complications than Whites (CCF, 2014; Moran, 2017). Additional covariates were examined including genetic and environmental factors.

Selection bias could have been present in this study because I conducted a secondary data analysis. Selection bias occurs when the sample in the study is not representative of the population (Laerd Dissertation, 2012b; San José State University, n.d.). While selection bias can usually be prevented through random assignment of participants into groups, this was not possible because the participants in the secondary

data were already placed into their designated groups (see Laerd Dissertation, 2012b). This threat to external validity was addressed by not limiting the sample to any one race, ethnicity, or age to provide the best chance at having a representative sample (see San José State University, n.d.). In this study, little could be done to prevent selection bias since I used convenience sampling to collect the data from the secondary data set; however, since there were no limitations placed on these demographic variables, the sample might be more generalizable to the larger population.

Results

Descriptive Statistics

Participant characteristics. Based on the aforementioned inclusion and exclusion criteria, all participants were children and adults of all ages with and without an IBD diagnosis who were or were not exposed to SHS during childhood. I performed descriptive statistics for the continuous variable age at consent (not used in analysis). For age of consent, the minimum was six years old, the maximum was 76 years old, the mean 25.82 years old, the median was 16.00 years old, and the standard deviation was 18.227 years old.

Frequencies and percentages for age at consent. Out of 74 participants ranging from ages of 6 to 76 years old, 16 years old was the most common age at consent with eight participants (10.8%) being this age. The second most common age at consent was 15 years old with seven participants (9.5%) being this age when consenting occurred. The frequency for age at consent is presented in Table 1.

Table 1

Frequency for Age at Consent

		Frequency	Percent
Valid	6	2	2.7
	7	1	1.4
	8	2	2.7
	9	2	2.7
	10	3	4.1
	11	4	5.4
	12	2	2.7
	13	4	5.4
	14	4	5.4
	15	7	9.5
	16	8	10.8
	17	3	4.1
	19	1	1.4
	21	1	1.4
	22	1	1.4
	23	1	1.4
	24	1	1.4
	26	2	2.7
	29	1	1.4
	30	2	2.7
	32	1	1.4
	37	2	2.7
	38	1	1.4
	40	1	1.4
	41	1	1.4
	43	1	1.4
	44	1	1.4
	45	1	1.4
	46	1	1.4
	50	1	1.4
	51	2	2.7
	55	1	1.4
	56	1	1.4
	57	1	1.4

(*table continues*)

	Frequency	Percent
60	1	1.4
61	1	1.4
62	2	2.7
74	1	1.4
76	1	1.4
Total	74	100.0

Frequencies and percentages for disease diagnosis. Out of 74 participants, 19 participants (25.7%) were diagnosed with UC, 35 participants (47.3%) were diagnosed with CD, and 20 participants (27.0%) were not diagnosed with IBD.

Frequencies and percentages for continuous age at diagnosis. Out of 74 participants, 54 participants (73.0%) were diagnosed with IBD with the age at diagnosis ranging from 5 to 74 years old. The most common age at diagnosis was 16 years with seven participants (9.5%) being diagnosed with IBD at that age. The 20 missing values represent the participants who were not diagnosed with IBD (i.e., non-IBD), so there is not an age at diagnosis for these participants. The frequency for continuous age at diagnosis is presented in Table 2

Table 2

Frequency for Age at Diagnosis

		Frequency	Percent
Valid	5	1	1.4
	6	1	1.4
	7	1	1.4
	8	2	2.7
	9	1	1.4
	10	2	2.7
	11	2	2.7

(*table continues*)

		Frequency	Percent
	12	2	2.7
	13	4	5.4
	14	3	4.1
	15	6	8.1
	16	7	9.5
	17	1	1.4
	19	1	1.4
	21	1	1.4
	22	1	1.4
	24	2	2.7
	25	1	1.4
	26	1	1.4
	28	1	1.4
	29	2	2.7
	30	5	6.8
	37	1	1.4
	41	1	1.4
	43	1	1.4
	45	1	1.4
	58	1	1.4
	74	1	1.4
	Total	54	73.0
Missing	999	20	27.0
Total		74	100.0

Frequencies and percentages for categorical age at diagnosis. Out of the 54 participants with an IBD diagnosis, the age at diagnosis ranged from 5 to 74 years old. I grouped the age at diagnosis into categories based on the Montreal classification. Thirty-two participants (43.2%) were diagnosed at the age of 16 years old and younger, 17 participants (23.0%) were diagnosed between 17 to 40 years old, and five participants (6.8%) were diagnosed at more than 40 years of age.

Frequencies and percentages for childhood secondhand smoke exposure. Out of 74 participants, 27 participants (36.5%) were exposed to SHS during childhood, while

47 participants (63.5%) were not exposed to SHS during childhood.

Frequencies and percentages for sex. Out of 74 participants, 38 participants (51.4%) were male and 36 participants (48.6%) were female.

Frequencies and percentages for being breastfed as an infant. Out of 74 participants, 24 participants (32.4%) were not breastfed as an infant, 43 participants (58.1%) were breastfed as an infant, and seven participants (9.5%) were missing this data.

Frequencies and percentages for taking antibiotics before the age of 1. Out of 74 participants, 16 participants (21.6%) did not take antibiotics before the age of 1, 22 participants (29.7%) did take antibiotics before the age of 1, and 36 participants (48.6%) were missing this data.

Frequencies and percentages for being born prematurely. Out of 74 participants, 59 participants (79.7%) were not born prematurely, nine participants (12.2%) were born prematurely, and six participants (8.1%) were missing this data.

Frequencies and percentages for race. Out of 74 participants, 67 participants (90.5%) were White, and seven (9.5%) were considered non-White (Black or African American, more than one race, other).

Frequencies and percentages for relative's disease diagnosis. Out of 74 participants, 53 participants (71.6%) did not have relatives with IBD, 19 participants (25.7%) did have relatives with IBD, and two participants (2.7%) were missing this data.

Frequencies and percentages for having pets growing up. Out of 74 participants, 21 participants (28.4%) did not have pets growing up, 52 participants

(70.3%) did have pets growing up, and one participant (1.4%) was missing this data.

Frequencies and percentages for daycare attendance as a child. Out of 74 participants, 43 participants (58.1%) did not attend daycare as a child, 30 participants (40.5%) did attend daycare as a child, and one participant (1.4%) was missing this data.

Frequencies and percentages for born via C-section. Out of 74 participants, 59 participants (79.7%) were not born via C-section, 13 participants (17.6%) were born via C-section, and two participants (2.7%) were missing this data.

Crosstabulations for Research Question 1

A crosstabulation was performed for the dependent variable (i.e., disease diagnosis) and each independent variable. Regarding the entire study population (n = 74), it was determined that 47 participants were not exposed to SHS during childhood (12 non-IBD, 12 with UC, 23 with CD) and 27 participants were exposed to SHS during childhood (eight non-IBD, seven with UC, 12 with CD). The majority of the participants were not exposed to SHS during childhood.

Regarding the entire study population (n = 74), it was determined that 38 participants were male (10 non-IBD, eight with UC, 20 with CD) and 36 participants were female (10 non-IBD, 11 with UC, 15 with CD). Overall, there was an equal distribution of males and females.

Regarding the entire study population (n = 74), it was determined that 24 participants were not breastfed as an infant (nine non-IBD, four with UC, 11 with CD), 43 participants were breastfed as an infant (nine non-IBD, 14 with UC, 20 with CD), and seven participants were missing this data. The majority of the participants were breastfed

as an infant.

Regarding the entire study population (n = 74), it was determined that 16 participants were not given antibiotics before the age of 1 (four non-IBD, eight with UC, four with CD), 22 participants were given antibiotics before the age of 1 (six non-IBD, two with UC, 14 with CD), and 36 participants were missing this data. The majority of the participants were given antibiotics before the age of 1.

Regarding the entire study population (n = 74), it was determined that 59 participants were not born prematurely (14 non-IBD, 17 with UC, 28 with CD), nine participants were born prematurely (four non-IBD, one with UC, four with CD). The majority of the participants were not born prematurely.

Regarding the entire study population (n = 74), it was determined that 67 participants were White (19 non-IBD, 16 with UC, 32 with CD) and seven participants were non-White (one non-IBD, three with UC, three with CD). The majority of the participants were White.

Regarding the entire study population (n = 74), it was determined that 53 participants did not have relatives with an IBD diagnosis (16 non-IBD, 15 with UC, 22 with CD), 19 participants did have relatives with an IBD diagnosis (four non-IBD, three with UC, 12 with CD), and two participants were missing this data. The majority of the participants did not have a relative with an IBD diagnosis.

Regarding the entire study population (n = 74), it was determined that 21 participants did not have pets growing up (five non-IBD, three with UC, 13 with CD), 52 participants did have pets growing up (15 non-IBD, 16 with UC, 21 with CD), and one

participant was missing this data. The majority of the participants did have pets growing up.

Regarding the entire study population (n = 74), it was determined that 43 participants did not attend daycare as a child (15 non-IBD, 11 with UC, 17 with CD), 30 participants did attend daycare as a child (five non-IBD, eight with UC, 17 with CD), and one participant was missing this data. The majority of the participants did not attend daycare as a child.

Childhood SHS Exposure and IBD Development

A multinomial logistic regression analysis was conducted to examine the potential association between the independent variable (i.e., childhood SHS exposure) and the dependent variable (i.e., IBD diagnosis) while controlling for the potential effects of demographic (i.e., sex and race), genetic, and environmental variables. The covariates for RQ1 were sex, race, relatives' disease diagnosis, breastfed as an infant, daycare attendance, having pets growing up, born prematurely, and antibiotics before the age of 1; the following variable was not included in RQ1 due to the crosstabulations resulting in zero individuals in some categories: born via C-section.

Table 3 contains the model fitting information which compares the overall model (i.e., including all predictors/independent variables) to the null model (i.e., does not include any predictors). A p value of less than or equal to 0.05 is statistically significant which represents that the overall model is a better fit for the data when compared to the null model whereas a p value greater than 0.05 is nonsignificant which indicates that the final model is not a better fit for the data when compared to the null model. The p value

of 0.666 is not significant at the 0.05 level, which means that the overall model is not a significant improvement in fit compared to the null model.

Table 3

Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	*Df*	Sig.
Intercept only	64.972			
Final	50.026	14.946	18	.666

Table 4 shows whether the model is a good fit for the data. A *p* value of less than or equal to 0.05 is statistically significant which means that the model does not fit the data well, whereas a *p* value greater than 0.05 is nonsignificant which means that the model does fit the data well. The Pearson chi-square value of 0.022 is statistically significant and indicates that the model does not fit the data well. However, the deviance chi-square value of 0.144 is nonsignificant and indicates that the model does fit the data well. Due to the conflicting results of the goodness of fit tests, it is difficult to determine if the model actually fits the data or not.

Table 4

Goodness-of-Fit

	Chi-Square	*Df*	Sig.
Pearson	57.485	38	.022
Deviance	47.253	38	.144

The Cox and Snell pseudo R-square value of 0.373 means that 37.3% of the variability in the dependent variable (i.e., disease diagnosis) can be explained (i.e., is

accounted for) by the independent variable (i.e., childhood SHS exposure). The Nagelkerke pseudo R-square value of 0.424 means that 42.4% of the variability in the dependent variable (i.e., disease diagnosis) can be explained (i.e., is accounted for) by the independent variable (i.e., childhood SHS exposure). The McFadden pseudo R-square value of 0.221 means that 22.1% of the variability in the dependent variable (i.e., disease diagnosis) can be explained (i.e., is accounted for) by the independent variable (i.e., childhood SHS exposure).

In Table 5, the likelihood ratio tests test the contribution of each independent variable to the overall model. The variable antibiotics before the age of 1 is the only statistically significant independent variable for this model with a *p* value of 0.048. All other independent variables are nonsignificant at the 0.05 significance level.

Table 5

Likelihood Ratio Tests

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	*Df*	Sig.
Intercept	50.026[a]	.000	0	.
Childhood SHS exposure	51.373	1.348	2	.510
Sex	50.551	.525	2	.769
Breastfed as infant	50.213	.187	2	.911
Antibiotics before age 1	56.090	6.064	2	.048
Born prematurely	52.127	2.101	2	.350
Race	50.031	.006	2	.997
Relatives' disease diagnosis	50.327	.301	2	.860

(*table continues*)

	Model Fitting Criteria	Likelihood Ratio Tests		
	-2 Log Likelihood of Reduced Model	Chi-Square	*Df*	Sig.
Have pets growing up	51.333	1.308	2	.520
Daycare attendance	50.368	.342	2	.843

Note. The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

[a.] This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table 6 compared each of the UC and CD diagnoses to the reference group (i.e., non-IBD) for each independent variable. None of the independent variables were statistically significant for the comparison between UC and non-IBD; likewise, none of the independent variables were statistically significant for the comparison between CD and non-IBD.

Table 6

Parameter Estimates

								95% Confidence Interval for Exp(B)	
Disease Diagnosis[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	Lower Bound	Upper Bound
Ulcerative colitis	Intercept	-2.066	5.831	.125	1	.723			
	Daycare attendance	.590	1.448	.166	1	.684	1.804	.106	30.788
	Childhood SHS exposure	.269	1.712	.025	1	.875	1.309	.046	37.483

(*table continues*)

Disease Diagnosis[a]		B	Std. Error	Wald	df	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	95% Confidence Interval for Exp(B) Upper Bound
	Born prematurely	-1.605	1.555	1.066	1	.302	.201	.010	4.229
	Breastfed as infant	.719	1.702	.178	1	.673	2.052	.073	57.632
	Antibiotics before age 1	-.971	1.262	.592	1	.442	.379	.032	4.492
	Relatives' disease diagnosis	-.205	1.690	.015	1	.903	.815	.030	22.346
	Race	.145	2.216	.004	1	.948	1.157	.015	89.041
	Sex	.974	1.432	.463	1	.496	2.649	.160	43.852
	Have pets growing up	1.367	1.620	.712	1	.399	3.923	.164	93.913
Crohn's disease	Intercept	-1.817	4.781	.144	1	.704			
	Daycare attendance	-.143	1.201	.014	1	.906	.867	.082	9.127
	Childhood SHS exposure	1.501	1.525	.969	1	.325	4.487	.226	89.153
	Born prematurely	-1.790	1.478	1.467	1	.226	.167	.009	3.023
	Breastfed as infant	.332	1.206	.076	1	.783	1.394	.131	14.828
	Antibiotics before age 1	1.653	1.149	2.069	1	.150	5.224	.549	49.709
	Relatives' disease diagnosis	.499	1.254	.158	1	.691	1.646	.141	19.236
	Race	.122	2.006	.004	1	.951	1.130	.022	57.569
	Sex	.214	1.180	.033	1	.856	1.238	.123	12.510
	Have pets growing up	-.286	1.308	.048	1	.827	.751	.058	9.756

[a.] The reference category is: non-IBD.

Table 7 shows the predictive ability of the model for each diagnosis group. The diagnosis of non-IBD was predicted by the model 37.5% of the time. The diagnosis of

UC was predicted by the model 66.7% of the time. The diagnosis of CD was predicted 73.3% of the time. The overall predictive ability was 62.5%.

Table 7

Classification

	Predicted			
Observed	non-IBD	ulcerative colitis	Crohn's disease	Percent Correct
non-IBD	3	2	3	37.5%
Ulcerative colitis	1	6	2	66.7%
Crohn's disease	2	2	11	73.3%
Overall percentage	18.8%	31.3%	50.0%	62.5%

Crosstabulations for Research Question 2

A crosstabulation was performed for the dependent variable (i.e., age at diagnosis) and each independent variable. Regarding the participants who were diagnosed with IBD (n = 54), it was determined that at the time of diagnosis 32 participants were aged 16 years or younger (10 with UC, 22 with CD), 17 participants were diagnosed between the ages of 17 and 40 years (seven with UC, 10 with CD), and five participants were diagnosed at more than 40 years of age (two with UC, three with CD). The majority of the participants were diagnosed at 16 years of age or younger.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 35 participants were not exposed to SHS exposure during childhood (21 aged 16 years and younger, 11 aged 17 to 40 years, and three aged more than 40 years) and 19 participants were exposed to SHS exposure during childhood (11 aged 16 years and younger, six aged 17 to 40 years, and two aged more than 40 years). The majority of

the participants were not exposed to SHS exposure during childhood.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 45 participants were not born prematurely (29 aged 16 years and younger, 12 aged 17 to 40 years, and four aged more than 40 years), five participants were born prematurely (one aged 16 years and younger, three aged 17 to 40 years, and one aged more than 40 years), and four participants were missing this data. The majority of the participants were not born prematurely.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 43 participants were not born via C-section (25 aged 16 years and younger, 14 aged 17 to 40 years, and four aged more than 40 years), nine participants were born via C-section (five aged 16 years and younger, three aged 17 to 40 years, and one aged more than 40 years), and two participants were missing this data. The majority of the participants were not born via C-section.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 16 participants did not have pets growing up (11 aged 16 years and younger, four aged 17 to 40 years, and one aged more than 40 years), 37 participants did have pets growing up (21 aged 16 years and younger, 13 aged 17 to 40 years, and three aged more than 40 years), and one participant was missing this data. The majority of the participants did have pets growing up.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 37 participants did not have relatives with IBD (22 aged 16 years and younger, 11 aged 17 to 40 years, and four aged more than 40 years), 15 participants did

have relatives with IBD (nine aged 16 years and younger, five aged 17 to 40 years, and one aged more than 40 years), and two participants who were missing this data. The majority of the participants did not have relatives with IBD.

Regarding the participants who were diagnosed with IBD (n = 54), it was determined that 28 participants were male (20 aged 16 years and younger, five aged 17 to 40 years, and three aged more than 40 years) and 26 participants were female (12 aged 16 years and younger, 12 aged 17 to 40 years, and two aged more than 40 years). About half of the participants were male and about half of the participants were female.

Childhood SHS Exposure and Age at Diagnosis for Individuals Diagnosed with IBD

A multinomial logistic regression analysis was conducted to examine the potential association between the independent variable (i.e., childhood SHS exposure) and the dependent variable (i.e., age at diagnosis) for those individuals diagnosed with IBD development while controlling for the potential effects of demographic (i.e., sex and race), genetic, and environmental variables. The covariates for RQ2 were sex, relatives' disease status, having pets growing up, born via C-section, and born prematurely; the following variables were not included in RQ2 due to the crosstabulations resulting in zero individuals in some categories: race, breastfed as an infant, daycare attendance, and antibiotics before the age of 1.

Table 8 contains the model fitting information which compares the overall model (i.e., including all predictors/independent variables) to the null model (i.e., does not include any predictors). A p value of less than or equal to 0.05 is statistically significant which represents that the overall model is a better fit for the data when compared to the

null model whereas a *p* value greater than 0.05 is nonsignificant which indicates that the final model is not a better fit for the data when compared to the null model. The *p* value of 0.560 is not significant at the 0.05 level, which means that the overall model is not a significant improvement in fit compared to the null model.

Table 8

Model Fitting Information

	Model Fitting Criteria	Likelihood Ratio Tests		
Model	-2 Log Likelihood	Chi-Square	*Df*	Sig.
Intercept only	60.476			
Final	49.834	10.642	12	.560

Table 9 shows whether the model is a good fit for the data. A *p* value of less than or equal to 0.05 is statistically significant which means that the model does not fit the data well, whereas a *p* value greater than 0.05 is nonsignificant which means that the model does fit the data well. The Pearson chi-square value of 0.110 is nonsignificant and indicates that the model fits the data well. The deviance chi-square value of 0.158 is also nonsignificant and indicates that the model fits the data well.

Table 9

Goodness-of-Fit

	Chi-Square	*Df*	Sig.
Pearson	39.733	30	.110
Deviance	37.678	30	.158

The Cox and Snell pseudo R-square value of 0.207 means that 20.7% of the variability in the dependent variable (i.e., age at diagnosis) can be explained by the

independent variable (i.e., childhood SHS exposure). The Nagelkerke pseudo R-square value of 0.250 means that 25.0% of the variability in the dependent variable (i.e., age at diagnosis) can be explained by the independent variable (i.e., childhood SHS exposure). The McFadden pseudo R-square value of 0.132 means that 13.2% of the variability in the dependent variable (i.e., age at diagnosis) can be explained by the independent variable (i.e., childhood SHS exposure).

In Table 10, the likelihood ratio tests test the contribution of each independent variable to the overall model. None of the independent variables are significant at the 0.05 significance level.

Table 10

Likelihood Ratio Tests

	Model Fitting Criteria	Likelihood Ratio Tests		
Effect	-2 Log Likelihood of Reduced Model	Chi-Square	*Df*	Sig.
Intercept	49.834[a]	.000	0	.
Childhood SHS exposure	50.381	.547	2	.761
Born prematurely	52.553	2.719	2	.257
Born via C-section	50.322	.488	2	.783
Have pets growing up	51.475	1.641	2	.440
Relatives' disease diagnosis	49.959	.125	2	.939
Sex	54.033	4.199	2	.122

Note. The chi-square statistic is the difference in -2 log-likelihoods between the final model and a reduced model. The reduced model is formed by omitting an effect from the final model. The null hypothesis is that all parameters of that effect are 0.

[a.] This reduced model is equivalent to the final model because omitting the effect does not increase the degrees of freedom.

Table 11 compared each of the age at diagnosis groups (i.e., 17 to 40 years old and more than 40 years old) to the reference group (i.e., 16 years old and younger) for each independent variable. None of the independent variables were statistically significant for the comparison between the 17 to 40 years old group and the 16 years old and younger group; likewise, none of the independent variables were statistically significant for the comparison between the over 40 years old group and the 16 years old and younger group.

Table 11

Parameter Estimates

								95% Confidence Interval for Exp(B)	
Age at Diagnosis (categorical)[a]		B	Std. Error	Wald	*df*	Sig.	Exp(B)	Lower Bound	Upper Bound
17 to 40 years	Intercept	-5.333	2.788	3.658	1	.056			
	Childhood SHS exposure	.286	.784	.133	1	.715	1.332	.286	6.195
	Born prematurely	1.810	1.323	1.870	1	.171	6.108	.457	81.695
	Born via C-section	-.632	1.115	.322	1	.571	.531	.060	4.725
	Have pets growing up	1.148	.951	1.458	1	.227	3.152	.489	20.322
	Relatives' disease diagnosis	.319	.930	.118	1	.732	1.376	.222	8.510
	Sex	1.591	.821	3.755	1	.053	4.911	.982	24.559
more than 40 years	Intercept	-6.452	3.749	2.962	1	.085			
	Childhood SHS exposure	.846	1.190	.506	1	.477	2.331	.226	24.016
	Born prematurely	2.089	1.689	1.530	1	.216	8.077	.295	221.224
	Born via C-section	.286	1.524	.035	1	.851	1.331	.067	26.364

(*table continues*)

	B	Std. Error	Wald	*df*	Sig.	Exp(B)	95% Confidence Interval for Exp(B) Lower Bound	Upper Bound
Have pets growing up	.286	1.299	.049	1	.826	1.331	.104	16.982
Relatives' disease diagnosis	.208	1.396	.022	1	.882	1.231	.080	19.007
Sex	.243	1.272	.036	1	.849	1.275	.105	15.424

[a.] The reference category is: 16 years and younger.

Table 12 shows the predictive ability of the model for each diagnosis group. The age at diagnosis of 16 years and younger was predicted by the model 82.1% of the time. The age at diagnosis of 17 to 40 years was predicted by the model 64.3% of the time. The age at diagnosis of more than 40 years was predicted by the model 0.0% of the time. The overall predictive ability was 69.6%.

Table 12

Classification

	Predicted			
Observed	16 years and younger	17 to 40 years	more than 40 years	Percent Correct
16 years and younger	23	5	0	82.1%
17 to 40 years	5	9	0	64.3%
more than 40 years	2	2	0	0.0%
Overall percentage	65.2%	34.8%	0.0%	69.6%

Summary

The purpose of this study was to examine the potential relationship between childhood SHS exposure and IBD diagnosis while controlling for demographic, genetic, and environmental covariates. Additionally, this study also investigated the potential relationship between childhood SHS exposure and age at diagnosis for individuals

diagnosed with IBD while controlling for demographic, genetic, and environmental covariates. Regarding RQ1, there was not a statistically significant association between childhood SHS exposure and the development of IBD after controlling for demographic, genetic, and environmental factors; I failed to reject the null hypothesis for RQ1. Regarding RQ2, there was not a statistically significant association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic, genetic, and environmental factors; I failed to reject the null hypothesis for RQ2.

The findings of this study will be considered further in Chapter 5 by comparing the findings of this study to existing literature results. In Chapter 5, I will also discuss the limitations of this study, recommendations for future research relative to this specific topic, and implications of these results.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this study was to examine the association between childhood SHS exposure and the development of IBD after controlling for demographic (i.e., sex and race), genetic, and environmental covariates. In addition, I also examined the association between childhood SHS exposure and the age of IBD diagnosis after controlling for covariates. The covariates used were sex, race, relatives' disease diagnosis, breastfed as an infant, daycare attendance, having pets growing up, born via C-section, born prematurely, and antibiotics before the age of 1.

Previous literature has shown that studies regarding the effect of smoking and IBD have been conducted; however, research regarding SHS exposure and IBD is limited. Examining the association between SHS exposure during childhood could contribute to the knowledge regarding the effects of environmental factors on the development of IBD. The findings of this study could lead to physicians learning more about the causes of these diseases and individuals having a better understanding of their potential risks associated with the environment.

In this study, I used a quantitative approach and a cross-sectional design to assess the association between the independent and dependent variables. Secondary data from the National Institutes of Health were used for this study because the data set contained information regarding individuals with and without IBD who were or were not exposed to SHS exposure during childhood. Multinomial logistic regression was performed for both research questions to determine if there was an association between the independent

and dependent variables while controlling for demographic, genetic, and environmental covariates.

The findings of this study were not statistically significant for both research questions. For RQ1, the overall model was not significant; however, the variable of antibiotics before the age of 1 was found to be statistically significant when only comparing its specific contribution to the overall model. For RQ2, none of the findings were significant.

Interpretation of the Findings

The overall scope of the study was to examine the relationship between childhood SHS exposure and IBD diagnosis. The sample population of this study consisted of 74 children and adults of all ages with and without an IBD diagnosis who were or were not exposed to SHS during childhood. The first research question was: What is the association between childhood SHS exposure and the development of IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors? The second research question was: What is the association between childhood SHS exposure and the age at diagnosis for those who have IBD after controlling for demographic (i.e., sex and race), genetic, and environmental factors? Previous researchers had not fully examined the potential association between childhood SHS exposure and the development of IBD; therefore, there was limited literature that directly related to either research question. Since the results of the multinomial logistic regression tests for both research questions were not statistically significant, the findings of this study did not confirm, disconfirm, or extend any previous knowledge regarding the main variables in

both research questions; however, previous literature regarding the covariates were used in this study.

The covariates used in this study were sex, race, relatives' disease diagnosis, breastfed as an infant, daycare attendance, having pets growing up, born via C-section, born prematurely, and use of antibiotics before the age of 1. Use of antibiotics before the age of 1 was the only independent variable that was statistically significant (p value = 0.048) in contributing to the overall model (see Table 5). This variable was significant in contributing to the overall model; however, this variable was not statistically significant when the groups of disease diagnosis were compared (see Table 6). Previous researchers stated that the use of antibiotics has been associated with new cases of CD but not UC (Ungaro et al., 2014). Future research is needed to further understand the potential association between antibiotics and IBD development. The other covariates were also mentioned briefly in previous literature, but the nonsignificant results of these variables do not contribute any meaning to the literature or fill any gaps in the literature. Further research is also needed to evaluate these variables to determine whether they are involved in the development of IBD because there is currently only a limited amount of research available regarding early life exposures and the development of IBD.

As stated previously, the only variable that was statistically significant (p value = 0.048) for this study was use of antibiotics before the age of 1 when examining the contribution of each independent variable to the overall model (see Table 5). Therefore, I can only interpret the theoretical framework in terms of use of antibiotics before the age of 1. The theoretical framework I used in this study was Bronfenbrenner's ecological

systems theory, which is based on the premise that there are multiple systems in which an individual lives and that each system contributes to the development of an individual (The Psychology Notes Headquarter, 2013). In this interpretation, the use of antibiotics before age 1 can be considered to be a part of the microsystem of the individual because it directly affects the individual; the potential for the use of antibiotics before the age of 1 to have an effect on the development of the individual over time is considered part of the chronosystem. In this context, there is an association between the use of antibiotics before the age of 1 and the IBD diagnosis over time since the use of antibiotics before the age of 1 is statistically significant in contributing to the overall model. However, since the use of antibiotics before the age of 1 was not statistically significant when the different groups of IBD diagnosis were compared, it is not possible to say exactly what kind of association exists between the use of antibiotics before the age of 1 and IBD diagnosis. More research is needed in the future to further explore this relationship. Additionally, more research is also needed to further explore the potential for an association between IBD diagnosis and other environmental factors.

Limitations of the Study

I identified several limitations in this study. The first limitation was the use of a secondary data set to perform the analyses needed to answer the research questions. This is considered a limitation for a couple of reasons. First, the secondary data set was not originally collected for the purposes of this study, so the data were not intended to answer the research questions posed in this study (see Cheng & Phillips, 2014). Second, because I was not involved with the data collection process, there might be additional aspects of

the data that I could not account for regarding the variables (see Cheng & Phillips, 2014). For example, the variable childhood SHS exposure was my main independent variable; however, the variable is vague, and I cannot know if the participants who were diagnosed as children were exposed to SHS before, during, or after being diagnosed; this could lead to some complications if I was trying to determine causation rather than correlation.

Another limitation of this study was the small sample size, which could have affected the results of the study in several ways. A small sample size decreases the generalizability of the extrapolation of the findings; this is the same as saying that the sample is not representative of the population (Faber & Fonseca, 2014). Studies with small samples may not yield reliable or precise results (Hackshaw, 2008). Since I was using a secondary data set to collect data for my study, I was unable to control the sample size. I had to use what was available in the secondary data set. The data set contained several entries for the same patient, which led to eliminating entries of duplicates. In addition, the inclusion and exclusion factors had to be met for a participant to be included in this research study; these factors greatly limited the number of participants that could be included. There were also limitations regarding the included covariates and the potential covariates that were excluded. Race was included in the analyses, but instead of using the predetermined groups (i.e., White, Black or African American, more than one race, and other), the last three groups had to be combined, which resulted in only two groups (i.e., White and Other). This recategorization was essential in order to be able to include race at all since there were not enough participants in the remaining groups. Ethnicity was not able to be included in the analyses due to a limited response of those

who were Hispanic or Latino. Relatives' disease diagnosis also had to be modified to be able to include it in the analysis; instead of having several groups that distinctly explained all of the possibilities, this variable had to be grouped into the participant having relatives with IBD or the participant having relatives without IBD. There was no specification of IBD allowed in order to include this variable of relatives' disease diagnosis in the analyses. However, since genetics plays a role in the development of IBD, this was a very important variable to include (CCF, 2014; Orholm et al., 1991). The change in the categorization of and the exclusion of these aforementioned variables from the analysis resulted in the sample not being representative of the entire population. A larger sample size could have potentially increased the number of usable covariates and decreased the amount of regrouping of some variables.

Recommendations

After conducting and reviewing the results of this study, I have some recommendations for further study. First, I recommend that research regarding IBD and children is continually performed; the ethical issues that are evident when involving vulnerable populations, such as children, in research can keep relevant and crucial research from being conducted, but vulnerable populations need the most help in terms of research results. In the literature, there has not been enough research performed that involves children with IBD and environmental or other factors that can help determine the causes of these diseases.

I also recommend that this research study be repeated with different samples. The sample size (n = 74) was very small and did not allow for a proper comparison between

the different groups of IBD diagnosis. A more diverse sample would also be beneficial because it is important to study the differences in diseases for different races and ethnicities in order to be able to tailor treatments or preventive measures to those individuals who might be more susceptible to developing IBD. In addition, since the amount of data on IBD and environmental exposures was very limited, it might be beneficial to conduct a primary data analysis; although this would definitely be more time consuming, the researcher would be able to play a role in the data collection process and gain insight into any idiosyncrasies seen in the data. Repeating this study with different samples would also be important; even if the results were statistically significant for this study, the results can only be generalized so far, and research can only be proved with repetition. One study is not enough to determine clarity on the relationships between variables.

Implications

Social Change

This study, along with future related research, has the potential to have an impact for positive social change at many levels. This study could lead to additional studies that might examine the risk of an individual for developing IBD. Knowledge of personal risks of disease could lead to preventative measures that might eliminate or reduce the chance of an individual developing the disease. This research, and others like it, might help those diagnosed with IBD because they will see that they are not alone in this fight against the disease. Since these diseases tend to run in families, it is important to examine the potential risk factors for individuals within the family as well. If an

environmental factor, such as SHS, is determined to be associated with the development of IBD, then it would be important to examine the habits (in this case, smoking) of family members that might increase the risk for IBD for the entire family. In addition to the individual and family levels, it is important to consider the community level, which can focus on taking these results and transforming them into policies that may help prevent the development of IBD and focus on increasing public health and awareness regarding GI diseases. Furthermore, physicians can use research regarding potential risk factors to help them better diagnose and prepare individuals for the treatment of IBD.

Theoretical Framework

As previously mentioned, the theoretical framework for this study was Bronfenbrenner's ecological systems theory, which has been used previously in social work, education, psychology, policymaking, and public health ("Ecological systems theory," 2018). This theory suggests that the environment of an individual affects the individual's growth and development and that there are many different levels of an individual's environment that all interact together ("Ecological systems theory," 2018). Bronfenbrenner's ecological systems theory was used as the framework for this study while keeping in mind the effects that the environment, at many different levels, might influence the health of an individual. I only examined the microsystem and the chronosystem in this study because the microsystem consists of the individual's direct environment (i.e., represented by SHS exposure), and the chronosystem represents the development over time (i.e., represented by the development of IBD; see "Ecological systems theory," 2018). I evaluated the potential association between childhood SHS

exposure and IBD development with this theory as the underlying basis for how the environment can play a role in the development of an individual.

Recommendations for Practice

The results from this study were aimed at determining an additional risk factor for IBD development that might aid in guiding physicians regarding the prevention and diagnosis of IBD. The findings indicated the need for additional studies in order to increase knowledge regarding IBD and the potential associations between environmental exposures and IBD development. The nonsignificance of these results also showed that more work is needed to create a valuable research design. The lack of ability to gather a meaningful sample size should lead professionals to try to find new ways to reach out to patients and extend the pool of patients for analysis in order to be able to obtain relevant and significant data. The statistically significant result for the use of antibiotics before the age of 1 occurred only when comparing the effects of each variable to the overall model. Conducting studies with a larger sample size can lead to better results because more variables can also be evaluated without worrying about some groups having zero frequencies, which was the major problem with this study.

Conclusion

Although there are several studies regarding IBD development, the exact causes of IBD are unknown. Researchers believe the cause of IBD to be multifactorial and include genetics, environmental factors, and the immune system response (CCF, 2014; Moran, 2017). There is also a very limited amount of extant studies regarding children and IBD. This is most likely due to ethical concerns regarding the use of children in

research because they are vulnerable populations. While additional protections are necessary for children in research, it is extremely important for research to be conducted with this population in mind because their bodies are different than adults so it is difficult, and slightly impractical, to generalize the results from adult studies to the IBD population of children.

There are studies in the current literature that focus on the effect of smoking on the development of IBD; however, studies regarding childhood SHS exposure are not available. Therefore, in this study, I examined the potential association between childhood SHS exposure and the development of IBD as well as the potential association between childhood SHS exposure and the age of diagnosis for those individuals diagnosed with IBD. The results of this study were nonsignificant except for when it comes to the variable of the use of antibiotics before the age of 1, but this variable was only statistically significant when determining its effect on the overall model.

With this study, I sought to address the gap in the literature; however, a small sample size, the major limitation, did not allow the results to address this gap. Future research, hopefully with a much larger sample size, could now address this gap while steering clear of the limitations and pitfalls of this study. Even though this research provided very limited results, it is still important because future researchers can adapt to the complications seen in this study and use the limitations of this study to conduct research that might lead to statistically significant results.

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