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Posthurricane Environment's Impact on Childhood Cancer Rates in Louisiana, 2004-2010

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This is to certify that the doctoral dissertation by

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Abstract

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Doctor of Philosophy

Community Health & Advocacy

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Abstract

Childhood cancer is the second leading cause of death in children aged 0-19 years. Research efforts to identify factors associated with or influencing this growing health problem are limited. The purpose of this research study was to examine, in reference to Louisiana during the period 2004-2010, the annual number of children diagnosed with cancer; the types of cancers; the possible effects of the environmental aftermath resulting from Hurricanes Katrina, Rita, and Gustav; and any correlation between environmental contaminants following these hurricanes with the number of children diagnosed with cancer. This study employed correlational quantitative methodology using archival data from the Louisiana Tumor Registry that identified childhood cancer types and incidence for the years 2004–2010. Data were analyzed using logistic regression. Data analysis demonstrated statistically significant differences in the number of children diagnosed with cancer in Louisiana following Hurricanes Katrina, Rita, and Gustav, more specifically between the northern (p = .011) and southern (p =.013) regions. However, this may have no or limited practical significance. The sample size was large in this study, and given a large enough sample, regardless of insignificant population differences, almost any difference or any correlation will be statistically significant. The positive social change implication of this study is that it may lead to the development of preventive tools/measures for healthcare professionals and parents to help reduce childhood cancers associated with exposure to adverse environmental factors.

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Dedication

With unconditional love, I dedicate this dissertation to my dad, whom I love dearly, and my mom, who has been an amazing example of a true trailblazer. To my children, Chester “Cee” (Janea), Cyra, and Craig, thank you for your unconditional love, encouragement, and support. To the world’s most wonderful grandkids, Raynell (Ray J), Raylen (Lala), Brayah, and baby Caleb, Memo loves each of you beyond measure. To my sister, Tamia; Nephew “Tre”; and my sons, the three Johnson men, I love you all more than you will ever know. To the Robinson/Hairston family and my dearest friends, Greg Johnson and Leonard Harris, Jr., you both have truly been unfailing in supporting me. You have celebrated my victories and always encouraged me through the challenges and shortfalls along this academic journey and in life. To my brother, “Alvin,” your words (and actions) encouraged me to pursue my desire to bring this lifelong dream to fruition. Thank you to the entire St. Jude Family for the many hours of care you provide to so many children from around the world. To Dr. Shelia Moore, Dr. Deyo, and the Baton Rouge St. Jude Affiliate Clinic family, thank you for giving of yourselves to care for children in South Louisiana and Mississippi battling cancer and catastrophic illnesses. Dr. Hiroto Inaba, St. Jude Children’s Research Hospital, and especially “A” clinic, you all are the best “family” ever. A special thanks to Dr. Sohail Rana and the pediatric department at Howard University Hospital. Thank you all for your unparalleled faith and support. To Dr. Richard “Rick” Shaydac, thank you for the countless sacrifices you have made to fulfill the dreams of your dad and Danny Thomas, treating and curing childhood cancer. To my nieces; Laurice, LaShun, & LaToya, and to Glo, I love you and thank you.

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Chapter 1: Introduction to the Study

Introduction

Childhood cancer has previously been classified as “rare”; however, childhood cancer is the second leading cause of death in children from birth to 18 years of age in the United States, second only to automobile accidents (Centers for Disease Control and Prevention [CDC], 2013). The incidence of pediatric cancer in the United States has risen by 29% in the past 20 years (National Cancer Institute [NCI], 2012). Although cancer is a major health issue for children and adults, childhood cancer is different from cancer in adults (Mendes, 2014). Children are especially vulnerable to environmental factors because they spend more time outdoors (Vinson et al., 2011), and developmentally, children are experiencing a period of rapid cellular growth (Sly, 2012). Children are exposed to environmental contaminants via air, water, and absorption through the skin, and they are exposed more often than adults (Sly, 2012). A cancer diagnosis occurs in association with three main sources: Approximately 5% of cancer cases are genetic, 5-10% are due to lifestyle, and 90-95% can be attributed to environmental chemicals, toxins, and pollutants (Vinson et al., 2011). Given this fact, the environment of developing children is very important, and more initiatives are needed to address major risk factors resulting from exposure to environmental chemicals and toxic agents, especially following environmental disturbances such as the hurricanes and flooding events regularly experienced in Louisiana.

For many years, environmental-health-related issues have existed, particularly along an area in southern Louisiana called the Industrial Corridor (Sierra Club, 2015). For years, Louisiana has had a high number of children diagnosed with cancer and receiving treatment at St. Jude Children's Research Hospital and St. Jude affiliate clinics annually (V. W. Chen et al., 2002). However, studies associating environmental factors with the rate of children diagnosed with cancer in Louisiana are limited, if not scarce. The current study focused on the number of children diagnosed with cancer in Louisiana from 2004 through 2010 and used correlational quantitative methodology to gain an understanding of this traumatic event plaguing children in Louisiana (Laureate Education, 2010b). In addition, this study identified how exposure to contamination, pollutions, and toxins present in the environment following Hurricanes Katrina, Rita, and Gustav contributed to childhood cancer incidence in Louisiana from 2004-2010. In a previous study examining childhood cancer in Louisiana from 1988-1996, V. W. Chen et al. (2002) identified patterns and provided data that specifically focused on rates and types of childhood cancers identified in Louisiana. This current research study used a correlational research method to compare statistical relationships between two events: (a) the presence of an increase in environmental contaminants following Hurricanes Katrina, Rita, and Gustav and (b) the rate of cancer incidence for children aged 0 to < 19 years in Louisiana from 2004 through 2010. Using a correlational research method, I investigated and identified the possibility of a relationship existing between these occurrences and to what extent the relationship existed (Clarke, 2005). This study expanded existing research by adding to the scope, breadth, and understanding generated by the 2002 Louisiana childhood cancer study (V. W. Chen et al., 2002). The primary focus of the V. W. Chen et al. cancer study was incidence numbers and types of cancer diagnoses in children in Louisiana from 1988 through 1996.

A major challenge for researchers studying childhood cancer is the lack of current and relevant literature addressing this devastating event (Lim et al., 2009). This challenge applies to attempts to conduct research on childhood cancer in Louisiana. Although the origin of most cancers is unknown, according to Yu, Tsunoda, and Tsunoda (2011), several research studies have suggested that environmental contaminants and pollutants are contributing factors to some cancers (Vinson et al., 2011). In the current research study, I sought to determine whether environmental factors impacted the rate of children being diagnosed with cancer annually in Louisiana, and if so, to what extent this was the case (Novogradec et al., 2004). My intent in this research was to study environmental contaminants following the three severe hurricanes that occurred in Louisiana between 2004 and 2010 and how they might have impacted the number of children diagnosed with cancer throughout the state during the same period (Nicholas et al., 2010). The rate of children diagnosed with cancer continues to increase annually throughout the United States as well as in Louisiana (Surveillance, Epidemiology, and End Results [SEER] Program, 2013). In fact, in the United States, childhood cancer is the second leading killer of children from birth to < 19 years of age, second only to automobile accidents (National Institutes of Health, 2012).

The positive social change implications of this childhood cancer study involve its potential to demonstrate a greater need for stricter preventive measures. Preventive implementations should include regular health and cancer screening procedures for Louisiana children under 19 years old during routine physicals. This research study may also support the development of educational efforts that could empower parents and teachers to identify symptoms and signs that often serve as indicators of various types of cancers but are often dismissed in association with developmental changes (St. Jude, 2009). The findings from this research should demonstrate the need to promote the development of policies and standards for decontamination, disaster site cleanup, and rebuilding residential dwellings after flooding, natural disasters, and similar events to establish environmentally safe communities (Reuben, 2010). Currently, the Department of Environmental Quality (DEQ) has no established policies in place that specifically identify standards for decontaminating and cleaning up disaster sites.

It is well documented that childhood cancer is a major life-changing event. Childhood cancer diagnoses greatly affect quality of life for children and their families (Mendes, 2014). Currently, there are no procedures or policies in place at the local, state, or national levels to address the hardships of families with children diagnosed with cancer (American Cancer Society, 2014). Procedures need to be developed to address the severity of this event. These procedures should take into account the psychological and financial impacts that childhood cancer has on families in the United States (NCI, 2013). Because knowledge of childhood cancer in Louisiana is limited, without current or well documented information, families face difficulties in identifying “how or where” to obtain information and needed resources addressing issues and concerns associated with a childhood diagnosis (Mendes, 2014). Through this research, the general population could gain a greater understanding of the extent of childhood cancer incidence in Louisiana. Moreover, the general population could gain insight into the hardships that families must endure after diagnosis. The research findings demonstrate the immediate need to develop policies to address existing deficiencies in the prevention of environmental exposure to hazardous conditions associated with illnesses such as childhood cancer.

This research was conducted with the intent of providing a basis for identifying childhood cancer as a major public health issue for vulnerable children in Louisiana. In view of the growing number of children diagnosed annually, childhood cancer prevention and treatment need to be given high priority in Louisiana, along with the establishment of procedures that may be instrumental in providing resources to families impacted by a childhood cancer diagnosis (CDC Cancer Facts, 2012). The purpose of this study was to more effectively inform the public of the severity of the childhood cancer phenomenon in this state and to encourage public support for increased research efforts focused on prevention, intervention, treatment, and post-treatment of childhood cancer in Louisiana (Mendes, 2014). Although years of research have provided valuable information on treating and curing childhood cancers, the need for additional research persists (Kazak, 2005). The results of this research study support the need for the development of an educational component that could empower parents and teachers in identifying symptoms and signs that often serve as indicators of various types of cancers but are often dismissed in association with developmental changes (St. Jude, 2009).

Leukemia is the most common childhood cancer, with acute lymphoblastic leukemia (ALL) being the type most often diagnosed in children (Leukemia & Lymphoma Society, n.d.). Symptoms associated with an ALL diagnosis are bone and joint pain, fatigue, weakness, bleeding from the nose and gums, fever, and weight loss (Leukemia & Lymphoma Society, n.d.). Researchers who have conducted various cancer studies have frequently observed that brain tumors and other nervous system tumors are characteristically associated with headaches, dizziness, balance problems, vision, hearing or speech problems, and frequent vomiting (American Cancer Society, 2014).

Researchers conducting studies at St. Jude Children's Research Hospital (2009) have also made notable observations associated with neuroblastoma and Wilms tumors. Neuroblastoma is more common in males than in females. Additionally, a small percentage of children with neuroblastoma have a family history of this disease. Symptoms of neuroblastoma most often include difficulty walking or inability to walk, changes in eyes (dark circles, droopy eyelids), pain in various parts of the body, diarrhea, and high blood pressure. Wilms tumor is most often diagnosed in preschoolers aged 3 to 4 years and is not common in children over 6 years old. The symptoms of Wilms tumor include swelling or lump in the belly, fever, pain, nausea, and poor appetite (St. Jude, 2009). According to St. Jude Children's Research Hospital research trials, children diagnosed with lymphoma usually have swollen lymph nodes in the neck, armpit, or groin area and experience weight loss, fever, frequent and uncontrollable sweats, and overall weakness throughout the body (St. Jude, 2009).

Findings from this research could encourage the Louisiana Department of Environmental Quality to develop guidelines, policies, and standards for decontaminating disaster sites, cleaning up debris and other storm aftermath, and rebuilding residential dwellings after flooding and natural disasters, as well as related procedures for establishing environmentally safe communities (Reuben, 2010). In addition, policies need to be implemented to address the ongoing health, academic, and psychosocial difficulties children impacted by a cancer diagnosis experience during and after treatment (Kazak et al., 2003). The intent of this research was to identify childhood cancer as a major public health priority in Louisiana while establishing procedures that could be instrumental in providing resources for families impacted by this catastrophic illness (CDC Cancer Facts, 2012). This research study provides greater insight into the severity of childhood cancer and hardships associated with this phenomenon in Louisiana. The research findings may promote and encourage public support for increased research efforts focused on prevention, intervention, treatment, and posttreatment of childhood cancer in Louisiana (Mendes, 2014). Although years of research have provided valuable information on treating and curing childhood cancers, the need for preventive research still exists (Kazak, 2005).

In this chapter, I address the study's background, problem statement, purpose, research questions, nature, theoretical framework, definitions, assumptions, scope and delimitations, limitations, significance, concluding with a summary. I provide an in-depth examination of environmental impacts throughout Louisiana following Hurricanes Katrina, Rita, and Gustav while identifying those pollutants and toxins that have previously been identified as carcinogenic to humans and describing the impact and health risks that the posthurricane environment poses in relation to children's health in Louisiana.

Background

A significant portion of the Louisiana economy is generated by the many industrial sites, refineries, and petrochemical plants located and operating in the state (Scott, 2013). The state is also home to a major coal industrial site and a nuclear plant. For years, these industrial sites, refineries, and petrochemical plants have been suspected of being major contributing factors to the health disparities affecting Louisiana citizens, including rates of cancer for both children and adults (CDC, 2011). South Louisiana, more specifically the area along the Mississippi River, familiarly referred to as the River Parishes, contains many industrial plants that have been and continue to be sites frequently publicized and ridiculed for causing (or at least contributing) to the high cancer incidence in Louisiana (Natural Resources Defense Council, 2011).

Cancer studies in Louisiana are limited and outdated; moreover, childhood cancer studies are scarce and represent an ongoing gap in research (Chamiedes, 2009). The findings from this research study provide statistical evidence in support of a greater need for regular cancer screening procedures for Louisiana children from birth to 18 years of age. These preventive screenings should become a routine part of the customary physical examination process. Assessments should focus on preventive care and detection, especially during developmental milestones for children, which are when common cancers such as leukemia are most prevalent (American Cancer Society, 2014). Environmental pollution and contamination continue to be a growing problem in Louisiana (Helsloot et al., 2012). This environmental problem has been exacerbated by worsening weather-related disasters that have included record-setting rainfall and flooding, which intensified the environmental damage that occurred during and after the devastation of Hurricanes Katrina, Rita, and Gustav.

The findings from this research study should be used to further promote research efforts focusing on childhood cancers and the environmental factors that may contribute to their incidence. The correlation between deplorable environmental conditions and continuously rising numbers of childhood cancer cases needs to be explored more rigorously, given the fact that environmental factors can theoretically be controlled. As more is learned about environment-related causes of cancer, more can be done to eliminate adverse effects imposed by the environment, and parents can better protect their children from, reduce, and prevent exposure to chemicals, pesticides, and pollutants that may contribute to a diagnosis of childhood cancer.

A previous research study focused on the rates of children diagnosed with cancer annually in Louisiana (V. W. Chen et al., 2002). V. W. Chen et al. (2002) provided a basis for research in this area by identifying cancer incidences for children in Louisiana younger than 15 years of age, the various types of cancer diagnosis, and the hospitals and medical facilities administering chemotherapy and medical services to childhood cancer patients in Louisiana from 1988 through 1996. Although the rate of cancer in Louisiana is high (American Cancer Society, 2011), residents of the state have little or limited knowledge of the rate of childhood cancer diagnoses and of the population of Louisiana children being treated at St. Jude annually. The residents of Louisiana are unaware of the increased risks associated with long-term cancer treatments and the tremendous health disparities and social effects that childhood cancer survivors encounter after treatment (Pui et al., 2011). For many years, a disproportionate population of children from Louisiana diagnosed with cancer has received treatment from St. Jude Children's Research Hospital (St. Jude, 2009).

In a research study (Santella et al., 2010), various environmental contaminants were identified following Hurricanes Katrina and Rita; the presence and increase of various environmental toxins were also identified after Hurricane Gustav (Dietrich et al., 2011). These toxins may account for, or at least impact, the rates of children diagnosed with cancer during these periods. A review of the literature supports the presence of hazardous chemicals and environmental contaminants in water and air sources throughout the state following Hurricanes Katrina, Rita, and Gustav. Research studies, including

Pardue et al. (2005), have provided evidence identifying contaminated water and air sources that have previously been identified as contributing to an increasing rate of children diagnosed with cancer from 2004-2010 in Louisiana (SEER, 2007). Although it is known that hazardous contaminants in the environment (Santella et al., 2010) can contribute to diagnoses of cancer and other diseases (Presley et al., 2006), a gap in the literature exists concerning how (and whether) the aftermath of devastating hurricanes relates to the rate of children diagnosed with cancer.

Presently under construction is the new Louisiana Cancer Research Center. This 10-story, $102-million, state-of-the-art research facility is located in New Orleans, Louisiana. The Louisiana Cancer Research Center plans to compete for NCI designation in the hope of becoming a functioning NCI-designated cancer center that leads the state in the implementation of initiatives focused on cancer prevention and control. The Louisiana Cancer Research Center will play a large role in significantly reducing the rate of deaths from cancer as well the associated loss of productivity and the economic impact that cancer diagnoses impose on residents of Louisiana and their families.

There is also a need to determine the underlying cause(s) of the increasing rate of childhood cancers in Louisiana, along with identifying contaminants in the environment that children in Louisiana were exposed to daily following Hurricanes Katrina, Rita, and Gustav. In this research, I took into consideration that families and children have no or limited control over exposure to contaminants found in the environment after hurricanes and that a better understanding is needed concerning the potential health risks that exposure to these contaminants presents to residents of Louisiana overall (Pan et al., 2010). From 2006 through 2010, childhood deaths in Louisiana were significantly higher in comparison to the previous 4 years for many preventable causes, including cancer, HIV, accidents, and homicides (SEER, 2011). To better address childhood cancer incidence, the Louisiana Tumor Registry has established rapid case ascertainment of statistical data, which could provide opportunities for timely research on childhood cancer (SEER, 2011). Much time and effort have been devoted to cancer research in Louisiana, but this research has focused primarily on adults (e.g., Cancer in Louisiana, 2006-2010 [Andrews et al., 2011]; Cancer Statistics, 2014 [Hsieh et al., 2014]; and Cancer Alley, Louisiana [Taylor, 2004]). The current research study is needed to provide a more in-depth understanding of childhood cancer incidence in Louisiana, especially given that childhood cancer incidence continues to rise and cancer is presently the second leading cause of death in children under the age of 19 years (Copeland, 2013). According to Andrews et al. (2013), Louisiana cancer rates outpace the national average. This research study helps in identifying possible environmental factors negatively contributing to the rising number of childhood cancers and provides the groundwork needed to guide advanced research opportunities focused on reducing, eliminating, and possibly preventing childhood cancer incidence.

Problem Statement

Childhood cancer is a growing problem for Louisiana, the nation, and other countries (World Health Organization [WHO], 2012). Childhood cancer is the leading cause of death by disease of children in the United States (National Institutes of Health, 2013). Childhood cancers impose extenuating health risks and conditions on diagnosed children and their families (Peek et al., 2010).

In a previous study addressing the prevalence of childhood cancers in Louisiana, V. W. Chen et al. (2002) focused on the diagnosis rate for children aged 0 to 15 years as well as the specific types of cancers with which these children were diagnosed. V. W. Chen et al. made no reference to possible causes for these diagnoses. Although it is known that hazardous contaminants in the environment can contribute to diagnoses of cancer and other diseases (Presley et al., 2006), a gap in literature exists regarding how the aftermath of recent devastating hurricanes correlates to the increase in the number of children diagnosed with cancer. Moreover, the potential mechanisms by which Department of Environmental Quality and Environmental Protection Agency policies govern clean ups and decontamination procedures unfavorably impact the health of children in Louisiana (Pardue et al., 2005).

Childhood cancer incidence continues to rise annually throughout the United States, as well as in Louisiana (SEER, 2013), yet research articles and research materials on childhood cancer are very limited. Much of the assessable research materials on childhood cancer are outdated. Data from this study provides needed information identifying the presence of various chemicals, contaminants, and pollutants in Louisiana from 2004-2010 following severe hurricanes and related adverse conditions affecting the environmental makeup throughout the state (Santella et al., 2010). It also addresses a gap in literature concerning childhood cancer.

Purpose of the Study

The purpose of this childhood cancer study was to identify the possible effects of the environmental aftermath resulting from Hurricanes Katrina, Rita, and Gustav in Louisiana for the years 2004 through 2010. Furthermore, in this childhood cancer research study, I sought to determine whether there was a correlation between environmental contaminants following these hurricanes and the rate of children diagnosed with cancer during the 2004-2010 period.

The focus of this study was on the presence and relevance of chemicals, contaminants, and pollutants in the environment and how their presence correlated with the growing rate of children diagnosed with cancer annually in the state of Louisiana. This is especially important as childhood cancers rates continue to increase and a childhood cancer diagnosis often imposes additional extenuating health disparities on childhood cancer survivors and their families during and after the diagnosis (Peek et al., 2010). For this study, the independent variables were the environmental contaminants (chemicals, pollutants, and toxins) present in the environment specifically following Hurricanes Katrina/Rita and Gustav, and the dependent variable was the number of children diagnosed with cancer in Louisiana annually.

Research Questions and Hypotheses

The research questions that guided this study were as follows:

RQ1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, were there significant differences in the number of children annually diagnosed with cancer in Louisiana?

$H_0$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were no significant differences in the number of children annually diagnosed with cancer in Louisiana.

$H_1$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were significant differences in the number of children annually diagnosed with cancer in Louisiana.

RQ2—Quantitative: Were there significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively?

$H_0$2: There were no significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

$H_1$2: There were significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

RQ3–Quantitative: Were there significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period?

$H_0 3$: There were significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period.

$H_1 3$: There were no significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period.

In this study, the independent variables were the environmental contaminants (chemicals, pollutants, and toxins) present following Hurricanes Katrina, Rita, and Gustav, and the dependent variables were the rate (or number) of children diagnosed with cancer and types of childhood cancers apparent in Louisiana.

Theoretical Framework

This research used the conceptual model of uncertainty (Stewart et al., 2010), which was derived from Mishel's uncertainty in illness theory. As described by Stewart (2010), Mishel's uncertainty in illness theory identifies sources of stimuli surrounding uncertainty. In her theory, Mishel further discussed the impact that variables of symptom pattern, treatment of care, education, social support, and credible authority have on the state of illness and presented an explanation for uncertainty arousal (Mishel et al., 1988). In relation to uncertainty of illness, there are increases in day-to-day caring requirements, the complexities of managing associated activities, and changes in lifestyle and family dynamics, which, alone or collectively, may influence long-term health outcomes (Kazak et al., 2003). Furthermore, uncertainty in relation to chronic health conditions such as childhood cancer may affect the financial status as well as the social, community, and school interactions of the child and family (Kazak, 2003). As in Mishel's uncertainty in illness theory, uncertainty related to a child or adolescent becoming ill or being diagnosed with cancer as a result of being exposed to environmental pathogens, dealing with the side effects and/or treatment for cancer and other childhood diseases, and making required lifestyle and health management adaptations in order to cope (Simon, 2014) represents a major source of stress for patients and their families (Brown et al., 2008).

Various studies have examined the potential impact of childhood chronic illness on parents and families. The literature has identified a myriad of stressors that parents may experience while adjusting to the various components of the medical system and protocols, planning for the future, and experiencing general uncertainty with regard to their child's prognosis (Kazak et al., 2003). All of these experiences may lead directly and indirectly to anxiety, depression, posttraumatic stress, hopelessness, and feelings of loss of control for parents and the ill child (Brown et al., 2008). What is not known is how single or "alone" parents try to navigate the complex needs of maintaining a home, family, and a chronically ill child, and successfully adapt to these challenges (Brown et al., 2008).

Because knowledge of this statewide phenomenon is limited, without current and well-documented information, families face difficulties in determining "how or where" to obtain information and needed resources to address issues and concerns associated with a childhood diagnosis (Mendes, 2014). It is well documented that childhood cancer is a major, life-changing event that greatly affects quality of life for children and their families (Mendes, 2014). Through the current research, the severity of childhood cancer incidence may receive increased exposure, and insight may be provided into the urgent need to develop policies that address existing deficiencies in efforts to prevent environmentally hazardous conditions associated with illnesses of children, including childhood cancer.

The likelihood of developing cancer due to exposure to certain environmental contaminants and pollutants (Reuben, 2010) is often impacted by other factors, such as the amount and length of exposure and age at the time of exposure (Natural Resources Defense Council, n.d.). According to the Natural Resources Defense Council (n.d.), the risk of developing cancer due to exposure to certain environmental contaminants and pollutants substantially increases with age.

The Industrial Corridor, also known as Cancer Alley, consists of an 85-mile stretch along the Mississippi River from Baton Rouge to New Orleans (Sierra Club, 2015). In the late 1980s, the area gained local and national attention after numerous incidences of cancer were identified and reported in small rural communities along both sides of the river (Taylor, 2004). In St. Gabriel, one of these communities, 15 cancer cases were identified in a two-block area (Taylor, 2004). None of the reports indicated how many, or if any, of these cases involved children under the age of 18 years. The Industrial Corridor includes Ascension, East Baton Rouge, Iberville, St. James, St. John the Baptist, St. Charles, and West Baton Rouge parishes. These parishes collectively have come to be known as “Cancer Alley” because they have higher cancer incidence than the national average (Cancer Alley, Louisiana, 2000). In addition, the Natural Resources Defense Council (2011) noted that parishes outside Cancer Alley were known to also have cancer incidences that exceeded the national average; however, this information did not make reference to childhood cancer.

According to the Natural Resources Defense Council (2011), Louisiana has suffered from at least three confirmed disease clusters, two of which involve children. Clusters of cancer and other chronic illnesses have sometimes been linked to chemicals or other toxic pollutants in Louisiana communities. There is a need for better documentation and investigation of disease clusters in Louisiana to identify and address possible causes (Natural Resources Defense Council, 2011). This research study identified the increase in the environmental exposure variables and how the increase in these environmental variables and exposure to them has also increased the uncertainty of being diagnosed with cancer before the age of 19. This research study examined how environmental contaminants resulting from the aftermath of Hurricanes Katrina, Rita, and Gustav may correlate with the number of children diagnosed annually with cancer in Louisiana and determined if there were significant differences in the number of children diagnosed with cancer annually in Louisiana during the period immediately following Hurricanes Katrina, Rita, and Gustav (2004-2010).Theoretically, the possibility of environmental contaminants and related factors causing and contributing to the number of children diagnosed with cancer supports the notion that childhood cancer is preventable (Anand et al., 2008).

Nature of the Study

This quantitative study used the correlational research method because the study relied on numerical data and/or statistical treatment of the data to examine childhood cancer incidence numbers and types from 2004 through 2010 after major hurricanes in Louisiana. A quantitative approach was used for this study because the intent of this study was to determine the relationship between the number of children diagnosed with cancer and the types of cancers prevalent in Louisiana from 2004 through 2010 (dependent variables) and environmental contamination following Hurricanes Katrina, Rita, and Gustav (independent variable) present in Louisiana from 2004 through 2010. In addition, the experimental research design was carried out by examining measures of subjects before and after a treatment or event.

This study used data from the Louisiana cancer registry along with data from the Louisiana Department of Environmental Quality. Data from the Louisiana cancer registry identified the number of children diagnosed with cancer and the types of cancers children were diagnosed with annually from 2004 through 2010. The data from the Louisiana Department of Environmental Quality identified the types of environmental contaminants present following Hurricanes Katrina, Rita, and Gustav from 2004 through 2010. Data from these agencies were also used to compare the 2004 through 2010 findings to similar findings from 2000 through 2003.

The correlation method was chosen for this research study because it often identifies causal relationships, as in the case of health disparities, including cancers, caused by environmental toxins (Ames & Gold, 1997). The correlational method is pragmatic; collecting and/or analyzing correlational data is easy and inexpensive in comparison to experimental data (Creswell, 2009). Subsequently, very often cause-effect relationships become apparent through correlations detected in observational data.

In addition, this study examined the significance of environmental contaminants (chemicals, pollutants, and toxins) resulting from Hurricanes Katrina, Rita, and Gustav, respectively, and the possible correlation existing between these contaminants and the number of children diagnosed with cancer as well as the types of cancers prevalent in Louisiana (Chamiedes, 2009). The independent variables were the environmental contaminants (chemicals, pollutants, and toxins), and the dependent variables were the rate (or number) of children diagnosed with cancer and the types of cancers in Louisiana annually.

Data sets were analyzed using the IBM SPSS software program. Various types of statistical relationships existed among the variables, and these types of relationships involved some form of connection or association between the variables. This correlational quantitative research study used paired *t* tests and ANOVA to determine whether there were significant differences in the numbers and types of childhood cancers in Louisiana for the years 2004-2010 and compared the presence and rate of various toxins, contaminants, and pollutants in the environment to the rate of children diagnosed with cancer in Louisiana from 2004-2010. The paired *t* tests and ANOVA were chosen to analyze the archived data in this correlational research study because the connection may have been a causal one (i.e., changes in one variable may have caused changes in another variable or variables). Other associations among variables are no less real, but the causal nature of the connection may be obscure or unknown. Other variables may be related statistically even though there is no causal or real connection among them. Using the paired *t* test in this research study provided a means of testing whether a relationship between two variables existed. One way to consider a relationship between two variables in this correlational research study was to imagine that one variable affected or influenced another variable. ANOVA was also chosen to analyze the archived data used in this correlational research study because it is also useful in comparing variables between different groups.

Definitions

Carcinogens: Substances or agents that can cause cells to become cancerous by altering their genetic structure so that they multiply continuously and become malignant ("Carcinogen," 2015).

Childhood cancer (also known as *pediatric cancer*): Dependent variable in this study; refers to cancer in a child. In the United States, the term typically refers to cancer in an individual up to 14 years 11.9 months of age. However, the definition of childhood cancer may apply to young adults between 15 and 19 years old ("Childhood Cancers," 2015).

Contaminants: Independent variable; any physical, chemical, biological, or radiological substance or matter in water, air, or soil (U.S. Environmental Protection Agency, n.d.).

Environmental contaminants: Independent variable in this study; refers to biological, chemical, physical, or radiological substance(s) (normally absent in the environment) that, when accidentally or deliberately introduced into the environment, may have the potential to harm people, wildlife, and plants (Extension, 2015).

Hurricane: Independent variable; a tropical cyclone with winds of 74 miles (119 km) per hour or greater, usually accompanied by rain, thunder, and lightning ("Hurricane," n.d.).

Louisiana parish: Independent variable; one of the 64 divisions in the state of Louisiana that are similar to counties in other states ("Parish," n.d.).

Neoplasm: A tumor or tumors; any new and abnormal growth of tissue in some part of the body, in which cell multiplication is uncontrolled and progressive, especially as a characteristic of cancer ("Neoplasm," 2015).

Pollutants: Independent variable; substances that make something (e.g., air or water) impure and often unsafe ("Pollutant," nod).

Toxins: Independent variable; colloidal proteinaceous poisonous substances that are specific products of the metabolic activities of a living organism and are usually very unstable, notably harmful when introduced into the tissues, and typically capable of inducing antibody formation ("Toxin," n.d.).

Tumor: An abnormal mass of new tissue growth that serves no function in the body and is usually classified as benign or malignant (cancerous; "Tumor," 2015).

Toxic Release Inventory (TRI): A publicly available database containing information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities (U.S. Department of Health and Human Services, 2015).

Type of childhood cancer: Dependent variable in this study. Childhood cancers are generally more aggressive than adult cancers. Childhood cancers are rare, and only specially trained medical personnel have the knowledge and experience to properly treat them (American Childhood Cancer Organization, n.d.). Most childhood cancers fall into one of 10 specific types:

1. *Bone cancers*: The most common malignancies of bone tissues in children are osteosarcoma and Ewing's sarcoma.
    - *Osteosarcoma*: A bone tumor that occurs predominantly in adolescents and young adults.
    - *Ewing's sarcoma*: The second most common malignant bone tumor in children, comprising 10-15% of childhood bone cancers, with tumors most frequently occurring in teenagers.
2. *Brain cancers*: Account for about 15% of pediatric cancers and represent the second most common type of cancer in children; occur in various parts of the brain (American Cancer Society, n.d.).

- *Medulloblastomas*: Arise from primitive neuroectodermal tissue. Medulloblastomas is a general term for a collection of many different brain tumors that arise from undeveloped brain cells. These tumors are more common in boys than in girls and usually occur between the ages of 2 and 6 years (American Cancer Society, n.d.).
- *Ependymomas*: Arise from the cells that line the internal surfaces of the brain. These tumors arise from *ependyma*, cells that line the fluid spaces of the brain and spinal cord. This type of tumor occurs primarily in children and adolescents. These tumors are capable of malignant behavior; however, they are almost always benign (American Cancer Society, n.d.).
- *Astrocytomas*: Arise from brain cells that form part of the supportive system of the brain. These tumor types are usually slow growing. Many astrocytomas are considered curable, and they are particularly easy to remove completely (American Cancer Society, node).
- *Optical nerve gliomas*: Slow-growing tumors that form along the optic nerves; usually occur in children under the age of 10 years (American Cancer Society, n.d.).
- *Brain stem glioma*: Located in the brain stem; can be either slow or fast growing, and are more common in children than in adults. Surgery is usually not possible in these tumors; in such cases, radiation and chemotherapy must be used (American Cancer Society, n.d.).

- *Oligodendrogliomas*: Slow-growing tumors that arise from cells that make the myelin that insulates nerve fibers; usually located in the frontal and temporal lobes. In children, these tumors are more common in the thalamus (American Cancer Society, n.d.).
- *Gangliogliomas*: Usually slow growing, and rarely malignant. These tumors can be located anywhere in the brain but are most often found in the temporal lobe; frequently occur in children and young adults (American Cancer Society, n.d.).
- *Craniopharyngiomas*: Benign (noncancerous) congenital tumors. They are usually cystic and found primarily in children and adolescents (American Cancer Society, n.d.).
- *Pineal region tumors*: Located in the pineal gland at the posterior portion of the third ventricle. Over one-third of these tumors are located in this region. Most common in teenagers (American Cancer Society, n.d.).

3. *Hepatoblastomas*: Solid tumor cancers of the liver (American Cancer Society, node).
4. *Leukemias*: Cancers in which abnormal white blood cells are produced in the bone marrow. There are six types of leukemias. *Acute lymphoblastic leukemia* (ALL) and *acute myeloid leukemia* (AML) are the most common types occurring in children and adolescents (Leukemia & Lymphoma Society, (n.d.).

5. *Lymphomas*: Cancers that develop in the lymph system. Lymphomas are more common in boys. Lymphomas are classified as non-Hodgkin's and Hodgkin's types. Non-Hodgkin's lymphoma (NHL) is the more common lymphoma in children, frequently occurring between the ages of 10 and 20 years. Hodgkin's lymphoma is rare in children under 5 years of age (Leukemia & Lymphoma Society, n.d.).
6. *Neuroblastoma*: A solid cancer of the nerve tissue of the sympathetic nervous system. Neuroblastoma usually begins in early childhood, with about two-thirds of cases diagnosed before the age of 5 (American Cancer Society, n.d.).
7. *Retinoblastoma*: A malignancy of the retinal cell layer of the eye; the most common eye tumor in children. Diagnosis usually occurs before the age of 5 years. The tumor can occur in one eye (unilateral) or in both eyes (bilateral; American Cancer Society, (n.d.).
8. *Rhabdoid tumors*: Rare and highly aggressive tumors, generally found in the cerebellum. These tumors occur in young children; the mean age at diagnosis is 3.5 years, with a range from 2 to 13 years (American Cancer Society, n.d.).
9. *Sarcomas*: Soft tissue cancers. Soft tissue sarcomas in children can appear in muscle, fat, fibrous tissue, blood vessels, tendons, connective tissues, or other supporting tissues of the body. Sarcomas accounts for 5-8% of childhood cancers (American Cancer Society, n.d.).

10. *Wilms' tumor:* Wilms' tumor is the most common form of kidney cancer in children. Wilms' tumor can affect one kidney (unilateral) or both kidneys (bilateral; American Cancer Society, n.d.).

Assumptions

Louisiana relies heavily on oil and gas production, agriculture, and other natural resources for revenue and for the support of families residing in the state (Raimi & Newell, 2014). This research identified how the environment impacts the health of residents in the state, especially the most vulnerable, the children. According to Baily (2017), various chemicals have been identified as carcinogenic by a variety of health and environmental agencies, yet chemical exposure continues to be apparent but unaddressed throughout the state. In 2000, statistical data from the CDC showed that Louisiana had the second highest rate of cancer-related deaths in the United States. For this research study, I assumed that environmental contaminants (chemicals, pollutants, and toxins) were responsible for, or at least contributed to, the high cancer rates of children and adults in Louisiana.

Childhood cancer data were obtained from the SEER Program, the Louisiana Tumor Registry, the Louisiana Cancer Registry, and the Louisiana State Department of Environmental Quality. The SEER Program of the NCI was created with the intent of providing information on cancer statistics in an effort to reduce the burden of cancer in the United States. Every feature of the SEER Program, the Louisiana Tumor Registry, and the Louisiana Cancer Registry impacts data quality, including relationships with medical facilities and physicians in the coverage area, data collection system design and capabilities, qualifications and training of registry staff, and review of data for analysis and reporting (North American Association of Central Cancer Registries [NAACCR], 2015). The assumption was that data were properly coded and recorded into the registries.

Scope and Delimitations

The measures of childhood cancer and environmental contamination rates incorporated statistical data from 2004, which was 1 year before Hurricane Katrina, and through 2010, which was 2 years after Hurricane Gustav. The descriptive design was not chosen for this study because a descriptive approach only establishes an association between variables, whereas an experimental approach establishes causality. This research study also established an accurate estimate of the rate of childhood cancer diagnosis in Louisiana from 2004 through 2010, while also identifying known carcinogenic contaminants present in the environment from 2004 to 2010, possibly establishing a correlational relationship.

Observations (February 2009 and January 2010), indicate that Louisiana and Illinois patients make up a significant portion of the annual treatment population at St. Jude Children's Research Hospital in Memphis, Tennessee. Louisiana was chosen for this study because there appears to be a dense population of children treated at St. Jude Children's Research Hospital annually who are from Louisiana; because the state is prone to flooding, which is a major means of spreading pollution and contaminants; and because there is an area in the southern region of the state known as "Cancer Alley." Cancer Alley includes Ascension, East Baton Rouge, Iberville, St. Charles, St. James, St. John the Baptist, and West Baton Rouge parishes. The overall cancer incidence rates in this geographic location are significantly higher than elsewhere in the state and exceed statewide rates for all cancers combined (Hsieh et al., 2014).

An issue identified with this research study was changes in the rates of children diagnosed with cancer in Louisiana from 2004 through 2010, which could have been due to something other than the pollutants, chemicals, and contaminants present in the environment following Hurricanes Katrina, Rita, and Gustav. Examining data from 2004 through 2010 with a crossover design may be a solution to this problem, in that it provides a reference point. For this experimental study, I used data from state and federal agencies in order to address reliability issues. The results for this research study are not generalizable because environmental data may vary among adjacent states and states located in this region.

Limitations

A majority of the children diagnosed with cancer in Louisiana are treated at St. Jude Children's Research Hospital in Memphis, Tennessee. Following Hurricanes Katina and Rita, a substantial portion of Louisiana's population temporarily and/or permanently relocated outside the state. A major limitation of this study on childhood cancer and environmental factors, as with many studies conducted after 2008 that are used as references, was that many families relocated to other areas in Louisiana and to other states following Hurricanes Katrina, Rita, and Gustav. Those families relocating to Texas that experienced a childhood cancer diagnosis would likely have sought treatment at Texas Children's or M. D. Anderson in Houston, Texas, whereas families who relocated to other states might have chosen treatment for their children at medical facilities in closer proximity (instead of St. Jude's) and participated in the SEER reporting process. However, the statistics did not take into account those children who received and are receiving treatment at other facilities, and whose cancer diagnoses are being appropriately treated using St. Jude protocols.

A major challenge in studying childhood cancer incidence is the scarcity or absence of current and relevant literature on this topic (Charlson et al., 2009). Moreover, studies specifically addressing cancer incidence in Louisiana primarily pertain to adult cancers, making minimal (if any) reference to childhood cancer numbers, rates, and/or incidence.

The American College of Surgeons Commission on Cancer (CoC), the CDC National Program of Cancer Registries (NPCR), and the SEER Program of the NCI have collaborated to clarify coding rules and instructions to provide a consensus on data collection issues (SEER, 1998). This research study may have been impacted by coding rules and instructions that were changed for cancers diagnosed in utero, or prior to birth, in 2009. For cases diagnosed prior to 2009, SEER recorded the actual diagnosis and treatment dates, even when the dates occurred prior to the date of birth (SEER, 1998). Another limitation with data from SEER is that the program does not add a cancer incidence diagnosis to the data analysis if the area of the diagnosis has less than 16 cases (SEER, 1998).

The correlational design was appropriate for this research study because the number of subjects needed was low and the estimate of the relationship was less likely to be biased, given that the sources provided an abundance of data for a reliable investigation. Data had been retrieved from randomly selected samples representing the state's population of children diagnosed with cancer. This study focused on archived statistical data and environmental contaminants specifically identified in Louisiana from 2004 through 2010 following Hurricanes Katrina, Rita, and Gustav; there was limited consideration given to connecting states or other states within the region.

Significance

Since the late 1970s, researchers have increasingly directed their attention to studies focusing on understanding the impact of childhood cancer on the lives of children and their families. However, a limited number of research studies have acknowledged the numerous challenges that families must endure when faced with a childhood cancer diagnosis (St. Jude Patient Education, 2014). In general, TV and newspaper media coverage of childhood cancer is only apparent during the various St. Jude home giveaways that occur throughout the state several times a year. Although St. Jude commercials air frequently on local TV and radio stations, the hospital's efforts for children diagnosed with cancer and treated at St. Jude Children's Research Hospital are not widely publicized or well known among the general public in the state of Louisiana

(Baton Rouge Cancer Services Resources, *2*011). The significance of this research study resides in the effort to encourage greater exposure for St. Jude, specifically pertaining to children diagnosed with cancer, as well as to highlight the unusually large population of Louisiana children treated at St. Jude annually (St. Jude Children's Research Hospital*,* 2009).

Given that childhood cancer continues to be a growing problem in Louisiana (WHO, 2012), the findings from this study may result in increased media exposure that specifically informs those residing in Louisiana of the prevalence of childhood cancer in the state. Cancer researchers and clinicians largely agree that success in eliminating cancer will be achieved by implementing prevention strategies focused on early detection, which occurs through regular examinations by trained medical personnel. These preventative measures should primarily focus on developmental periods, when cancers such as leukemias are most prevalent (American Cancer Society, 2009).

This study spotlighted childhood cancer as a rapidly growing health disparity affecting children in Louisiana. Results of this study identified childhood cancer as a preventable health priority that is adversely impacted by the environment. The findings of this research study indicate a need for more extensive prevention-focused research. An increase in research initiatives is needed to focus specifically on the most vulnerable population impacted by a cancer diagnosis (Sly, 2012).

This research study changes or at least challenges current perspectives on addressing childhood cancer. This quantitative research study establishes and promotes childhood cancer prevention as a health priority, especially after identifying and/or establishing a link between adverse environmental exposure and children being diagnosed with cancer after Hurricanes Katrina, Rita, and Gustav.

Findings from this study should also encourage and promote the development of a protocol or protocols focused on early cancer detection. Such protocols need to be implemented into routine screenings for leukemia and lymphoma, the most common and most curable cancers of children younger than 19 years of age (Peek & MeInyk, 2010). Current genomic research studies also suggest that the susceptibility of children to cancer may be particularly impacted by specific environments (Pui, 2014).

Summary

Cancer continues to be a major health issue for adults and children in Louisiana (SEER, 2013). Environmental pollution and contamination also remain growing problems in the state (Helsloot, 2012). The vulnerability of children to environmental hazards is enhanced because they spend more time exposed to environmental factors than adults do. This associated risk is related to an array of health disparities in children. They are exposed to environmental chemicals via air, food, and water, as well as through the skin.

This research study on childhood cancer in Louisiana has identified pollutants and contaminants present throughout the state that may have contributed to health problems in children, as indicated by the increased rate of childhood cancer and cancer types documented in Louisiana between 2004 and 2010 (Fontham, 2009). This research study used data from state and federal environmental agencies, including the Louisiana Department of Environmental Quality (LDEQ), the Environmental Protection Agency (EPA), and other environmental agencies within the state, to determine the presence and levels of chemicals, pollutants, and toxins following Hurricanes Katrina, Rita, and Gustav and how the presence of these pollutants and contaminants may have caused or contributed to the increased number of childhood cancer cases in Louisiana during the years following these historic hurricanes from 2004 and 2010 (Fontham, 2009).

The environment of a developing child is very important, given that the period from before birth to age 19 is when individuals are most vulnerable to the harmful effects of exposure to environmental factors (Sly, 2012). This period of development is characterized by rapid cell growth in children, adolescents, and young adults (Anderson, 2011). Because of the special vulnerability of children to their environment, greater efforts and implementations are needed to address these major risk factors resulting from exposures to environmental chemicals and toxic agents. Statistical data identifying Louisiana's incidence of cancer among children younger than 19 years of age from 2004 to 2010 were obtained from the SEER Program via the Louisiana Cancer Registry, Louisiana State University Health Science Center, and LDEQ.

In Chapter 2 of this research study, I elaborate on the increased number of childhood cancer cases in Louisiana and the potential harm that environmental components in Louisiana posed for children exposed to them following Hurricanes Katrina, Rita, and Gustav. Research studies, journals, news articles, the St. Jude Family intake information manual, and Internet sources were used to examine and establish possible links between environmental factors and the rates of certain types of cancers in children. By identifying harmful environmental factors and linking them to specific types of cancers and the most common cancers in children, it may be possible to implement more preventive care and health initiatives to reduce and/or prevent child cancer diagnoses in Louisiana annually.

Chapter 2: Literature Review

Introduction

Childhood cancer incidence continues to be a major health concern worldwide (WHO, 2012), as well as in the United States (Howler et al., 2013). Cancer is responsible for more deaths of children over 6 months of age than any other disease (Bleyer, 2012). Childhood cancer also seems to adversely impact children in Louisiana at an above average rate. This research study identified the number of children diagnosed with cancer, and the types of cancer occurring, from 2004-2010 in the United States and in Louisiana, while identifying the presence of hazardous chemicals and environmental contaminants after Hurricanes Katrina, Rita, and Gustav, respectively. This study also examined possible correlations between the presence of environmental pollutants and contaminants and the increased number of cancer cases in children residing in Louisiana between 2004 through 2010, 1 year before Hurricanes Katrina and Rita and 5 years after Hurricanes Katrina and Rita and 2 years after Hurricane Gustav, respectively.

Most public health experts believe that because the number and rate of childhood cancers continue to increase significantly (Cancer Facts, 2012), there is cause for concern. Public health professionals attest that the general public is more aware of HIV/AIDS, human papillomavirus (HPV), and obesity as health issues impacting this age group in comparison to cancer (SEER, 2013). This is primarily because the general public believes that these health issues are more or less treatable, curable, and/or preventable (Halpin, Morales-Suárez-Varela, & Martin-Moreno, 2010). Much like a cancer diagnosis, these health conditions exist primarily due to a cause-and effect event (Pan et al., 2010).

Chapter 2 provides more detailed information on risk factors associated with cancer incidence in children and adolescents. Chapter 2 also contains an overview of literature identifying trends in childhood cancer incidence; exposure to toxins, pollutants, and chemicals that are suspected of being carcinogenic to humans; and the presence and risk factors associated with contaminants, chemicals, and toxins identified in the environment after Hurricanes Katrina, Rita, and Gustav.

Literature Search Strategy

The primary intent for this review was to provide background information about environmental conditions that were prevalent following Hurricanes Katrina, Rita, and Gustav and to examine this association with the number of children diagnosed with cancer in Louisiana. Methods for execution of this literature review included searching for peer-reviewed and academic literature using databases and other resources, including the Walden University Digital Library, Google Scholar digital data, InfoSci Full Text Journals, Cumulative Index to Nursing and Allied Health Literature (CINAHL), MEDLINE with Full Text, the WHO with Full Text, St. Jude Children's Research Hospital with Full Text, Louisiana Tumor Registry, NCI with Full Text, American Cancer Society with Full Text, and applicable resource books. The following keywords were used alone and in combination as search terms: *childhood cancer*, *pediatric cancer*, *environmental toxins*, *hurricane environmental aftermath*, *environmental contaminants*, *environmental health hazards*, and *environmental chemical hazards and child health*. Only text in English was reviewed, with most literature published between the years 1995 and 2015.

The search produced 56 research resources. However, 29 research sources were used in the correlational quantitative research study. The rejected study resources were outdated or focused on childhood cancer survivorship, which did not enhance the focus of this research study. These key words retrieved few current studies on childhood cancer in the United States and/or in Louisiana and a few studies on childhood cancer, the environment, and those environmental contaminants presently suspected of being carcinogenic. Although the majority of articles were full text and peer reviewed, many articles were not from within the past 5 years; these, however, contained pertinent accountings of the environmental composition throughout Louisiana following Hurricanes Katrina, Rita, and Gustav. The search also yielded excerpts from panel studies conducted by the CDC, the National Center for Chronic Disease Prevention and Health Promotion, the American Cancer Society, the NCI, the NPCR, the NAACCR, and the SEER Program.

Cancer Rates in the United States

The SEER Program of the NCI provides annual information on the nation's cancer incidence in an effort to address and reduce the burden of cancer in the United States (Edwards et al., 2010; NCI, 2006-2013). Through its annual statistical reports, the

SEER Program remains the professional authority on data providing evidence of the growing rate of children diagnosed with cancer annually in the United States.

Early statistics released by SEER referencing the number of children in the United States diagnosed with cancer from 2004-2010 were briefly referenced in the 2013 SEER data; U.S. cancer statistics 1975-2010 (Howlader et al., 2013). Automobile accidents are the only other event that statistically, has been more responsible for the death of children 18 years and younger in the United States (Edwards et al., 2013). According to Edwards et al. (2013) and Pellegriti et al. (2013), the rate of cancer incidence has experienced continuous growth worldwide and in the United States over the past two decades. The severity of this disease in the United States has been identified in several reports, articles, and forums, and through SEER-generated reports. This childhood cancer study provides an indication of how and to what extent chemicals and toxins like those present in the environment after Hurricanes Katrina, Rita, and Gustav may alter immune system function (Pan et al., 2010), which may increase the risk of developing diseases such as cancer (Steingraber, 2009), especially in reference to concerns compounded by contaminated and polluted water sources (Steingraber, 2009). Results from this study and similar studies could provide a knowledge base for the development of preventive practices such as screenings and routine health assessments, or at least for efforts to reduce the number of children diagnosed with cancer annually as a result of environmental exposures. According to WHO (2010), 90% of cancers are rooted in environmental or behavioral causes. This supports the need for increased research efforts focusing on the environment and how it impacts the health of children (Mendez, 2014).

A collaborative report of the September 2008 and January 2009 Presidential Cancer Panel composed by various medical experts on cancer was presented to special interest groups, legislators, lobbyists, and health agencies to indicate the status of cancer in the United States. Reuben (2010) provided a detailed accounting of the Presidential Cancer Panels, which specifically identified research focused on environmental factors linking genetic, immune, and endocrine dysfunctions that are suspected of leading to diagnoses of cancer and other diseases.

In a research article, Peek and Melnyk (2010) noted that there are over 12,000 children diagnosed with cancer in the United States annually. Although medical advances have improved the survival rate for childhood cancer, Peek and Melnyk noted, pediatric cancers continue to negatively impact the mental health and coping outcomes of diagnosed children and their parents. This current study further identified the number of children diagnosed with childhood cancer in the United States and in Louisiana annually, described the uncertainty associated with this unexpected illness (Stewart et al., 2010), provided supporting evidence identifying the physical, financial, and mental health difficulties experienced by children, and parents of children, after surviving a cancer diagnosis (Fletcher, 2010); and noted the burden that childhood cancer incidence presents on the state and national health systems (U.S. Burden of Disease Collaborators, 2013).

Cancer Rates in Louisiana

In an early study V. W. Chen et al. (2002), identified children diagnosed with cancer from 1988-1996. Data from the Louisiana Tumor Registry were also used to identify children 15 and younger who had been diagnosed with cancer, as well as the specific types of cancers represented within this population. This study expanded on the research findings of the previous study by V. W. Chen et al. (2002) and incorporated methodology used in a book by Yu et al. (2011), which addressed various studies examining the biological and health effects that pollutants, toxins, and contaminants may have had on children diagnosed with cancer in Louisiana from 2004-2010.

In the V. W. Chen et al. (2002) research study on childhood cancer in Louisiana from 1986-1996, data from the Louisiana Tumor Registry were used to examine cancer incidence among children younger than 15 years. Cases for this current study included children diagnosed and treated for childhood cancer at any hospital and medical facility in Louisiana, at St. Jude Children's Research Hospital in Memphis, at M. D. Anderson in Houston, and at hospitals in neighboring states. Rates and numbers were age-adjusted and compared to the combined rates and numbers of the SEER Program. The significance of rate differences was assessed at the 0.05 level. From 1988-1996, approximately 125 children were diagnosed with cancer each year. The results from this study indicate that rates were higher in younger children than in older children, higher in males than in females, and higher in White children than in African American children. The five most commonly diagnosed childhood cancers in Louisiana from 1986-1996 were leukemias (28%), central nervous system malignancies (22%), lymphomas (13%), renal tumors (8.4%), and soft tissue sarcomas (7.6%).

Andrew et al. (2013) conducted a comparative study examining cancer incidence rates for all populations in Louisiana, in an effort to identify how these rates compared to cancer incidence rates in the United States from 2006-2010. In their study, entitled "Cancer in Louisiana, 2006-2010," only a small section referenced cancer among children and adolescents. According to Andrews et al. (2010) study, Louisiana incidence rates for invasive cancer among children and adolescents in the 0–14 and 0–19 age groups were significantly lower than national rates for 2006-2010. Andrews et al. (2010), states that each year, approximately 130 cases were diagnosed among children ages 0-14, and about 60 were diagnosed among children aged 15-19. Although this current study stated that all populations were included, the information on childhood cancer was limited. In addition to the minimal information provided on childhood cancer incidence, this information did not sufficiently address the associated limitations resulting from the 2005 hurricane events. The areas primarily impacted by Hurricanes Katrina and Rita the Gulf Coastline, parts of Texas, and the Gulf of Mexico, were barely mentioned. A significant number of families were forced to relocate 2 to 3 times within a 30-day period, then again 3 years later (Boin et al., 2012). Initially, many families moved to other areas within the state, and subsequently Hurricane Rita forced many of these families to relocate a second time, likely to other states. Boin et al. (2012) further identified that in crisis situations such as Hurricanes Katrina, Rita, and Gustav, obtaining data representative of the population is challenging because many families have permanently relocated to other states.

In my personal observation, few studies have been conducted to provide strong quantitative evidence that could associate the hazardous environmental conditions resulting from Hurricanes Katrina, Rita, and Gustav with the unusually large population of children diagnosed with cancer and treated at St. Jude for the period immediately following these events between the years 2004 and 2010. In addition, even fewer studies have been undertaken linking the uncertainty of being diagnosed with childhood cancer to causes associated with environmental toxins, contaminants, and pollutants, especially after weather forces similar to a hurricane (Yu et al., 2011).

Environmental Factors and Pollutants

A study conducted by the American Cancer Society (2009) provided resources for preventing cancer risk from environmental toxic pollutants. In this study, several toxins and pollutants were identified as hazardous to the health of humans. A research study conducted by Yu et al. (2011) also involved an examination of biological and health effects associated with environmental pollutants. In a report generated by the President's Cancer Panel (Reuben, 2010), several expects in the field of human health suggested measures and implementations addressing the reduction of environmental cancer risks.

Thompson et al. (2008) investigated various environmental factors that have been linked to childhood cancer, including industrial pollutants and population mixing. Thompson et al. (2008), examined the Geographic Risk Modeling of childhood cancer associated country level crops, hazardous air pollutants, and population density characteristics for a population in Texas. Texas is a neighboring state bordering to the west of Louisiana. "Cancer in Louisiana, 2006-2010" by Andrews et al. (2013) was similar in relating cancer incidence to pollutants. In another similar study, Boffetta et al. (2003) assessed environmental factors suspected of contributing to the risk of being diagnosed with cancer. This current childhood cancer study seeks to identify the contribution of environmental factors associated with the risk of being diagnosed with cancer. Andrews et al. and Boffetta et al. (2003), both examined assessments of environmental factors contributing to the risk of being diagnosed with cancer in general, rather than receiving a cancer diagnosis in childhood specifically, which could have resulted in differences in the incidence rates.

Parlikar (2013) conducted a comparative study identifying the differences between cancer in children and in adults, and Sly et al. (2012) discussed the impact of environmental toxins and pollutants on the diagnosis of cancer in children and adolescents, taking into consideration the special vulnerabilities of children and adolescents. Chamiedes (2009) further supported the notion that exposure risks are more prevalent during various developmental periods in children, adolescents, and young adults. Anand et al. (2008) stated that cancer is prevalent in children due to their immature and rapidly growing cells, their developing immune systems, and the extended lengths of time in which children and young adults are exposed to environmental toxins and pollutants (Chamiedes, 2009).

Findings from Sly et al. (2012) and Chamiedes (2009) were further supported in a study by Simon (2014), who identified the types of cancers more prevalent at certain stages in life. Simon stated that children and adolescents diagnosed with cancer have unique needs, have been exposed to environmental contaminants, and have a risk of prolonged and frequent exposure to these contaminants The fact that environment-related cancers are more prevalent in young children and adolescents because of their prolonged and frequent exposure provides a baseline for the immediate need to implement programs such as the Risk Evaluation/Corrective Action Program in Louisiana (Chamiedes, 2009). The adverse effects of prolonged and frequent exposure to industrial sites, gasoline, and gasoline byproducts were discussed in an article titled "The 24/7 Wall St. Ranking of the 10 Least Green States (2011)" According to this article, several industrial entities in the United States are able to pollute the environment without consequences.

Sources of Environmental Challenges in Louisiana

Louisiana is one of the nation's most industrialized states, and its industrial entities are largely responsible for and/or contribute to pollution and contamination of all aspects of the environment in Louisiana (Louisiana Department of Environmental Quality, 2011). According to Kotkin (2014), Louisiana is primarily a "blue collar" state that is financially dependent on the petrochemical and gas industry. The oil and gas industry is a major part of Louisiana's economy: Louisiana is America's third largest producer of petroleum and the third leading state in petroleum refining (Scott, 2014). As

Scott (2014) reported, Louisiana also has the greatest concentration of crude oil refineries, natural gas processing plants, and petrochemical production facilities in the Western Hemisphere. Louisiana is the second largest producer of natural gas in America (Kotkins, 2014). In addition to its lucrative petrochemical and gas industry, Louisiana is also home to two nuclear power plants (Nuclear energy in Louisiana, 2012) and six coal-fired power plants (Existing coal plants in Louisiana, 2014). Because of the financial impact of the energy industry in Louisiana, it is difficult to publicize the negative impact of this industry on human health in general and the health of children specifically (Scott, 2014).

Louisiana's water pollution is deplorable and ranks in the bottom five of the 50 states for releasing carcinogenic toxins, total water pollution, and chemicals which can cause birth defects (10 most and least green US states, 2011). At roughly 3.8 million tons annually, Louisiana also produces the third-most toxic waste each year (Wall St ranking of the ten least green states, 2014). People; including children, living near large industrial facilities, are more likely to experience the adverse effects of long-term exposure to toxic air pollutants (Toxic Air Pollutants Fact Sheet, 1998). In light of Louisiana's deplorable environmental rankings, improving the overall environment should be the starting point for Louisiana's "war on preventing and curing childhood cancer.

Theoretical Framework

The uncertainty of becoming ill due to causes associated with exposure to environmental toxins, contaminants, and pollutants is a major concern since all humans are at risk of developing some form of cancer (Nelson, 2001). The uncertainty in Louisiana is often compounded by environmental disturbances generated and/or resulting from harsh weather conditions like hurricanes (Demirbilek et al., 2010). The uncertainty of becoming ill due to causes associated with exposure to environmental contaminants, especially children, provides a basis and demonstrates a need for implications for additional clinical practices and future research (Anand et al., 2008). This is especially true for environmental related cancer research that focuses on three major areas: addressing and reducing the uncertainty of becoming ill by implementation of preventive measures, an in depth study of the long-term effects of human exposure to environmental toxins, contaminates, and pollutants following weather disturbances like Hurricanes, and an examination of the offspring of children exposed to environmental toxins, contaminates, and pollutants after post Hurricanes Katrina, Rita, and Gustav (Stoppler, 2005).

Mishel's theory of uncertainty in illness was developed by Merle Mishel, a nurse whose father was dying of colon cancer (Alligood et al., 2010). Mishel realized that her father attempted to control certain aspects of his life while trying to deal with the uncertainty of his illness (Alligood et al., 2010). Mishel initially referred to what her father was experiencing as ambiguity. However, as a part of dissertation for her doctoral degree, Mishel created the scale for the testing of perceived ambiguity in illness, which was later renamed the Mishel's uncertainty in illness scale. Mishel's uncertainty in illness theory was chosen for this study because this theory of uncertainty in illness is strongly supported among subjects who are experiencing the acute phase of illness or by a subject who is experiencing a rapid decline in their heath (Mishel et al., 1988). In a previous research study on childhood cancer (Lee et al., 2009), Mishel's uncertainty in illness theory provided an opportunity for examining possible causes for the increasing rate of childhood cancers and for the increasing number of patients relapsing (De Graves et al., 2008). Mishel's uncertainty in illness theory was chosen for this study since it correctly identifies childhood cancer as a health priority, warrants and supports an increase in clinical research trials and studies to establish preventive measures that may reduce the rate of children experiencing and dealing with the uncertainty of being diagnosed with an acute illness (Mishel, 1997). Mishel's uncertainty in illness theory also establishes the need to examine the long-term effects of children 18 years and younger, who were exposed to toxins, contaminants, and pollutants after Hurricanes Katrina, Rita, and Gustav (Lee et al., 2009).

Various research studies; Gottlieb et al. (2010), Yu et al. (2011), and Brulle et al. (2006) have established that exposure to toxins, contaminants, and pollutants may alter genetic transcriptions in humans. This may increase the risk of being diagnosed with a childhood cancer by the offspring of the children exposed to toxins, contaminants, and pollutants, after Hurricanes Katrina, Rita, Gustav, and similar environmental disturbances. Mendes (2014) addressed the toxicity of chemotherapy and radiation use to treat children diagnosed with cancer. In this article Mendes (2014) identified that these lifesaving treatments are toxic and have detrimental risks, including an increased rate of relapsing. Finally, Mishel's uncertainty in illness theory collaborates with the research findings by Anand et al. (2008), who expresses that cancer is a preventable disease, but only with major lifestyle changes that include reducing exposure to harmful environmental factors.

The uncertainty of illness theory will provide the theoretical framework for this study and how environmental factors may contribute to the uncertainty of becoming ill from environmentally related illnesses like cancer. Theoretically, various research studies similar to Anand et al. (2008) suggest that 90–95% of all cancers are caused by environmental exposure and lifestyle choices. The research questions will attempt to support theoretical framework of this study by identifying if level of environmental contaminants in Louisiana were present and/or at higher than normal levels following Hurricanes Katrina, Rita, and Gustav, while the research questions provide data identifying if the annual rate of children diagnosed with cancer, and type of cancer, in Louisiana significantly increased following Hurricanes Katrina, Rita, and Gustav. The research questions will further explore if it is reasonable to assume that there is a correlation between the environmental make up following Hurricanes Katrina, Rita, and Gustav and the number of children diagnosed with cancer in Louisiana from the 2004-2010-time period.

Environmental pollution has been linked to various cancers (Belpomme, 2007) and children living in Louisiana are more likely to be exposed to environmental pollution due to dense population of industrial facilities in the state. In the article, "Wall St

Ranking of the ten least green states" (2011), the presence and effect of Benzene is discussed. Benzene is a known cancer-causing substance found in gasoline, cleaning solvents, and often found in air and water samples in Louisiana. Gasoline sold in the United States is composed of approximately 1.6 percent benzene. Exposure to benzene has been associated with childhood leukemia diagnosis (Sly et al., 2012) however, for the most part, evidence isolating specific agents definitively as carcinogenic to humans is still inconclusive; moreover, many of these agents are suspected of contributing to cancers that develop many years after exposure during childhood (Donato et al., 2006). According to Belpomme (2007), specific environmental hazards are suspected of contributing to certain childhood cancer. A major environmental factor associated with childhood leukemia is motor vehicle exhaust (Anand et al., 2008). According to Anand et al. (2007), childhood leukemia has also been linked to chlorinated drinking water, nitrates in drinking water and pesticides. Pesticides have also been identified as a notable culprit or contributing factor in Lymphoma, brain tumors, Wilms' tumors, Ewing's sarcoma, and germ cell tumors (Anand et al., 2008, p. 2103). Environmental factors are potentially modifiable (Griggs, 2004), especially those that present notable threats to children's health (Sheffield et al., 2011). According to Sheffield (2011), grasping a more in depth understanding of prevention strategies and the modifiable nature of environmental factors; and how environmental factors may cause or contribute to a childhood cancer diagnosis, will further lends itself in support of the theory that identifies childhood cancer as a preventable health disparity (Irigaray et al., 2007).

Epidemiology and Environmental Health

Conducting research on the environment with reference to epidemiology assessments is problematic according to Allen (2005). The article by Allen (2005) provides an extensive discussion of problems associated with assessing toxic data that makes references to environmental health. In the immediate aftermath of a disaster, there is the potential for increased incidence of infectious diseases (Stephens, 2007). This was also the case in New Orleans and other areas in Louisiana after Hurricanes Katina and Rita, along with the added risks associated with exposure to contaminants, toxins, and pollutants (Environmental Protection Agency, 2007). A major challenge associated with assessing toxic data that makes references to environmental health is that other variables can and often impact research outcomes (Thompson, 2008).

After Hurricanes Katrina and Rita, September and October 2005

An article by Pardue et al. (2005) elaborates on the presence of several chemicals and toxins in the floodwaters post Hurricane Katrina. Another study by Reible et al. (2006) identified an excess of approximately 565 oil spills noted in the wake of Hurricane Katrina. In addition to the release of toxin from the oil spills, more than 100 commercial business establishments; services stations, pest control businesses, dry cleaners, etc., may have contributed to presence of toxins and contaminants released into the floodwaters associated with Hurricane Katrina and Rita (Reible et al., 2006). In articles by Pelley et al. (2006) and Lamphear et al. (2005); Lead was identified as a notable hazard in Post-Katrina Sludge, and Rabito et al. (2011) also discussed environmental lead after

Hurricane Katrina while identifying specific implications for future populations. Both studies identified the presence of lead above recommended levels in soil and dust samples, around residences, and in the sludge residuals present after receding floodwaters of Hurricane Katrina (United States Environmental Protection Agency, 2011).

In a research study conducted by Presley et al. (2006), several chemical pathogens and toxins where identified in an assessment of the environment following Hurricanes Katrina and Rita. An assessment of receding waters and soil sediments post Hurricanes Katrina and Rita identified the presence of varying concentrations of aldrin, arsenic, lead, and seven semivolatile organic compounds in sediments/soils (Presley et al., 2006, p. 470). According to levels established by the United States Environmental Protection Agency, all levels assessed following Hurricanes Katrina and Rita exceeded one or more thresholds for human health soil screening levels and high priority bright line screening levels (USEPA, 2011). In addition to the immediate potential for adverse human health concerns, these high levels found in soil screening levels and bright line screenings may also pose harmful long-term risks of health disparities to families moving back into areas throughout the state devastated by these storms (Stoppler, 2005).

In a research article by Santella et al. (2010), several hazardous materials from various industrial sites were identified in an assessment of runoff and standing water and soil sediment along the industrial corridor post Hurricane Katrina and Rita. Similar assessment processes were conducted and discussed in depth in an article by Roper et al. (2011) which elaborated on the presence of toxins in the public water systems and the measures implemented in assessing and monitoring water quality after Hurricane Katrina and Rita. An article by Pardue et al. (2005) further identified the widespread of floodwaters and the extensive statewide areas impacted by Hurricane Katrina. The effects of Hurricane Katrina (August 2005), was widespread and accompanied record setting floodwaters across the 64 parishes in Louisiana (Pardue et al., 2005). Hurricane Katrina was one of the deadliest and economically devastating natural disasters in the United States. Stephens (2007), states that following Hurricane Katrina and additional devastation by Hurricane Rita, Louisiana was faced with many challenges associated with flooding and standing waters.

After Hurricane Gustav, August-September 2008

It was difficult to identify and /or distinguish between damages from Hurricanes Katrina and Rita since these events occurred less than 30 days apart (Brown et al., 2008) however, the tedious process of rebuilding from Hurricanes Katrina and Rita compounded the recovery process of Hurricane Gustav (Boin et al., 2012). In an article by Boin et al. (2014), the authors compared the crisis management procedures; including assessment of utilities and public resources and cleanup and rebuilding efforts of infrastructures, resembled those implemented in response to post Hurricanes Katrina and Rita. Forbes et al. (2010) conducted a study evaluating the Storm Surges produced by Hurricane Gustav in 2008. Findings from this study identified many of the same toxins, pollutants, and contaminants previously found in post Hurricanes Katrina and Rita aftermath. Boin et al. (2014) insisted that very little was learned from the devastation of

Hurricanes Katrina and Rita. Boin et al. (2014), compared the crisis management recovery efforts of Hurricane Gustav to the efforts health agencies use to address public health concern. In general, more efforts were focused on addressing health issues after they had impacted a massive amount of a population, or when it has become a major health issue. In response, the costs associated with addressing and managing this health concern became a financial burden on the health system.

The articles identified in this study were chosen based on the reliability of the information and/or statistical data provided, in support of the independent variables: the environmental contaminants (chemicals, pollutants, and toxins) present in the environment following Hurricanes Katrina, Rita, and Gustav. The articles chosen for this study on childhood cancer and the impact of exposure to environmental contamination provided information and statistical data which supports the dependent variable: the rate (or number) of children diagnosed with cancer in Louisiana from 2004-2010. The articles chosen provides statistical data indicating the prevalence and severity of this health concern, identified the associated health and financial impact of a cancer diagnosis of children ages 0 to 19 years, and their families, and provides pertinent and sufficient information representing the experiences of childhood cancer patients in Louisiana, in the United States, and around the world.

The use of these articles provided data and/or statistical information that produced a description and explanation of the contaminants, pollutants, and toxins present in the environment and to what extent and the amounts of these contaminants, pollutants, and toxins as they existed after Hurricanes Katrina, Rita, and Gustav. Examining environmental composition and childhood cancer data from articles focused on the period immediately following Hurricanes Katrina, Rita, and Gustav, provided information that strongly supported the premise that environmental contaminants, pollutants, and toxins as a cause and/or contributor to the rising number of children under the age of 18 years, who are diagnosed with cancer in Louisiana annually.

Summary

This chapter highlighted the presence of various contaminants, toxins, and pollutants that existed in the environment throughout the state of Louisiana, after Hurricanes Katrina, Rita, and Gustav. Although the data supports some premises of the study, there is not adequate evidence to declare a "root-cause" finding. This chapter also examined the public health disparity of childhood cancer in Louisiana, while identifying the need for, and the importance of adequate surveillance, early detection, and implementation preventive methods. Although there are established protocols used by data collecting agencies, accuracy of reporting of childhood cancer incidences needs modifying to include every diagnosis. Initiatives geared towards increasing public awareness of the severity and the impact childhood cancer has on children in Louisiana, under the age of 19 years and the associated burden childhood cancer imposes on the state and national health system.

This study on childhood cancer and the environment post Hurricane Katrina, Rita, and Gustav begins a positive initiative towards filling the existing gap in environmental literature that associates childhood cancer with environmental factors that were apparent in abundance after Hurricane Katrina, Rita, and Gustav. In addition, this study identified specific environmental contaminants that are suspect for causing, or at least a contributing factor in the diagnosis of specific childhood cancers or significantly contributing to an increased risk of being diagnosed with cancer prior to turning 19 years of age. This study also provided depth in extending existing knowledge on the prevention, treatment, and post treatment experiences of children and adolescents.

Chapter 3 provided details about the methodology used to investigate contaminants, toxins, and pollutants, for identification of the rate of children diagnosed with cancer annually, and to identify if a possible correlation exists between the presence of environmental contaminants and the rising rates of childhood cancer incidences among children ages 0-18 years in Louisiana. Chapter 3 also included a description of the research design and methodology, the sample population with justification of the diagnostic measures used to confirm environmental exposure, the rate of childhood cancer incidences, the percentage of specific cancers, demographics, and the equipment/procedures used by the environmental and public health teams.

Chapter 3: Research Method

Introduction

In Chapter 2, current literature addressing childhood cancer was reviewed, with emphasis on the posthurricane environmental contaminants resulting from Hurricanes Katrina, Rita, and Gustav and the potential impact of these environmental dynamics on the rate of children in Louisiana being diagnosed with cancer from 2004 through 2010. The review of the literature also examined the harmful effects of postdisaster environmental exposures on children's health. Through a review of the literature, I further analyzed and identified an association between certain types of cancers and specific toxins and pollutants as well as the presence and abundance of these toxins and pollutants in the environment following Hurricanes Katrina, Rita, and Gustav. A large and detailed body of knowledge provided supporting data for this study, representing the epidemic nature of childhood cancer in Louisiana. However, gaps exist in the literature on the influence of environmental exposure, and more specifically, the aftermath of major hurricanes such as Hurricanes Katrina, Rita, and Gustav. Therefore, the purpose of this correlational quantitative research study was to examine the annual numbers of children diagnosed with cancer, and the cancer types seen, for the years 2004-2010, as well as the possible effects of environmental contaminants resulting from major Louisiana Hurricanes Katrina, Rita, and Gustav in 2004 through 2010, in order to establish the possible impact of these environmental events on the rate of children diagnosed with cancer during and immediately following them.

This chapter addresses the specific elements of the research design, methods, and sample I used; the characteristics of the archival datasets employed; and the statistical analysis of the data. Documentation required to conduct this research was sent to and received by the Institutional Review Board (IRB) for approval. The review was successfully completed, and approval was granted. The IRB approval ID was 04-20-16-0264096.

Rationale and Research Design

This correlational quantitative research study used archived data sets from the Louisiana Tumor Registry to focus on the rate of children diagnosed with cancer in Louisiana from 2004 through 2010. The correlational research methodology was chosen for this quantitative research study because this methodology is primarily used to determine the extent of a relationship between two or more variables using statistical data (Creswell, 2014). Using this methodology allowed for the interpretation of recognized trends and patterns in the data, it ensured that relationships between and among the number of facts were not changed, and it did not impose on the analysis used to establish cause and effect for them. With correlational research methods, data, relationships, and distributions of variables are only observed. Variables are not manipulated; they are only identified and studied as they occur in a natural setting. Correlational research is frequently considered a type of descriptive research, in that no variables are manipulated (Walden University Tutorials, 2015). However, use of the descriptive methodology was not considered because descriptive research seeks to describe the current status of an identified variable or phenomenon and this research study employed achieved data, not data from current variables. In addition, this correlational research study analytically assessed the environment following Hurricanes Katrina, Rita, and Gustav to identify the presence of certain chemicals, pollutants, and toxins currently associated with specific childhood cancers. Identifying the presence of certain chemicals, pollutants, and toxins that have been suspected of being carcinogenic to humans could provide an acceptable statistical and analytical explanation of how, and to what extent, the environmental aftermath of Hurricanes Katrina, Rita, and Gustav may have contributed to the rates of childhood cancers in Louisiana from 2004-2010. In an effort to advance knowledge in the public health discipline, this study used a quantitative research method to test the statistical relationship between the presence and/or increased presence of environmental contaminants following Hurricanes Katrina, Rita, and Gustav and the rate of childhood cancers in Louisiana from 2004 through 2010. Further, using a correlational quantitative research method, I examined and identified whether, and to what extent, a relationship exists between these occurrences. In this study, the independent variables were the environmental contaminants (chemicals, pollutants, and toxins), parish of residency, contaminants/pollutants/toxins, and the hurricane associated with storm-related environmental conditions, and the dependent variables were the number of children diagnosed with cancer and the types of cancer, in Louisiana. There were no anticipated time or resource constraints for this study.

Methodology

Population

The target population of studies conducted by the Louisiana Tumor Registry includes the population of children diagnosed with cancer annually in Louisiana, ranging in age from newborn (age 0) to younger than 19 years. In this study, I focused on the number of childhood cancer cases involving children in Louisiana diagnosed and treated from 2004-2010. The ages of individuals in the sample population were determined by their ages at the time of diagnosis and were residing in one of the 64 Louisiana parishes or relocated to another state less than two years when diagnosed. The approximate and/or estimated size of the sample population was age adjusted according to the SEER Program age-adjusts using the 2000 US standard population based on single years of age (SEER, 2004).

Sampling and Sampling Procedures

The archival data for this study were provided by the Louisiana Tumor Registry, which collects incidence of childhood cancer information from the entire state, reflecting all 64 parishes (Louisiana Tumor Registry, n.d.). The data collected include type of cancer (morphology, grade, and behavior), anatomic location, extent of cancer at the time of diagnosis (stage), treatment, and outcomes (survival and mortality; Louisiana Tumor Registry, n.d.).

The Louisiana Tumor Registry's legislative rules (Louisiana Tumor Registry, n.d.) established the following inclusion criteria, reporting procedures, and deadlines:

1. One month after diagnosis—All cases must be reported to the Louisiana Tumor Registry, whether pathologically or clinically diagnosed, for children and adolescents under 19 years. Only demographics and minimal details about the diagnosis are required.
2. Two months after diagnosis—Pathology laboratories, radiation and oncology clinics, and physician practices are required to report their findings to the Louisiana Tumor Registry.
3. Six months after diagnosis or first contact—Hospitals are required to provide a complete abstract referencing the cancer diagnosis.

The Louisiana Tumor Registry legislative rules state if a facility fails to meet these reporting requirements by the specified deadlines and/or in the format specified by the Louisiana Tumor Registry, and/or submits data of unacceptable quality, personnel from the Louisiana Tumor Registry may enter the facility to screen and abstract the information (Louisiana Tumor Registry, n.d.).

The G power analysis tool was used to calculate the necessary sample size (UCLA Statistical Consulting Group, 2015). The power analysis determining sample size for this research study was calculated using the G power version 3.1.9.2. The G power calculator was set to the χ^2 – tests. A priori power analyses, sample size *N*, were computed as a function of the required power level (1 - β), the prespecified significance level α, and the population effect size, which is detected with probability 1- β. In this research study, the calculated effect size was 0.3, the α error probability was 0.5, the power (1 – β error probability) was .95, and the degrees of freedom were 9. The sample size for this research study, which was calculated using G power analysis, was 263.

Data Collection

Cancer registration and reporting in Louisiana began in 1947 at the Charity Hospital Tumor Registry in New Orleans (Louisiana Tumor Registry, n.d.). In 1974, as part of its SEER Program, the NCI provided funds for a population-based cancer incidence and survival registry covering Jefferson, Orleans, and St. Bernard parishes (Louisiana Tumor Registry, n.d.). Approximately 5 years later, the Louisiana Tumor Registry moved to the state's Office of Public Health, and in 1983, the Louisiana Tumor Registry expanded to include all 35 parishes of South Louisiana (Regions I-V; Louisiana Tumor Registry, n.d.). The 29 parishes of North Louisiana (Regions VI-VIII) were added in 1988, and statewide coverage was finally achieved (Louisiana Tumor Registry, n.d.). The legislation that established the Louisiana Tumor Registry (R.S. 40:1299.80 et seq.) specifies that any health care facility or provider diagnosing or treating cancer patients shall report each case of cancer to the registry (Louisiana Tumor Registry, n.d.). In addition, health care providers and facilities are required to establish remote access to electronic health records (Louisiana Tumor Registry, n.d.).

This study examined data collected by the Louisiana Tumor Registry that identified the number of children younger than 19 years diagnosed with childhood cancer from Louisiana from January 1, 2004 to December 31, 2010. In addition, the data included the year of diagnosis, type of cancer, age of child at time of diagnosis, and the parish (area) in which the child resided in Louisiana. The resulting information was used to establish the cumulative rate of childhood cancer cases per 100,000 population under 19 years from 2004-2010, and the incidence rate of childhood cancer incidences per 100,000 population under 19 years stratified by age and by geographic area. Environmental data were retrieved from the LDEQ database. These levels were calculated to establish, first, unusually high incidences of childhood cancer, and second, the presence of contaminants, pollutants, and toxins indicating human exposure to environmentally harmful substances, following Hurricanes Katrina, Rita, and Gustav.

A request was sent to the Louisiana Tumor Registry to gain permission for access to the data. The archival data for this study are accessible to the public and located on the Louisiana Tumor Registry website (http://sph.lsuhsc.edu/louisiana-tumor-registry). The letter to the Louisiana Tumor Registry and the letter from the Louisiana Tumor Registry are provided in an appendix.

An inquiry was made to the LDEQ to obtain information about environmental analysis throughout the state at monthly intervals for the first 6 months following Hurricanes Katrina, Rita, and Gustav and quarterly thereafter, from January 1, 2004, through December 31, 2010.

Operationalization of Constructs

Operationalization

In this study, the independent variables were the environmental factors (contaminants, pollutants, and toxins), parish of residency, and the hurricane associated with the storm-related environmental conditions, and the dependent variables were the type and the number of children diagnosed with cancer in Louisiana annually from 2004 through 2010.

Table 1 describes how the variables were operationalized.

Table 1

Operationalization of Variables

Name of variable	Type of variable	Data coding
Dependent variable: Types of childhood cancers diagnosed in the 64 Louisiana parishes, 1/1/2004-12/31/2010	Nominal	1—Leukemias 2—Central nervous system tumors (including intracranial and intraspinal neoplasms) 3—Neuroblastoma (including other sympathetic nervous system tumors) 4—Lymphomas (including other reticuloendothelial neoplasms) 5—Soft-tissue sarcomas 6—Malignant bone tumors 7—Renal tumors 8—Retinoblastoma 9—Germ cell, trophoblastic, and other 10—Gonadal neoplasms
Independent variable: Louisiana parish of residency of the children diagnosed with cancer	Nominal	1—Acadia Parish 2—Allen Parish 3—Ascension Parish 4—Assumption Parish 5—Avoyelles Parish 6—Beauregard Parish 7—Bienville Parish 8—Bossier Parish 9—Caddo Parish 10—Calcasieu Parish 11—Caldwell Parish 12—Cameron Parish 13—Catahoula Parish 14—Claiborne Parish 15—Concordia Parish 16—Desoto Parish 17—East Baton Rouge Parish 18—East Carroll Parish 19—East Feliciana Parish 20—Evangeline Parish

(table continues)

Name of variable	Type of variable	Data coding
		21—Franklin Parish
		22—Grant Parish
		23—Iberia Parish
		24—Iberville Parish
		25—Jackson Parish
		26—Jefferson Davis Parish
		27—Jefferson Parish
		28—Lafayette Parish
		29—Lafourche Parish
		30—LaSalle Parish
		31—Lincoln Parish
		32—Livingston Parish
		33—Madison Parish
		34—Morehouse Parish
		35—Natchitoches Parish
		36—Orleans Parish
		37—Ouachita Parish
		38—Plaquemines Parish
		39—Pointe Coupee Parish
		40—Rapides Parish
		41—Red River Parish
		42—Richland Parish
		43—Sabine Parish
		44—St. Bernard Parish
		45—St. Charles Parish
		46—St. Helena Parish
		47—St. James Parish
		48—St. John Parish
		49—St. Landry Parish
		50—St. Martin Parish
		51—St. Mary Parish
		52—St. Tammany Parish
		53—Tangipahoa Parish

(table continues)

Name of variable	Type of variable	Data coding
		54—Tensas Parish
		55—Terrebonne Parish
		56—Union Parish
		57—Vermilion Parish
		58—Vernon Parish
		59—Washington Parish
		60—Webster Parish
		61—West Baton Rouge Parish
		62—West Carroll Parish
		63—West Feliciana Parish
		64—Winn Parish
Independent variable: Post-Hurricanes Katina, Rita, & Gustav contaminants	Nominal	1—Contaminants 1. Lead 2. Polycyclic aromatic hydrocarbons 3. *E. coli* 2—Pollutants 0—Storm Debris Not Present 1—Storm Debris Present 3—Toxins 1. Arsenic/fertilizer 2. Benzo[a] pyren 3. Diesel 4. Oil
Independent variable: Named hurricanes	Nominal	1—Katrina & Rita 2—Gustav

Data Analysis Plan

The intent of this study was to provide a detailed description of the epidemic of childhood cancer in Louisiana using the Louisiana Tumor Registry database for the years 2004 – 2010. To accomplish the objective of the study, the endemic level of childhood cancer incidences in Louisiana during the period from 2004-2010 was determined, as well as the environmental contamination incidence levels resulting from Hurricanes Katrina Rita, and Gustav during the same period. This provided information essential to answering the following research questions:

RQ1: For the years 2004-2010, after Hurricanes Katrina/Rita, and Gustav, were there significant differences in the rate and types of cancers children were annually diagnosed with in Louisiana?

$H_0$1: For the years 2004-2010, after Hurricanes Katrina/Rita, and Gustav, there were no significant differences in the rate and types of cancers children were annually diagnosed with in Louisiana.

$H_1$1: For the years 2004-2010, after Hurricanes Katrina/Rita, and Gustav, there were significant differences in the rate and types of cancers children were annually diagnosed with in Louisiana.

The paired t-tests test was used to determine whether a relationship between two categorical variables in a sample were likely to demonstrate a real association between these two variables in the population (Fields, 2013). In this study, if there were significant differences in the types of cancers children were annually diagnosed with in

Louisiana following Hurricane Katrina/Rita and Gustav, the *p*-value of .05 or less was used to test for statistical significance. When the *p*-value is less than .05, the null hypothesis is rejected.

RQ2: Were there significant differences in the level of environmental contaminants (chemicals, pollutants, and toxins) in Louisiana's 64 parishes during the 2004-2010-time periods after Hurricanes Katrina, Rita, and Gustav, respectively?

$H_0$2: There were no significant differences in the level of environmental contaminants (chemicals, pollutants, and toxins) in Louisiana during the 2004-2010-time period after Hurricanes Katrina, Rita, and Gustav, respectively.

$H_1$2: There were significant differences in the level of environmental contaminants (chemicals, pollutants, and toxins) in Louisiana during the 2004-2010-time period after Hurricanes Katrina, Rita, and Gustav, respectively.

The paired t-tests was used to derive an answer to this question. The Paired t-tests was used to determine whether a relationship existed between two categorical variables in a sample; environmental contaminants (chemicals, pollutants, and toxins) during the period after Hurricanes Katrina/Rita, and Gustav (Fields, 2013). The *p*-value of .05 or less was used to test for statistical significance. When the *p*-value is less than .05, then the null hypothesis is rejected.

RQ3: Do environmental contaminants (chemicals, pollutants, and toxins) resulting following Hurricanes Katrina, Rita, and Gustav, correlate with the number of children annually diagnosed with cancer in Louisiana during the 2004-2010-time period?

$H_0$3: Environmental contaminants (chemicals, pollutants, and toxins) resulting following Hurricanes Katrina/Rita, and Gustav, does not correlate with the number of children annually diagnosed with cancer in Louisiana during the 2004-2010-time period.

$H_1$3: Environmental contaminants (chemicals, pollutants, and toxins) resulting following Hurricanes Katrina /Rita, and Gustav, correlates with the number of children annually diagnosed with cancer in Louisiana during the 2004-2010-time period.

The *p*-value of .05 or less was used to test for statistical significance. If the *p*-value is less than .05 then the null hypothesis can be rejected. The Paired t-tests was used to determine casual relationships among variables in a hypothesized model. This test was chosen to determine whether a relationship exist between environmental contaminants (chemicals, pollutants, and toxins) resulting following Hurricanes Katrina, Rita, and Gustav and the rate of children diagnosed with cancer following, Hurricanes Katrina/Rita and Gustav. The paired t-tests was conducted using the IBM SPSS statistical software package, version 21. Visual display of quantitative data was made available through the use of graphs.

Threats to Validity

External validity is the degree to which the results of a study can be generalized (Creswell, 2009). The use of archived data from a source like the Louisiana Tumor Registry limits and/or minimizes the threat to external validity. Creswell (2003) discussed the external threat of incorrect inferences from the sample data to other persons, other settings, and past or future situations. When conducting research, it is imperative to remain cognizant of the origin of data, and take caution not to overgeneralize beyond that. In this study, another possible threat to external validity may include the children being exposed to environmental chemicals, pollutants, and toxins after Hurricanes Katrina, Rita, and Gustav are interactions of the causal relationship with settings (the 64 parishes) and the effect that is present in a particular setting may not be present (or present to the same extent) in a different setting.

The threats to internal validity can sometimes establish and/or identify biases in the study, including one that threatens the ability to conclude that the independent variable is the cause of the differences in the dependent variable (Creswell, 2009), which is similar to the events in this study. The selection-maturation effect can also pose threats to internal validity (Shi, 2007). The selection-maturation effect exists when an event occurs in multiple sites or within a multi-group design where the participants in one of the groups experience a different rate of exposure than the participants in a different group (Shi, 2007).

Research is undertaken to learn something new or to support a belief or theory (Glanz, 2008). Therefore, biases may have a bearing on the research and/or experiments because of the desired outcome or results (Creswell, 2009). Bias may occur in this study by the inexperience and lack of preexisting knowledge of the research content and focus. Therefore, the best strategy to control this bias is unknown. The term “unbiased estimates” is used to describe the fact that any observed effect differences between the study results and the “true” population are due to chance (Shadish, 2002).

This study used archived data that had been received by and analyzed via the Louisiana Tumor Registry, in conjunction with the Surveillance Epidemiology, and End Results. This data in the registry was edited by computer checks and manual review (Louisiana Tumor Registry, n.d.). The completeness rate of the Louisiana Tumor Registry, in conjunction with the Surveillance Epidemiology, and End Results exceeds 98% overall, and is even higher for pediatric cancer cases, since these cases require hospitalization (Louisiana Tumor Registry, n.d.). The imperfection of the Louisiana Tumor Registry, in conjunction with the Surveillance Epidemiology, and End Results (SEER), is that dates of diagnosis may be off; usually late, by a few days (Louisiana Tumor Registry, n.d.). However, in recognition of the data sources, the SEER Program of the National Cancer Institute has placed the Louisiana Tumor Registry in their top tier, based on completeness and accuracy, for the past five years—and this ranking is likely to again be the attained status for this year (Louisiana Tumor Registry, n.d.).

Ethical Procedures

Permission to use the Louisiana Tumor Registry data was requested and acknowledged (See Appendix C). Although this archived data is in the public domain, meaning “No” permission is required. This archived data can be accessed and retrieved by the public via the Louisiana Tumor Registry website. This data is anonymous and does not provide any reference or identifying information linking it to any patients therefore, confidentiality is not a concern. Legislative rules have been developed, documented, and established governing the Registry’s confidentiality policies. These policies have established procedures for the release of aggregate and case-specific data, and states that all registry employees or other data users agree to and sign confidentiality agreements. In addition, these rules authorize the Louisiana Tumor Registry to exchange data with other states so that it may obtain data about residents of Louisiana who seek care outside of state. Likewise, the Registry may provide data to other states about their residents. Crediting is required for all data used in research studies, article, and related data using sources (Louisiana Tumor Registry, n.d.). Prior to data collection, IRB approval was obtained from the Walden University IRB. Data was stored on a password protected laptop. Data will be retained for five years and then be destroyed. No one other than this researcher had access to the data.

Summary

In summary, this chapter referenced the research design and rationale, the sampling and sampling procedures, data analysis plan, threat to validity, and ethical procedures. A quantitative methodology was instrumental in identifying the intensity, extent, and the environmental conditions existing post Hurricanes Katrina/Rita and Gustav. This study examined the rate of childhood cancer in Louisiana by utilizing archived data from the Louisiana Tumor Registry (in conjunction with SEER) and data from the Louisiana Department of Environmental Quality. The study results could support a correlation between the rate of children diagnosed with cancer, and type of cancer, following Hurricanes Katrina/Rita and Gustav and/or referencing the environmental contamination throughout Louisiana during and after the storm/ flooding associated with Hurricanes Katrina/Rita and Gustav. Data was analyzed using paired t tests and an ANOVA analysis. Chapter 4 describes the results of the analyses that was conducted to address this study's research questions.

Chapter 4: Results

Introduction

This descriptive quantitative correlational research study included 1,326 children residing in Louisiana, aged 0-19 years, diagnosed with cancer a year prior to and 2 years after Hurricanes Katrina/Rita and Gustav, respectively. The purpose of this descriptive quantitative correlational research study was to examine the number of children aged 0-19 years who were diagnosed with childhood cancer in Louisiana for the years 2004-2010 and to identify the presence of any pollutants, chemicals, and toxins in the environment following Hurricanes Katrina/Rita and Gustav. The intent of this study was to examine any possible correlation between the presence of pollutants, chemicals, and toxins and the number of children diagnosed with childhood cancer in Louisiana for the years 2004-2010.

The research questions and hypotheses that guided this study were as follows:

RQ1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, were there significant differences in the number of children annually diagnosed with cancer in Louisiana?

$H_0$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were no significant differences in the number of children annually diagnosed with cancer in Louisiana.

$H_1$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were significant differences in the number of children annually diagnosed with cancer in Louisiana.

RQ2—Quantitative: Were there significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively?

$H_0$2: There were no significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

$H_1$2: There were significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

RQ3—Quantitative: Were there significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period?

$H_0$3: There were significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period.

$H_1$3: There were no significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period.

For this study, the independent variables were the environmentally impacted parishes after Hurricanes Katrina/Rita and Gustav, and the dependent variables were the rate (or number) of children diagnosed with cancer and the gender of the children diagnosed with cancer in Louisiana from 2004-2010.

In this chapter, I present and provide an analysis of data from the Louisiana Tumor Registry and the LDEQ. The locations were identified as *parishes* instead of *counties*. Louisiana is composed of 64 parishes. To further this quantitative research study, the state was divided into three regions: north, central, and south.

Data Collection

This quantitative research used archival data from the Louisiana Tumor Registry and the LDEQ, both of which are state entities whose archival data sets are available and publicly accessible. The collection of data sets from the Louisiana Tumor Registry began on April 27, 2016 and was completed and organized by May 2, 2016. However, as the data analysis progressed, an error in the number of years of the data sets referencing race and gender of the patients diagnosed was noted and had to be corrected. The editing of the data sets required 3 additional days.

The written request for the LDEQ data sets was initiated on April 29, 2016 (see Appendix C). The request for these data sets was completed in early May 2016, was mailed via U.S. Postal Service on May 9, 2016, and was received on May 12, 2016. The data sets were saved on 17 compact discs. As the review and organizing of the data progressed, it was noted that 6 disks were corrupt and/or damaged and that retrieving the data sets from these discs was not possible. Replacing the damaged discs required an additional request to reorder data sets, which was completed online on June 6, 2016. This second request to replace damaged data sets was completed on June 20, 2016, was mailed via U.S. Postal Service on June 23, 2016, and was received on June 27, 2016. An examination of these 6 discs identified that 4 of them could not be opened. On July 5, 2016, I had a conversation with an LDEQ data specialist to initiate an additional request for replacement data sets. On July 8, 2016, all LDEQ data originally requested had been sent and received via email.

The descriptive characteristics of the Louisiana Tumor Registry samples included an assessment of childhood cancer incidence for 2004-2010. The annual totals are in Table 2.

Table 2

Number of Children in Louisiana Diagnosed With Cancer Annually From 2004-2010

2004	2005	2006	2007	2008	2009	2010
184	181	175	189	205	193	199

Based on the information provided in Table 2, the annual childhood cancer incidence totals by parish for 2005 and 2006, after Hurricanes Katrina/Rita, were lower than in 2004. However, for the years 2007, 2008, 2009, and 2010, the annual childhood cancer parish incidence totals were higher. The 2008 annual childhood cancer incidence total was the highest in the 7-year span. In 2008, Hurricane Gustav and associated flooding severely impacted Louisiana.

The state of Louisiana consists of 64 parishes. However, the prevalence of childhood incidence is significantly disproportional among the 64 parishes. Of the top 10 parishes leading the childhood cancer incidences, seven are in the southern region. From 2004 through 2010, there were 10 parishes that accounted for more than half of the childhood cancer incidences in Louisiana. Table 3 illustrates the 10 parishes with the highest number of childhood cancer cases in Louisiana from 2004 through 2010.

Table 3

Regional Locations of the 10 Parishes With the Highest 7-Year (2004-2010) Childhood Cancer Counts in Louisiana, Regional Demographics, and Percentage Incidence Totals

Region	Parishes	# of Cancer Incidences	Percentage (%) of Incidences
South	East Baton Rouge	135	10%
South	Jefferson	130	9.8%
South	St. Tammany	84	6.3%
South	Orleans	76	5.7%
Central	Calcasieu	68	5%
South	Lafayette	68	5%
North	Caddo	60	4.5%
Central	Rapides	48	3.6%
North	Ouachita	43	3.3%
South	Tangipahoa	42	3.2%
	Total	**754**	**57%**

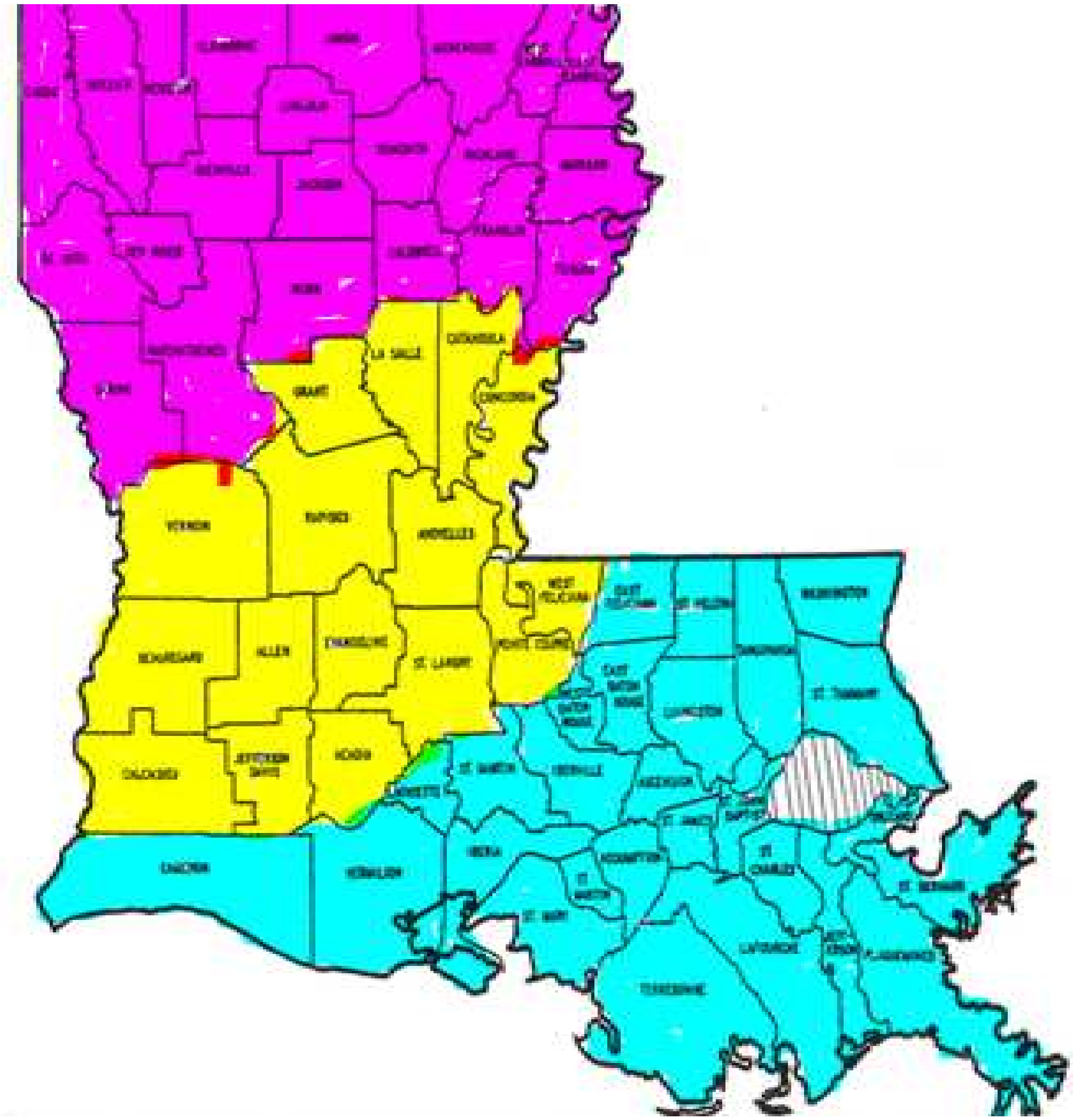

Figure 1. Regional demographic map of Louisiana. From "Louisiana—Parish Map," by WorldAtlas, 2017 (http://www.worldatlas.com/webimage/countrys/namerica/usstates/counties/lacountymap.htm). Copyright 2017 by WorldAtlas.com. Permission Granted

Table 4

Regional Table of Parishes

North Louisiana	Central Louisiana	South Louisiana
Caddo	Grant	Cameron
Bossier	La Salle	Vermillion
Webster	Catahoula	Lafayette
Claiborne	Concordia	St. Martin
Union	Vernon	Iberville
Morehouse	Rapides	West Baton Rouge
West Carroll	Avoyelles	East Baton Rouge
East Carroll	Beauregard	Iberia
Lincoln	Allen	Ascension
Bienville	Evangeline	Livingston
Jackson	Calcasieu	Tangipahoa
Ouachita	Jefferson Davis	St. Tammany
Richland	Acadia	St. Mary
Madison	St. Landry	Assumption
De Soto	Pointe Coupee	St. James
Red River	West Feliciana	St. John the Baptist
Sabine	East Feliciana	Terrebonne
Natchitoches	St. Helena	La Fourche
Winn	Washington	St Charles
Caldwell		Jefferson
Franklin		Plaquemines
Tensas		Orleans
		St. Bernard

Figure 2 provides a demographic visual of the 64 parishes in Louisiana and where they are located in the state.

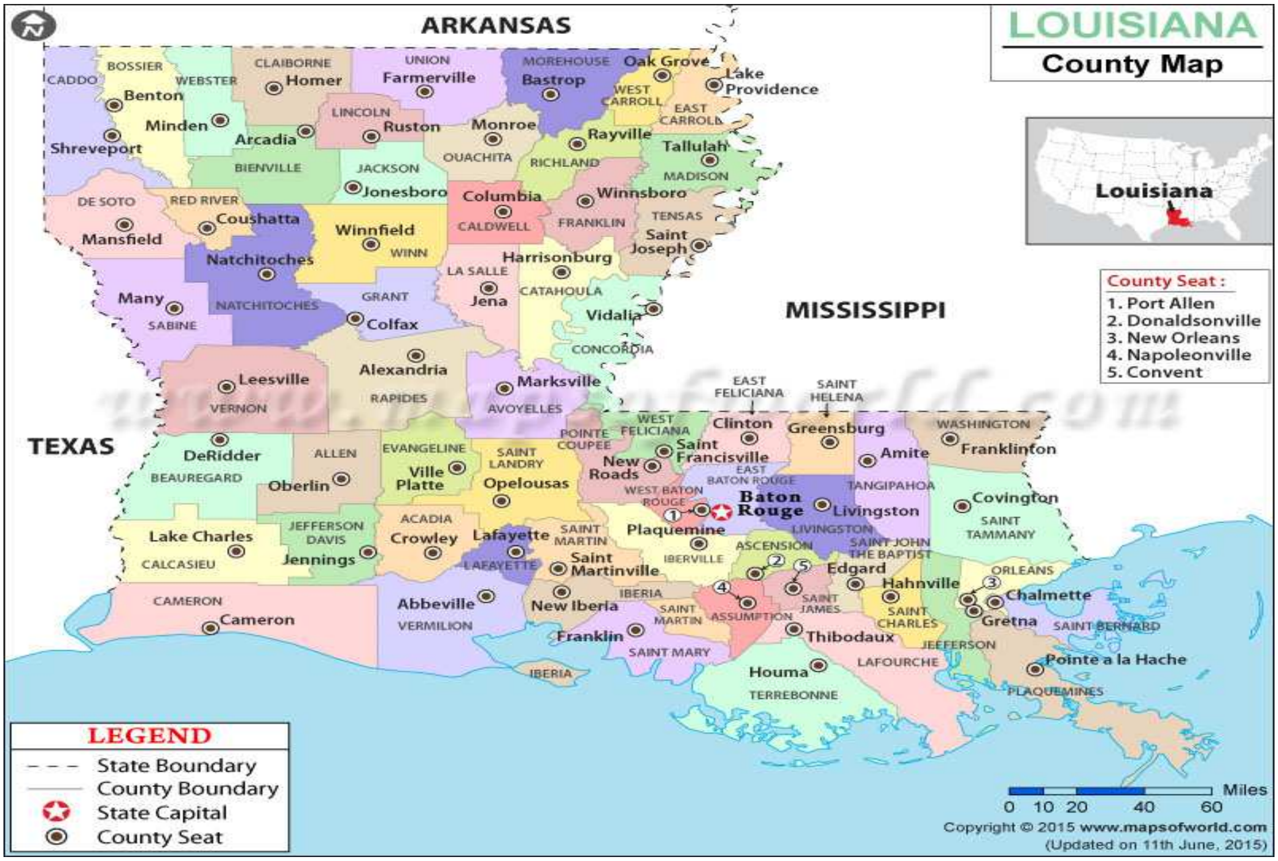

Figure 2. Map of parishes in Louisiana. From “Louisiana—Parish Map,” by WorldAtlas, 2017 (http://www.worldatlas.com/webimage/countrys/namerica/usstates/counties /lacountymap.htm). Copyright 2017 by WorldAtlas.com. Permission Granted

Per Louisiana Tumor Registry data, 7 of the 10 parishes with the highest numbers of childhood cancer cases from 2004-2010 were in the southern and southwestern regions of the state. The regional analysis of childhood cancer incidences also presented results that identified the statistically significant difference in the childhood incidences from 2004-2010.

Hurricane Katrina

In late August 2005, Louisiana was hit by Hurricane Katrina. The hardest hit and evacuated areas were primarily in South Louisiana. See Appendix A for the parishes declared disaster areas following Hurricane Katrina. Tropical storms and tornadoes following landfall of Hurricane Katrina caused flooding throughout South and Central Louisiana.

Hurricane Rita

In September 2005, Louisiana was hit by Hurricane Rita. The hardest hit and evacuated areas were primarily in South and Central Louisiana. See Appendix B for a list of the parishes impacted by Hurricane Rita. Although tropical storms following the landfall of Hurricane Rita caused flooding throughout Central Louisiana, a large portion of North Louisiana was also severely impacted.

Hurricane Gustav

On September 1, 2008, Hurricane Gustav made landfall in Louisiana. The state reported that about 100,000 people remained on the coast after evacuation. Nearly 2 million people had evacuated from South Louisiana in the days before Gustav's arrival. The communities of Upper South Louisiana, Central Louisiana, and North Louisiana sustained extensive wind damage. Central Louisiana was also hit hard and inundated with floodwaters. Ultimately, 50 parishes were declared disaster areas. See Appendix C for the parishes declared a disaster immediately following Hurricane Gustav. Although Hurricane Gustav did not directly hit the remaining northern parishes, they were also inundated with rain and severe flooding that persisted for weeks.

This quantitative research study proportionally represents the population of children in Louisiana aged 0-19 years. The archival cancer statistics included all childhood cancer diagnoses in Louisiana, and the environmental statistical data were retrieved from sites located throughout the state, including all 64 parishes.

Table 5
Children Diagnosed With Cancer in Louisiana, Mississippi, Texas, & Arkansas, 2004-2010

State	Population ranking	# of counties (parishes)	2004	2005	2006	2007	2008	2009	2010	7-year total
LA	25	64	184	181	175	189	205	193	199	1,326
MS	31	82	88	133	129	113	122	125	135	845
TX	2	254	1,310	1,269	1,411	1,414	1,506	1,506	1,542	9,958
AR	32	75	114	109	118	138	116	145	135	875

Note. Source for population: 2014 Demographic Profile, U.S. Census Bureau.

The neighboring state to the east, Mississippi, like Louisiana, borders the Gulf of Mexico on the south. Mississippi was also directly impacted by Hurricanes Katrina/Rita and was severely affected by tornadoes, excessive wind damage, and heavy rains and flooding. In terms of population size, Louisiana ranks 25^{th} in the United States, and Mississippi ranks 31st (U.S. Census, 2014). Mississippi had a total of 845 children aged 0-19 diagnosed with cancer from 2004-2010.

The neighboring state to the west, Texas, also borders the Gulf of Mexico on the south and east. Hurricane Katrina did not directly impact Texas. However, Hurricane Rita and Hurricane Gustav produced associated weather conditions that severely impacted the southern and eastern regions of Texas with excessive winds, heavy rains, and flooding. In terms of population size, Texas ranks second in the country. Texas had a total of 9,958 children aged 0-19 years diagnosed with cancer from 2004-2010 (U. S. Census, 2014).

The neighboring state to the north, Arkansas, does not border the Gulf of Mexico. Hurricane Katrina did not impact Arkansas. Hurricanes Rita and Gustav minimally impacted Arkansas with moderate wind and rains. Arkansas's population size ranks 32nd in the nation (U. S. Census, 2014). Arkansas had a total of 875 children aged 0-19 diagnosed with cancer from 2004-2010.

South Carolina ranks 24th in population size, and Kentucky ranks 26th in population size (U. S. Census, 2014). These states are similar in population size to Louisiana. Neither of these states borders the Gulf of Mexico; however, South Carolina borders the Atlantic Ocean and has been impacted by several major storms, including hurricanes, and has experienced record flooding over the past 15 years. Both states encountered various weather-related disasters between 2004 and 2010 and had similar childhood cancer incidence counts. Neither of these states is heavily populated with chemical plants or depends on chemical plants and production as a major revenue-producing resource. However, South Carolina, Kentucky, and Louisiana share similar increases in childhood cancer counts following weather-related natural disasters between 2004 and 2010. This further suggests that the increase in childhood cancers may be impacted by poststorm environments.

Table 6

Children Diagnosed With Cancer in South Carolina and Kentucky, 2004-2010

State	Population ranking	# of counties (parishes)	2004	2005	2006	2007	2008	2009	2010	7-year total
LA	25	64	184	181	175	189	205	193	199	1,326
SC	24	46	184	157	200	195	181	172	180	1,269
KY	26	120	197	211	167	206	188	210	212	1,391

Note. Source for Population: 2012 Demographic Profile, U.S. Census Bureau.

The population sizes of South Carolina and Kentucky are similar to the population size of Louisiana. The annual childhood cancer counts for South Carolina, Kentucky, and Louisiana are also similar.

Results

There are 64 parishes in Louisiana, thus n in every analysis was 64. The paired *t*-test measures were used to analyze data collected and used to address research focus of this quantitative study. The paired t-test measures were applied to identify the significance of the differences between the two time-frame totals by parishes and by regions. The paired tests, in general are applied in pre-posttest experiments involving same subjects (or population, objects, units, areas, etc.) (Wilkerson, 2008). The research questions and hypotheses that were used in this research study to address the results of the data analysis were as follows:

RQ1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, were there significant differences in the number of children annually diagnosed with cancer in Louisiana?

$H_0$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were no significant differences in the number of children annually diagnosed with cancer in Louisiana.

$H_1$1: For the years 2004-2010, after Hurricanes Katrina/Rita and Gustav, there were significant differences in the number of children annually diagnosed with cancer in Louisiana.

According to the data analysis results, there were significant differences in the number of children annually diagnosed with cancer in Louisiana. The post Hurricanes Katrina/Rita (2005) data analysis results show that the annual childhood cancer incidence totals for 2005 and 2006 where lower than the 2004. The data analysis results indicated that the annual childhood cancer incidence totals for 2007, 2008, 2009, and 2010 were higher, with 2008 being the highest in the 7-year time span. These data analysis results are shown in Table 7.

Table 7

Annual Number of Children in Louisiana Diagnosed With Cancer, 2004-2010

2004	2005	2006	2007	2008	2009	2010
184	181	175	189	205	193	199

Note. Data source: Louisiana Tumor Registry, 2012.

In 2008, Louisiana was again severely impacted by a catastrophic weather event, Hurricane Gustav. According to data analysis results, after Hurricanes Katrina/Rita, and Gustav, significant differences were observed in Louisiana, for the years 2004-2010. The average number of incidences in each parish during 2007-2010 (12.28) were significantly higher than the 2004-2006 year-range, signified by the ***t*** statistic of 4.011 (P=.000). Table 8 illustrates significant differences observed between the 2004-2006 and 2007-2010 year-ranges throughout Louisiana. Table 9 illustrates Louisiana Childhood Cancer Parish Average Incidences 2004-2006 and 2007-2010. Based on the results of the statistical analysis presented in Table 8 and Table 9, the null hypothesis was rejected. Table 9 illustrates the Annual Counts of Children in Louisiana Diagnosed with Childhood Cancer 2004-2010, by Parish and Region. Table 10 further supports the alternative hypothesis, in that the average number of incidences per parish, from 2007-2010 (12.28) were significantly higher than the average number of incidences per parish, from 2004-2006. Statistically, this was supported by the ***t*** statistic of 4.011 (P=.000).

Table 8

Comparison of Louisiana Childhood Cancer Incidence Statistics, 2004-2006 and 2007-2010

Paired samples statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error mean
Cancer incidences (0-19) distribution 2007-10	12.28	64	17.475	2.184
Cancer incidences (0-19) distribution 2004-06	8.44	64	10.794	1.349

Note. Data source: Louisiana Tumor Registry, 2012.

Table 9

Two Time-Frame Totals for Childhood Cancer Incidences, 2004-2006 and 2007-2010

Paired samples statistics								
	Paired differences							
				95% conf. interval diff				
Pair 1	Mean	Std deviation	Std. error mean	Lower	Upper	*t*	*df*	Sig 2-tailed
Cancer incidences (0-19) distribution 2007-10 Cancer incidences (0-19) distribution 2004-06	3.844	7.666	.958	1.929	5.759	4.011	63	.000

Note. Data source: Louisiana Tumor Registry, 2012.

Table 10

Annual Counts of Children in Louisiana Diagnosed 2004-2010 by Parish and Region

Parish	Region	2004	2005	2006	2007	2008	2009	2010
Acadia	2	1	2	3	0	4	4	2
Allen	2	2	1	1	0	2	0	2
Ascension	3	1	3	6	7	6	5	3
Assumption	3	1	0	1	0	0	1	0
Avoyelles	2	1	0	4	2	1	3	1
Beauregard	2	0	2	1	2	2	0	2
Bienville	1	1	0	0	0	0	0	1
Bossier	1	3	6	6	7	5	2	7
Caddo	1	11	3	5	9	10	13	9
Calcasieu	2	7	10	8	8	9	10	16
Caldwell	1	0	0	0	0	0	0	0
Cameron	3	0	0	1	0	1	0	1
Catahoula	2	0	0	0	0	0	0	0
Claiborne	1	0	1	0	1	0	0	1
Concordia	2	0	1	1	0	2	1	1
De Soto	1	0	1	1	1	1	2	3
East Baton Rouge	3	22	10	20	17	25	17	24
East Carroll	1	0	0	0	0	2	1	0
East Feliciana	2	0	0	2	3	1	0	1
Evangeline	2	1	0	2	3	0	0	2
Franklin	1	1	1	3	2	2	0	1
Grant	2	0	1	2	2	1	2	1
Iberia	3	4	2	5	4	4	3	1
Iberville	3	3	1	0	2	3	1	1
Jackson	1	1	0	0	0	2	0	1
Jefferson	3	17	15	13	23	27	17	18
Jefferson Davis	2	0	5	2	3	0	5	0
Lafayette	3	9	4	14	12	6	10	13
Lafourche	3	4	4	3	3	5	3	3
La Salle	2	2	2	1	1	0	0	0
Lincoln	1	3	5	0	1	2	1	0
Livingston	3	4	6	6	2	3	11	9
Madison	1	1	0	0	0	0	0	0
Morehouse	1	1	1	1	1	1	2	2
Natchitoches	1	1	1	1	2	0	2	1
Orleans	3	16	12	8	8	12	9	11
Ouachita	1	5	6	6	4	11	2	9
Plaquemines	3	2	2	2	1	0	2	2
Pointe Coupee	2	0	0	2	1	0	0	1

(table continues)

Parish	Region	2004	2005	2006	2007	2008	2009	2010
Rapides	2	4	11	5	8	6	9	6
Red River	1	0	1	0	0	0	1	0
Richland	1	0	0	0	1	2	0	2
Sabine	1	1	1	1	1	2	1	4
St Bernard	3	3	4	1	1	1	3	0
St Charles	3	1	4	1	4	2	3	1
St Helena	2	1	0	0	0	0	0	0
St James	3	0	1	1	0	1	0	0
St John the Baptist	3	1	1	2	3	0	1	2
St Landry	2	7	4	0	2	3	2	1
St Martin	3	1	2	1	3	1	1	2
St Mary	3	5	6	0	3	2	1	3
St Tammany	3	8	13	12	10	17	15	9
Tangipahoa	3	3	7	4	3	2	7	6
Tensas	1	0	0	0	0	0	0	0
Terrebonne	3	9	6	4	2	5	5	3
Union	1	1	0	0	1	1	2	1
Vermilion	3	2	4	4	2	2	4	3
Vernon	2	3	4	1	1	1	3	2
Washington	2	3	0	3	3	1	2	2
Webster	1	2	1	1	2	2	1	1
West Baton Rouge	3	2	1	1	2	1	3	1
West Carroll	1	2	1	0	4	2	0	0
West Feliciana	2	0	1	1	0	1	0	0
Winn	1	0	0	1	1	0	0	0

Note. Data from Louisiana Tumor Registry, 2012. Regions were coded as 1 = North, 2 = Central, 3 = South.

RQ2–Quantitative: Were there significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively?

$H_0$2: There were no significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

$H_1$2: There were significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively.

There were significant differences found between parish averages in the North and South regions (p=.011, .013 respectively). The Central region based on the t statistic, did not appear to be significant (p=.078). It was also noted that the highest differences were found in the South region of Louisiana. The parishes located in the south region are located closer to the Gulf of Mexico and was the area(s) primarily impacted by the storms associated with Hurricanes Katrina/Rita and Gustav. Based on the results of the data analysis, there were significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav, respectively, since the data analysis results for the North and South regions (p=.011, .013 respectively) supports that there was a significant difference in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav. Therefore, the null hypothesis was rejected since the data analysis supported that there were significant differences in the number of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav. Based on the *t* statistic, the Central region did not appear to be significant (p=.078). There are 22 parishes in the North region of Louisiana, thus N in the analysis was 22. There are 19 parishes in the Central region of Louisiana, thus N in the analysis was 19. There are 23 parishes in the South region of Louisiana, thus N in the analysis was 23, respectively. The regional data analysis results are presented in Tables 11-16.

Table 11

Louisiana North Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error mean
Cancer incidence (0-19) distribution 2007-10	7.09	22	9.889	2.108
Cancer incidence (0-19) distribution 2004-06	4.05	22	5.636	1.202

Note. Data source: Louisiana Tumor Registry, 2012.

Table 12

Louisiana North Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf. interval diff				
Pair 1	Mean	Std deviation	Std. error Mean	Lower	Upper	*t*	*df*	Sig 2-tailed
Cancer incidence (0-19) distribution 2007-10 Cancer incidence (0-19) distribution 2004-06	3.045	5.094	1.086	.787	5.304	2.804	21	.011

Note. Data source: Louisiana Tumor Registry, 2012.

Table 13

Louisiana Central Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error mean
Cancer incidence (0-19) distribution 2007-10	8.11	19	10.519	2.413
Cancer incidence (0-19) distribution 2004-06	6.05	19	6.433	1.476

Note. Data source: Louisiana Tumor Registry, 2012.

Table 14

Louisiana Central Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf. interval diff				
Pair 1	Mean	Std deviation	Std. error mean	Lower	Upper	*t*	*df*	Sig 2-tailed
Cancer incidence (0-19) distribution 2007-10 Cancer incidence (0-19) distribution 2004-06	2.053	4.790	1.099	-.256	4.361	1.868	18	.078

Note. Data source: Louisiana Tumor Registry, 2012.

Table 15

Louisiana South Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error mean
Cancer incidence (0-19) distribution 2007-10	20.70	23	23.971	4.998
Cancer incidence (0-19) distribution 2004-06	14.61	23	14.333	2.989

Note. Data source: Louisiana Tumor Registry, 2012.

Table 16

Louisiana South Region: Cancer Incidence Statistics, 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf. interval diff				
Pair 1	Mean	Std deviation	Std. error mean	Lower	Upper	*t*	*df*	Sig 2-tailed
Cancer incidence (0-19) distribution 2007-10 Cancer incidence (0-19) distribution 2004-06	6.087	10.774	2.247	1.428	10.746	2.709	22	.013

Note. Data source: Louisiana Tumor Registry, 2012.

RQ3–Quantitative: Were there significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period?

$H_0$3: There were significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period?

$H_1$3: There were no significant differences in the gender of children diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav during the 2004-2010 period?

Further data analysis was conducted to include gender analysis of male and female cancer incidences for the state of Louisiana, years 2004-2010. Of the 1,326 incidences of childhood cancers in Louisiana, 2004-2010, females in Louisiana accounted for 45% of all childhood cancer incidences (females *n*=592), while males accounted for 55% of all childhood cancer incidences (males *n*=734). The racial incidences of childhood cancers in Louisiana from 2004-2010 for all childhood incidences were white males (*n*=471) (36%), white females (*n*=392) (30%), black males (*n*=236) (18%), black females (*n*=201) (14.3%), other males (*n*=17) (1%), and other females (n=9) (.7%). Males accounted for the majority childhood cancer incidences in all racial groups.

Significant differences were observed with the higher propensity of cancer occurring among males 0-19 years. Tables 17 and 18 display the results of gender specific childhood cancer diagnosis in Louisiana, for years 2004-2010. The average male cancer incidences were 20.72, as compared to 9.47 of female cancer incidences for years 2004-2010. The differences were statistically significant with t=5.87, p=.000. Tables 17 and 18 show the statistical data supporting these results.

Table 17

Statistical Differences in the Gender of Childhood Cancer Incidences in Louisiana, 2004-2010

Paired sample statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error mean
Male cancer incidences (0-19) distribution 2004-10	20.72	64	28.018	3.502
Female cancer incidences (0-19) distribution 2004-10	9.47	64	12.925	1.616

Note. Data source: Louisiana Tumor Registry, 2012.

Table 18

Statistical Differences in the Gender of Childhood Cancer Incidences in Louisiana 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf. interval diff				
Pair 1	Mean	Std deviation	Std. error mean	Lower	Upper	*t*	*df*	Sig 2-tailed
Male Cancer incidences (0-19) distribution 2004-2010 Female Cancer incidences (0-19) distribution 2004-2010	11.250	15.316	1.914	7.424	15.076	5.876	63	.000

Note. Data source: Louisiana Tumor Registry, 2012.

The data analysis further supports that there were significant differences in male cancer incidences and female incidences observed regionally. The results of the regional data analysis also identified a higher propensity of cancer occurring among males 0-19 years. The regional analysis provided a more concise view of how this trend was consistent regionally and throughout the state. Tables 18-23 provide data analysis results that supports a more in-depth view into how childhood cancer incidences impact the male and female population regionally in Louisiana.

Table 19

North Region Gender Statistics of Childhood Cancer Incidences in Louisiana, 2004-2010

Paired sample statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error
Male cancer incidences (0-19) distribution 2004-10	11.14	22	15.270	3.256
Female cancer incidences (0-19) distribution 2004-10	5.09	22	7.077	1.509

Note. Data source: Louisiana Tumor Registry, 2012.

Table 20

North Region: Gender Statistics of Childhood Cancer Incidences in Louisiana 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf.				
		Std	Std. error	interval diff				Sig
Pair 1	Mean	deviation	mean	Lower	Upper	*t*	*df*	2-tailed
Male Cancer incidences (0-19) distribution 2014-2010 Female Cancer incidences (0-19) distribution 2004-2010	6.045	8.449	1.801	2.300	9.791	3.356	21	.003

Note. Data source: Louisiana Tumor Registry, 2012.

Table 21

Central Region: Gender Statistics of Childhood Cancer Incidences in Louisiana, 2004-2010

Paired sample statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error
Male cancer incidences (0-19) distribution 2004-10	14.16	19	16.767	3.847
Female cancer incidences (0-19) distribution 2004-10	6.32	19	7.258	1.665

Note. Data source: Louisiana Tumor Registry, 2012.

Table 22

Central Region: Gender Statistics of Childhood Cancer Incidences in Louisiana 2004-2010

	Paired samples statistics							
	Paired differences							
				95% conf. interval diff				
	Mean	Std Deviation	Std. error Mean	Lower	Upper	*t*	*df*	Sig Pair 1 2-tailed
Male Cancer incidences (0-19) distribution 2014-2010 Female Cancer incidences (0-19) distribution 2004-2010	7.842	9.788	2.246	3.124	9.791	3.492	21	.003

Note. Data source: Louisiana Tumor Registry, 2012.

Table 23

South Region: Gender Statistics of Childhood Cancer Incidences in Louisiana, 2004-2010

Paired sample statistics				
Pair 1	Mean	*N*	Std. deviation	Std. error
Male cancer incidences (0-19) distribution 2004-2010	35.30	23	37.999	7.923
Female cancer incidences (0-19) distribution 2004-2010	16.26	23	17.649	3.680

Note. Data source: Louisiana Tumor Registry, 2012.

Table 24

South Region: Gender Statistics of Childhood Cancer Incidences in Louisiana 2004-2010

Paired samples statistics								
	Paired differences							
				95% conf.				
		Std	Std. error	interval diff				Sig
Pair 1	Mean	Deviation	Mean	Lower	Upper	*t*	*df*	2-tailed
Male Cancer incidences (0-19) distribution 2014-2010 Female Cancer incidences (0-19) distribution 2004-2010	19.043	20.606	4.297	10.133	27.954	4.432	22	.000

Note. Data source: Louisiana Tumor Registry, 2012.

As evident from the south region tables 22 and 23 illustrating male and female results, there were significant differences (*p*= .013) resulting between parish averages of male and female cases, as well as in all regions. It is thus, safe to conclude that the pre-post cancer impact, if attributed to natural disasters in Louisiana, had higher propensity among male children and young adult males (0-19) when compared to female children and young adult females (0-19). The null hypothesis was not rejected since the data analysis indicated that there were significant differences in the number of males diagnosed regionally in Louisiana following Hurricanes Katrina, Rita, and Gustav

The 2005 and 2006 annual childhood cancer incidence totals were lower by parish than the 2004 post Hurricanes Katrina/Rita incidences. For years 2007, 2008, 2009, and 2010, the annual parish childhood cancer incidence totals were higher. In 2008, the annual childhood cancer incidence total was the highest in the 7-year span. Confidence intervals were calculated at the 95% confidence interval of the difference for the statistical analyses. The sample sizes used for analysis in this quantitative study were the 1,326 children, age 0-19, diagnosed with a childhood cancer, from 2004-2010. This analysis included all races/ethnicities and genders residing in 1 of the 64 parishes in Louisiana.

Summary

This quantitative environmental research study was conducted to provide a clearer understanding of the possible role post hurricane environments and associated flooding events have on the increasing numbers of childhood cancers and the increasing susceptibility to environmental related diseases, including childhood cancers in Louisiana. This research attempted to identify the unique environmental conditions that existed post Hurricanes Katrina/Rita and Gustav, the exposure of children to these impacted environments throughout Louisiana, and how these factors may explain why an increasing number of children in Louisiana were diagnosed with some form of childhood cancer following Hurricanes Katrina/Rita and Gustav.

While the data supports some premises of the study, the ‘total count” of childhood cancer incidence in Louisiana, based solely on the dataset, might not be adequate to declare a “root-cause” finding that the increasing childhood cancer incidence in Louisiana, 2004-2007, is due to the post hurricane environmental aftermath of Hurricanes Katrina, Rita, and Gustav. Although, the data analysis from the Department of Environmental Quality indicated an increase in toxins, pollutants, and chemicals in several parishes throughout the state following Hurricanes Katrina, Rita, and Gustav, none of these elements have definitively been identified as carcinogenic to children 0-19 years old. In addition, the length of time of exposure and when the exposures occurred are variables whose significance remains undetermined among Louisiana Children, age 0-19. Since 2005, four major hurricanes and the Deepwater Horizon (BP) oil spill have accelerated marsh loss and degradation along the Gulf Coast (Gulf Coastal Prairie; Habitat issues, 2008). There is other evidence of environmental damage that might have induced the propensity of a public health threat such as the spread of childhood cancer.

The research data supports that childhood cancer incidence has been on an incline since 2007 (Louisiana Tumor Registry, 2012). In addition, Louisiana has experienced record setting weather events, including hurricanes, tropical storms, tornadoes, and severe flooding at an increasing rate and more frequently since 2000, with the most intense of these weather events beginning with Hurricanes Katrina/Rita in 2005. More than 80% of these weather events were associated with intense winds and flooding. The presence of intense winds and flooding presents risks such as loss of shelter, downed powerlines, loss of electricity, contaminated drinking water, mold, and the possible dispersing of chemical and toxins from farms, gas station, chemical plants, chemically treated play grounds and ball fields, and industrial businesses in the local vicinity. The possibility of associated health risks due to environmental exposure is rarely considered and more likely than not, little thought is given to the associated health risks these post weather events may pose and the areas they adversely affect. Chapter 5 will provide further interpretation of the study findings and recommendations for future research.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative research study was to elaborate on the increasing number of childhood cancer cases following Hurricanes Katrina/Rita and Gustav. This research study was conducted on the premise that 90%-95% of all cancers occur due to or in response to environmental contacts and or exposures (Anand et al., 2008). In addition, this study examined whether there were possible correlations between the environment following Hurricanes Katrina/Rita and Gustav and the increasing number of childhood cancer incidences after these severe weather events occurring between 2004 and 2010. Numerous environmental and health-related studies have supported the notion that the environment is a major factor causing death and disease in humans. Research studies including Gottlieb et al. (2010), Yu et al. (2011), and Brulle et al. (2006) have established that exposure to toxins, contaminants, and pollutants may alter genetic transcriptions in humans. In contrast, other research studies have attributed death and disease in humans to poor diet and lifestyle choices, rejecting the possibility of environmental factors causing these outcomes, or at least greatly minimizing the idea that the environment and environmental factors are catalysts for the development of death and disease in humans, including childhood cancer (Booth, et al., 2012).

Linking environmental causes to childhood cancer in Louisiana would provide the groundwork needed to begin reducing, and possibly eliminating, environmental risk factors that put children at risk of developing childhood cancer (Anand et al., 2008). This would be a key element in the effort to prevent childhood cancer and could better inform parents of risk factors that their developing children should avoid (Anand et al., 2008). Information on identified risk factors would better prepare physicians and oncologists for a possible increase in childhood cancers that due to prior exposures (Yu et al., 2011).

During the period 2004-2010, there were 592 females and 734 males diagnosed with childhood cancer in Louisiana (Louisiana Tumor Registry, 2012). Females accounted for 45% of all childhood cancer incidences, and males accounted for 55% of all childhood cancer incidences (Louisiana Tumor Registry, 2012). The racial/gender breakdown for childhood cancer incidence in Louisiana from 2004-2010 was as follows: White males (n = 471, 36%), White females (n=392, 30%), Black males (n=236, 18%), Black females (n=201, 14.3%), other males (n=17, 1%), and other females (n=9, .7%; Louisiana Tumor Registry, 2012).

Interpretation of the Findings

According to Mendes (2014), potentially lifesaving chemotherapy and radiation treatments are toxic and present risks, including an increased rate of relapse. Mishel's uncertainty in illness theory complements the findings of Anand et al. (2008) as well as the current research, which expresses that cancer is a preventable, but only with major lifestyle changes that include reducing exposure to contaminants and/or other harmful environmental factors. For Louisianans, preventive measures should include, but not be limited to, areas that have experienced severe weather events such as hurricanes and severe storms, especially in those parishes located in the southern region of the state.

Mishel's uncertainty in illness theory establishes the need to examine the long-term effects of exposure to toxins, contaminants, and pollutants after Hurricanes Katrina, Rita, and Gustav on children 19 years and younger (Lee et al., 2009) as well as those who have undergone chemotherapy and/or radiation and still reside in Louisiana (Mendes, 2014).

Most public health experts believe that because the number and rate of childhood cancers continue to increase significantly (Cancer Facts, 2012), there is cause for concern. Various research studies, such as Gottlieb et al. (2010), Yu et al. (2011), and Brulle et al. (2006), have established that exposure to toxins, contaminants, and pollutants may alter genetic transcriptions in humans, which may increase the risk of children of childhood cancer survivors being diagnosed with a childhood cancer due to being exposed to toxins, contaminants, and pollutants such as those prevalent after Hurricanes Katrina, Rita, and Gustav as well as similar severe weather events.

Through the use of time-sensitive pre- and postdisaster data, this quantitative research study was able to clearly demonstrate a rise in childhood cancer incidence after the hurricanes in Louisiana and probable environmental and chemical calamities enhanced by or due to such events. The consensus of most public health professionals is that the general public has focused primarily on group-related health issues such as HIV/AIDS, HPV, and obesity (SEER, 2013), primarily because the general public views these health issues as treatable, curable, and/or preventable (Halpin et al., 2010). However, like childhood cancer, these health conditions exist because of, and resulting from, a cause-and effect event (Pan et al., 2010).

Although childhood cancer is the leading cause of death by disease in children 0-19 years, it has not been sensationalized across public domains and the media. The American public in general has no or limited knowledge of childhood cancer, the different types of childhood cancers, how this disease affects children 0-19 worldwide, and the severity of this growing health problem for children 0-19 in the United States and globally. More specifically, the citizens of Louisiana are largely oblivious to number of children 0-19 in the state who have been diagnosed with childhood cancers, even though the state is home to two St. Jude affiliate clinics. This quantitative research provided results that could inform the citizens of Louisiana of how childhood cancer is impacting the children in the state and how the growth of childhood cancer has continued to rise annually since 2007, after Hurricanes Katrina/Rita and Gustav.

Through this quantitative research, I have attempted to establish the need for health policies that implement invasive cancer screenings for children following severe weather events such as hurricanes, tornadoes, and floods. This is needed because childhood cancer symptoms are similar to and are often inappropriately identified as growing pains, viruses, or colds or flu in children and adolescents. Because of the increasing impact of childhood cancer on children in Louisiana, cancer screenings should become a routine part of annual health exams for children who are experiencing symptoms characteristically associated with a cancer diagnosis (see Figure 3).

Continuous weight loss with no explanation
Headaches, frequently including early morning vomiting
Increased persistent pain and/or swelling in the bones, joints, back, or legs
Lump or mass, most often appearing in the abdomen, neck, chest, pelvis, or armpits
Distinguishable bruises, bleeding, or rashes
Commonly associated with constant infections
Appearance of a whitish color behind the pupil
Nausea is frequent, persistent or vomiting occurs but without nausea
Constantly tired and or notably pale in appearance
Eye(s) and/or vision changes occurring suddenly and persistently
Recurring and/or persistent fevers with no apparent or associated origin

Figure 3. Symptoms of childhood cancer. Adapted from "Signs of Childhood Cancer," by P. Feist, 2005 (http://www.ped-onc.org).

Based on data analysis results from this quantitative research study, Louisiana childhood cancer incidence rose annually from 2007 through 2010. The data analysis also indicated that childhood cancer incidence in males exceeded childhood cancer incidence in females. The greater prevalence of childhood cancer was in the southern region of the state. According to the data analysis, the southern region of the state was also the area most often impacted by hurricanes, severe rain events, and flooding.

Linking environmental causes to childhood cancer has been difficult, and this difficulty exists primarily because it is almost impossible to determine what children have been exposed to, the length of exposure time, prioritizing and addressing the growing childhood cancer epidemic, and the disproportional funding allocated for childhood cancer research. The results of this quantitative research study are weak in regard to establishing a cause-and-effect and/or a causal relationship, given the three criteria that must be met to definitively declare a causal relationship: temporal precedence, covariation of cause and effect, and no plausible alternative explanation (Trochi, 2006). In considering the temporal precedence, the cause must happen before the effect. In this quantitative research study, the incidence of childhood cancer was high prior to Hurricanes Katrina, Rita, and Gustav and their effects on the environment.

Temporal precedence easily establishes casual relationships because it identifies the measures before the effect (Trochim, 2006). In this study, it seems plausible that after the environmental disturbances of Hurricanes Katrina, Rita, and Gustav, there would have been an increase in toxins and pollutants, and children would likely have been exposed to harmful environmental conditions. This could, at least partially, have been a cause for an increase in childhood cancer incidence in Louisiana, but the increases in toxins and pollutants and in childhood cancer rates occurred together and on an ongoing basis. However, it is not possible that fluctuations in childhood cancer rates affect the presence of or the increase in harmful environmental conditions. This makes it very difficult to establish a causal relationship in this situation.

According to Trochim (2006), establishing covariation of cause and effect is relatively simple because there is some control over the cause. In this study, some children would have been exposed to toxins and pollutants after the hurricanes, whereas others would not (if X and if not X). Although these three storms (Hurricanes Katrina, Rita, and Gustav) collectively impacted the entire state, the southern region is more often and more severely impacted by hurricanes. This is because this region is closest to the Gulf of Mexico. Many families (including children) evacuated prior to Hurricanes Katrina, Rita, and Gustav; in some of these families, children would have been exposed to these harmful environmental conditions after returning home. Other families permanently relocated to other areas of the state and to other states and were not exposed to these harmful environmental conditions. These factors eliminate the possibility of a cause-and-effect relationship.

Lastly, Trochim (2006) stated that the existence of a relationship does not mean that the relationship is causal. In this quantitative research study, there may have been some other variable or factor that caused the outcome; ruling out alternative explanations for the observed outcome is difficult.

Limitations of the Study

The U.S. Census Bureau (2005) estimated that 203,937 persons were displaced in 2005 from Alabama, Louisiana, Mississippi, and Texas due to Hurricanes Katrina and Rita. Therefore, the CDC did not include these persons in 2005 population counts for these states.

Hurricanes Katrina/Rita and Gustav destroyed pertinent Louisiana Tumor Registry records housed in the registry's New Orleans headquarters. Although the

Louisiana Tumor Registry works in conjunction with the CDC, Hurricane Katrina more likely than not negatively impacted the data source. In addition, Hurricanes Katrina/Rita and Gustav destroyed testing stations operated by the LDEQ. The timeframe between Hurricanes Katrina and Rita did not allow for repair and/or replacement of test sites. To date, several parishes do not have working environmental testing sites. The impact of any natural disaster could also contribute to health anomalies, stress, toxin and chemical decomposition, and other health-related "root causes." This quantitative research study, however, was not extended to further granular levels of causes because of its academic scope and significant funding requirements. Analysis was also conducted to identify count differences by region as well as gender distribution.

This descriptive quantitative childhood cancer research study cannot infer causality due to its design and the other missing criteria for causality. This study employed descriptive statistical data; according to Creswell (2009), such data provide basic summaries, counts, and rates for a sample population. Descriptive statistics simply identify what the data illustrate (Trochim, 2006). This quantitative research study on childhood cancer in Louisiana from 2004-2010 was a randomized experiment. Randomized experiment is a strong design that is generally employed when a researcher is interested in establishing a cause-effect relationship (Trochim, 2006). In the case of this research study on childhood cancer in Louisiana, the design included multiple groups and/or multiple measurements. However, it has been established that the fact that a relationship exists does not mean that the relationship is causal, and it is highly possible that some other variables or factors had an effect on the outcome. Therefore, it is difficult to rule out alternative explanations of observed outcomes, and it is equally difficult to declare that the posthurricane environmental exposure of children aged 0-19 years caused an increase in childhood cancer incidence in Louisiana from 2004-2010.

Recommendations

Possible environmental risk factors, including parental exposure to cancer-causing chemicals, prenatal exposure to pesticides, childhood exposure to common infectious agents, and chemically treated playgrounds and ballfields, should be furthered explored. Identifying minimal correlations can provide a basis for implementing preventive measures geared toward reducing the number of childhood cancer cases.

Based on findings from this quantitative research study, future research efforts should focus on environmental conditions after severe weather events such as hurricanes, tornadoes, and severe floods and the potential role of postdisaster environmental conditions on the health of children. In addition, epidemiological research should focus on the possible correlations between these severe weather events, environmental exposure following severe weather events, and the prevalence of childhood diseases, including childhood cancer, following these weather events. Although weather-related environmental disturbances are occurring more frequently and the questions posed should be to what extent and how are these environmental disturbances impacting public health in Louisiana, and more precisely how does it impact the health of children (0-19) in the state. The premise, however, to establish a "case-effect" relationship is beyond the scope of this study and opens the door for noteworthy future research.

Implications

In the United States, more children die of childhood cancer than any other disease (American Childhood Cancer Organization, 2012). Through this quantitative research study, I hope to make citizens across Louisiana aware of the severity of this disease and the short- and long-term effects it is having on children in Louisiana. The findings of this research study indicate that there is a need to promote the implementation of policies that make medical exams mandatory that include routine screening measures, especially during developmental stages and after severe weather events such as hurricanes, tornadoes, and floods. The results of this research study are intended to support the need for childhood cancer in children aged 0-19 years to be declared a high-priority health concern in Louisiana. The success and survivorship of childhood cancer patients depend largely on early detection and the treatment and care given by pediatric oncologists who are experienced in treating specific childhood cancers. This quantitative research study may identify and inform Louisiana citizens of the degree to which this life-threatening disease has impacted and is likely to impact children in Louisiana. Finally, with this quantitative research study, I intend to establish and promote the urgent need for additional research and funding for research on childhood cancer in Louisiana and in the United States as a whole.

Conclusion

The public should be made aware of the prevalence of childhood cancer, of the degree to which this life-threatening disease impacts children in Louisiana, and of the fact that the annual number of children diagnosed in Louisiana has steadily increased since 2007. This quantitative research methodology has provided results that better inform parents, health care professionals, and families of how childhood cancer impacts the population of children younger than 19 years old and the parishes in which this disease is most prevalent. Further, this study should serve to encourage more aggressive methodology for screening for early detection of childhood cancers. In this case, the term *methodology* is used to describe techniques used to gain a better understanding of the world and the roles people assume in the schematics.

The results of this study may also encourage the development of more detailed regulatory guidelines for returning to disaster-impacted properties, which should address the possible risks associated with exposure due to returning to disaster-impacted areas, especially in relation to the health of children. Finally, this quantitative research study may raise awareness of the prevalence of childhood cancer and the degree to which this life-threatening disease impacts children in Louisiana. As the number of children diagnosed with childhood cancer has risen annually following Hurricanes Katrina/Rita and Gustav, there is an urgent need for additional research and research funding specifically for childhood cancer and other environmental-health-related concerns affecting children in Louisiana.

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Appendix A: IRB Approval

From: **IRB** <irb@waldenu.edu>

Date: Wed, Apr 20, 2016 at 10:17 AM

Subject: IRB Materials Approved - Lenora Robinson

To: "Lenora Robinson (lenora.robinson@waldenu.edu)

Dear Ms. Robinson,

This email is to notify you that the Institutional Review Board (IRB) confirms that your doctoral capstone entitled, "Post Hurricane Environmental Aftermath: Its Impact on Childhood Cancer Rates in Louisiana 2004-2010," meets Walden University's ethical standards. Since this project will serve as a Walden doctoral capstone, the Walden IRB will oversee your capstone data analysis and results reporting. **Your IRB approval number is 04-20-16-0264096.**

This confirmation is contingent upon your adherence to the exact procedures described in the final version of the documents that have been submitted to IRB@waldenu.edu as of this date. This includes maintaining your current status with the university and the oversight relationship is only valid while you are an actively enrolled student at Walden University. If you need to take a leave of absence or are otherwise unable to remain actively enrolled, this is suspended.

If you need to make any changes to the project staff or procedures, you must obtain IRB approval by submitting the IRB Request for Change in Procedures Form. You will receive confirmation with a status update of the request within 10 business days of submitting the change request form and are not permitted to implement changes prior to receiving approval. Please note that Walden University does not accept responsibility or liability for research activities conducted without the IRB's approval, and the University will not accept or grant credit for student work that fails to comply with the policies and procedures related to ethical standards in research. When you submitted your IRB materials, you made a commitment to communicate both discrete adverse events and general problems to the IRB within 1 week of their occurrence/realization. Failure to do so may result in invalidation of data, loss of academic credit, and/or loss of legal protections otherwise available to the researcher.

Both the Adverse Event Reporting form and Request for Change in Procedures form can be obtained at the IRB section of the Walden website:

http://academicguides.waldenu.edu/researchcenter/orec

You are expected to keep detailed records of your capstone activities for the same period of time you retain the original data. If, in the future, you require copies of the originally submitted IRB materials, you may request them from Institutional Review Board.

Both students and faculty are invited to provide feedback on this IRB experience at the link below:

http://www.surveymonkey.com/s.aspx?sm=qHBJzkJMUx43pZegKlmdiQ_3d_3d

Sincerely,

Libby Munson

Research Ethics Support Specialist

Office of Research Ethics and Compliance

Email: *irb@waldenu.edu*

Fax: 626-605-0472

Phone: 612-312-1283

Office address for Walden University:

100 Washington Avenue South, Suite 900

Minneapolis, MN 55401

Information about the Walden University Institutional Review Board, including instructions for application, may be found at this link:

http://academicguides.waldenu.edu/researchcenter/orec

Appendix B: Letter to Louisiana Tumor Registry via National Cancer Institute

Thank you for contacting the National Cancer Institute. Below is a response to your recent request for information.

Subject: Louisiana Childhood Cancer Data 2004-2010

National Cancer Institute Response

Discussion Thread

Response Via Email (NCI Agent) 04/14/2016 07:46 AM

Thank you for your request for information from the National Cancer Institute's (NCI) Cancer Information Service (CIS). Below are links to the information that was discussed during our conversation.

National Program of Cancer Registries

Centers for Disease Control and Prevention (CDC)

http://nccd.cdc.gov/dcpc_Programs/default.aspx?NPID=3&PID=157

State Cancer Profiles - Louisiana

http://statecancerprofiles.cancer.gov/quick-profiles/index.php?statename=louisiana

Surveillance, Epidemiology, and End Results Program

http://seer.cancer.gov/

Please do not respond to this e-mail. If you have follow-up questions or would like to request more information, we invite you to contact us again.

Please be aware that the information provided does not constitute medical or legal advice.

Sincerely,

NCI's Cancer Information Service

1-800-4-CANCER (1-800-422-6237)

http://www.cancer.gov/contact

Question Reference #150914-000074

Date Created: 04/14/2016 07:30 AM

Last Updated: 04/14/2016 07:46 AM

Status: Completed

Dear Ms. Andrews,

4/25/16

I was referred to your department by the National Cancer Institute. I am interested in conducting childhood cancer research**. I have received IRB approval!!!** I emailed you a few months ago, requesting research assistance. I am a doctoral student at Walden University. I'm interested in conducting childhood cancer research and I need assistance in obtaining research data on childhood cancer incidences on Louisiana children diagnosed from 2004 – 2010. I am interested in this time frame since I am attempting to establish a correlation between the post environmental conditions impacting Louisiana after 3 major Hurricanes; Katrina, Rita, and Gustav. Is permission needed to obtain these data sets?

Sincere thanks,

Lenora M. Robinson

Walden University

Doctoral Student

04/25/16 at 3:09 PM

Yes, this data is available through our department. Parish data are definitely in the public domain, meaning No permission needed. To get the software and data requested, go to http://seer.cancer.gov/seerstat/. SEER*Stat is accessible via the SEER Public Use Data Set. Version 8.3.1, which includes data through 2012

Appendix C: Letter to Department of Environmental Quality

Public Record Request 39378 for contaminates and etc. following Hurricane Katrina/Rita

Dear Ms. Moliere

I am requesting DEQ data to complete a doctoral research study. I need data identifying the contaminants, pollutants, chemicals, and toxins found in the air, water and sludge following Hurricanes Katrina/Rita just prior/following (July 2005 through October 31st, 2005) and Hurricane Gustav just prior/following (July 2008 - October 31, 2008) for all 64 parishes.

Melinda Molieri <Melinda.Molieri@LA.GOV> Good Afternoon Lenora: Regarding the status of your public records request, PRR 39378, we have contacted the appropriate DEQ contacts and are currently processing your request.

To

'lmrproperties@yahoo.com'

CC

Tina Gibeson

04/25/16 at 2:31 PM

Good Afternoon Lenora:

Regarding the status of your public records request, PRR 39378, we have contacted the appropriate DEQ contacts and are currently processing your request. We have been advised that the request in its current form is very broad and would take a large amount of time to process. The earliest estimate is middle of next month.

Our DEQ contacts also advice that several different federal and state agencies were involved in the sampling after Katrina and Rita. DEQ was involved in some but not all of the sampling. In addition, some data can be obtained only from our monitoring stations. For example, for air quality we would be able to provide the data from our ambient air monitoring stations and all results from canister samples collected during those time periods.

You can visit http://airquality.deq.louisiana.gov/ to see the sites and pollutants that may be available.

Do you have any additional information about the kind of data that you are looking for that would help narrow down your request?

Thanks,

Melinda Molieri

Access Sciences Public Records Technician

Louisiana Department of Environmental Quality

Phone: 225.219.3168 Email: melinda.molieri@la.gov

Records Management: Access - Integrity – Security

Good Afternoon Lenora:

We have finished gathering the information for your public records request.

Please see the notice of cost below for the total data processing fee at the reduced rate.

Thank you,

Tina Gibeson

Access Sciences Records Management Analyst

Louisiana Department of Environmental Quality

Phone: 225.219.3171 Email: tina.gibeson@la.gov

NOTICE OF COST

We have prepared the following cost statement for the records you requested. Please submit your check or money order for the appropriate total. Your requested records cannot be sent until after your payment is received. Standard shipping quoted below will take 3-5 business days. Please notify us if you prefer expedited shipping at an additional cost.

	Cost Per Unit	**Units Provided**	**Cost**
Copies	$0.25 / page	0	N/A
Color Copies	$1.00 / page	0	N/A
Compact Discs	$5.00 / disc	0	N/A
Data Processing Time	$5.00 / hour	4	$20.00
Shipping	Variable	0	N/A
		Total:	**$20.00**

CHECK OR MONEY ORDER accepted for all charges. Make checks payable to LA-DEQ.

CASH accepted with exact change for charges $5.00 or less for records picked up in person.

Credit cards are not accepted.

Mail checks to:	**For FedEx Mail to:**
Custodian of Records, 8th floor	Custodian of Records, 8th floor
P.O. Box 4303	602 N. Fifth Street
Baton Rouge, LA 70821-4303	Baton Rouge, LA 70802

Please send payment or make arrangements to pick up and pay for copies. If payment is not received or arrangements for payment are not made within 10 working days after this notice is sent, your request will be closed. If your request is closed and you still want copies, you will need to file a new request. Please contact me with any questions.

PAYMENT DUE DATE: 05/06/2016

Appendix D: Request for Texas Cancer Registry Data

(Request # 17057)

On Thu, 4/13/17, Arend, John (DSHS) <John.Arend@dshs.texas.gov> wrote:

Subject: **Request for Texas Cancer Registry Data (Request # 17057)**

To: "lmrproperties@yahoo.com" <lmrproperties@yahoo.com>

Date: Thursday, April 13, 2017, 3:32 PM

Good afternoon,

Please find attached an excel spreadsheet with Childhood cancer incidence data for

Texas,

2004-2010. Please feel free to contact me with any questions about the data.

Thank you,

John Arend, MPH

Senior Epidemiologist

Texas Cancer Registry

Texas Department of State

Health Services

1100 W. 49th

St

Austin, TX 78756

P: 512-776-6036 || F:

512-776-7681

John.Arend@dshs.texas.gov

Please note My email address has changed to reflect

@dshs.texas.gov domain. Please be sure to update your

contact information with the new address.

Appendix E: Parishes Declared a Disaster Post-Hurricane Katrina

New Orleans

St. Tammany Parish

Jefferson Parish

Terrebonne Parish

Plaquemines Parish

St. Bernard Parish

Washington Parish

Appendix F: Parishes Declared a Disaster Post-Hurricane Rita

Calcasieu Parish

Cameron Parish

Iberia Parish

Lafourche Parish

St. Charles Parish*

St. John the Baptist Parish*

St. Mary Parish

Terrebonne Parish

Vermilion Parish

Appendix G: Parishes (Regionally) Declared a Disaster Post-Hurricane Gustav

North	**Central**	**South**
Caddo	Grant	Cameron
Bossier	La Salle	Vermillion
Webster	Catahoula	Lafayette
Claiborne	Concordia	St Martin
Union	Vernon	Iberville
Morehouse	Rapides	West Baton Rouge
West Carroll	Avoyelles	East Baton Rouge
East Carroll	Beauregard	Iberia
Lincoln	Allen	Ascension
Bienville	Evangeline	Livingston
Jackson	Calcasieu	Tangipahoa
Ouachita	Jefferson Davis	St Tammany
Richland	Acadia	St Mary
Madison	St Landry	Assumption
De Soto	Pointe Coupee	St James
Red River	West Feliciana	St. John the Baptist
Sabine	East Feliciana	Terrebonne
Natchitoches	St Helena	La Fourche
Winn	Washington	St Charles

Caldwell	Jefferson
Franklin	Plaquemines
Tensas	Orleans
	St Bernard

Appendix H

Permission to use Copywrited Works in a Publication

World Atlas
Aug 23 at 5:18 PM

LETTER FOR PERMISSION TO USE COPYRIGHTED WORKS IN A PUBLICATION

August 18, 2017

WorldAtlas.com

RE: Copyright Permission

Dear Sir/Ma'am:

I am a graduate student attending Walden University. I am in the process of preparing a doctoral dissertation for publication and am seeking permission to include the following material in my publication; (a) Louisiana and (b) map of Louisiana showing parishes. A copy of the work is enclosed.

The work will be used in the following manner: These images are included as figure illustrations in my dissertation to be published. The publication information is as follows:

Posthurricane Environment's Impact on Childhood Cancer Rates in Louisiana, 2004-2010

Please let me know if there is a fee for using this work in this manner.

Please indicate your approval of this request by signing the letter where indicated below and returning it to me as soon as possible via email at lenora.robinson@waldenu.edu. Your signing of this letter will also confirm that you own the copyright to the above-described material. See Attached.

Very truly yours,

Lenora M. Robinson

Doctoral Candidate

Walden University

225-252-3302

For copyright owner use:

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:

By: Rachel Cribby

Title: Managing Editor of World Atlas

Date: August 24, 2017