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Analyzing Interrelationships Between Food Safety Practices and Inspections Among Food Staff in Manitoba

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Abstract

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MPH, Lakehead University, 2012

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Dissertation Submitted in Partial Fulfillment

Of the Requirements for the Degree of

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Abstract

The incidence and prevalence of food safety practices among food staff working in food establishments in Manitoba is underrepresented and has not been adequately reviewed and researched. Uncertified food staff are at higher risk of not following food safety practices that can cause contamination of food and result in foodborne illness. The purpose of this quantitative study was to determine the prevalence of food safety practices among food staff in Manitoba and to determine the relationship between food safety certification and routine health inspections. Pender's health promotion model and Bandura's social cognitive theory were used to explain the relationships and associations between variables. Archived data dating from 2012 to 2014 of health inspection reports on 558 food establishments were collected and analyzed using the Manitoba Health Hedgehog database. Chi Square, Pearson Correlation Coefficients, and Fisher's Exact Tests revealed the association of food safety practices, routine health inspections, and food safety certification. Results indicated no statistical difference between food safety practices and routine health inspections. Pearson's *r* analysis revealed a weak relation between routine inspections, internal temperature, thermometer use, and food storage/food protection noncompliance. Logistic regression analysis revealed that food safety certification was not a predictor of food safety practice compliance. This study can provide a bridge to reevaluate current health policies pertaining to food safety practices in Manitoba. This study adheres to the need for social change in establishing and creating prevention programs for food staff. Food safety programs can safeguard the food industry and protect public health from foodborne illnesses.

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Dedication

I would like to dedicate this dissertation to my parents and siblings especially to my sister Suman Brar. Throughout my life she has always supported me and taken good care of me. She has always put her life on hold for me, and for this I thank her. To my mom for her love, patience and always praying for me. To my father who always believe in me, and supported be throughout my educational career. I give thanks to God for encouragement and love.

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A special thanks to my mom, Pam Brar, who has been supportive throughout this entire process .You have always taught me to be strong and never give up, for this I thank you. To my dad Naib Brar, who has always supported me and provided me with strength. To my brother Jb Brar, who has been listened to my complaints and given me motivational speeches. To my sisters Navdeep Brar and Robin Brar, who have always supported me and given me words of encouragement. To Suman Brar, who has always been my person and my other half. I am blessed to have such an amazing family; I thank all of you for your patience and love.

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Chapter 1: Introduction to the Study

In 2006, The Public Health Agency of Canada reported 11 to 13 million cases of food borne illness in Canada (Public Health Agency of Canada, 2006). The proportion of these foodborne illnesses that result from the consumption of food from restaurants is unknown, but it is clear that the restaurant industry plays an important role by setting standards for microbiological hazards and implementing procedures and practices to ensure that food safety practices are achieved (Henson, et al., 2006). Food safety practices are those practices that describe handling, preparation, and storage of food in ways that prevent foodborne illness (Government of Canada, 2014). To reduce the risk of foodborne illness, it is essential that food service workers follow food safety practices. Knowing how to properly cook, clean, chill, and separate foods while handling and preparing them can help avoid complications from foodborne illness (Kramer, 2004). Primary health promotion programs, such as mandatory food safety trainings and certifications, are needed to educate food service workers about proper food handling and preparation behaviors. Secondary health promotion programs should address risk behaviors associated with food safety noncompliance (Green & Selman, 2005). The occurrence of food safety noncompliance practices is alarming. According to an article presented in CBC News (2012), 70 health violations were found in 11 Manitoba chain restaurants. Health violations are a result of improper food safety practices, cleanliness, and pest infestations. In 2013 and 2014 about 20 restaurants were closed in Manitoba due to inadequate food safety practices, general sanitation, pest control, and lack of running water (Manitoba Health, 2014c).

To address issues of proper food safety practices and implementation in food service establishments, the Government of Manitoba employees regulatory bodies, public health inspectors, to enforce the provisions of the food safety regulation. Public health inspectors are trained individuals in food safety and other Environmental Health related issues. Manitoba Health has continued to change its regulations, standards and guidelines in food safety. Currently, Manitoba Health has proposed changing sections of food safety regulation to include mandatory food safety certification for those individuals and operators in food establishment's located in rural environments (Manitoba Health, 2014b).

Research has shown that many food service workers do not engage or follow food safety practices (Brown et al., 2013). Health promotion programs that address barriers for food safety noncompliance are required to increase food safety compliance amongst food service workers. The lack of accurate statistics and limited scholarly research concerning food safety practices amongst food service workers in Manitoba contribute to this phenomenon. It is essential that research on food safety practice compliance and noncompliance among food service workers in Manitoba be conducted in their sociocultural setting to be able to contribute to varying health promotion programs. It is also essential in that it will help generate scholarly documentation that may assist health policy makers to craft new policies to improve public health.

Background

Research has shown that 53% of consumers eat outside the home at least once per week, 17% dine outside the home on average of five or more times per week, and 4% dine outside the home seven or more times in any given week (Jones, Vugia, Selman, Angulo, & EIP FoodNet Working Group, 2002). Given the increasing number of individuals that dine in food service establishments on a daily basis, food safety practices are critical to protecting the health of the public.

Restaurant operations have been reported to be the cause of between 52% and 59% of foodborne illnesses in the United States (Centers for Disease Control and Prevention, 2012b). Food service staffs play a pivotal role in the prevention of foodborne disease. Research continues to indicate inadequate, lack of, and poor food safety practices in food establishments (Green et al., 2005). Food service staffs continue to not follow food safety practices when working in food service facilities (Kibret & Abera, 2012). One study's findings suggested cold holding temperature was one major food safety practices that was not being followed by food service staff (Menachemi et al., 2012). The National Collaborating Centre for Environment Health identified risk factors for foodborne illness; personal hygiene, cross-contamination, improper time/temperature control and unsafe food (Lukacsovics, Hatcher, & Papadopoulos, 2014). Foodborne illnesses result from food services staff following inadequate and poor food safety practices while working in food establishments (Centers for Disease Control and Prevention, 2012b). Retail foodservice operations are problematic in that employee contamination of an initially safe food item can occur (Little & McLauchlin,

2007).Examples of such contaminations have been reported (Lukacsovics, Hatcher, & Papadopoulos, 2014).

Many studies have shown that there are food safety practices in restaurants that are simply not being followed. For example, Roberts, Junehee, Shanklin, Pei and, Wen-Shen (2011), compared compliance with the food code between varying food establishments and found improper food temperatures, cross contamination, and employee hygiene were amongst the major concerns in these food establishments. In 2004, The U.S. Food and Drug Administration reported poor personal hygiene, time and temperature control, and contaminated equipment as the three major food safety contributors to foodborne illness outbreaks in retail food service operations.

Jones, Pavlin, LaFleur, Ingram and, Schaffner (2004) examined statewide restaurant inspection data from Tennessee. Data were available from 167,574 restaurant inspections. Results indicated that during this period the following food safety practices not being followed: food protection during storage, preparation, display, service, transportation (frequency of 69,509); thermometers provided and conspicuous, (frequency of 69,595), food protection during storage, preparation, display, service, transportation (frequency of 101,126) (Jones, Pavlin, LaFleur, Ingram, & Schaffner, 2004). The results affirmed that food safety practices continue to be problematic amongst food establishments.

Improving safe food handling practices and addressing issues related to food safety practices are paramount in overall health. Following safe food handling practices is the primary way to reduce the prevalence of foodborne hazards. The lack of food safety

practices being implemented in food establishments is a public health concern that must be addressed. A review of current literature showed limited research on determining food safety practices of food service workers in Manitoba, and relatively few relevant Canadian studies on food safety practices of food service workers.

Problem Statement

Food safety is a public health priority; millions of people become sick from consuming unsafe foods (Public Health Agency of Canada, 2006).The research problem addressed in this study is to attempt to fill the gap in current literature related to food safety practices and to contribute current data regarding the prevalence of food safety practices and its relationship to routine health inspections, as well as food safety certification in Manitoba, Canada.

Food safety practices are essential in food service premises and an importance component of public health. When an individual consumes food from a restaurant, they assume and trust that the food has been stored, handled, and prepared in a manner that deems it safe (Allwood, Lee, & Borden-Glass, 1999).To ensure appropriate food safety practices are being implemented routine health inspections of commercial food establishments are conducted. Routine health inspections are designed to ensure the immediate physical safety of restaurant patrons and workers in the environment (Choi & Almanza, 2012). Although much is known about how routine food inspections work in improving food safety practices, emerging research suggests that lack of food safety practices and poor food safety practices are continuously accruing regardless of these routine inspections (Blake Waters et al., 2013). The primary goal of routine health

inspections is to ensure compliance and assurance of the implementation of good food safety practices (Allwood et al., 1999). Health inspections are successful in identifying inadequate or poor food safety practices if and when they exist. However, while numerous research studies have been conducted in the area of food safety practices amongst food service workers, no studies have been conducted in Manitoba, Canada. This research will aim to address the gap in literature when it comes to correlating inspection frequencies with reported food safety practices in the Province of Manitoba using a food safety program like no other in Canada. In addition, this research will address the gap in literature when it comes to the relationship between food safety practices and food safety certification of food service workers.

Purpose of the Study

The purpose of this quantitative research study was to determine the prevalence of food safety practices among food service staff working in food establishments in Manitoba, Canada. The researcher examined the relationship between food safety practices and health inspections and the predisposing factor of food safety certification of food service staff working in food establishments in Manitoba. An analytical approach was used to explore the variables of the study.

Research Questions and Hypotheses

The research questions were developed based upon the need to explore food safety practices, health inspections, and food safe certification. The research questions to be answered in this study are:

RQ1: What is the prevalence of food safety practices among food service workers working in food establishments in Manitoba, Canada?

$H_0$1: There is an association between food safety practices and health inspections among food premises in Manitoba, Canada.

***H_a*1**: There is no association between food safety practices and health inspections

RQ2: What is the relationship between food safety practices and health inspection?

$H_0$2: There is an association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

H_a2: There is no association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

RQ3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

$H_0$3: There is an association between food safety practices and the predisposing factor of food safety certification in Manitoba Canada?

H_a3: There is no association between food safety practices and the predisposing factor of food safety certification Manitoba Canada?

Theoretical Base

Theories and models present a systematic way of understanding events, behaviors, and/or situations. Researchers employ theories and models to fill specific gaps in research and support and provide an understanding of the framework of research studies such as the framework of quantitative studies (Glanz, Rimer & Viswanath, 2008). This study

utilized the social-cognitive theory (SCT) and the Health Promotion Model (HPM) proposed by Pender (1982; revised, 1996). The SCT was first known as the social learning theory, proposed by Miller and Dollard in 1941 (Bandaura, 1998). It was renamed SCT when concepts from cognitive psychology were integrated (Bandura, 1977a). The SCT is based on the idea that human behavior is the product of the interactions of personal, behavioral, and environmental influences and that self efficacy is the perception of an individual's ability to succeed in a particular situation in order to obtain a desired outcome (Bandura, 1998). The SCT describes how individuals gain and retain specific behavior patterns and provide a foundation for intervention strategies (Galloway, 2003).

The SCT theory provides scientific foundation for risk behaviors like poor food safety practices and identifies ways to promote change amongst individuals and communities. Behaviors like food safety practices need to be identified. The SCT helps to understand and predict group and individual behavior, as individuals are not born predisposed to risky behaviors such as poor food safety practices (Glanz et al, 2008). Individuals learn behaviors through their interaction and exposure to the environment (Bandura, 1998). The SCT theory identifies methods in which behaviors can be changed or modified to reduce risky behaviors such as poor food safety practices or inadequate/lack of food safety practices. This theory is regularly used in interventions aimed at personal development, behavior pathology, and health promotion, with respect to cultural, demographics, and geographic variations (Bandura, 1977b).

Pender's HPM is focused on achievement of higher levels of well being and

achievement of one's full potential. The HPM assumes that individuals have unique personal characteristics and that experiences will affect their actions (Galloway, 2003). It is a conceptual framework; cognitive-perceptual elements influence health promoting behaviors. The cognitive-perceptual elements are those that are defined in the framework as the individual's perception of health, definition of health, health status, and control of health, self-efficacy, benefits of and barriers of health promoting behaviors (Pender, 1996). This framework provides guidance to motivate individuals to engage in healthy behaviors. Engaging in food safety practices is a healthy promoting behavior.

Pender's HPM focuses on three areas, (a) individual characteristics and experiences, (b) behavior-specific cognitions and affect and (c) behavioral outcomes. Individual characteristics and experiences are those that include prior related behavior or personal factors (biological, psychological, and sociocultural) (Pender, 2002). Behavior-specific cognitions and affects are those that include the following: (a) perceived benefits of action, (b) perceived barriers to action, (c) perceived self-efficacy, (d) activity-related affect, (e) interpersonal influences, and (f) situational influence (Pender, 2002). Behavioral outcomes are influenced by immediate competing demands, and preferences, which can affect health-promoting behavior (Marriner & Raile, 2005).

In reference to this study, the HPM and SCT demonstrate the relationship between (a) behavior-specific cognitions and (b) affects of the HPM and (c) self-efficacy (a person's confidence in performing a particular behavior), (d) behavior capability (knowledge and skill to perform a given behavior), and (e) the environment (factors that can affect a person's behavior) of the SCT in relation to food safety practices, integrating

Bandura's and Pender's theories (Glanz et al, 2008; Pender, 2002). Food safety workers can develop self-efficacy, obtain behavior capability (Bandura, 1998) in their environment (food establishments) and have cognitive-perceptual elements. These competences can be used when practicing food safety. In following, these competences food safety workers will have positive health promoting behaviors.

Nature of the Study

This study used a quantitative methodology, with a cross-sectional study design. A cross sectional design was used to measure the prevalence of food safety practices among the population of study. Through the use of the secondary data analysis, the researcher examined the following objectives: (a) the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada, (b) the relationship between food safety practices and health inspection, and (c) the relationship between food safety practices and the predisposing factor of food safe certification. The research questions were developed based upon the statement of problem. Through the use of the secondary data analysis, the researcher also examined the characteristics of association between food safety practices, health inspections, and food safety certification.

The variables used in this study were food safety practices, health inspections, and food safety certification. The dependent variable was food safety practices, food safety certification (predisposing factor) and health inspections were the independent variables for this study. The study population included food service establishments in Manitoba, Canada that were categorized as high risk establishments and medium risk

establishments. Secondary data was obtained from the Manitoba Health Protection Unit, information system hedgehog. The data was extracted from the information system, placed into excel and analyzed using (SPSS) Statistics version 20. Description of variables were established and coded with respect to the information obtained from the secondary data source. All statistical analysis were carried out with $\boldsymbol{\alpha}$ = .05 level of significance. Descriptive analyses were used on characteristic information on food establishments, frequencies, percentages, and means were obtained.

Statistical tests were conducted to analyze the information that was inputted in SPSS. To test research hypotheses 1 and 2 chi-square tests of association were utilized (Field, 2009). Those with cell counts less than five, were analyzed using the Fisher's Exact test as they did meet the assumption. To test research hypothesis 3, multiple logistic regression was used. Multiple logistic regression was used to determine the association between food safety practices (dependent variable) and the independent variables (health inspections and food safety certification, the predisposing factor), adjusting for characteristic variables as required. The research questions and hypotheses were developed based upon the problem statement. This information is further discussed in Chapter 3.

Assumptions, Limitations, Scope and Delimitations

Assumptions

The study was based on assumptions that reflected the variables and assumptions that reflected the study design.

Assumptions pertaining to variables

The variables of the study were based on three assumptions which were validated by literature reviewed. The first assumption was that food safety practices were poor and/or they were not being implemented in food service establishments by food service workers. Observations studies have revealed that food service workers frequency engage in unsafe food practices (Bryan, 1988). According to numerous research studies, most outbreaks associated with food service establishments can be attributed to food service workers improper food practices (Clayton & Griffith, 2004; Manning & Snider. 1993). This is a major public health concern; improvement of restaurant worker's food practices is needed to reduce the burden of foodborne illness. The second assumption is that there is a relationship between food safety practices, health inspections, and the predisposing factor of food safe certification. Studies reported that food safety education should be offered to food safety workers and that health inspections are indicative of food safety practices in food establishments (Allwood, Lee, & Borden-Glass, 1999; Mathias, Sizto, Hazlewood & Cocksedge, 1995). The third assumption is that food safety practices are those practices that involve food handling, food preparation, food storage, temperature control, cross contamination, and hand hygiene (Green et al., 2005) concluded that poor food safety practices and or/lack of food safety practices by food service workers is related to food safety education. Tessema, Gelaye, and Chercos (2014) suggested that the implementation or lack of food safety practices being followed by food service workers is due to also behavioral, environmental, and social factors. Although environmental factors

influence food safety practices, such as lack of adequate infrastructure of a restaurant, the researcher did not design the study to directly measure this or address this.

Assumptions pertaining to study itself

The Hedgehog data documentation system is the format used by Manitoba's Health Protection Unit to keep track of all food service facilities in Manitoba that hold a food handling permit and are inspected by Public Health Inspectors (Manitoba Health, 2014a). The Manitoba Health Protection Unit also uses this system to keep track of housing, pool, daycare inspections and public health complaints that pose a health hazard. As a result, the researcher assumed that the data, which was obtained from the Manitoba Health Protection Unit is complete, accurate, and correct. The researcher also assumed that the data in the Hedgehog data documentation system were entered and coded correctly because it is a system that is used to keep track of services offered by the Manitoba Health Protection Unit.

Limitations

The main limitations to this study came from the use of secondary data. There is a chance of mistakes in the data due to such things as incorrect reporting or incorrect data inputting or just simple human error, but due to the large sample size, this will be minimized. Data randomization will not be done; some of the limitations the researcher cannot control for as it was critical in this study to have all the available data on food safety practices included due to their importance. Another limitation was the possibility that the documentation of health inspections was not consistent. High risk food establishments require three routine inspections a year and medium risk establishments

require two routine inspections. As a result, there may be a lack of data regarding health inspections conducted because health inspectors were not able to conduct routine inspections as required due to varying reasons, such as lack of time, high work load, and other pressing public health issues that are the responsibilities of public health inspectors. Another limitation was that literature and statistical information about food safety practices among food service workers in Manitoba, Canada is limited. To address this lack of to address this lack of information, the researcher studied all available information.

Scope

In this study, the researcher aimed to identify the prevalence of food safety practices among food service workers working in food establishments in one of the Canadian Provinces, Manitoba. The sample included food safety workers who are legally allowed to work in Canada. In this study the researcher focused on the association between food safety practices implementation and or lack of and health inspections-and food safety certification.

Delimitations

This research was limited to include only food establishments that are high risk and medium risk in Manitoba. The researcher did not use low risk food establishments in the study to compare prevalence among food service workers and food safety practices. As a result, the outcome of the study can only be generalized to food establishments that are high risk and medium risk receiving health inspections from the Manitoba Health Protection Unit.

Significance of the Study

Researchers continue to find poor food safety practices and or lack of food safety practices being implemented by food service workers in food establishments (Newbold, McKeary, Hart, & Hall, 2008). According to Allwood et al (1999), health inspections impact food safety practices amongst food service workers. It is important to continue to collect more statistical information on food safety practices in food establishments to increase awareness of poor or lack of food safety practices.

This study added to the literature on prevalence rates of poor and or lack of food safety practices in food establishments in Manitoba, Canada. The results will help to improve the understanding of food safety practices not being followed or implemented in food establishments. In addition, the information from this study will help to gain a better understanding of what is required from health inspectors when conducted routine health inspections.

Increased knowledge regarding food safety practice importance could result in better health promotion programs and policy development designed specifically to help eliminate poor food safety practices. To reduce poor, or lack of, food safety practices in food establishments, food service workers must be provided training and experiencing in addition to good work environments to promote social change (Brown, 2013). Social change is improvement of individuals, communities and organizations and can occur by creating and applying ideas and interventions which will allow for healthy behaviors and therefore a healthy population

Operations Definitions (Variables of the Study)

Food premise: High risk and medium risk restaurants in Manitoba (Manitoba Health Protection Unit, 2014).

Food safety certification (Predisposing factor): Food service workers who are food safe certified in Manitoba. Manitoba Health Protection unit offers the Manitoba Health Certified Food Handler Training Program. There are also independent contractors associated with Manitoba Health protection unit that offer food safe training program, for those individuals who require alternate date and time for a food handlers class (Government of Manitoba, n.d).

Food safety practices: Practices that involve safe food handling, safe food preparation, and safe food storage in ways that prevent foodborne illnesses and therefore deems the food safe (Canadian Food Inspection Agency, 2010). This study only focused on food safety practices; it did not focus on pest control, maintenance and sanitation of nonfood equipment and washrooms and, structure of premises.

Health inspections: Routine health inspection conducted by Public Health inspectors, using Manitoba Health Protection Unit, Food safety program inspection checklist (Manitoba Health, 2014b).

Definitions of Special Terms

The following terms will facilitate a better understanding of concepts related to this research.

Cold holding: Refers to those food safety practices where potentially hazardous foods must be held at or below 5C except during necessary periods of preparation (Manitoba Health, 2014a).

Cross-contamination: The process by which bacteria, parasites or other microorganisms are unintentionally transferred from one individual to another, through foods or objects. Cross contamination can be transferred to food by hands, food-contact surfaces, sponges, cloth towels and utensils that touch raw food, are not cleaned, and then touch ready-to-eat foods (Manitoba Health Protection Unit, 2011).

Extensively handled: Food preparation that involves, cooking, cutting, mixing, chopping, blending, cooling and reheating food. This significantly increases potential for cross contamination (Manitoba Health Protection Unit, 2011).

Foodborne illness: An illness caused by the consumption of contaminated food with evidence indicating that food was the source of exposure to the contaminant. A food borne illness occurs when a person consumes food that is contained by bacteria viruses, parasites or toxins (Public Health Agency of Canada, 2013).

Food service workers: Individuals working in a restaurant (Alberta Health and Wellness, 2003).

Food storage and display: Food safety practices where food is adequately stored and displayed in a prescribed manner that will prevent it from contamination. These include practices such as food stored 6inches off the floor on clean shelves, food stored in food grade containers, food grade containers with food stored adequately, food displayed in a manner that will prevent contamination (Manitoba Health , 2014a).

Hand hygiene: "A general term referring to any type of hand cleansing" (World Health Organization, 2009, p. 1).

Hazardous products and toxic materials: Materials in a restaurant that can potentially contaminate food; cleaning agents, pesticides, disinfectants, sanitizers (Manitoba Health Protection Unit, 2011).

High Risk Food Premises: Establishments that make meals from scratch and are involved in chopping, cutting, mixing, cooking, cooling, and reheating of potentially hazardous foods, especially raw meats (Manitoba Health Protection Unit, 2011).

Hot holding: Food safety practices where potentially hazardous food must be held at or above 60C except during necessary periods of preparation (Manitoba Health Protection Unit, 2011).

Minimally handled: "In relation to food, means prepackaged "ready-to-eat" food that has been or is being reheated or served in a food service establishment without having been removed from the original packaging" (Manitoba Health Protection Unit, 2012, p. 2).

Moderately handled: "In relation to food, means food that is neither extensively handled nor minimally handled" (Manitoba Health Protection Unit, 2012, p. 2). This include food that has been taken from the frozen state and cooked in one step, or ready to eat food, that has been re-heated or served once taken out of the package (Manitoba Health Protection Unit, 2011).

Medium Risk Food Premises: Establishments where potentially hazardous foods are frozen and cooked in one step, or where food is reheated, or premises making sandwiches with deli meats (Manitoba Health Protection Unit, 2011).

Potentially Hazardous foods: "means any food that consists in whole or in part of milk or milk products, eggs, meat, poultry, fish, shellfish, edible crustacean, or other ingredients, including synthetic ingredients, in a form capable of supporting rapid and progressive growth of infectious or toxigenic microorganisms, but does not include foods which have a pH level of 4.6 or below or a water activity value of 0.85 or less" (Manitoba Health, 2014b, p. 5).

Temperature control/internal temperature: Potentially hazardous foods maintained below 5C or above 60C (Manitoba Health, 2014a).

Temperature control/thermometer use: Thermometers used to verify food preparation and storage temperatures (Manitoba Health, 2014a).

Summary

This chapter presented an introduction to this quantitative study of the prevalence of food safety practices among food service staff and the relationship between food safety practices and health inspections and the predisposing factor of food safety certification in Manitoba, Canada. There is evidence that food safety practices amongst food service workers are lacking, inadequate or poor. Food safety practice implementation is related to health inspections and the predisposing factor of food safety certification. Inadequate food safety practices are often detrimental to health. Information on food safety patterns in food establishment in Manitoba needs to be documented, as well as the role that food

safety practices plays in maintaining a healthy population in Manitoba when it comes to food consumption. Accurate data on food safety practices among food establishments in Manitoba is needed to understand patterns and variations in food safety practices, which will help to develop primary preventative interventions and create positive social change.

In Chapter 2, literature related to food safety practices was reviewed. Based on the previous review, there is not enough evidence in the literature of food safety practices amongst food establishment in Manitoba. The literature contains many studies on this topic conducted in Canada, the United States and other parts of the World. The literature review for this proposed study was based on the analysis of the variables to be examined: food safety practices, health inspections, and the predisposing factor of food safety certification. In Chapter 2, an overview of the Canadian province of Manitoba, where the proposed study was conducted, is presented, in addition to an overview of the Manitoba food safety program.

Chapter 3 describes the methodology and justification of the statistical analysis used to evaluate food safety practices. Also included in the chapter was information regarding the research design, setting, sample, data collection process, and data analytic procedures. The research design that was used was quantitative cross-sectional research design and multiple logistic regression analysis. Chapter 4 presents findings and data regarding the test of each hypothesis in this study. Chapter 5 reiterates the purpose, nature of the study, implication for social change, recommendations for further research and conclusions drawn.

Chapter 2: Literature Review

Introduction

This chapter reviewed current literature on specific factors related to food safety practices. Relevant studies for this proposed study were collected and reviewed. The purpose of the literature review was to summarize what is known about the relationship between food safety practices, food safety inspections, and food safety certification among food establishments in Manitoba.

Based upon an extensive review of the literature, the review established the relationship between food safety practices and routine food safety inspections, as well as the predisposing factor of food safety certification. The following areas were identified and discussed in the review: (a) food safety importance; (b) factors associated with food safety practices; (c) food safety practices and health inspections and (d) food safety practices and previous food safety certification experience. Theoretical constructs are presented in relation to food safety behavior and quantitative methodology literature is presented.

Literature Search Strategy

In this literature review, the researcher explored studies using epidemiological, behavior science, food safety literature, medical and psychological peer-reviewed articles from 1978 to the present. The literature review was completed by using online reference system. ProQuest and EBSCOhost were used as search strategies for the following databases: CINAHL Plus, Academic Search Complete, MEDLINE, Hospitality & Tourism, Business Source and SocINDEX. In addition to this Pubmed and ScienceDirect

were used. The search includes journal articles, and to retrieve information regarding food safety practices, the following terms were used: *food violations, food safety, food safety and health inspections, food borne illnesses, health inspectors, food handling, food sanitation, food safety certification, food handlers, inspection frequency behaviors in food safety, knowledge and food safety, Enforcement and Education in food safety inspections* and *Manitoba Food Safety Program.* After completing my search, I found approximately 70 articles that provided significant evidence to support this study.

Manitoba

Manitoba is a Canadian prairie province with an area of 649,950 square kilometers, with thousands of lakes and many rivers (Statistics Canada, 2014). It is 6.5% of 9,984,670 km ^{2} proportion of Canada (Statistics Canada, 2013). Manitoba is located in the center of Canada between, the Province of Ontario and the Province of Saskatchewan. Manitoba adjoins Hudson Bay to the northwest, and is the only prairie province with a salt water coastline. Manitoba has an extreme continental climate; temperatures generally decrease from south to north (Statistics Canada, 2014).

Manitoba has a moderately strong economy based largely on natural resources. Manitoba's economy relies heavily on agriculture, tourism, energy, oil, mining, and forestry (Statistics Canada, 2013). Agriculture is extremely vital in Manitoba, it is found mostly on the southern half of the province. Farm lands in Manitoba include cattle farming, assorted grains and oil seeds. The total GDP in 2011 was C$55.894 billion, per capita C$44,654 (Statistics Canada, 2013).

At the 2011 census, Manitoba had a population of 1,208,268 (Statistics Canada, 2014). Manitoba is divided into 10 communities; Morden, Winnipeg, Pierson, Dauphin, Steinbach, Portage le Prairie, Brandon, The Pas, Thompson, and Churchill. Winnipeg is the capital and largest city of the Province of Manitoba, Canada. More than half of the population resides in the Capital. Brandon is the second largest city in by population in Manitoba with 46,061 people (Statistics Canada, 2014).

Currently, there are 6,203 food premises in Manitoba. A food premise is any place that is preparing and selling food to the public (Manitoba, 2014). Food premises in Manitoba are categorized as the following: restaurants, grocery stores, bakeries, butcher shops, delicatessens, catering facilities, take-outs, mobile vending carts, farmers markets, and temporary food events at fairs or festivals. These food premises sell different types of food product and varying cuisine; each cuisine involves food preparation in a particular style of food to produce distinct meals. African cuisine, Asian cuisine, European, Oceanian, and Cuisines of the Americas are just some of the types of cuisines offered at food premises in Manitoba.

In Manitoba food safety is under the provision of the Environmental Health Branch, that is the Manitoba Health, Healthy Living and seniors, Health Protection Unit. The Mission of the Health Protection Unit is to protect the health of Manitobans using strategies such as education and intervention which will reduce the health risks to the public (Manitoba Health, Healthy Living Seniors, 2014b).

The Manitoba Public Health Act (Chapter P-210) and the Manitoba Food and Food Handling Regulation (MR 339/88R) are the two pieces of legislation that

are used by the Health Protection Unit when it comes to governing food safety in Manitoba. These two pieces of legislation reflect the legality of the food safety program. Under the ruling of these two pieces of legislation all food premises must have a valid food handling permit to operate a food premise in Manitoba. The food handling permit is issued by Public Health Inspectors on behalf of the government of Manitoba.

Food premises in Manitoba are inspected on a regular basis to ensure compliance with the Food and Food Handling Regulation (MR 339/88R), which is under The Public Health Act (Chapter P-210). Food safety inspections determine if food premises are being maintained in accordance with the laws prescribed above. The inspections determine whether or not minimum standards are being followed by owners, operators, and staff with respect to sanitation, employee hygiene, general food handling, and disinfection procedures for the specific type of process and temperature control.

In Manitoba food safety certification is only mandatory and required in the city of Winnipeg. In accordance with the City of Winnipeg Food Service By law, food certification is required in the following prescribed manner (Manitoba Health, Healthy Living and seniors, 2014b):

- No person can operate a food service establishment unless the person in charge has successful completed the Certified Food Handler Training Program.

- Food premises with less than five food handlers must have a person on staff who is food safe certified
- Food premises with more than five food handlers working at one time must have a person who is food safe certified on duty at all times.

The food safety course in Manitoba is offered online or in person. The course is completed over a varying amount of time, which is from one day to two days depending on the course delivery. After the completion of the course an exam is provided. Students must score above 70% to pass the course. The course outline covers all the following areas of food safety: microbiology, foodborne illness, health and hygiene, serving and dispensing, food protection, receiving and storage and cleaning and sanitizing.

The health protection unit in Manitoba, which mandates and regulates health inspections conducted by Public Health Inspectors, continues to see food safety violations occurring in food premises with and without individuals that are food safety certified. Such food safety violations include but are not limited to, operators selling food under insanitary conditions, operators failing to ensure potentially hazardous food is maintained at a safe internal temperature, operators selling food that is unfit for human consumption and operators failing to take effective measures against the entry of pests, specifically mice (Manitoba Health Protection Report, 2014a). These food safety violations are not specific to Manitoba that is they are seen in other provinces in Canada as well (Serapiglia, Kennedy, Thompson, & de Burger, 2007). The general idea of food safety violations is similar within Canada

and the U.S. Food safety violations are those items that may place the public's health at risk and lead to foodborne illnesses (Yeager, Menachemi, Braden, Taylor, Manzella, & Ouimet, 2013).

Presently, there are no studies that have been conducted in Manitoba and therefore no data available that determines the relationship between routine food inspections and reported violations in food premises located within Winnipeg. However minimal studies have been conducted in other parts of Canada and the U.S. which illustrate very little scientific research to support how the numbers of routine food inspections affect the number of reported violations in addition to the types of violations seen in varying food premises. These studies provide mixed results or changes to inspection frequency mixed with other regulatory changes or requirements (Corber, Barton, Nair, & Dulberg, 1984; Kaplan, 1978; Mathias, Sizto, Hazlewood, & Cocksedge, 1995). Some studies illustrate that one or two inspections in a year result in declines in violations while others illustrate that this is insufficient and more inspections (upto four times a year) are required to ensure and maintain sanitary conditions (Allwood, Lee, Borden, Glass, 1999; Bader, Blonder, Henriksen, & Strong, 1978; Kaplan, 1978). A study conducted in Ontario, Canada found that increasing the number of inspections did not lead to improved sanitary conditions within food premises (Corber, Barton, Nair, & Dulberg, 1984). These studies use varying methodologies, use a food safety program that is completely different from that of Manitoba, and use different pieces of legislations, standards and guidelines to enforce the varying food safety programs (Campbell, Foggin, Elliott & Kosatsky, 2011; Mathias, Sizto,

Hazlewood, & Cocksedge, 1995; Pham, Jones, Sargeant, Marshall & Dewey, 2010). Therefore it is necessary to obtain scientific validated data on this phenomenon in Winnipeg, Manitoba. Results from this study will contribute to vital information, about the relationship between routine food inspections and reported violations that could be used to create a food safety program to reduce the number of food safety violations in Winnipeg, Manitoba. This will enable positive social change because food safety practices prevent food borne illnesses.

Theoretical Concepts

The researcher used the Social Cognitive Theory (SCT) which was developed in 1986 (Bandura, 1998). It started as the Social Learning Theory in the 1960's by Bandura (Glanz et al, 2008). It was renamed SCT when concepts from cognitive psychology were integrated to understand biases that influence learning and the growing human information processing capacities (Bandura, 1998). The SCT argues that both individuals and their environments interact and influence each other resulting in individual and social change (Glanz et al, 2008). The idea that environmental factors influence individuals and groups can be turned around where groups and individuals influence their environment and therefore regulate their own behavior (Bandura, 1998). One of the many features of SCT is that it offers a number of concepts; these include reciprocal determinism, outcome expectations, self-efficacy, collective efficacy, observational learning, incentive motivation, facilitation, self-regulation, and moral disengagement (Glanz, Rimer & Viswanath, 2008). The concepts of SCT can be grouped into five categories: (a) moral disengagement, (b) self-regulation, (c) environmental determinants of behavior, (d)

observational learning, and (e) psychological determinants of behavior (Bandura, 1998). SCT posits that human behavior is a result of environmental, personal and behavioral influences (Glanz et al, 2008). This theory focuses on people's potential abilities to alter their environment to suit their purposes in addition to a person's ability to interact with their environment (Bandura, 1998). This allows individuals to work in collaboration with one another to achieve environmental changes that will benefit them as an entire group (Bandura, 1998).

It is expected that employees working in a food premise follow food safety practices to ensure the safe delivery of food to their customers. The World Health Organization (WHO) suggests that the most critical line of defense of food safety is the implementation of food safety practices, through the implementation of a food safety education programs (2001). The lack of food safety knowledge and lack of applicable knowledge into practice are major obstacles for food service staff (Egan et al., 2007; Ehiri et al.,1997; Seamen and Eves, 2006). Food handlers often exhibit a poor understanding of microbial or chemical contamination of food and the measures necessary to correct them (Hobbs & Roberts, 1993). This leads to inappropriate food practices and the occurrence of food safety violations and foodborne illnesses.

Knowledge acquired on food safety practices can be obtained through many mechanisms such as training, vicarious learning, learning on your own, or through various educational means, such as food safety programs or education offered by public health inspectors. However possessing knowledge does not necessary mean that food service staff will follow rules of food safety. A number of studies have indicated that

although training may bring about an increased knowledge of food safety this does not always result in a positive change in food handling behavior (Ball, Wilcock, & Aung, 2009; Deborah, Clayton, Griffith, Price & Peters, 2002). Behavior in the work place is independent of acquired knowledge. It is expected that some individuals will pose behaviors in the work place, irrelevant of what knowledge they pose, when it comes to food safety which will result in food safety violations from occurring (Byrd-Bredbenner et al., 2001). Individual behavior is based on and influenced by many factors such as environmental factors (Bandura, 1998).

As stated by Seaman and Eves (2009), social cognition models, such as the Social Cognitive theory is the foundation that has been used for many years by researchers to explore health related behaviors, such as food safety practices, which include hand hygiene practice, food handling, and the use of food thermometers. The Social Cognitive theory has been used to highlight food safety practices of food service employees in food premises. Social Cognitive theory proposes an understanding of the effects behind food service employee's behavior (Byrd-Bredbenner et al., 2001; Deborah, Clayton, Griffith, Price, & Peters, 2002; Medeiros, Hillers, Kendall & Mason, 2001). Social Cognitive theory is grounded in the notion that human behavior is the product of personal, behavioral and environmental influences. This theory maintains that people have abilities to alter and construct the environment to suit themselves (Bandura, 1998). According to this theory, acquired knowledge in food safety does not prevent food safety violations (Deborah et al., 2002).

Research conducted on food safety practices and individual's behavior in food premises determined that education in food safety is noncompliant with behavior. Food service staff knowingly will create food safety violations and this is influenced by a number of mitigating factors, such as the environment (Bandura, 1998). Bandura (1998) stated that environmental factors influence individuals and that individuals can influence the environment therefore resulting in the regulation of their own behavior. Consequently, individual's behavior when it comes to public health related behaviors such as food safety includes controlling the environment and social factors that influence both health outcomes and behaviors.

The health promotion model (HPM) proposed by Pender (1982; revised, 1996) was designed as a framework to predict and describe health promoting behaviors, based on wellness behavior along with research findings in health promotion. The framework can be used to guide research of the psychosocial processes that enable individuals to adapt healthy behaviors. Pender's (1996) HPM revised model was used to describe how people interact with their environment to pursue a healthy lifestyle. The HPM is similar to the SCT when it comes to two central ideas, observational learning and self-efficacy. The motivation in health promotion behavior comes from the desire of an individual to increase their health and well-being (Pender, 2002). Inherited and acquired characteristics and prior behavior are factors that influence beliefs, affect, and enhancement of health-promoting behaviors. The greater the commitments to a specific plan of action, the more likely health promoting behaviors are to be maintained over time (Galloway, 2003)

The Health Promotion Model focuses on three areas: behavior-specific cognitions, individual characteristics and experiences, and affect and behavioral outcomes (Pender, 2002). Each of these three areas represents different variables and these different variables roles in developing particular health behavior. The goal of the health HBM is that the outcome is health promoting behavior (Galloway, 2003). Health promoting behaviors result in improved health and a better quality of life throughout and individual's lifespan (Pender, 1996).

In this study the researcher attempted to develop an understanding of food service staff practices when it comes to food safety. Encouraging healthy practices in food premises continues to be a challenge in public health. According to Pender, (2002) situational influences in the external environment can increase or decrease commitment to or participation in health promoting behavior. Prior behavior and inherited and acquired characteristics influence beliefs, affect, and enactment of health-promoting behavior, (Pender, 2002). Guiding and therefore helping individuals to further understand the relationship between behavior and health may be necessary to motivate them to make changes in their behaviors (Galloway, 2003). Individuals like food service staff should reject behaviors that will threaten health, such as not following food safety practices. HPM is consistent with this attitude of engaging in healthy practices (Galloway, 2003).

Manitoba's Food Safety Program

In Manitoba, a food service establishment is defined as any place where food is prepared or provided in individual proportions for consumption on or off the premises and includes restaurants, delis, take-out food premises, and similar type establishments

(Manitoba Health, 2012a). All food service establishments are subject to the requirements of Manitoba Regulation 339/88R, Food and Food Handling Establishments Regulation under The Manitoba Public Health Act (Manitoba Health, 2014b).

Food service establishment inspections are conducted by Public Health Inspectors (Manitoba Health, 2014b). Public Health Inspectors are experienced individuals in the field of Public Health. Public Health Inspectors hold two university degrees: a Bachelor of Science majoring in subjects such as food sciences, microbiology, environmental sciences, or chemistry, and an after degree Bachelor of Environmental Health (Canadian Institution of Public Health Inspectors, 2014). After the completion of an Environmental Health Degree, those individuals that wish to pursue a career as a Public Health Inspector have to go through a practicum training period. The practicum training period varies depending on what college/university you attended for your Environmental Health Degree. After the successful completion of the practicum, submission of written reports, and an oral examination, candidates are certified by the Canadian Institute of Public Health Inspectors. The Certificate in Public Health Inspection is recognized by the departments of health and other agencies in Canada as evidence of satisfactory training (Canadian Institution of Public Health Inspectors, 2014).Certified Public Health Inspectors are appointed by Winnipeg Health Region as Public Health Inspectors to carry out the provisions of the Manitoba Public Health Act and Regulations.

At the municipal level, regulatory activities, such as health inspections aimed at retail food premises (restaurants, food stores, etc.) are conducted to monitor and enforce compliance with the applicable legislation (Manitoba Health, 2014b). Public health

inspections determine if regulatory requirements and industry standard practices are being followed with respect to food temperature control, food protected from contamination, employee hygiene and handwashing, food handling and procedures for cleaning and/or sanitizing equipment or food contact surfaces, pest control and storage/removal of waste (Allwood et al., 1999; Yeager et al., 2013).

Each visit by the Public Health Inspector generates an inspection report that is provided to the operator. The health inspection reports either confirm that the food premise is compliant with regulations, or to inform that there are food safety practices that are not being followed and that need to be addressed. Those food premises that are compliant will be inspected as per next routine scheduled inspection date (Manitoba Health, 2012). Those food premises with food safety practice(s) noncompliance will require a re-inspection within a prescribed time, which is indicated by the health inspector to ensure compliance with the regulation (Manitoba Health, 2012).

Inspection frequencies are established in an internal document created by Manitoba Health. Inspection frequencies are based on a hazard assessment which is based on factors such as how extensive is the food preparation, population served and amount of food produced (Manitoba Health, 2012). The hazard assessment allows for the classification of food establishments into one of six levels; Level 1: Handling of pre-packaged low risk foods other than in a retail food store, Level 2. Handling of un-packaged low risk foods, Level 3. Handling of pre-packaged potentially hazardous foods, Level 4. Minimally handled potentially hazardous foods, Level 5. Moderately handled potentially hazardous foods and Level 6. Extensively handled potentially hazardous

foods. Based on these classifications, internal documents of Manitoba health establishes that food establishments must be inspected according to the following: establishments with a risk assessment score of 10 to 20 are considered low risk. The inspection frequency for these establishments is once every 12 months. Establishments with a risk assessment score of 25 to 30 are considered medium risk. The inspection frequency of these establishments is once every 6 months. Establishments with a risk assessment score of 35 to 55 are considered high risk. The inspection frequency for these establishments is once every 4 months (Manitoba Health, 2014a). Additional inspections occur as necessary, such as investigation of food-borne illnesses and food-borne outbreaks, investigation of consumer complaints and correction of noncompliance with the ManitobaFood and Food Handling Establishments Regulation (Manitoba Health, 2012).

In Manitoba food establishments are classified in three categories: food handling establishment, food processing plant and food service establishment. A food handling establishment includes a food service establishment, retail food store, food processing plant, temporary food service establishment, meat processing plant or any place, premise were food is manufactured, processed, prepared, packaged, stored or handled, or sold or offered for sale (Manitoba Health, 2014a). A food processing plant is a commercial establishment in which food is manufactured, processed or packaged. A food service establishment is any place where food is prepared or provided for individual consumption, does not include a food processing plant or retail food (Manitoba Health, 2014b).

Restaurant inspections are conducted to ensure compliance with the Public Health Act Food and Food Handling Establishments Regulation (Manitoba Health 2014b). They serve as additional goal of ensuring immediate physical safety of patrons and workers in the environment. A routine inspection is an inspection of a facility that is performed at relatively consistent intervals and is intended to determine compliance with the Manitoba Food Regulation (Manitoba Health, 2014a). A re-inspection is an inspection of a facility that is performed to determine if noncompliant food safety practices noted in the previous routine inspection have been corrected.

Food safety practices of the regulation may be considered critical or non-critical. Critical practices are those that, if let uncorrected, are more likely to cause or contribute to food contamination or food-borne illness. Critical conditions include the following; water supply, food source, food condition, food protection, food handling, cold food storage, hot food storage, Pest/Animal Control, Equipment Sanitation, Utensil Sanitation, Staff/Employee Health and Hygiene, Manual Dishwashing and Mechanical Dishwashing and construction (Manitoba Health, 2014a). All conditions are checked by the health inspector during each routine inspection. When a food safety practice is considered critical, an immediate corrective action is required by the food establishment operator and a re-inspection is to be conducted in a timely manner. When a food safety practice is considered non-critical, more time is generally given to the operator to provide corrective action (Manitoba Health, 2012).

Food Safety Practice Importance

Canada's food industry is changing, growing rapidly, and is a major sector of the economy employing 670,000 individuals in food service. Canadians are now spending an average 10% of their disposable income on food (Industry Canada, 2013). The food retail and hospitability industry is growing, changes in Canadian's lifestyle has led to greater number of people eating meals prepared in food establishments. In 2007, $50 billion was spent in restaurants and bars (Government of Canada, 2012). These changes have brought increase concerns for food safety as eating out increases risk of contracting foodborne illness (Munro, Le Vallee, & Stuckey, 2012)**.** In 2008, The National Restaurant Association indicated that restaurant sales were projected to reach $558.3 billion. Studies show that foodborne illnesses are linked to eating outside the home that is in food premises (Jones et al., 2004; Bogard, Fuller, Radke, Selman & Smith, 2013).Retail foodservice operations are problematic in that employee contamination of an initially safe food item can occur.

The Government of Canada estimates that there are about 4 million cases of domestic foodborne illness in Canada every year (Public Health Agency of Canada, 2014). In the province of Ontario there were 29, 897 gastrointestinal (GI) tract infections reported by health authorities from 2007- 2009. The most frequently reported diseases were campylobacteriosis (10,916 cases or 36.5% of all GI illnesses) and salmonellosis (7,514 cases, 25.1%). The most commonly reported sources of infections were food (54.2%), with food premises (29.7%) being one of the commonly reported exposure setting and private homes (45.5%) being the other (Vrbova, Johnson, Whitfield &

Middleton, 2012). Foodborne illnesses are infections or irritations of the gastrointestinal (GI) tract caused by food or beverages that contain harmful bacteria, parasites, viruses, or chemicals (Public Health Agency of Canada, 2014). The Ontario Ministry of Health has indicated that one in eight Ontarians will have suffered from food poisoning, with most reported cases traced to restaurants and institutions.

In 2006, 1,247 foodborne disease outbreaks were reported to the Centers for Disease Control and Prevention (CDC). Of that number, 610 (49%) outbreaks occurred in restaurants and delicatessens (Lee, Nelson & Almanza, 2012). Studies have shown that food service workers often do not follow food safety practices (Baş et al., 2006; Tessema at el., 2014). Food service workers are those individuals in the food industry whose hands come in direct contact with food (Kibret et al., 2012). It is important that food service workers follow food safety practices to prevent foodborne illnesses. Addressing issues related to food safety practice and improving food handling practices to deem them safe are paramount in food establishments. Safe food handling practices are a preventive measure to foodborne illnesses in overall health. Following safe food handling practices is the primary way to reduce the prevalence of foodborne hazards (Havelaar et al., 2013).

Food safety practice is a scientific discipline describing handling, preparation, and storage of food in ways that prevent foodborne illness (Roberts et al., 2008). This includes a number of routines that should be followed to avoid potentially severe health hazards, from foodborne illnesses (Centers for disease control and prevention, 2006). Routines include separation of raw and cooked foods to prevent contamination of cooked foods, cooking foods for the appropriate length of time and at the appropriate

temperatures to kill pathogens, storing food at proper temperatures, preparation/handling of food in sanitary and clean environments (food premises) (Tessema, 2014).

Food facilities in the nation and in varying provinces of Canada have food safety programs that are put in place to ensure safe food handling practices and therefore prevent foodborne illnesses. Although food safety programs are mandated they are not always followed by food handlers (Deborah et al., 2002; Kibret et al., 2012). Studies have shown that food service workers continue to not follow food safety practices in food premises (Green et al., 2005; Kibret et al., 2012). Such food practices include, not washing hands, not cooking foods thoroughly and not storing foods at proper temperatures (Allwood et al., 1999).

A 2011 study conducted with Public Health Inspectors from the Central West regions of Ontario, Canada, explored Public Health Inspector's perceptions of the key food safety issues in public health. In addition to their opinions and needs with regards to food safety information resources. A standardized questionnaire was used to collect qualitative data from a total of 23 Public Health Inspectors. Five themes emerged as key food safety practice issues: time-temperature abuse, inadequate handwashing, cross-contamination, the lack of food safety knowledge by food handlers and food premise operators, and the lack of food safety information and knowledge about specialty foods (i.e., foods from different cultures). Issues related to time-temperature abuse (insufficient cooking temperature and improper hot-holding, cold-holding, and cooling), were frequently cited as food safety issues by public health inspectors. Public Health Inspectors illustrated that the result of this was due to lack of understanding by food

handlers about the proper temperatures and the lack of understanding of the need to handle food properly before the cooking process, for maintaining food safely (Pham, Jones, Sargent, Marshall & Dewey, 2010). Cooking foods at adequate temperatures is important to eliminate and food safety risks that may be present in the food (Government of Alberta, 2014). Cross-contamination was frequently raised as a key food safety issue by Public Health Inspectors, illustrated by food handlers (Pham et al., 2010). Cross-contamination is what happens when bacteria from one food item are transferred from to another food item, such as unwashed cutting boards or countertops, knives and other kitchen utensils (Havelaar et al., 2013). Cross-contamination can also result from kitchen staff touching contaminated surfaces and then touching food being prepared to serve is one of the most common causes of food borne illness (Allwood et al., 1999). Food handlers can be a source of food contamination and facilitators of cross-contamination (Little & McLauchlin 2007). Therefore cleanliness of hands is extremely importance in food safety (Green et al, 2006). Inadequate handwashing was one of the key issues reported my Public Health Inspectors in this study. They found that food handlers did not wash their hands properly or did not wash their hands at all (Pham et al., 2010).

In another study, Noble, Griffiths, Thompson & Maclaurin (2009) identified a total of 863 infractions from the 1,417 inspection records of food premises in operation in Toronto from 2001 and 2002. Infractions associated with food safety practices that were identified in this study were, Employee hygiene and handwashing, Food temperature control, Food protected from contamination, Maintenance/sanitation of food contact surfaces/equipment. The average infractions/inspection ratio for all premises in the City

of Toronto for 2001–2005 was 1.4 infractions/inspection. The data collected reveled that many food premises continue to have poor food safety practices (Noble et al., 2009). Research has indicated that these food safety practices are critical in the line of defense when it comes to the prevention of foodborne illnesses (Centers for Disease Control and Prevention, 2012b; Government of Alberta, 2014; Public Health Agency of Canada, 2013).

In the United States, Harris et al., (2014) explored food safety practices amongst chain restaurants and non-chain restaurants in the state of Florida. Food safety practices that were illustrated in this study were those that if not followed are more likely to directly contribute to foodborne illnesses. Some examples of these include poor temperature control, improper cooking or holding of food, cross contamination, or improper reheating of food items, and poor personal hygiene (Roberts et al., 2008). Results indicated that chain restaurants followed food practices 26% greater than non-chain restaurants. Therefore regardless of the status of the restaurant, food safety practices were not being followed in both cases. The issue of inadequate food safety practices in restaurants is faced in countries such as Canada, Australia, Great Britain and China. These countries face the same challenges of food safety practices noted in this study. Therefore food safety practices are a global concern (Henson et al., 2006; Tebbutt, 1991). Although government agencies, health departments and schools are taking steps in preventing inadequate food safety practices in food premises, through various means, the problem has not being eradicated (Fielding et al., 2000; Reske et al., 2007; Yarrow et al, 2009). The occurrence of inadequate food safety practices in food premises continues to

problematic. Research demonstrates that food service workers will continue to not adhere to food safety practices, knowingly (Deborah et al., 2002).

Most researchers have found barriers that prevent food service workers from not following food safety practices (Reske et al., 2007; Roberts et al., 2008). Food service workers in some cases will not perform adequate food safety practices due to environmental factors. Food service workers have reported that due to the lack of basic infrastructure, existence of shower facility and unclean premise they are unable to follow adequate food safety practices (Tessema et al., 2014). Socio-demographic, such as gender, marital status and monthly income has also been reported by researchers as barriers to food safety practices in food premises. Zain et al., (2002) noticed that out of the sample size of 208, females (75.5%) were more knowledgably then males (24.5%) when it came to food safety practices.

In previous literature we could find a high prevalence (percentile) of inadequate food safety practices among food safety staff due to behavior (Deborah et al, 2002; Green et al., 2007). Behavior in the work place is influenced by social and environmental factors. (Baranowski, Perry & Parcel, 1997). As a result, food service workers may or not follow food safety practices knowledgably (Afifi et al., 2012), yet additional research is required to better understand this situation. Pilling, Brannon, Shanklin, Howells & Roberts (2008) studied behaviors of food service workers and reported employees' attitudes were one of the consistent predictor of intentions for performing food safety practices. In a telephone survey conducted by the Environmental Health Specialists Network (EHS-Net), a network of environmental health specialists and epidemiologists at

federal and state health agencies, 53% of the food service workers said that they did not use a thermometer to check food temperatures and 60% did not wash their hands between handling raw food and ready to eat food, behavior was illustrated as one of the mitigating factors (Green et al., 2005). Researchers have developed and used instruments to measure retail foodservice staff motivation for following food safety practices. Arendt, Ellis, Strohbehn & Paez (2011), developed an instrument containing 35 questions assessing internal and external motivational factors. Respondents rated the extent to which they are aware of food safety violations and the probable causes of such violations according to the following 3 point Likert scale: 1 Agree; 2 Disagree; 3 Indifferent. The questionnaire was hand delivered to takeaway food handlers and emailed to fast food and hotel food handlers. Cross contamination, environmental violations of food safety personal hygiene and food safety were seen. Through the use of these instruments food service operators can begin to understand what motivates food service workers to carry out safe food handling practices and prevent foodborne illnesses (Arendt et al., 2011).

In Manitoba, research on food safety practices amongst food service workers is scarce. No statistical analysis has been conducted on the number of food safety practices or lack of. Most studies on food safety practices have been conducted in other provinces. These studies have focused on food safety inspection frequency and food safety practices using varying food safety programs, which are different than Manitoba's. The issue of food service workers not following food safety practices continues to be re-occurring in Manitoba. If food safety practices are not followed, during a health inspection, or other noncompliance of food safety practices occur, health inspectors record this in their health

inspection report (Manitoba Health, 2014a).

Following food safety practices in food premises is vital. If not followed they can cause foodborne illnesses as indicated previously. Foodborne illness is a major cause of morbidity and mortality (Centers for Disease Control and Prevention, 2012). The top five risk factors that are most often responsible for foodborne illness are: Improper hot/cold holding temperatures of potentially hazardous food, Improper cooking temperatures of food, Dirty and/or contaminated utensils and equipment, Poor employee health and hygiene and Food from unsafe sources (Centers for Disease Control and Prevention, 2012). These food related safety practices therefore must be followed by food service workers to ensure food safety.

Factors Associated with Food Safety Practices

Many variables have been postulated in varying literature as predisposing, mediating or moderating factors related to food safety risk and therefore food safety practices (Tessema et al., 2014; Roberts et al., 2008; Zain et al., 2002). Food safety inspections have been associated with food safety practice compliance and food safety non-compliance (Allwood et al., 1999; Pham et al., 2010; Reske et al., 2007). Fielding, Aguirre & Palaiologos (2000) presented a study to examine the relationship between food safety inspections and food safety practice compliance. They found that inspection scores continued to increase, that is food safety noncompliance continued to increase regardless of inspection frequency. Those premises that had owner-initiated inspections resulted in improved scores, which were maintained during subsequent inspections. These findings

suggested that food safety inspections impact food safety noncompliance practices and food safety compliance practices. Food safety inspections are important as they help to ensure food is safely prepared and protected from chemical, biological and physical contamination (Fielding, Aguirre & Palaiologos, 2000; Irwin, Ballard, Grendon & Kobayashi, 1989; Jones, Pavlin, LaFleur, Ingram, & Schaffner, 2004).

Another factor influencing food safety practices is behavior. A number of studies have demonstrated that behavior impacts food safety practice compliance and food safety practice noncompliance. Deborah, Clayton, Griffith, Price, & Peters, (2002) conducted a study that showed the elements of social cognitive theory to examine food handler's self reported practices. A questionnaire was completed by 137 food handlers. Generally food handlers were aware of the food safety practices they should be implementing in the work place. Of the 137 food handlers, 63% admitted to sometimes not implementing food safety practices. Researchers found that food safety training should be based around a risk-based approach and behavioral change does not occur only as a result of training.

Green and Selman (2005) also conducted a study that showed the relationship between food safety practices and factors that impacted food safety compliance. Eleven focus groups were conducted with food service workers. In these focus groups food service workers discussed implementation of food safety practices and factors they believed impacted the implementation of those food safety practices. They found that some participants reported unsafe food preparation practices. Lack of motivation, time pressures, mixed beliefs and negative consequences were some of the factors that impacted food safety compliance. Some food safety practices were followed when

workers knew there would be negative consequences if they did not. Results suggested that food safety programs need to address factors such as behaviors that impact food safety practices. Behaviors can impact the implementation of food safety practices (Green et al., 2007). Behaviors of food safety workers can be influenced by other food service workers and environmental factors (Afifi & Abushelaibi, 2012; Almanza, Namkung, Ismail & Nelson, 2007; Green et al, 2005; Aziza & Dahan, 2013; Saada, Seea, Azam & Adilb, 2013; Zain et al.,2002).

According to Jianu and Golet, (2014), food safety certification is essential in food safety practice compliance. The purpose of their study was to determine if food safety knowledge impacted food safety practices. Their study sample consisted of 168 meat handlers operating in 11 meat processing facilities. A self-administered questionnaire was provided to the meat handlers. They found that practices differed significantly with education. That is those individuals with more education had better food safety practices and were able to identify food safety risks. Food safety knowledge can influence food safety practices (Yarrow, Remig & Higgins, 2009).

In another study, Bas, Ersum and Kivanc (2006) evaluated basic food safety training. They conducted face to face interviews with 746 food handlers. The mean food safety knowledge scores were 43.4 ± 16.3. The study illustrated that food handler's need education regarding safe food practices.

As mentioned before, some literature has shown food safety education as being a factor the influences food safety practices. Yarrow et al., (2009) studied the relationship between food safety knowledge and food safety practice implementation. They found that

even after food safety knowledge improved with exposure to the study's educational intervention, participants performed risky food safety practices, such as not using a thermometer to check temperatures of meat. This finding was also supported by a study conducted by Redmond and Griffith (2003) where they also illustrated in their study that food safety knowledge does not always correspond to the implementation of safe food practices.

Socio-demographic, such as marital status, monthly income and gender are factors that also influence food safety practice compliance and food safety practice non-compliance. Tessema et al., (2014) assessed factors associated with food handling practices. A cross-sectional quantitative study design was conducted among 406 food handlers. They found factors such as marital status and monthly income influence food safety practices. Food handlers with a higher monthly income hand better food handling practices (AOR = 0.395, 95% CI, 0.25-0.62) than those with lower incomes. Food handlers that were divorced had better food handling practices (AOR = 7.52, 95% CI, 1.45-38.97) than those that were single.

Muinde and Kuria (2005) also conducted a study that looked at hygiene and sanitary practices of street food vendors. They looked at factors that influenced food safety practices. One of the factors they looked at was gender. They found a significant relationship between gender and utensil storage (P <0.05). 68% of women vendors covered their utensils compared to 32% of the men. Havelaar et al., (2013) found work responsibility as being a factor that influences food safety practice compliance and food safety practice noncompliance.

Environmental factors such as lack of basic infrastructure and unclean premises can also influence food safety practice compliance and food safety practice non-compliance. Tessema et al., (2014) found food safety workers working in a food establishment which and insects are rodents were 65% less likely to have good food handling practices compared to those food establishments that had no insects and rodents (AOR = 0.348, 95% CI, 0.196-0.617). They also found that food establishments that had shower facilities had better food handling practices than those that did not have shower facilities (AOR = 1.89, 95% CI, 1.12-3.21).

Many empirical investigations related to food safety risks/practices are available; however, most of the studies have reported different causes. Often the results from these studies have numerous variables related to the phenomenon of food safety practices/risks. This study emphasized two particular variables: food safety inspections and food safety certification (education or lack of education) with food safety practices/risks. The variables of the study will be examined separately and then they will be related to the food safety practices/risk.

Food Safety Practices and Health Inspections

Health inspections determine if food service workers are following food safety practices. In 2009, Lee, Nelson and Almanza, Ghiselli (2009) conducted a study that used secondary data analysis; general linear models and a logistic regression model to analyze 1,067 regular routine inspection results, to explore the relationship between impact of inspector and operation type on restaurant inspection scores. They also estimated the probability of each noncompliant food safety practice found by each inspector and

operation type. Results of the study indicated the impact of health inspectors and operation type on health inspection scores. Results also indicated particular areas of deficiency. Inadequate food safety practices that were seen at high numbers were hygienic practices, frequency of 115, and protection of contamination after receiving, frequency of 216 and improper holding of food which was seen at a frequency of 205. These particular areas of deficiency can be used to identify potential training needs of food service workers (Lee et al, 2008).

In 2014 Harris et al analyzed Florida's foodservice outlet inspection data to evaluate the differences in the number of critical violations and in the number of inspections between the types of restaurants, that is chain restaurants and non-chain restaurants. Critical violations are a result of poor food safety practices, such as poor personal hygiene, contaminated equipment, improper holding temperatures, inadequate cooking and failure to use or provide thermometers. These are also more likely to cause foodborne illness (Roberts et al., 2005). They found that non-chain restaurants had higher numbers of critical violations than chain restaurants. They also found that the number of inspections impacts the number of violations cited. In addition researchers found that district, type of restaurant are significant predictors to predict the number of critical violations that occur in a food premise.

Food safety practices are influenced by a lot of factors. Chain restaurants are more likely to have fewer violations than non-chain restaurants due to their propensity to have internal food safety monitoring systems and varying food safety quality control programs. The issues of inconsistent training, delivery of service, thoroughness of inspectors,

competence, and prior contamination of food products before arriving to food premises can impact the goal of providing safe foods in sanitary environments (Harris et al., 2014).

Health inspections impact food safety practices, amongst food service workers. The primary goal of health inspections is to protect the public from foodborne illness. This is best achieved with health inspections of food premises, during which food handling practices are identified by health inspectors and corrected by food service workers. In 1999, Allwood et al., (1999) conducted a study that used a quantitative approach to measure the impact of food safety inspections and explore the relationship between inspection frequency and reported violations. Results of the study indicated that restaurant inspections continue to play a vital role in food safety practices. In addition to this results indicated that sanitary rating of a restaurant is positively associated with the frequency with which the restaurant is inspected (Allwood, et al., 1999). No particular studies have been conducted in Manitoba concerning the impact of food safety inspections. Newbold, McKeary, Hart and Hall (2008) presented a study that used a mixed methodology approach, a combination of both quantitative and qualitative tools, to explore the relationship between the effectiveness of increased inspections as measured by a series of compliance measures capturing food safety infractions. They also included the professional opinions of Public Health Inspectors about the effectiveness of increased inspection frequency versus other available compliance tools. Knowing about variations in inspection frequency and how they impact food safety practices may be instrumental in measuring the degree to which the numbers of health inspections are required to prevent

inadequate food safety practices and therefore protect the public against foodborne illnesses.

In any food premise biological, chemical, and physical hazards may exist. As a result of these hazards a large portion of the world's population are affected by foodborne diseases (Centers for disease control and prevention, 2012b). Routine health inspections conducted by Public Health Inspectors help to ensure food is safe and protected from contamination. Knowing about the frequency of inspections that are sufficient to reach overall compliance amongst food premises may be instrumental in measuring the degree to which the amount of education is required by food service staff from Public Health Inspectors, in food safety practices. This information is crucial in the development of food safety programs and policies that promote social change.

Relationships among health inspections and food safety practices were also assessed by Salt Lake City health department (Blake et al., 2013). This study examined how announced and unannounced health inspections impacted food safety practices. Both types of inspections impacted food safety practices. However those premises that were told that a health inspection was going to occur resulted in having fewer inadequate food safety practices than those that were not told. Reductions in equipment cleaning and poor personal hygiene were observed. It has been demonstrated that food service staff addressed obvious and easily correctable issues prior to an announce inspections and failed to address food safety practices that were not immediately visible. These findings do support the idea that health inspections impact food safety practices, regardless if they are announced or unannounced. Announced inspections may be useful in addressing

problems within violating food premises to promote behavior change. In addition these findings support the idea of the need of social change and for interventions to reduce and prevent inadequate food safety practices among food service workers (Blake et al., 2013).

Food Safety Practices and Previous Food Safety Certification Experience

Another factor influencing food safety practices is food safety certification experience. A number of studies have demonstrated that food safety certification improves food safety practices of food service workers. Also it has been suggested that food safe certification is dependent on health department legislative bodies. McIntrye, Peng, & Henderson (2014) presented a study to examine the effectiveness of food handler retraining in food safety. Food safety knowledge scores were compared between previously food safety trained food handlers who received training, previously food safety trained handlers who did not receive training and untrained food handlers in British Columbia. Data was collected via telephone survey which assessed knowledge. Results indicated that periodic training is required and overall food safety education is required for those individuals who were untrained food handlers. Food safety training is an important component in the food system. Food safety certification allows workers to learn the principles that explain actions they take to handle and prepare food in a safe manner (Ekanem, Mafuyai-Ekanem, Tegegne, & Adamu, 2012).

According to a study performed in Toronto, Canada using the Toronto food inspection and disclosure system, findings were that there was greater compliance in food premises with certified food handlers compared with those without. Those premises with food certified handlers experienced less infractions compared to those without food

certified handlers. These finding suggested that investment in food handler training and certification programs have positive long-term implications for food safety, as a reduction in infractions is known to be associated with foodborne illness (Serapiglia, Kennedy, Thompson and de Burger, 2001).

Research has suggested that multiple factors play a role in the ability and willingness of food service workers to perform adequate food safety practices (Tessema et al., 2014; Yarrow et al., 2009). It is not a requirement by Manitoba Health to have all workers in the food industry to be food safety certified (Manitoba Health, 2014b). Food safety is a practice that is influenced by attitude and behavior. The link between food safety knowledge and application of food safety practices can be understood from a social learning perspective (Glanz et al., 2008), in which environmental factors, facilitation, and outcome expectations influence food services workers beliefs and behaviors associated with food safety. Because food service workers work with others, their behavior may be influenced and therefore their willingness to perform or not perform adequate food safety practices may be hindered (Green et al, 2005).

According to Zain et al., (2002), food safety certification is essential in food safety practice. They found that there were significant differences of knowledge and practice between trained food service workers and untrained food service workers. Food safety certification provides accurate knowledge of the trade to food service workers to prevent foodborne illness. Education and training are key components in the process of ensuring that food service workers are proficient in and knowledgeable about food safety

practices (Jacob, 1989); it is important to emphasize the effectiveness of food safe certification for food service workers.

As mentioned before, some literature has connected food safety certification with the ability of food service workers to follow adequate food safety practices. Kassa, Silverman and Baroudi (2010) studied the relationship between food facilities of certified food safety personnel and non-certified food safety personnel. Results indicated that food service premises with certified personnel had followed food safety practices significantly more that those food service premises without certified personnel.

In 2013, Murray, Feldman, Lee and Schuckers (2013) studied the significance of food safety from 18 delicatessens serving prepared and ready-to-eat foods for takeout. They used *Escherichia coli* and *Staphylococcus aureus* as indicators to assess food handling and the public's risk for pathogenic contamination. Results indicated that those premises with high *Escherichia coli* and *Staphylococcus aureus* counts had inadequate food safety practices. This study showed that food safety education, such as food safe certification is a predictor of food safety practices. This was done by illustrating how the strategy of critical violation control and training and certification has proved so effective for chain operators.

Park, Kwak and Chang (2010) examined the extent of improvement off food safety knowledge and practice of food service workers through food safety training. They evaluated employee knowledge and practices concerning food safety through the development of a training program and questionnaires. In addition to this they used a checklist to determine food safety performance of restaurants. The general purpose was

to examine the impact of food safety knowledge on food service workers practices. The investigators used a quantitative methodology; research design was the nonequivalent pretest and posttest control group method. Twelve restaurants participated in the study. The results showed that in the case of the intervention group knowledge increased at a total score of 66.6 points at post-test ; up from 49.3 points at pre-test after training. In addition the results showed that that in the case of the intervention group food safety practices after training did not increase significantly. This study showed that knowledge and training in food safety isn't a predictor of food safety practices.

Mathias et al., (1994), also conducted a study that showed the relationship between the number of individual trained in food safety and the number of reported violations or reported foodborne disease. A survey of 141 jurisdictions was conducted; the response rated was 100%. All jurisdictions inspection restaurants, but the frequency of routine inspections varied from none to six or more times per year. Food handler education courses were mandatory in 32% of jurisdictions. They found that there was no correlation between the numbers of trained individuals in the past year and violations or foodborne disease

In another study, McIntyre, Vallaster, Wilcott, Henderson, Kosatsky, (2013) examined food safety knowledge of trained food handlers certified under the food safe training program in British Columbia, Canada. They also evaluated food safety knowledge, attitudes and self-reported handwashing practices in trained and untrained food handler groups. Data was collected via telephone survey, which demonstrated knowledge of food safety. Results showed that knowledge scores were significantly

higher in trained food handlers compared with untrained food handlers. Certified trained food handlers reported significantly better handwashing practices then those that were not certified. This study supports the need for food safety certified individuals and demonstrates the need for educational training programs in food safety.

Researchers studying food safety practices and knowledge have used the Social Cognitive theory and The Health Belief Model (HBM). Clayton et al., (2008) used elements from the Social Cognitive theory and the HBM to examine the beliefs of food service workers (those certified and not certified) towards food safety and to determine food service workers food safety practices. Salient beliefs, attitude, subjective norms, descriptive norms, perceived behavioral control and intention and food handler's perceived knowledge of someone getting ill from inadequate food handling practices may account for the likelihood of food services workers carrying out inadequate food safety practices (Byrd-Bredbenner et al., 2001; Clayton et al., 2008).

In order to prevent inadequate food safety practices amongst food service workers, it is important to design food safety certification programs with objectives focused on changing beliefs and attitudes. Clayton et al., (2008) found that 85% of food handlers had formal training that is qualification or certificate. Those food handlers who had received training were significantly more likely to report that they carried out food safety practices than those who had not received training. Lack of food safety certification can result in inadequate food safety practices and therefore the risk of foodborne illnesses. For example, Jones et al., (2014) noted that restaurants are an important source of foodborne illness due to inadequate food safety practices. The

relationship between food safety practices and food safety certification is important in the fact that restaurants serve over 70 billion meals a year.

Literature Related to the Study Methodology

In this proposed study a quantitative cross-sectional design was used as the methodology of study. The quantitative study design allows researchers to explore the relationships between study variables. The quantitative study design is applicable for status of phenomena of a population or sample at a fixed point (Frankfort-Nachmias & Nachmias, 2008). For example, this quantitative study described the characteristics of an association between food safety practice, health inspections, and food safety certification. In this study the purpose was to try to identify, explore and conclude factors of the research problem (Creswell, 2009; Frankfort et al, 2008; Black, 1999). The researcher established the characteristics of Manitoba's food safety program; established the frequency of inadequate food safety practices seen among the population of study (Food service workers) and explored, identified and verified the association of food safety practice variable with health inspections and food safe certification

Menachemi et al., (2012) used multivariable analysis and logistic regression to examine the frequency, incidence and predictors of food safety practices in Jefferson County, Alabama. This study used three consecutive years of inspection data collected on all food establishments in the Jefferson County. A total of 5,488 inspections of food establishments were conducted on average of 1,829 food establishments during 2008-2010. Factors at baseline that were predictive of food safety practices were identified by logistic regression analysis. The findings suggested that frequency of inadequate food

safety practices changed over time, commonly in response to policy and enforcement and that certain food establishments are prone to specific food safety practices.

Miguel, Katz and Suarez (2001) also used logistic regression to study food safety inspections to determine their usefulness in predicting foodborne outbreaks. All food variables associated with food safety practices were identified. Results of logistic regression analysis showed restaurant characteristics associated with foodborne illnesses, those being seating capacity (43.4%) and evidence of vermin (9.2%).

Cates et al., (2009) used a logistic regression and correlation analysis to examine the relationship between restaurant inspection results, concentrating on the occurrence of critical violations, and the presence of a certified kitchen manager. They analyzed routine inspection records for 2005 and 2006 for three types of food service establishments in Iowa, restaurants that serve liquor, restaurants that do not serve liquor and taverns with food preparation. An establishment was included in the data set when it had at least one routine inspection during the period of 2005 or 2006. The number of food service establishment's use was 4,461. Logistic regression analysis revealed that the presence of a certified kitchen manager is protective of most food safety practices. As a result of this study, targeted educational programs (such as a food safe certification courses that addresses specific violations that are associated with the different types of establishments) and interventions (such as a campaign mentioning the adverse effects of foodborne illness) for food service establishments should be developed and implemented to prevent inadequate food safety practices.

Logistic regression is one of the most common multivariate analysis models utilized in epidemiology. It is an approach to predict an outcome. However, with logistic regression, the researcher is predicting a dichotomous outcome (Sperandei, 2014). Logistic regression is a type of study design that can be used to resolve the effect size of both independent variables on the dependent variables (Cresswell, 2009). It can also be used to determine a categorical dependent variable on the basis of continuous and/or categorical independents and it can be used to understand the impact of covariate control variables. Lastly logistic regression can be used to rank the relative importance of independents and to assess interaction effects (Field, 2009).

In order for findings to have validity, cross-sectional studies must be done on representative samples of the population. These studies provided information about the prevalence of health-related conditions and health-related states; however they did not differentiate between new occurring and long-established conditions. These studies can only demonstrate associations in addition to identifying the existence of health problems and measure the frequency (prevalence) of conditions and they cannot identify cause-and-effect relationships (Creswell, 2009). These studies provide a useful way to gather information about people's knowledge, attitude, and practices when it comes to health.

This study is a quantitative study that is utilizing a cross-sectional study design to measure prevalence. The analyzed literature was consistent and provided evidence in determining that chi-square and regression analysis would be the two best statistical methods when it came to data collection for this study (Field, 2009).

Critique of Methods

The intent of this study is to provide evidence on food safety practices among food service staff working in food establishments in Winnipeg, Manitoba.What follows is a critique of methods of previous literature.

Menachemi et al. (2012) used a multivariable analysis and logistic regression to examine the frequency, incidence and predictors of food safety practices in Jefferson County, Alabama. A total of 5,488 inspections of food establishments were conducted on average of 1,829 food establishments during 2008-2010.Descritpive statistical analyses were conducted to examine 16 critical food safety violations. Chi Square tests were used to detect differences among the variables within the three years. A Multivariable logistic regression was used to examine the relationship between each individual critical violation and restaurant characteristics.

The study was significant as it assessed changes in critical violations over a three year period. However, a weakness of the study was location; it was only representative of one county in Alabama, thus the findings could not be generalized to all food establishments. Additionally, data examined was not consistent, it was not until 2010 that non-compliant food establishments received critical violations (personnel training/certification), which would account for the large increase of violations in 2010. The study provided no statistical difference between food safety practices among food certified staff and non-food certified staff.

Miguel et al. (2001) conducted a study assessing routine restaurant inspections and there affect on the prevention of food-borne illness by ensuring safe food handling

practices. Inspection reports of restaurants with no reported outbreaks in 1995 (cases; n =51) were compared with those with reported outbreaks (controls; n=76). For each case involved in the study, data was obtained from the last inspection report. In addition for each case, two controls were randomly selected and paired by the month and year of inspection.

The study was significant because it assessed a variety of critical violations associated with food safety. The results indicated that both the cases and controls did not differ in mean number of critical violations or by overall inspection outcome and that critical violation continue to be a concern in food establishments. However, a limitation of the study was the small sample size; thus, the findings could not be generalized to all food establishments. Additionally, the study calculated the matched odds ratio and the 95% confidence intervals for predictor variables; descriptive analysis was not used on characteristic information on food establishments. The study provided no statistical difference between the association of routine health inspections and the occurrence of critical violations that would help predict a relationship between these two variables.

Cates et al. (2009) conducted a study on food establishments in Iowa that were inspected during 2005 and 2006 that sought to assess the relationship between restaurant inspection results, concentrating on the occurrence of critical violations, and the presence of a certified kitchen manager among 8,333 total inspections conducted. Inspectors involved in the study used a checklist (44-point) to assess whether or not the food establishments were in accordance with the Iowa Food Code. In this study any food

establishments that had at least one routine inspection during 2005-2006 was included in the data set.

The study was significant as it assessed a diverse population of restaurants. The results of the study indicated food certified kitchen managers are more knowledgeable about safe food handling and preparations then those that are not. In addition the results indicated that food certified kitchen managers are more likely to follow and enforce food safety practices. However, a limitation of the study was the analysis relied on inspection data for a particular time period. Additionally, the analysis was also limited to food establishments in Iowa; thus providing a small sample size. The study also presented limited data on characteristics of food establishment characteristics.

Knowledge Gap

Although there is progress in research on food safety practices, limitations in methodology of previous work still exist. Small sample sizes, limited statistical associations and relationships among variables and limited data on characteristics that are associated with food establishments are some of the limitations that exist in the literature (Cates et al, 2009; Miguel et al, 2001; Menachemi et al, 2012). In addition to these limitations not addressing bias is yet another limitation that exists in the literature reviewed (Cates et al, 2009). Researchers did not address bias among health inspectors and their inspection process, those that are more likely to cite or not city a particular food safely practice.

Researchers continue to find poor food safety practices and or lack of food safety practices being implemented by food service workers in food establishments (Newbold, McKeary, Hart, & Hall, 2008). It is important to continue to collect more statistical information on food safety practices in food establishments to increase awareness of poor or lack of food safety practices.

This study could be used to advance the state of knowledge by providing literature on prevalence rates of poor and lack of food safety practices in food establishments in Manitoba, Canada. In addition the study may provide statistical information about the associations and relationships between food safety practices, routine health inspections and food safety certification. This information may help to improve the understanding of reasons why food safety practices are not being followed or implemented in food establishments. This study could be used by other health departments to help streamline restaurant inspections. In addition the information from this study may help to gain a better understanding of what is required from health inspectors when conducting routine health inspections. Increased knowledge regarding food safety practices importance could result in better health promotion programs and policy development, designed specifically to help eliminate poor food safety practices.

Summary

This chapter included the review of factors related to food safety practices. The following information was discussed: (a) food safety practice importance; (b) factors associated with food safety practices; (c) food safety practices and health inspections and (d) food safety practices and previous food safety certification experience. Literature on

food safety practices and the review of the Social Cognitive theory and Pender's Health Promotion Model all confirmed relationships between food safety inspections, food safety certification, and food service workers food safety practices. Research studies have found that food safety practices are not always followed by food service workers and that health inspections help to determine these practices.

Further in-depth understanding is needed in food safety practices amongst food service workers because they play a vital role in protecting public health when eating at food premises. The absence of studies in Manitoba of food service workers justified the development of this study to fill the gap in literature. The lack of limited scientific evidence on the effectiveness of restaurant inspection and food safety certification also justified the need of this study. This study concluded that food safety inspections and certified food service workers are associated with food safety practice compliance and noncompliance in food establishments.The next chapter provides an explanation of the methodology, sample, analysis, research setting, and ethical protection.

Chapter 3: Research Method

Introduction

The research questions that were formulated for this proposed study were:

RQ1: What is the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada?

RQ2: What is the relationship between food safety practices and health inspection?

RQ3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

The purpose of this quantitative study was to collect statistical information related to food safety practices among food service workers working in food establishments in Manitoba, Canada. The above noted questions guided the development and testing of hypothesis of the study, as they were developed based on the research problem. In testing the hypothesis the researcher was able to determine the relationship between the independent variables (food safety certification and health inspections) and the dependent variable (food safety practices).

In this chapter the researcher provides critical information regarding the research design, population, research setting, sampling method, sample size, data collection and data analysis. Lastly, the researcher provides ethical protection in application to this study.

Research Design

An analytical approach was used to explore the research questions and hypothesis. A cross-sectional design involves observations of a population or phenomenon at one point in time (Creswell, 2009). The research design that was used in this study was that being a cross-sectional design. It was used to estimate the frequency of food safety practices and describe the association between food safety practices and health inspections and a predisposition factor of food safe certification among the population of study. The dependent variable of the study was food safety practices. The dependent variable is defined as the response variable (or outcome) in which the researcher is interested in (Creswell, 2009).The independent variable of the study was health inspections. The independent variable is defined as the explanatory variable that leads changes in the dependent variable (Creswell, 2009). The predisposing factor (food safe certification) was also the independent variable for this study. A cross-sectional study design is a quantitative method of research that involves data collection from a population or from a representative sample at a specific point of time (Field, 2009). Two or more quantitative variables are examined from the specified population to describe some feature of the population. In addition to determine or establish if there is an association between variables which is a similarity between them. Cross sectional studies have many advantages (Creswell, 2009). One of the advantages of this design is that it is practical, many outcomes and risk factors can be assessed and can estimated prevalence of outcome of interest (Levin, 2006). Due to this designs practicality, it is feasible for this study because it allows for a competent and effective method of data collection.

Population

This study was a cross-sectional, nonequivalent group design based on primarily on secondary data obtained from Manitoba Health protection Unit. The study was carried out in Manitoba, a Canadian prairie province. Manitoba has a population of 1.272 million with an area of 649,950 square kilometres. The population for this study consisted of all the food premises in Manitoba served and receiving food safety inspections from Manitoba Health Protection Unit. At the time of data collection, there were approximately 6,203 food premises in Manitoba. The Manitoba Health Protection Unit serves food premises with food safety inspections to ensure that operators and staff providing food for sale are doing it in a manner that is deemed safe. In addition, the agency conducts food safety inspections to ensure that food premises are incompliance with the regulations and standards of the Manitoba Public Health Act. The agency also provides other public health inspections.

The sample was assessed for high risk and medium risk food safety inspections conducted in Manitoba. *High Risk* restaurants were large full service establishments where staffs are extensively handling food, and *Medium Risk* restaurants comprised smaller restaurants, where staffs are moderately handling food. The obtained data consisted of outcome data of food safety inspections for the fiscal years starting from January 2012 to December 2014.

Research Setting

This study was conducted in the Canadian prairie Province, Manitoba bordered by the provinces of Ontario to the east and Saskatchewan to the west (Statistics Canada,

2014). Manitoba has a moderately strong economy based largely on natural resources. Its Gross Domestic Product was C$50.834 billion in 2008 (Statistics Canada, 2013). Manitoba has over 75 distinct cultures from around the world, creating a veritable feast of dining options (Statistics Canada, 2014). The study used a secondary data source, which is Manitoba Health Protection Unit, information system hedgehog. This information system holds information on Manitoba's food establishments, such as the name of restaurant, location, risk rating, inspections conducted and type of restaurant (level 1, 2, 3, 4, 5, 6) (Manitoba Health, 2014a). The difference between these levels is that being the amount of food preparation and food handling going on. For instance at a level 1 food establishment there is no food preparation and extremely minimal food preparation. A level 6 food establishment is the highest level of food establishment, where there is maximum food handling and maximum food preparation (Manitoba Health, 2014a). Health inspectors use this information system to enter food safety inspections. Each restaurant is inspected for compliance with legislation and standards approved by Manitoba Health, Health Protection Unit (Manitoba Health, 2014b). When noncompliance of food safety practices are identified a restaurant is required to take corrective action and follow-up inspections are done to ensure all noncompliant food safety practices are satisfactorily addressed (Manitoba Health, 2009). The information system also holds health inspections of pools, housing, personal services, public health complaints and food safety inspections (Manitoba Health, 2014a).

The basis for the selecting this population where because of suggestions made by experts in the field and researchers which have conducted studies in the field of food

safety practices among food service workers working in food establishments (Campbell et al.,1998; Farrell, 2011; Mathias et al., 1995). Experts in the field suggested that specific divisions of the population or groups of the populations must be studied accordingly to identify barriers in food safety practices and establish correct strategies for managing these populations (Green et al., 2005; Mathias et al., 1995; Tessema et al., 2014; Zain et al., 2002). The reason in studying this population was to establish adequate strategies that will allow for creation of intervention and prevention programs and health promotion to prevent increases occurrences of food establishments with poor food safety practices. In order to prevent or reduce the phenomenon of poor food safety practices, it is imperative to work with smaller population groups. This will allow for a more effective intervention as part of a strategy and allow for formation of accurate public health policy (Frash, & MacLaurin, 2010; Mathias et al, 1995; Miguel et al., 2001).

Although the population includes food establishments that are low risk (selling of prepackaged foods only), the literature reports that food establishments that are medium risk (moderately handling food) and high risk (extensively handling food) are at more risk of poor food safety practices (Allwood et al, 1999; Menachemi et al., 2012; Yeager et al, 2013). Given that food safety practices are more subjective to facilities with food that is being extensively or moderately handled, this provides the reasoning in selecting this population for this study. Low risk establishments may be incorporated in the research study; the following is supported by the above mentioned investigations that identify low risk establishments which may cause a health hazard can be investigated.

This type of research within this population group is significant, as it will help to develop health promotion and prevention models of food safety in food establishments.

Sampling Method

Data was obtained on Manitoba's food establishments from Manitoba's Health Protection Unit internal documentation system Hedgehog. The hedgehog documentation system contains facility detail for each food premise: general (facility category, category style, community, health inspector responsible), location, mailing address, contacts and connected system (Manitoba Health, 2014a). Inspection data for each restaurant is also contained within this documentation system. Data was obtained from Manitoba Health's data system as tabulated data for all the medium and high risk food establishments in the agency's hedgehog databases (Manitoba Health, 2014a). There was no use of any identifiable information in this study and Manitoba Health's Protection Unit technology analysts assigned each food establishment a food establishment number. The data that was obtained from Manitoba Health Protection Unit contained the following information: food handling permit number, location of restaurant, type of restaurant (high risk/ medium risk), food certification, documented inspection reports by health inspectors (temperature control/cold holding, temperature control/internal temperature, food preparation and display/internal temperature, temperature control/ hot holding, temperature control/thermometer use, temperature control/cooling, temperature control/re-heating, personal practices/handwashing, food storage and display/cross contamination, food storage and display/food protection, hazardous products/toxic materials, food storage and display/ food containers, food sanitation and

source/potentially hazardous foods, food sanitation and source/food protection, food sanitation and source/approved source) closures (General Sanitation/Food Protection) and enforcement actions.

Inclusion Criteria

Medium risk and high risk food premises that were inspected between 2012 and 2014 were used in this study. This is necessary because food handling practices are more applicable to these premises than low risk premises were prepackaged foods is sold (Manitoba Health, 2014).

Exclusion Criteria

Low risk food premises were excluded from this study because the applications of food safety practices are minimum (Manitoba Health, 2014). These facilities sell prepackaged foods; there is no food preparation and minimum food handling. This criterion was necessary to decrease problems with incomplete data and increase confidence.

Procedures for Accessing Data

To get approval for the use of data, a meeting was arranged with the Chief Public Health Inspector, also known as the Manager (Health Protection Unit) and The Director of Health of the Province of Manitoba. The goal of the study was described and assistance to complete the study was requested. As a practicing Public Health Inspector with Manitoba Health, I use the hedgehog documentation system on a daily basis to enter inspections. Due to my familiarity with hedgehog database we did not discuss any technical information regarding the database. The Chief Public Health Inspector and The

Director of Health did discuss the implementation of the hedgehog documentation system. Prior to the use of the hedgehog database, food safety inspection reports were written by health inspectors conducting food safety inspections. The paper copies of all health inspections were kept by Manitoba Health in files. No documentation system was used. The hedgehog documentation system was put in place in 2008 by Manitoba's Health Protection Unit. Since then health inspectors use this documentation system on a daily basis.

All food premises in Manitoba that hold a food handling permit are in the hedgehog documentation system. In Manitoba, anyone wishing to prepare and sell food to the public must apply for a food service establishment permit. This includes restaurants, grocery stores, bakeries, butcher shops, delicatessens, catering facilities, take-outs, mobile vending carts, farmers markets, and temporary food events at fairs or festivals. The Manitoba Health Protection unit serves all these places with routine food safety inspections, re-inspections, request inspections, complaint inspections, and building assessment inspections.

The Chief Public Health Inspector and Director of Health explained their roles and responsibilities as well as my roles and responsibilities in using the data. Permission was obtained to access the provincial data from the both Chief Public Health Inspector and Director of Health of the Province of Manitoba. Approval for use of data was acquired by the above noted parties, and approval from the IRB (approval number 05-29-15-0376692) was also obtained to analyze data.

Sample size

The Java applet for power and sample size software was used to determine an adequate sample size which had characteristics of the population in the study proposed. The Java applet for power and sample size is a program that performs statistical power analysis for statistical tests in sciences, including behavior science (Length, 2006)

According to the literature, the coefficient of determination for food safety practices was 0.014 (Murphy, DiPietro, Kock & Lee, 2011). Utilizing this number the effect size was set at 0.014, with an alpha level of 0.05, and a power of 0.80. The sample size of the study was determined to be 558.

Operations Definitions of Variables

Below is a list of the variables used in the study.

- **Type of food premises**: Manitoba health places its food premises in categories based on their risk which is assessed using a model. This model evaluates the risk of foodborne illness outbreak. Medium risk food premises are the following; minimally handled potentially hazardous foods and moderately handled of potentially hazardous foods. High risk premises are extensively handled potentially hazardous foods. Medium risk food premises have a scoring between 25 to 30 points and high risk food premises have a scoring between 35 to 55 points. Medium risk food premises were scored as 1 and high risk groups were scored as 2. This information was obtained from the Manitoba's Health Protection Unit, Database hedgehog.

- **Food Safe certification:** Identified as Certified Foodhandlers Different categories were identified in this study using a number from 1 to 6 (some numbers were not used in the numerical tabulation). Training (N/S (no option selected, Yes, No, CDI (Corrected during inspection), N/O (Not observed), N/A (not applicable) were the categories. This information was obtained from the Manitoba's Health Protection Unit, Database hedgehog.
- **Number of Routine Health Inspections:** Frequency of inspections is based on a risk assessment. Medium Risk food premises require a 6 month inspection cycle and High Risk food premises require a 4 month inspection cycle. This information was extrapolated from the inspection frequency numbers from Manitoba's Health Protection Unit, Database hedgehog.
- **Type of food safety practice:** The following food safety practices are inputted into the hedgehog database by public health inspectors when doing routine inspections: temperature control/cold holding, temperature control/internal temperature, food preparation and display/internal temperature, temperature control/ hot holding, temperature control/thermometer use, temperature control/cooling, temperature control/re-heating, personal practices/handwashing, food storage and display/cross contamination, food storage and display/food protection, hazardous products/toxic materials, food storage and display/ food containers, food sanitation and source/potentially hazardous foods, food sanitation and source/food protection, food sanitation and source/approved source. Each of these food safety practices was identified in this study using the following scale

(1= Temperature control/cold holding, 2=temperature control/internal temperature, 3= food preparation and display/internal temperature, 4= food preparation and display/internal temperature, 5= temperature control/ hot holding, 6=temperature control/thermometer use, 7=temperature control/cooling, 8=temperature control/re-heating, 9=personal practices/handwashing, 10=food storage and display/cross contamination, 11= food storage and display/food protection, 12= hazardous products/toxic materials, 13= food storage and display/ food containers, 14=food sanitation and source/potentially hazardous foods, 15= food sanitation and source/food protection, 16=food sanitation and source/approved source. This information was obtained from the Manitoba's Health Protection Unit, Database hedgehog.

- **Enforcement:** Food inspectors may apply varying levels of enforcement for deficiencies/hazards/infractions observed during an inspection in a reasonable, fair, balanced and consistent manner. The varying levels of enforcement include the following: warning issued, health hazard order issued, offence notice issued, summons served, permit suspended, equipment seized and held, letter issued, product seized and held). Enforcement was identified in this study as yes= 1 and no=0. This data was obtained from the Manitoba's Health Protection Unit, Database hedgehog
- **Closures:** Identified as the premises are maintained in a manner that will not reasonably pose a health hazard, adversely affect the sanitary operation of the premises or adversely affect the wholesomeness of the food (N/S (no option

selected, Yes, No, CDI (Corrected during inspection), N/O (Not observed), N/A (not applicable). Closures were identified in this study as yes=1 and no=0. This data was obtained from the Manitoba's Health Protection Unit, Database hedgehog.

Data Collection

The data from Manitoba Health Protection Unit was assumed to be correct and accurate, having been collected by Manitoba Health Inspectors. The hedgehog system documents characteristics of food premises, health inspections (food, pool, housing) conducted by health inspectors and other public health services provided to the public that may pose a health hazard (Manitoba Health, 2014a). It was assumed the data collected contained correct and up-to-date information, because the data system is used for documentation of health inspections conducted by health inspectors on a daily bases and other public health services provided. Data from the hedgehog database is used by the organization to assist in program planning, do evaluations and understand specific trends that arise when it comes to food premises. It also enables studies to be conducted on different trends and associations captured by Manitoba's Food safety program. Furthermore the data allows for standards to be implemented for ongoing quality assurance in food safety. Data associated with food premises will be available for analyses of trends of food safety practices from 2012 to 2014.

Data pertaining to food safety was collected from the Manitoba's Health Protection Unit, hedgehog database from 2012 to 2014. Data from pre- 2011 to post-2011 prior to the amalgamation of city Manitoba Health Protection unit was not analyzed

because in April 2008, the provincial government of Manitoba amalgamated city inspectors to create one program. City health inspectors belonged to the Environmental Health Branch, for the city of Winnipeg and Public Health Inspectors belonged to the Health Protection Unit, for the Province of Manitoba. Information prior to 2011 had discrepancies as no one particular policy was used and standards varied for each department. Data is not consistent and cannot be analyzed to indicate true and reliable and accurate information in health practices. Consequently, data from 2012 to 2014 inclusively was used and incorporated into this study.

Categorical data from the Manitoba's Health Protection Unit Hedgehog documentation system was obtained. From the data provided, information from food premises (restaurants) that are high risk and medium risk was collected. Justification for this selection is that these food premises have food handling, food preparation and food storage. Low risk premises are those premises where there is handling of pre-packaged foods, no food preparation. The Health Protection Unit provided requested data by generating reports. The data was presented in tables with the identifying titles at the top of each column. The data that was obtained from the hedgehog documentation system contained information that pertained to each food premises (high risk and medium risk), with some sections purposefully left blank because of zero data for that category. Those sections left blank for the health inspection for some of the food premises in the province data receiving services, no health inspections were reviewed. In order to improve the data collected, data was "insert[ed] labels, improve[ed] variable names, and declare[ed] missing values" (Norusis, 2008). Once data had been consolidated, it was entered it into

the IBM Statistical Package for Social Sciences (SPSS) Statistics version 20. The exact consolidation of data was discussed in Chapter 4.Data entered into spss was checked for accuracy, repetition of subjects, and for any missing values (Norusis, 2003). Data collection and analysis occurred once approval from IRB was obtained.

Data Analysis Plan

Analysis was executed by using SPSS v.20 for Windows. Descriptive statistics were carried out on demographic data. Descriptive statistics included frequency (prevalence) and means/standard deviations. The data analysis for this study included logistical regressions, chi-square, fisher's exact test and multiple logistic regressions. The data analysis plan provided information for statistics used to explore, identify and verify hypotheses. In addition, the data analysis plan provided statistics used to explore the three research questions.

Logistic regression is a statistical test that is a quantitative method used with increasing frequency (Field, 2009). This statistical research method was used in this study to estimate the association between the variables and therefore test the each hypothesis proposed (Frankfort et al, 2008). Therefore logistic regression was used in the study to answer the research questions. Secondary data was compiled and organized by the author using a excel spreadsheet and analyzed data using IBM Statistical Package for Social Sciences (SPSS) Statistics version 20. All statistical analysis were performed with $\alpha = .05$ level of significance. Data was checked to ensure that it meets assumptions of statistical techniques that were used in this study.

Research Questions and Hypotheses

The research questions that were addressed in the proposed study and the hypotheses are identified and listed with the statistical analyses that were conducted. Data from the Manitoba Health Protection Unit was investigated. Statistical tests were performed on the data.

RQ1: What is the prevalence of food safety practices among food service workers working in food establishments in Manitoba, Canada?

H_0**1:** There is an association between food safety practices and health inspections among food premises in Manitoba, Canada.

H_a**1**: There is no association between food safety practices and health inspections among food premises in Manitoba, Canada.

RQ2: What is the relationship between food safety practices and health inspection?

H_0**2:** There is an association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

H_a**2:** There is no association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

RQ3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

H_0**3:** There is an association between food safety practices and the predisposing factor of food safety certification in Manitoba Canada?

***H_a*3:** There is no association between food safety practices and the predisposing factor of food safety certification Manitoba Canada?

Research Question 1 and 2 used chi-square test of association to test the research hypothesis H_o1/ H_a1 and H_o2/H_a2 using data from the Manitoba Health Protection Unit. The chi-square test of association was appropriate because it tests the univariate association between the dependent variable and independent variables (Field, 2009). The assumptions that both variables are either nominal or ordinal and each variable is comprised of two or more groups were met by the variables used in this study. To ensure that assumption of expected values is normally distributed, expected cell counts were reviewed. The minimum expected cell count for all cells should be at least 5 (Cochran, 1954). Expected sell counts that are less than 5 required the use of the Fisher's Exact Test. The Fisher's Exact Test is a statistical significance test, measuring the association between two variables in a 2x2 contingency table (Field, 2009). It assumes that marginal counts remain fixed at the observed values. The Fisher's Exact Test is employed when sample sizes are small and calculates exact probabilities of the observed values (Frankfort et al, 2008).

Research Question 3 used multiple logistic regression to test research hypothesis $H_0$3/H_a3 using data from the Manitoba Health Protection Unit. This test is appropriate as it allowed the researcher to approximate the association between food safety practices (dependent variable) and the independent variables (health inspections and food safe certification), adjusting for other variables as required. All independent variables were considered for inclusion despite of the statistical significance in the univariate Chi-square

analyses (Frankfort et al, 2008). In using multivariable analysis, issues such as the number of variables, level of measurement of variables controlling confounding variables were attended to (Field, 2009). The multiple logistic regression analysis allowed for analysis of all independent variables despite statistical significance in the univariate Chi-square analyses (Frankfort et al, 2008). In doing this additional information about issues of effect modification, confounding and variable interactions were provided as they are not acknowledged in the univariate analyses.The results of the analyses performed in this study were presented in Chapter 4.

The following is an overview of the statistical analysis of the research questions of this study:

Research question 1: What is the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada?

Variable: food safety practices

Statistical Analysis: Frequency/Percentage

Research question 2: What is the relationship between food safety practices and health inspection?

Variable: Food Safety Practice (Dependent)

Statistical Analysis: Frequency/Percentage

Variable: Health Inspections (Independent)

Statistical Analysis: Chi-square and Logistical Regression

Research question 3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

Variable: Food safety practices (Dependent)

Statistical Analysis: Frequency and Percentage

Variable: Food safe certification (Independent/Predisposing factor)

Statistical Analysis: Chi-square/Logistical Regression

Protection of Participant's Rights

There was no use of any personal or identifiable information on any food premises in the hedgehog database. An assigned number identified by myself from the Manitoba Health Protection Unit identified the food premises in the study. As a result, consent was not required from food premise operators. Consent was obtained from Chief Public Health Inspector and The Director of Health of the Province of Manitoba to use the data they provided. Consent was obtained from IRB. Date will be kept confidential on a password protected computer. The information used in this study will be kept for a period of seven years.

Summary

Chapter 3 provided descriptions about the data obtained from Manitoba Health Protection Unit. In this section, the method of investigation pertaining to the data and assessing the data for analysis was described. This study was a cross sectional study design with logistic regression analysis. Chi square and multiple logistic regressions was used to analyze the data in order to answer the identified research questions. In Chapter 4, descriptions of the finding and the results obtained are presented. In Chapter 5 a summary

of the findings are presented, conclusions were drawn and recommendations for future research needs were illustrated.

Chapter 4: Results

Introduction

The purpose of this quantitative research study was to determine the prevalence of food safety practices among food service staff working in food establishments in Manitoba, Canada. The purpose was also to determine the relationship between food safety practices and health inspections and the predisposing factor of food safety certification of food service staff working in food establishments in Manitoba by analyzing secondary data collected from the Manitoba Health and Health Protection Unit Database. Within this chapter data analysis and findings of secondary data of high and medium risk food establishments are presented. The three research questions that provided the basis for data analysis and data collection in this study are:

RQ1: What is the prevalence of food safety practices among food service workers working in food establishments in Manitoba, Canada?

RQ2: What is the relationship between food safety practices and health inspection?

RQ3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

For each research question and hypothesis in this study, results are presented using tables. SPSS version 20 was used to perform all data computations. All statistical tests performed in this study were based on the 0.05 level of significance.

Data Collection

Data were collected for this research study from the Manitoba Health Protection Unit database system called hedgehog. The researcher used the 2012-2014 dataset of high risk and medium risk food establishments located throughout the Province of Manitoba. The secondary data was provided to the researcher by Manitoba Health Staff on excel spreadsheets. Data on 558 food establishments was received. The data included the names of the food establishments in Manitoba and then a listing of the food establishments' risk type (high risk or medium risk), number of routine inspections done, number of food safety practices implemented and food safety certification status. Food establishments were identified by numbers, which were assigned in a sequence starting with 1 and ending in 558. Risk type was identified by numerical values of medium risk = 1 and high risk =0. The number of routine inspections and food safety practices were calculated for each food establishment. Food safety certification status, which is answered with a yes or no responses were given numerical values of yes=1 and no=0.

All the spreadsheets that were obtained from Manitoba Health Staff were consolidated in to one spreadsheet. During this process, to ensure data integrity, data was reviewed and crosschecked against the original spreadsheets. Data was checked for mistakes, missing data, and duplication. The original data obtained from Manitoba Health Protection Unit did not have the columns that were needed to assess the data. Columns were created with respect to the variables of the study. The original data consisted of a huge transformation into a data set that could be used for data analysis for this research study. Records of all changes to the data set were kept in separate document. Once

consolidation and changes were complete, each food establishment was identified by an assigned number, 1 through 558. This would allow for the use of data statically in SPSS. Data was then imported into SPSS version 20.

Once all the data obtained from the Manitoba Health Unit was imported into SPSS, it was again checked the information for any missing data and duplication of food premises. The 558 high risk and medium risk food premises were imported into the SPSS. The researcher chose to assess high risk and medium risk food premises in this study because the researcher was comparing the results to the general population, which were high risk and medium risk food establishment. Also food safety practices are generally more applicable to high risk and medium risk food establishments as opposed to low risk food establishments. In order to capture food safety practices noncompliance for each food establishment, the researcher created an all food safety practice noncompliance column that captures the total number of food safety practices non-compliance for each food establishment.

Within this section, results of the study are presented based on the three research questions. Food establishment characteristics—high risk or medium risk restaurants are presented. Other variables are examined in this study were enforcement actions (convictions) taken by the public health inspector and closures of food establishments. In addition to answering the three research questions, statistical results are provided and discussed from the testing of the three hypotheses formulated for this study.

Descriptive Analysis

Data on 558 high risk and medium risk food establishments inspected from 2012-2014 inclusive throughout the province of Manitoba was obtained from the Manitoba Health Protection Unit Database Hedgehog. The frequencies and percentages for demographics variables are displayed in Figure 1. Of the 558 food service establishments, 355were high risk (64 %), whereas 203 (36%) were medium risk establishments.

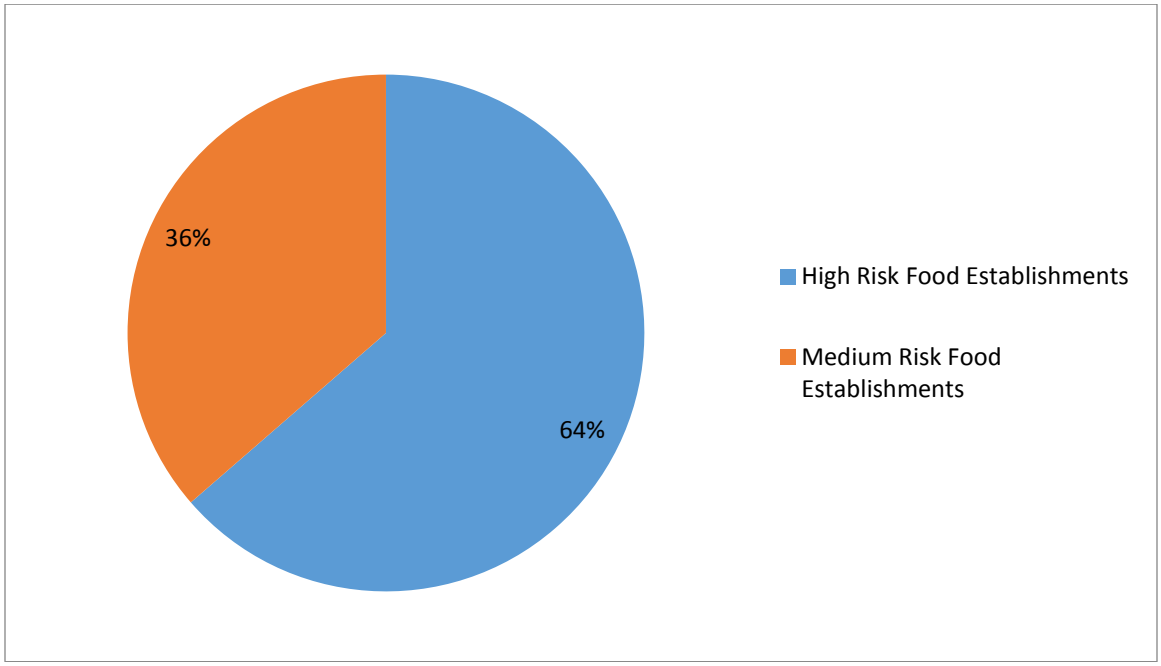


Figure 1. Frequencies and percentages of type of food establishment

Food Safety Practices

The frequencies of food safety practices compliance amongst high risk and medium risk establishments are displayed in Figure 2. From the 558 food establishments' food safety practices indicated the number of food safety compliance within a high risk food establishment and a medium risk food establishment (Figure 2). Food safety compliance was observed amongst 9 (1.6%) high risk food establishments and 18 (3.2%)

medium risk establishments, which gave a total of 27 (4.8%) food establishments with food safety compliance. A total of 402 (72%) food establishments (high risk and medium risk) had between 1 and 6 food safety noncompliance practices. 117 (21%) food establishments, which included both high risk and medium risk establishments had between 7 and 13 food safety non-compliance practices. 12 (2.1%) food establishments, which also included both high risk and medium risk food establishments had between 14 to 24 food safety noncompliance practices

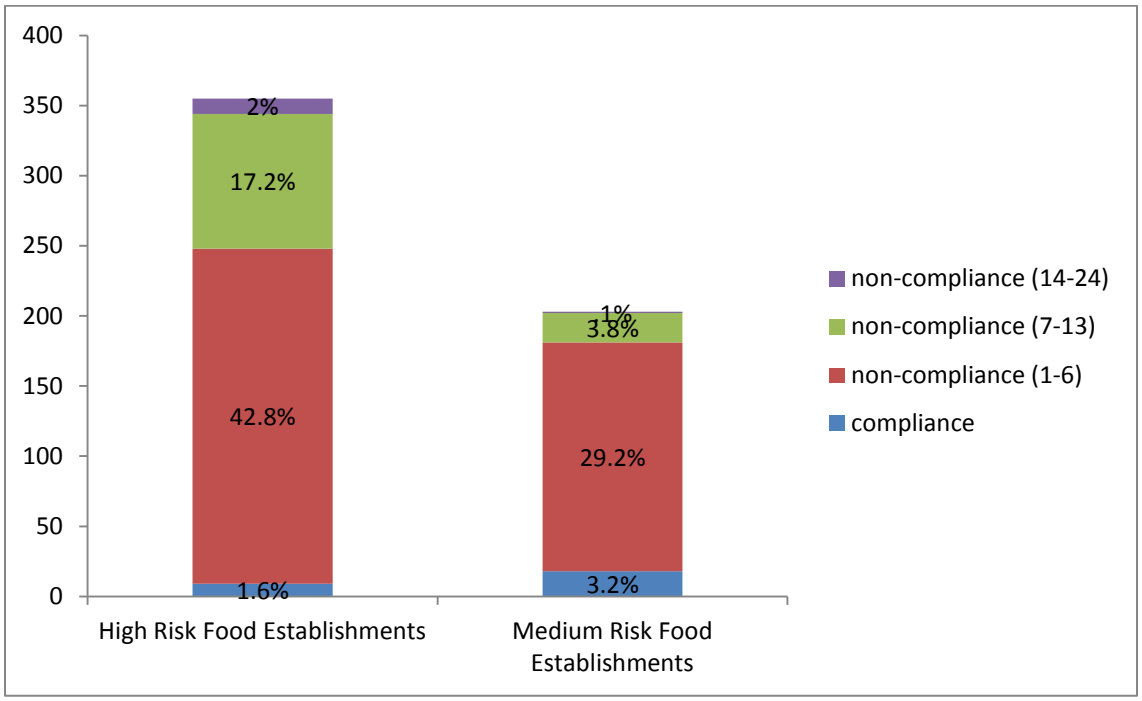


Figure 2. Frequencies of food safety practices compliance amongst high risk and medium risk food establishments

In respect to measuring food safety noncompliance practices (Table 1), it was observed that 62.2% (347) of food establishments had noncompliance of food storage and display/ food protection. Sixty percent (335) food establishments had noncompliance of

temperature control/thermometer use and 59.7% (333) food establishments had noncompliance of temperature control/internal temperature. Food safety noncompliance practices observed with 5% or lower were (a) food preparation and display/internal temperature (2.2%); (b) temperature control/re-heating (4.3%) and (c) food sanitation/potentially hazardous foods (5%). The food safety practice that was observed at 0% amongst the food establishments was Food sanitation and source/approved source practice. This illustrated 100% compliance of food sanitation and source/approved source food safety practice.

Table 1

Frequencies and percentages of food establishments by food safety practices

Variable	Yes		No		Total	
	n	%	n	%	n	%
Temperature control/cold holding	467	83.7	91	16.3	558	100
Temperature control/cold holding- refrigeration	466	83.5	92	16.5	558	100
Temperature control/internal temperature	225	40.3	333	59.7	558	100
Food preparation and display/internal temperature	546	97.8	12	2.2	558	100
Temperature control/ hot holding	454	81.4	104	18.6	558	100
Temperature control/thermometer use	223	40.0	335	60	558	100
Temperature control/cooling	508	91.0	50	90	558	100
Temperature control/re-heating	534	95.7	24	4.3	558	100
Personal practices/handwashing	459	82.3	99	17.7	558	100
Food storage and display/cross contamination	416	74.6	142	25.4	558	100
Food storage and display/food protection	211	37.8	347	62.2	558	100
Hazardous products/toxic materials	467	83.7	91	16.9	558	100
Food storage and display/ food containers	424	76.0	134	24	558	100
Food sanitation/potentially hazardous foods	530	95.0	28	5	558	100
Food sanitation and source/food protection	523	93.7	35	6.3	558	100
Food sanitation and source/approved source	558	100	0	0	558	100

Routine Health Inspections

Frequencies and percentages of food establishments by routine food health inspections (number of routine inspections conducted) are displayed in Figure 3. Within the data collected on 558 food establishments there were 189 (33.9%) food establishments that had two routine inspections (See Table 2). One hundred and sixty-nine (30.3%) food establishments had three routine inspections. In contrast, a higher percentage (35%), nearly one third of food establishments (n=194), had between four and six routine health inspections. The highest number of routine inspections (n=7) was seen in 1.1% (n=6) of food establishments.

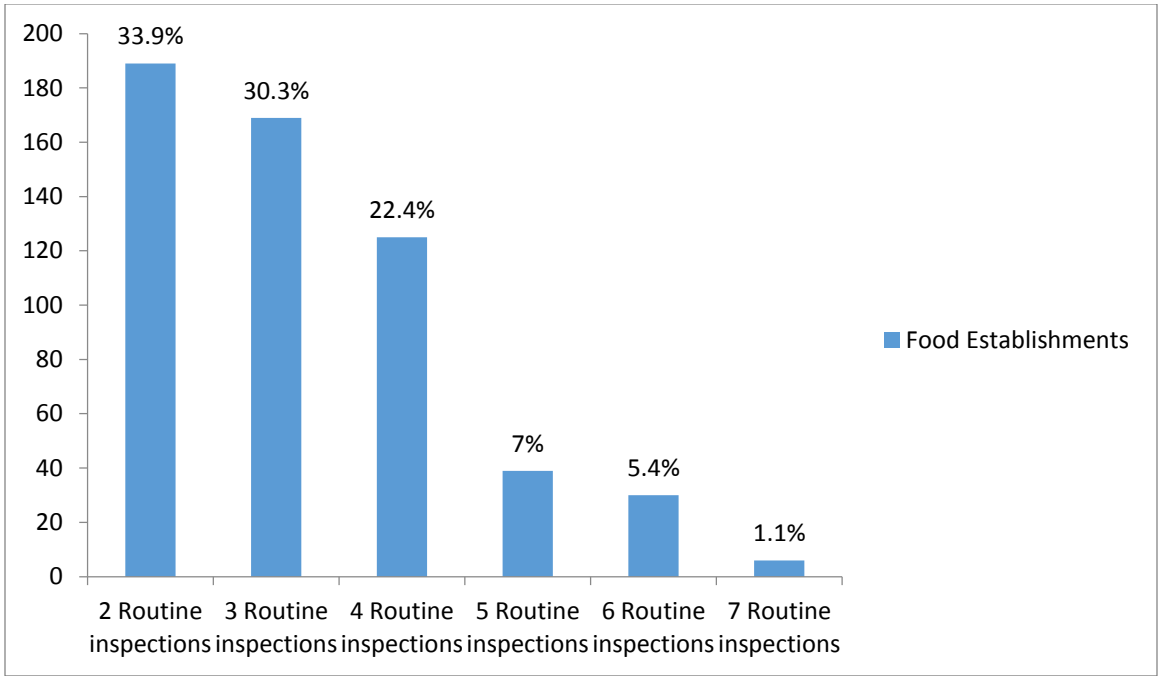


Figure 3. Frequencies and percentages of food establishments by routine food health inspections: number of routine inspections conducted

A cross tabulation was prepared to examine food establishments' by health inspection and food safety practices. In Table 2 data illustrates that 27 food establishments with routine health inspections between two and seven did have food safety practice compliance (no food safety noncompliance practices). In addition, 402 food establishments were observed to have between two to seven routine health inspections and did have food safety practice noncompliance (n= 1-6, food safety noncompliance were illustrated). There were 117 food establishments that were observed to have between two to seven routine health inspections and did have food safety practice noncompliance (n= 7-13, food safety noncompliance illustrated). Twelve food establishments with routine health inspections between two and seven also had food safety practice noncompliance (n= 14-24, food safety noncompliance illustrated).

Table 2

Distribution of food establishment by food safety practices and routine health inspection

	Food Safety Practices Compliance				
Health inspection	Yes n %		No n%		Total n%
	0	1-6	7-13	14-24	
2	9 (1.6)	165 (29.7)	15 (2.7)	0 (0)	189 (33.9)
3	8 (1.4)	119 (21.3)	42 (7.5)	0 (0)	169 (30.3)
4	8 (1.4)	73 (13.1)	38 (6.8)	6 (1.1)	125 (22.4)
5	0 (0)	21 (3.8)	15 (2.7)	3 (.53)	39 (7)
6	1 (.2)	19 (3.4)	7 (1.3)	3 (.53)	30 (5.4)
7	1 (.2)	5 (.9)	0 (0)	0 (0)	6 (1.1)
Total	27 (4.8)	402 (72)	117 (21)	12 (2.2)	558 (100)

Food Safe Certification (Predisposing Factor)

The Distribution of food establishment by predisposing factor of food safe certification is shown in Figure 4. The majority of high risk food establishments (67.3%) and medium risk food establishment had food safe certified workers (68.5%). It was

determined that 32.7% of high risk food establishments did not have food certified workers. In addition, 31.5% of medium risk food establishments did not have food certified workers. A total of 32.2% of the food establishments did not have workers that were food safe certified.

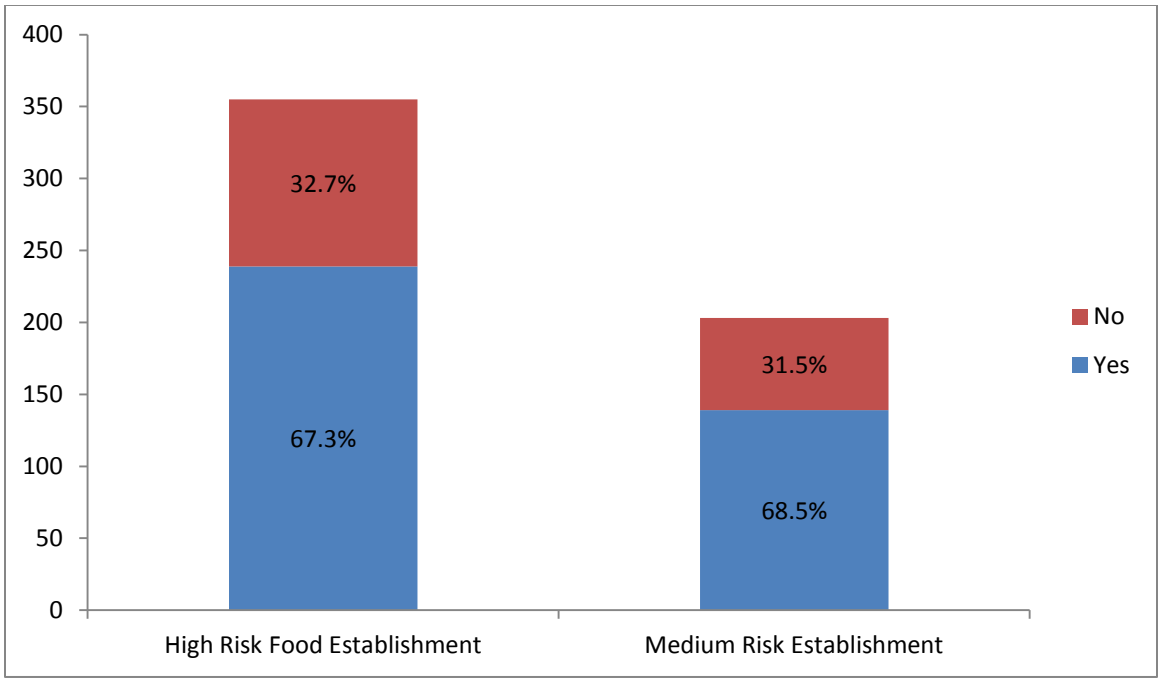


Figure 4. Distribution of food establishments by predisposing factor of food safe certification

Cross tabulation shown in Figure 5 shows the majority of food establishments that did not have food safety compliance did have food safe certification (64.9%).In contrast, a higher percentage of food safety practices compliance (2.9%) was observed in food establishments with food safe certification. In addition, 169 food establishments did not have food safety compliance (30.2%) and did not have food safe certification. These food establishments were not exposed to this predisposing factor.

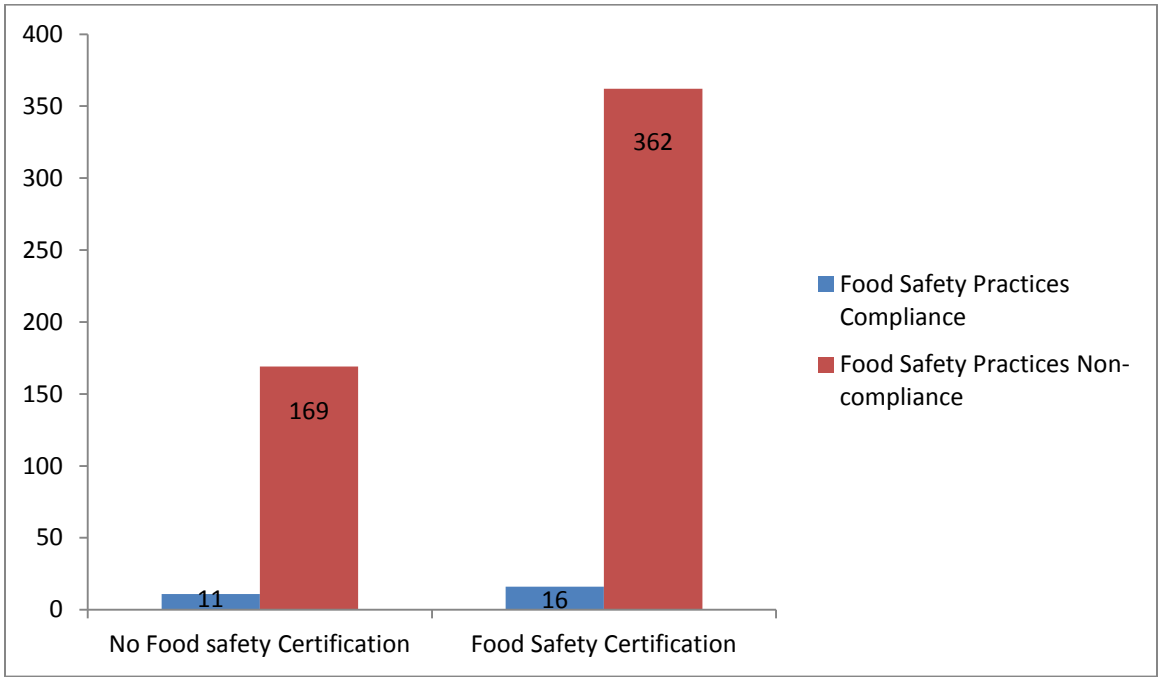


Figure 5. Distribution of food establishments by food safety practices of food safe certification.

The same analysis was conducted for food safety practices compliance that is based on the number of food safety practices compliance or food safety noncompliance. As illustrated in Table 3 the majority of food establishments with food safety practices noncompliance (50.5 %), which is between one to six food safety noncompliance practices did have food safe certification (2.9%). Those food establishments with food safety practices noncompliance, which is between 14-24 food safety noncompliance practices, did have food safe certification (.7%).

Table 3

Distribution of food establishments by number of food safety practices and food safe certification.

Pre-disposition factor: food safe certification	Food Safety Practices Compliance				
	Yes 0 n %	No 1-6, n%	7-13, n%	14-24 n%	Total n%
No	11 (2)	120 (21.5)	45 (8)	4(.7)	180 (32.2)
Yes	16 (2.9)	282 (50.5)	72 (13)	8 (1.4)	378 (67.8)
Total	27 (4.8)	402 (72)	117 (21)	12(2.1)	558 (100)

Test of Hypothesis

Research question 1: What is the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada?

Data was collected on 558 food establishments located in Manitoba, Canada. Prevalence was measured amongst this cohort included in the study. The number of food establishments that were observed to have food safety noncompliance was divided by the sample size of the number of food establishments. Cross tabulation by risk rating of food establishment was further conducted to provide a more intrusive examination of food safety practices prevalence amongst food establishments.

Prevalence of food safety practices among food service workers working in food establishments is illustrated in Table 4. From the 558 food establishments 95.2% were observed to have food safety noncompliance that is have food safety noncompliance practices. At the same time 4.8% of food establishments were observed to have food safety compliance that is have no food safety noncompliance practices. High risk food establishments had a greater prevalence of food safety noncompliance (62%) compared

to medium risk food establishments (33.2%). The analysis also provided those food safety noncompliance practices that were at a greater prevalence than others. The prevalence of food storage and display/food protection noncompliance was 43.7% in high risk food establishments. Temperature control/internal temperature noncompliance food safety practice had a prevalence of 41% amongst high risk food establishments. In a medium risk food establishment the prevalence of 20.4% was highest for temperature control/thermometer use non-compliance food safety practice. The second highest prevalence was 19% for temperature control/internal temperature food safety noncompliance practice for medium risk food establishment. Food sanitation and source/approved source was the food safety practice that was seen at the lowest prevalence of 0% in both high risk food establishment and medium risk food establishment.

Table 4

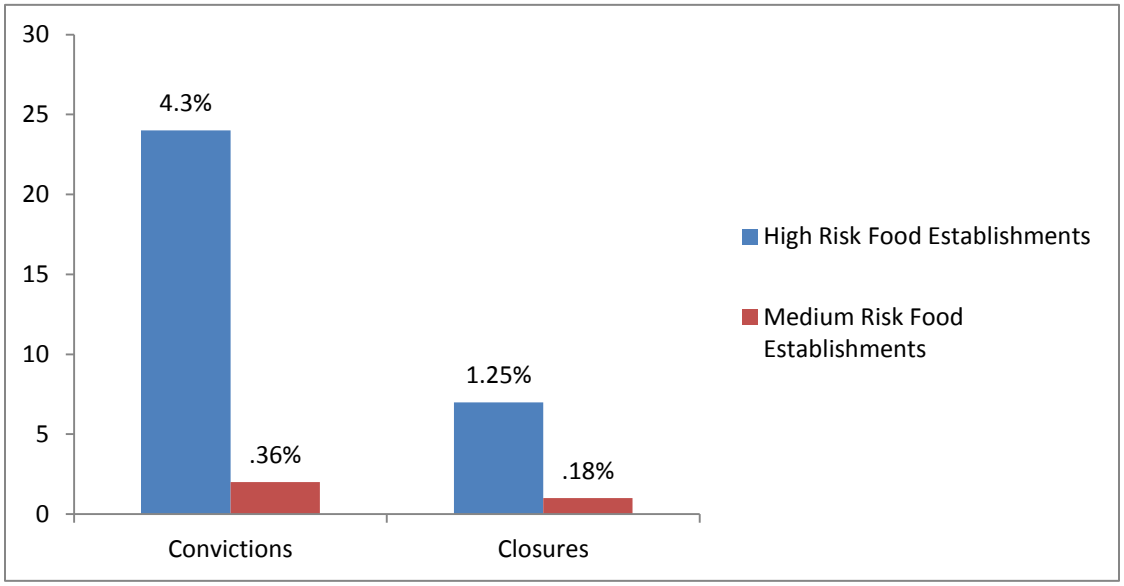
Prevalence of food safety practices among food service workers in food establishments.

Variable	Data by risk rating		
Food safety noncompliance	High Risk (n=346) **(62%)**	Medium Risk (n=185) **(33.2%)**	Total (n=531) **(95.2%)**
Temperature control/cold holding	77(14)	14 (2.5)	91 (16.3)
Temperature control/cold holding- refrigeration	78 (14)	14 (2.5)	92 (16.4)
Temperature control/internal temperature	227 (41)	106 (19)	333 (60)
Food preparation and display/internal temperature	8 (1.4)	4 (.7)	12 (2.1)
Temperature control/ hot holding	74 (13.3)	30 (5.4)	104 (18.6)
Temperature control/thermometer use	221 (40)	114 (20.4)	335 (60)
Temperature control/cooling	40 (7.2)	10 (1.8)	50 (9)
Temperature control/re-heating	16(2.9)	8 (1.4)	24 (4.3)
Personal practices/handwashing	68 (11.6)	31 (5.5)	99 (18)
Food storage and display/cross contamination	116(21)	26 (4.7)	142 (25.4)
Food storage and display/food protection	244 (43.7)	103 (18.4)	347(62.2)
Hazardous products/toxic materials	61 (11)	30 (5.4)	91 (16.3)

Food storage and display/ food containers	107 (19.2)	27 (4.8)	134 (24)
Food sanitation/potentially hazardous foods	21 (3.8)	7 (1.2)	28 (5)
Food sanitation and source/food protection	30 (5.4)	5 (.9)	35 (6.3)
Food sanitation and source/approved source	0 (0)	0 (0)	0 (0)
Food Safety Compliance	**9 (1.6)**	**18 (3.2)**	**27(4.8)**

Note. The numbers were calculated based on the corresponding number of food establishments (*n*) by risk.

Prevalence of food safety practices among food service workers working in food establishments with convictions and closures is illustrated in Figure 6. The analysis by convictions and closures reveled that 4.7% (food establishments) had convictions, 4.3% of those were high risk and .36 were medium risk food establishments. 1.25% of high risk food establishments were closed and .18% of medium risk food establishments were closed. This group represents 1.4% of the 558 food establishments included in the sample size.



Note. This figure includes food establishments that experienced convictions and closures (n=).

Figure 6. Prevalence of food safety practices among food service workers working in food establishments with Convictions and Closures.

Research question 2: What is the relationship between food safety practices and health inspection?

Pearson Chi-Square was prepared to determine if there was a relationship between the dependent variable, food safety practices and the independent variable routine health inspection. The dependent variable was measured by observed food safety compliance and non-compliance practice (temperature control/cold holding, temperature control/cold holding- refrigeration, temperature control/internal temperature, food preparation and display/internal temperature, temperature control/hot holding, temperature control/thermometer use, temperature control/ cooling, temperature control/re-heating, personal practices/handwashing, food storage and display/cross contamination, food storage and display/food protection, food storage and display/food containers, hazardous products/toxic materials, food sanitation/potentially hazardous foods, food sanitation and source/food protection and food sanitation and source/approved source). For this analysis, food safety practices consisted of the sum of scores for the 16 food safety practices observed for this variable for each food establishment in the secondary data obtained. Health inspections consisted of the sum of scores for routine inspections observed for each food establishment in the secondary data obtained. Both Food safety practices (coded as foodsafetynoncompliance) variable and Health inspection variable were categorical variables.

***H_0*1:** There is an association between food safety practices and health inspections among food premises in Manitoba, Canada.

***H_a*1**: There is no association between food safety practices and health inspections among food premises in Manitoba, Canada.

Results from Correlation between food safety practices and health inspections among food establishments in Manitoba are illustrated in Table 5. A positive and statistically significant relationship between food safety practices noncompliance and health inspection was observed among the food establishments included in this study x^2 (1)=19.2 p <0.01). This would indicate that as health inspections increase so does the number of food safety noncompliance practices. Additionally, logistic regression analysis was conducted to determine the impact of health inspections and food safety certification on food safety practices noncompliance. The dependent variable used for this analysis was food safety practices (dichotomous variable), coded 0=no and 1= yes. The independent variables used were food safety certification (categorical variable) and health inspections (categorical variable). SPSS outputs for logistic regression analysis are included as Appendix A. The odds of food safety practices =1, using logistic regression.

Table 5

Correlation Matrix between food safety practices and health inspections among food establishments in Manitoba.

Variables	Health Inspection	
Food Safety Practices (noncompliance)	Pearson Chi-square	.000
	Sig. (2-sided)	.000
	N	558

	N	558

2 cells (25.0%) have expected count less than 5. The minimum expected count is 1.61.

Using SPSS statistical analysis based on Pearson Chi-square and Fisher's Exact Tests were conducted to examine the relationship between food safety practices and health inspections among food establishments observed in this study. Results of the statistical analysis were presented in Table, 6. The assumption in this case was violated. The likelihood ratio was then observed. The likelihood ratio revealed that health inspection was not a significant predictor of food safety practices (p >0.01. Likelihood ratio). As a result the null hypothesis was accepted and concluded that there is no association between food safety practices and health inspections. The logistic regression analysis, presented in Table 16 revealed that routine health inspection was not a predictor of food safety practices (*OR*. 1.066, 95% CI .769-1.477, p =.701). As a result the null hypothesis was accepted, due to statistical evidence of the association between food safety practices and routine health inspections.

Table 6

Chi-Square and Fisher's Exact Tests for Food Safety Practices and Health Inspections among food premises in Manitoba, Canada.

Tests	Value	DF	Asymp.Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.888[a]	1	.346		
Continuity Correction$_b$	.426	1	.514		
Likelihood Ratio	1.028	1	.311		
Fisher's Exact Test				.561	.270
Linear-by-Linear Association	.886	1	.347		
N of Valid Cases	558				

a. 1 cells (25.0%) have expected count less than 5. The minimum expected count is 3.63.

b. Computed only for a 2x2 table

The top three noncompliance food safety practices were temperature control/internal temperature, temperature control/thermometer use and Food storage/food protection noncompliance. Using SPSS statistical analysis based on Pearson correlation and Cross-tabulation tests were conducted to examine the relationship between each of the top three non-compliance food safety practices and routine health inspections amongst food establishments observed in this study.

Cross-tabulation by type of food safety noncompliance practice was further conducted to provide a more intrusive examination of temperature control/internal temperature noncompliance amongst food establishments. Results of the statistical analysis were presented in Table, 7. Temperature control/internal temperature noncompliance was observed at the highest in those food premises that had two inspections. In one premise with six inspections temperature control noncompliance was observed four times. A Pearson's *r* data analysis, presented in table 8 revealed a week relation between routine inspections and temperature control noncompliance (r=.181, p <0.01). Temperature control/internal temperature noncompliance is not correlated with the changes in the number of routine inspections.

Table 7

Distribution of food establishment by temperature control/internal temperature noncompliance and routine health inspection.

Health inspection	temperature control/internal temperature	Total n

	noncompliance					
	1	2	3	4	6	
2	81	23	0	0	0	104
3	62	31	7	0	0	100
4	45	21	13	0	0	79
5	17	8	4	2	0	31
6	9	3	3	1	1	17
7	0	2	0	0	0	2
Total	214	88	27	3	1	333

Table 8

Correlation Matrix between temperature control/internal temperature and noncompliance and health inspections among food establishments in Manitoba.

Variables	Temperature control/internal temperature	
Temperature control/internal temperature	Pearson Correlation	1
	Sig. (2-tailed)	
	N	558
Routine Inspection	Pearson Correlation	.181**
	Sig, (2-tailed)	.000
	N	558

** Correlation is significant at the 0.01 level (2-tailed).

Using SPSS statistical analysis Cross-tabulation by type of food safety non-compliance practice was further conducted to examine the relationship between temperature control/thermometer use noncompliance amongst food establishments. Results of the statistical analysis were presented in Table, 9. Temperature control /thermometer use noncompliance was seen at the highest in those food premises that had

two inspections and occurred frequently in those premises with three and four routine inspections. A Pearson's *r* data analysis, presented in table 10 revealed a week relation between routine inspections and temperature control noncompliance (r=.127, p <0.01). Temperature control/thermometer use noncompliance is not significantly correlated with the changes in the number of routine inspections.

Table 9

Distribution of food establishments by temperature control/thermometer use noncompliance and routine health inspection.

Health Inspection	Temperature control/thermometer use				Total n
	1	2	3	4	
2	76	31	0	0	107
3	63	29	6	0	98
4	45	23	11	1	80
5	18	9	2	3	32
6	9	6	2	0	17
7	0	1	0	0	1
Total	211	99	21	4	335

Table 10

Correlation Matrix between temperature control/thermometer use and noncompliance and health inspections among food establishments in Manitoba.

Variables		Temperature control/thermometer use
Temperature control/thermometer use	Pearson Correlation	1
	Sig. (2-tailed)	
	N	558
Routine Inspection	Pearson Correlation	.127**

	Sig, (2-tailed)	.003
	N	558

** Correlation is significant at the 0.01 level (2-tailed).

Cross-tabulation by type of food safety noncompliance practice was prepared to determine if there was a relationship between food storage and display/food protection noncompliance amongst food establishments. Results of the statistical analysis were presented in Table, 11. Food storage and display/food protection noncompliance was seen at the highest in those food premises that had two inspections. In one food premise with six health inspections, food storage and display/food protection noncompliance was observed six times. That is at each health inspection this noncompliance was noted. A Pearson's *r* data analysis, presented in table 12 revealed a week relation between routine inspections and food storage and display/food protection noncompliance (r=.301, p <0.01). Food storage and display/food protection noncompliance is not correlated with the changes in the number of routine inspections.

Table 11

Distribution of food establishments by food storage and display/food protection noncompliance and routine health inspection.

Health Inspection	food storage and display/food protection noncompliance						Total n
	1	2	3	4	5	6	
2	78	25	0	0	0	0	103
3	57	39	7	0	0	0	103
4	35	31	18	2	0	0	86
5	6	11	6	4	1	0	28
6	11	5	3	1	2	1	23
7	3	0	1	0	0	0	4
Total	190	111	35	7	3	1	347

Table 12

Correlation Matrix between food storage/food protection noncompliance and health inspections among food establishments in Manitoba.

Variables		Food storage/food protection
Food storage/food protection	Pearson Correlation	1
	Sig. (2-tailed)	
	N	558
Routine Inspection	Pearson Correlation	.301**
	Sig, (2-tailed)	.000
	N	558

** Correlation is significant at the 0.01 level (2-tailed).

Research question 3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

***H_0*2:** There is an association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

***H_a*2:** There is no association between food safety practices and food safety certification of staff working in food premises in Manitoba, Canada.

Pearson correlation coefficient was prepared to determine if there was a relationship between the dependent variable food safety practices and the predisposing independent variable food safe certification. Results from Correlation Matrix between food safety practices and predisposing factor of food safe certification among food establishments in Manitoba are illustrated in Table 13. Five hundred fifty eight food establishments were observed for food safe certification and food safety practices. A

Pearson's *r* data analysis revealed a moderate negative correlation, (*r*=.-051, *p*<0.01). Food establishments with food safe certification did not have a significant number of more food safety noncompliance practices.

Table 13

Correlation Matrix between food safety practices and predisposing factor of food safe certification among food establishments in Manitoba.

Variables	Food Safe Certification	
Food Safety Certification	Pearson Correlation	1
	Sig. (2-tailed)	
	N	558
Food Safe Practices (noncompliance)	Pearson Correlation	-.051
	Sig, (2-tailed)	.233
	N	558

** Correlation is significant at the 0.01 level (2-tailed)

Hypothesis two was answered by conducting a Pearson Chi-Square and Fisher's Exact Tests. Food safety practices were measured by the predisposing factor of food safety certification. Fisher's Exact Test revealed that food safety practices noncompliance did not significantly differ by food safety certification among food establishments (*p* >0.01, FET). Table 14 illustrated that the association between food safety practices and the pre-disposition factor of food safety certification was not significant, $x2$ (1, n = 558) = .934, p >0.01. As a result the null hypothesis was accepted. The logistic regression analysis, presented in table 16 revealed that food safe certification was not a predictor of food safety practices (*OR*. 1.498, 95% CI .673-3.333, *p* =.322). As a result the null

hypothesis was accepted, due to statistical evidence of the association between food safety practices and food safe certification

Table 14

Chi-square and Fisher's Exact Tests for Food Safety Practices and Food Safety Certification of staff working in food establishments in Manitoba, Canada.

Tests	Value	DF	Asymp.Sig (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.934[a]	1	.334		
Continuity Correction[b]	.571	1	.450		
Likelihood Ratio	.900	1	.343		
Fisher's Exact Test				.399	.222
Linear-by-Linear Association	.933	1	.344		
N of Valid Cases	558				

[a] 0 cells (.0%) have expected count less than 5. The minimum expected count is 5.31.
[b] Computed only for a 2x2 table

***H_0*3:** There is an association between food safety practices and the predisposing factor of food safety certification in Manitoba Canada?

***H_a*3:** There is no association between food safety practices and the predisposing factor of food safety certification Manitoba Canada?

This hypothesis was examined using multiple logistic regressions. Statistical analysis revealed no association between food safety practices, routine health inspections and predisposing factor of food safety certification amongst food establishments in Manitoba. The classification table (see table 15) includes two predicted values of the dependent variable. The model is predicting food safety practices noncompliance. The overall percentage correct is 95.2%.

Table 15

Logistic Regression Classification Table

			Predicted Food Safety Practices		Percentage
			No	Yes	Correct
	Observed				
Step 1	Food Safety Practices	No	531	0	100
		Yes	27	0	0
	Overall Percentage				95.2

Constant is included in the model.
b The cut value is .500

Coefficients, their standard errors, Wald test statistic, degrees freedom, p-values and odd ratio are presented in table 16. The significance levels of each of the independent variables (routine health inspections, food safe certification and restaurant type) in the model are tested using the Wald Statistic and the significance level test within the logistic regression. The logistic regression analysis revealed that food safe certification was not statistically significant (*OR*. 1.498, 95% CI .673-3.333, *p* =.322). The logistic regression analysis, presented in Table 22 revealed that routine health inspection was not statistically significant (*OR*. 1.066, 95% CI .769-1.477, *p* =.701). The logistic regression analysis, presented in Table 16 revealed that restaurant type was statistically significant (*OR*. 3.851, 95% CI. 1.681-8.822, *p* =.001).The logistic regression results concluded that food safety certification and routine health inspections do not impact food safety practice

compliance The logistic regression results also concluded that restaurant type does impact food safety practices.

Table 16

Logistic Regression, Wald Statistics and Significance Levels Formatting.

								95%C.l.for EXP (B)	
		B	S.E.	Wald	df	Sig.	Exp (B)	Lower	Upper
Step 1a	Routine	-.012	.165	.005	1	.943	.988	.715	1.366
	Health Inspections	.064	.166	.147		.701	1.066	.769	1.477
	Predisposing:	.388	.403	.928	1	.335	1.474	.668	3.248
	Food Safe Certification	.404	.408	.980		.322	1.498	.673	3.333
	Restaurant type	1.348	.423	10.167	1	.001	3.851	1.681	8.822
	Constant	-3.082	.584	27.856	1	.000	.046		
		-4.016	.679	34.950			.018		

a. Variable(s) entered on step 1: routine health inspection, food safe certification, Restaurant type

Results from Correlation Matrix between food safety practices and routine health inspections, restaurant type, and a predisposing factor of food safety certification among food establishment in Manitoba are illustrated in Table 17. A negative relationship was seen between food safety practices, routine health inspections and the predisposing factor of food safe certification amongst food establishments in Manitoba. A positive relationship was seen between food safety practices and routine health inspections. Among food establishments in Winnipeg, Manitoba, the Logistic Regression highlighted the association between food safety practices and restaurant type. The results illustrated that high risk restaurants are four times more likely to have food safety practice noncompliance.

Table 17

Correlation Matrix between food safety practices and routine health inspections, and a predisposing factor of food safety certification among food establishments in Manitoba.

Variables		Routine Health Inspections	Predisposing Food Safety Certification	Restaurant Type
Factor				
Food Safety Practices (noncompliance)	Pearson Correlation	.305**	-.051	-.284**
	Sig. (2-tailed)	.000	.233	.000
	N	558	558	558
Routine Health Inspections	Pearson Correlation	1	-.041	-.135**
	Sig, (2-tailed)		.339	.001
	N	558	558	558

Predisposing factor: Food Safety Certification	Pearson Correlation	-.041	1	.012
	Sig, (2-tailed)	.339		.780
	N	558	558	558
Restaurant Type	Pearson Correlation	-.135**	.012	1
	Sig, (2-tailed)	.001	.780	
	N	558	558	588

** Correlation is significant at the 0.01 level (2-tailed).

Summary

The purpose of this study was to determine the prevalence of food safety practices among food establishments in Manitoba, Canada and to determine the relationship between food safety practices and health inspection and food safety practices and food safe certification. In addition to determining the relationship between food safety practices, health inspections and the predisposing factor of food safe certification. The sample size consisted of 558 food establishments. Of the 558 food establishments, 63.6% were high risk food establishments and 36.4% were medium risk food establishments. From the 558 food establishments, 4.3% of high risk establishments were issued convictions and 1.25% was closed. .36% of the medium establishments were issued convictions and .18 was closed, from a total of 558 food establishments.

With respect to Research Question 1, 95.2% of the 558 food establishments were observed to have food safety practice noncompliance that is have food safety practices that were not being followed. At the same time 4.8% of food establishments were observed to have food safety compliance that is following every food safety practice.

High risk food establishments had a greater prevalence of food safety noncompliance (62%) compared to medium risk food establishments (33.2%). The prevalence of food storage and display/food protection noncompliance was 43.7% in high risk food establishments. This food safety noncompliance practice was seen at the highest prevalence amongst all the food safety noncompliance practices for high risk food establishments (63.6%). In a medium risk food establishment the prevalence of 20.4% was highest for temperature control/thermometer use noncompliance food safety practice. Food sanitation and source/approved source was the food safety noncompliance practice that was seen at the lowest prevalence of 0% in both high risk food establishment and medium risk food establishment.

To answer Research Question 2, Pearson correlation coefficient was conducted to determine if there was a relationship between the dependent variable food safety practices and the independent variable routine health inspection. Hypothesis 1 was tested using Pearson Chi-square and Fisher's Exact Tests. The relationship between food safety practices and health inspections among food establishments was examined in this study. The researcher accepted the alternative hypothesis and failed to reject the null hypothesis. This concluded that there is no association between food safety practices and health inspections.

For Research Question 3, Multiple Logistic Regression with Pearson Chi-Squares and Fisher's Exact Tests and were conducted. For Hypothesis 2 statistical analysis concluded that there is no association between food safety practices and food safe certification amongst food establishments in Manitoba, Canada. The results for statistical

analysis for Hypothesis 3 based on multiple logistic regressions revealed that there was no association between food safety practices (noncompliance), health inspections, and the predisposing factor of food safety certification. There were no significant differences amongst food safety practices within food establishments with food safe certification and health inspections. An association between food safety practices and restaurant type among food establishments was observed. Based on this study, restaurant type contributed significantly to food safety practices (noncompliance). In Chapter 5, results from the statistical tests conducted, nature of the study, findings, limitations and recommendations for future research will be discussed.

Chapter 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative research study was to determine the prevalence of food safety practices among food service staff working in food establishments in Manitoba, Canada and to determine the relationship between food safety practices and health inspections and the predisposing factor of food safety certification of food service staff working in food establishments in Manitoba. The three central questions that were formulated for this study were:

1. What is the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada?
2. What is the relationship between food safety practices and health inspection?
3. What is the relationship between food safety practices and the predisposing factor of food safe certification?

The first research question was developed to determine the amount of food safety practices being implemented amongst food services workers working in food establishments throughout the province of Manitoba. This research question was answered using the data obtained on 588 food establishments from the Manitoba Health Protection Unit Hedgehog database. Researchers have shown that food service workers continue to not follow food safety practices (Deborah et al., 2002; Kibret et al., 2012).Not following food safety practices can result in foodborne illnesses (Henson et al., 2006). Because of reported cases of foodborne illness in Canada and the United States it is suspected that food service establishments in Manitoba also contribute to foodborne

illness that result from not following certain food safety practices (Public Health Agency of Canada, 2014). Results from this study did indicate that food safety practices continue to not be followed and implemented by food service workers. However, in comparison with other studies, rates were much lower than what had been predicted based on the literature reviewed.

For the second research question, the relationship between food safety practices and routine health inspections was investigated using the data obtained from the hedgehog database. There was a moderate positive relationship between food safety practice implementation, compliance, and routine health inspections. Finally, research question 3 was developed to determine whether or not there is a relationship between food safety practices and the predisposing factor of food safe certification. Results indicated that food safety certification was not a significant predictor of food safety practice implementation.

In this chapter a summary and interpretation of the study findings based on the three research questions and three hypotheses formulated for this study will be provided. Next, a discussion of the limitation of the study followed by recommendations for future research and social change implications will be illustrated. Lastly, a summary of the dissertation will be provided.

Interpretation of Findings

In this study secondary data obtained from Manitoba's Health Protection Unit Hedgehog Database was analyzed to answer the three research questions and test three hypotheses. The study used Fisher's Exact Test, logistic regression and Pearson Chi-

Square analysis. These statistical testes were used to determine the prevalence of food safety practices among food service workers working in food establishments in Manitoba to determine the relationship between food safety practices and health inspection and to determine the relationship between food safety practices and the predisposing factor of food safe certification. Research findings are presented below.

R Q1: What is the frequency (prevalence) of food safety practices among food service workers working in food establishments in Manitoba, Canada?

For this study the prevalence of food safety practice noncompliance among food service workers working in food establishments was (62%) for high risk food establishments and (33.2%) for medium risk establishments. 4.8% restaurants which include both high risk and medium risk were in compliance with food safety practices. Literature indicates a high prevalence of noncompliance of food safety practices among food service workers (Harris et al., 2014; Noble et al., 2009). These results are also supported by previous researchers who found a high prevalence of noncompliance of foods safety practices (Fielding et al., 2000; Reske et al., 2007; Yarrow et al, 2009).

Findings based on restaurant type might also be explained by previous research conducted by Harris et al. (2014) where they reported that chain restaurants followed food practices 26% times more often than nonchain restaurants. Regardless of the status of the restaurant, food safety practices were not being followed in both cases. Food service staff working in food establishments, chain or nonchain in Manitoba exhibited inadequate food safety practices. These results are also concurrent with results found in a study by baranowski, Perry, et al., (1997), where they demonstrated that behavior in the

work place is influence by social and environmental factors. As a result, food service workers may or not follow food safety practices knowledgably (Afifi et al., 2012).

R Q2: What is the relationship between food safety practices and health inspection?

A positive and statistically significant correlation between food safety practices and routine health inspections (r=.305, p<0.01) was observed among food service establishments that were used in this study. Researchers have identified both a positive correlation, of the relationship between food safety practices and health inspections (Allwood et al., 1999; Harris et al., 2014).

This observation was further supported from previous research where researchers found a relationship between food safety practices and frequency of inspections conducted (Blake et al., 2013; Lee et al., 2008). In a study conducted by Harris et al., (2014), they found that the number of inspections impacts the number of poor food safety practices. A plausible justification for this outcome is presented by Newbold et al., (2008), where they found that knowing about variations in inspection frequency and how they impact food safety practices may be instrumental in measuring the degree to which the numbers of health inspections are required to prevent inadequate food safety practices.

Pearson Chi-square and Fisher's Exact were used to test hypothesis 1 of this study. There is no association between food safety practices and health inspections among food premises in Manitoba, Canada. Therefore, the null hypothesis was accepted. There were grounds to believe that there is an association between food safety practices

and routine inspections (r= .305, p <0.01). However, the results from the logistic regression analysis illustrated that health inspections was not a predictor of food safety practices (*OR*. 1.066, 95% CI .769-1.477, p =.701). A plausible justification for this outcome is presented by Mathias et al. (1995), where they evaluated inspection frequencies of restaurants with relation to inspection scores. They found that inspections at a frequency of less than one year were not different from each other when it came to food safety practices.

Further to this analysis, Pearson Correlation and cross-tabulation analysis was conducted to examine the relationship between each of the top three noncompliance food safety practices and routine health inspections. A Pearson's *r* data analysis revealed a weak relation between routine inspections and temperature control/internal temperature noncompliance (r=.181, p <0.01) and temperature control/thermometer use (r=.127, p <0.01). The findings might be also explained by previous research conducted by Phillips et al., (2006) where they reported nonrandom distribution of recurrent violations among food service establishments.

A positive and statistically significant correlation between food safety practices and food storage/food protection noncompliance (r=.301, p<0.01) was observed among food service establishments that were used in this study. A positive correlation of the relationship between food safety practices and health inspections has been identified by researchers (Allwood et al., 1999; Harris et al., 2014). They also found that the number of inspections impacts the number of violations cited.

R Q3: What is the relationship between food safety practices and the predisposing factor of food safe certification?

A moderate negative relationship between food safety practices and the predisposing factor of food safe certification (r=-.51) was observed among food service establishments that were used in this study. Although a number of studies have demonstrated that food safety certification improves food safety practices of food service workers there have been some studies that did not result in the same outcome. Mathias et al., (1994), found that there was no correlation between the numbers of trained individuals in the past year and violations. Research has suggested that multiple factors play a role in the ability and willingness of food service workers to perform adequate food safety practices. Food safety is a practice that is influenced by attitude and behavior, environmental factors, facilitation, and outcome expectations influence food services workers beliefs and behaviors associated with food safety (Green et al, 2005). The moderate negative relationship in this study does not insinuate that food safety certification is not important; it could mean a lack of other factors, such as attitude, beliefs, descriptive norms do indeed influence food safety practice compliance within food establishments as described by Green (2005) and Clayton (2008).

These findings support the test for hypothesis 2 and hypothesis 3 of this study. $H_0$2: There is no association between food safety practices and food safe certification of staff working in food establishments in food premises in Manitoba, Canada. Therefore the null hypothesis was accepted. The result of the logistic regression analysis pointed out

that food safety certification was not a predictor of food safety practice compliance (*OR.* 1.498, 95% CI .673-3.333, *p* =.322)

$H_0$3**:** There is no association between food safety practices and the predisposing factor of food safe certification in Manitoba Canada? The logistic regression statistical analysis highlighted the association between food safety practices, health inspections, restaurant type, and food safe certification among the 558 food establishments in this study. There was evidence of poor significance level between food safety practices, health inspections, and food safe certification. In contrast, there was evidence of association between food safety practices and restaurant type. Noncompliant food safety practices are seen at high numbers in food establishments; however food safety certification and routine inspections were not predictive factors for food safety compliance, with the exception of restaurant type. These results are congruent with the results presented by Green et al., (2005) because food service workers work with others, their behavior may be influenced and therefore their willingness to perform or not perform adequate food safety practices may be hindered. Also Tessema, Gelaye and Chercos, (2014), found that sociodemographics, such as marital status, monthly income, and gender are related to the related to the phenomenon of food safety practices/risks in food establishments. These findings are also similar to those by Havelaar et al, (2013), where they found work responsibility as a cause of food safety risks/practices. Although studies have also found that sanitary rating of a restaurant is positively associated with the frequency with which the restaurant is inspected (Allwood, et al., 1999).

Limitations of the Study

Several factors resulted in limitations of this study, which then limited the ability to generalize the results of this study amongst all food establishments in North America. The data that was used for this study was secondary data; there is a chance of mistakes in the data due to such things as incorrect reporting, incorrect data inputting, or just simple human error. Another limitation was not doing data randomization. Data randomization allows a basis for an assumption-free statistical test (Field, 2009). Randomization was not selected for this study because data prior to 2011 had discrepancies as no one particular policy was used and standards varied for each department. Data was not consistent and cannot be analyzed to indicate true and reliable and accurate information in health practices. Data from 2012 to 2014 inclusively was used and incorporated into this study. The use of randomization would have improved generalizabilty, therefore some of the limitations could not be controlled for. Yet another limitation was the possibility that the documentation of health inspections conducted was not consistent. High risk food establishments require three routine inspections a year and medium risk establishments require two routine inspections. As a result, there may be a lack of data regarding health inspections conducted, because health inspectors were not able to conduct routine inspections as required due to varying reasons, such as lack of time, high work load, and other pressing public health issues that are the responsibilities of public health inspectors. These noted limitations provide validation for future studies regarding food safety practices.

Recommendations

There are only a very limited number of studies conducted in Canada regarding food safety practices within food establishments. Food safety practices amongst food establishments continue to be monitored by public health inspectors when conducting inspections. In Manitoba, no studies have been conducted on prevalence and relationships between foods safety, routine health inspections and food safe certification. The main aspects of this study should be replicated across all health departments in Canada. The results of the study highlighted the importance and need of social change action to promote healthy environment for food service staff, by using elements from the SCT and Health Promotion Model, of food service staff.

The following are different recommendations based on data collection and results of the study:

- Changes to the documentation system to capture food safety workers' response to why food safety practices were not being followed. Data would improve research. The detailed documentation would help in the understanding about why food safety practices are not being followed. This would intern add to the literature.
- Future preventive efforts among food safety workers concerning food safety practices.
- A stronger connection between food safety workers and management should be made utilizing health departments efforts in order to establish a healthy community and reduction in food borne illnesses.
- Food safety practices should be studied with a larger sample size.

- Collection of more statistical information on food safety practices in food establishments to increase awareness of poor or lack of food safety practices.
- Factors such as mental disorders, cultural beliefs, environmental factors, social factors, first language, education completed, and age should be further studied in relation to food safety practices (Glanz et al, 2008). Sociodemographic information, such as gender, marital status, and monthly income has also been reported by researchers as barriers to food safety practices in food premises (Zain et al., 2002).
- Future research should focus health department's food safety programs. These studies should focus on the effectiveness of the food program using various instruments.
- Another potential area of research is the investigation regarding the willingness of Public Health Inspectors to provide on-site training while conducting health inspections.
- In Manitoba, warnings and tickets are issued to those food establishments that are noncompliant with the Manitoba Food and Food Handling Regulation (MR 339/88R). Government should revise the law to issue tickets directly to food service workers not following food safety practices as opposed to the owner of the food establishment.
- The need to further evaluate food safety courses offered to food service staff.
- Identifying why the top three food safety noncompliance practices are seen at high numbers during inspections.

- Providing further food safety education on the top three food safety noncompliance practices. Temperature control/internal temperature was identified as one of the top three noncompliances. Food safety workers require additional knowledge about keeping foods within the required safe temperature zones and out of the danger zone.
- Further education can be provided during inspections. Pamphlets with clear instructions about temperature control, thermometer use, and food storage and display can be handed out to food service workers.
- On-site training about keeping foods within the safe temperature zone, using a thermometer and safe food storage and display.
- Implementation of a mandatory food safety plan, which addresses temperature control, thermometer use and food storage and display.
- Implementation of mandatory food safety checklists, which addresses temperature control of potentially hazardous foods, thermometer use and food storage and display.
- Evaluating attitudes, behaviour and work practices of food service workers.
- Managerial support and the availability of adequate equipment and tools to measures temperature of foods and store foods.

Implications for Social Change

This research study was designed to gather statistical information related to food safety practices among food service workers working in food establishments in Manitoba. The key element of this study was to observe and determine the relationship between

food safety practices, routine health inspections and the predisposing factor of food safer certification. The importance of this study was to bring an understanding of this issue to health departments and to the community. That is food safety practices are an important area of study because of the impact they cause if not followed, which is causation of foodborne illness (Henson et al., 2006).

Results of this study demonstrate a need for social change in generating prevention strategies for food service staff working in food service establishments. Consequently health departments should be able to develop health promotion programs that are effective for preventions and intervention of food safety practice implementation in food service establishments. Studies have shown that food service workers continue to not follow food safety practices in food premises (Green et al., 2005; Kibret et al., 2012).

Health Departments have a good chance at further addressing the implementation of food safety practices amongst food service staff. Health departments in most cases, develop food safety material that is taught to food service staff who wishes to become food safe certified. Therefore, health departments have a great ability to influence those individuals taking the food safety course during their working career in food establishments. Furthermore, it is the responsibility of the health department to be aware of food service staff food safety practices in order to prevent foodborne illnesses when working in food establishments.

Researchers have acknowledged that food safety staff continues to not follow food safety practices when working in food establishments. As a result, it may be important for health departments to create further preventative programs emphasizing

breaking the cycle of noncompliance of food safety practices. Food safety educational initiative can be taken by preparing food safety staff about the problem of food borne illness amongst food establishments. It is important to continuously teach food service staff about food safety practices and its benefits throughout their career in the food industry. This can be accomplished by having mandatory yearly food safety training and also by continuous on-site educational training by health inspectors when conducting routine inspections. Having food service workers following food safety practices when working in food establishments is the goal that health inspectors and ultimately the health departments would like to accomplish. Therefore it is important to design interventions among food safety workers aimed to improve their ability in order to achieve a healthy life style behaviors and standards in food safety.

Conclusion

Safe food handling practices are important and essential in food establishments, as they are the barrier to the prevention of food borne illness (Havelaar et al., 2013). It is imperative to continue to assess food handling practices as an important public health issue among food service staff working in food establishments in Canada. In this study the prevalence of food safety practices was investigated using secondary data from the hedgehog database from Manitoba Health. This study therefore initiated research data pertaining to the prevalence of food handling practices among food service staff. The results from this study validated high prevalence of noncompliance of food safety practices. These results were similar to those reported in the literature. 95.2% of the 558 food establishments were observed to have food safety noncompliance that is have food

safety practices that were not being followed. At the same time 4.8% of food establishments were observed to have food safety compliance that is following every food safety practice. In completing this study no association between food safety practice compliance and routine health inspections was identified in addition to the predisposing factor of food safety certification.

Results of this study did begin to fill in the gap in literature with respect to the implementation of food safety practices amongst food service staff working in food establishments. There was no difference in the numbers of those food establishments that got inspected at a high frequency as compared to those who didn't, with respect to food safety practice implementation. There was also no difference in the rates of those food establishments with food certified staff compared to those without food service certified staff, with respect to food safety practice implementation. There was a difference in the numbers of those food establishments that were high risk as compared to those that were medium risk, with respect to food safety practice implementation. Further research is required to develop evidence based strategies that can address the issue of noncompliance of food safety practices. The lack of food safety practice implementation in food establishments is a public health issue and has been identified as a barrier to intervention skills in health departments (Allwood et al., 1999). There is a need to develop advanced food safety programs, policies and standards in order to increase compliance of food safety practices amongst food service staff. In addition to this public health staff needs to focus on self-efficacy and its role in food safety practices amongst food service staff. With an increased understanding about food safety practices implementation amongst

food service staff there is an increased potential for health departments to create programs to decrease noncompliance of food safety practices and therefore reduce the burden of foodborne illnesses associated with food service establishments.

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Appendix A: Data Use Agreement

DATA USE AGREEMENT

This Data Use Agreement ("Agreement"), effective as of April 24, 2015 ("Effective Date"), is entered into by and between Kiran Brar (Kirandeep) ("Data Recipient") and Manitoba Health (Mike LeBlanc) ("Data Provider"). The purpose of this Agreement is to provide Data Recipient with access to a Limited Data Set ("LDS") for use in research **in accord with laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.** In the case of a discrepancy among laws, the agreement shall follow whichever law is more strict.

1. Definitions. Due to the study's affiliation with Laureate, a USA-based company, unless otherwise specified in this Agreement, all capitalized terms used in this Agreement not otherwise defined have the meaning established for purposes of the USA "HIPAA Regulations" and/or "FERPA Regulations" codified in the United States Code of Federal Regulations, as amended from time to time.

2. Preparation of the LDS. Data Provider shall prepare and furnish to Data Recipient a LDS in accord with any applicable laws and regulations of the governing bodies associated with the Data Provider, Data Recipient, and Data Recipient's educational program.

3. Data Fields in the LDS. **No direct identifiers such as names may be included in the Limited Data Set (LDS).** In preparing the LDS, Data Provider shall include the **data fields specified as follows**, which are the minimum necessary to accomplish the research: High risk and moderate risk establishments, routine inspections, infractions, food safety certification, enforcement and closures.

4. Responsibilities of Data Recipient. Data Recipient agrees to:

   a. Use or disclose the LDS only as permitted by this Agreement or as required by law;

   b. Use appropriate safeguards to prevent use or disclosure of the LDS other than as permitted by this Agreement or required by law;

   c. Report to Data Provider any use or disclosure of the LDS of which it becomes aware that is not permitted by this Agreement or required by law;

   d. Require any of its subcontractors or agents that receive or have access to the LDS to agree to the same restrictions and conditions on the use and/or disclosure of the LDS that apply to Data Recipient under this Agreement; and

   e. Not use the information in the LDS to identify or contact the individuals who are data subjects.

5. Permitted Uses and Disclosures of the LDS. Data Recipient may use and/or disclose the LDS **for its Research activities only.**

6. Term and Termination.

   a. Term. The term of this Agreement shall commence as of the Effective Date and shall continue for so long as Data Recipient retains the LDS, unless sooner terminated as set forth in this Agreement.

   b. Termination by Data Recipient. Data Recipient may terminate this agreement at any time by notifying the Data Provider and returning or destroying the LDS.

   c. Termination by Data Provider. Data Provider may terminate this agreement at any time by providing thirty (30) days prior written notice to Data Recipient.

   d. For Breach. Data Provider shall provide written notice to Data Recipient within ten (10) days of any determination that Data Recipient has breached a material term of this Agreement. Data Provider shall afford Data Recipient an opportunity to cure said alleged material breach upon mutually agreeable terms. Failure to agree on mutually agreeable terms for cure within thirty (30) days shall be grounds for the immediate termination of this Agreement by Data Provider.

   e. Effect of Termination. Sections 1, 4, 5, 6(e) and 7 of this Agreement shall survive any termination of this Agreement under subsections c or d.

7. Miscellaneous.

   a. Change in Law. The parties agree to negotiate in good faith to amend this Agreement to comport with changes in federal law that materially alter either or both parties' obligations under this Agreement. Provided however, that if the parties are unable to agree to mutually acceptable amendment(s) by the compliance date of the change in applicable law or regulations, either Party may terminate this Agreement as provided in section 6.

   b. Construction of Terms. The terms of this Agreement shall be construed to give effect to applicable federal interpretative guidance regarding the HIPAA Regulations.

   c. No Third Party Beneficiaries. Nothing in this Agreement shall confer upon any person other than the parties and their respective successors or assigns, any rights, remedies, obligations, or liabilities whatsoever.

d. Counterparts. This Agreement may be executed in one or more counterparts, each of which shall be deemed an original, but all of which together shall constitute one and the same instrument.

e. Headings. The headings and other captions in this Agreement are for convenience and reference only and shall not be used in interpreting, construing or enforcing any of the provisions of this Agreement.

IN WITNESS WHEREOF, each of the undersigned has caused this Agreement to be duly executed in its name and on its behalf.

DATA PROVIDER

Signed: M. V. LeBlanc

Print Name: Mike LeBlanc

Print Title: Program Manager

DATA RECIPIENT

Signed: Kirandeep Brar

Print Name: KIRANDEEP BRAR

Print Title: STUDENT

Appendix B: Multiple Logistic Regression

Table B1 Case Processing Summary

Unweighted Cases[a]		N	Percent
Selected Cases	Included in Analysis	558	100.0
	Missing Cases	0	.0
	Total	558	100.0
Unselected Cases		0	.0
Total		558	100.0

a. If weight is in effect, see classification table for the total number of cases.

Table B2 Dependent Variable Encoding

Original Value	Internal Value
no	0
Yes	1

Block 0: Beginning Block

Table B3: Classification Table[a,b]

Observed			Predicted		
			Foodsafetypractices		Percentage Correct
			no	Yes	
Step 0	Foodsafetypractices	no	531	0	100.0
		Yes	27	0	.0
	Overall Percentage				95.2

a. Constant is included in the model.

b. The cut value is .500

Table B4: Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)
Step 0	Constant	-2.979	.197	228.004	1	.000	.051

Table B5: Variables not in the Equation

			Score	df	Sig.
Step 0	Variables	RoutineInspections	.001	1	.975
		Foodsafe(1)	.934	1	.334
		Risk	11.245	1	.001
	Overall Statistics		12.406	3	.006

Block 1: Method = Enter

Table B6: Omnibus Tests of Model Coefficients

		Chi-square	df	Sig.
Step 1	Step	11.862	3	.008
	Block	11.862	3	.008
	Model	11.862	3	.008

Table B7: Model Summary

Step	-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
1	204.350[a]	.021	.065

a. Estimation terminated at iteration number 6 because parameter estimates changed by less than .001.

Table B8: Hosmer and Lemeshow Test

Step	Chi-square	df	Sig.
1	3.047	7	.881

Table B9: Contingency Table for Hosmer and Lemeshow Test

	Foodsafetypractices = no	Foodsafetypractices = Yes	Total

		Observed	Expected	Observed	Expected	
	1	75	74.475	1	1.525	76
	2	60	59.697	1	1.303	61
	3	67	67.431	2	1.569	69
	4	62	63.216	3	1.784	65
Step 1	5	63	62.886	2	2.114	65
	6	75	72.982	3	5.018	78
		1	2.433		.567	6
	8	50	50.784	6	5.216	56
	9	38	37.096	4	4.904	42

Table B10: Classification Table[a]

	Observed		Predicted		
			Foodsafetypractices		Percentage Correct
			no	Yes	
Step 1	Foodsafetypractices	no	531	0	100.0
		Yes	27	0	.0
	Overall Percentage				95.2

a. The cut value is .500

Table B11:Variables in the Equation

		B	S.E.	Wald	df	Sig.	Exp(B)	95% C.I.for EXP(B)	
								Lower	Upper
Step 1[a]	RoutineInspections	.064	.166	.147	1	.701	1.066	.769	1.477
	Foodsafe(1)	.404	.408	.980	1	.322	1.498	.673	3.333
	Restaurant type	1.348	.423	10.167	1	.001	3.851	1.681	8.822
	Constant	-4.016	.679	34.950	1	.000	.018		

a. Variable(s) entered on step 1: RoutineInspections, Foodsafe, Resturanttype.

Appendix C: Health Inspection Report

Province of Manitoba
Restaurant Inspection Report
[redacted]

Printed on: December 04, 2015
3:15 PM
Report Status: Closed

Facility Inspected:
[redacted]

Mailing Address:
[redacted]

Inspection #: [redacted]
Inspection Date: [redacted]
Completed: [redacted]

Site Address: [redacted]

Violations: 17

GPS:	49.8716912999 -97.1515115 33
Facility Type:	Restaurant
Risk Rating:	High
Delivery Method:	Email

Inspection Type:	Routine
Inspection Reasons:	Unannounced

Opening Comments and Observations:

[redacted]
No food preparation allowed in the basement. Basement only approved for food storage.

YES = In compliance NO = Not in compliance CDI = Corrected During Inspection

Question Category	Answer
Temperature Control	
1. Potentially hazardous frozen foods kept frozen. (Sec. 13)	YES
2. Food is thawed in a safe & controlled manner (ex. in refrigerator). (Sec .13)	YES
3. Potentially hazardous foods maintained below 5°C (41°F). (Sec. 13) **Kitchen - top section of the refrigerated prep. units - ensure food is stored directly inside the food storage inserts at all times. Do not store food on the top of the inserts or store in double containers as proper food temperatures will not be maintained.**	NO
4. Thorough cooking to minimum internal food temperatures of 74°C (165°F) for potentially hazardous foods. (Sec. 34)	YES

[redacted]

Facility Contact: [redacted]
Facility Address: [redacted]
Completed: [redacted]

Restaurant Inspection Report

5. Hot holding: food is held at a minimum of 60°C (140°F) after cooking/rapid re-heating. (Sec. 13)	YES
6. Food is cooled rapidly from 60°C (140°F) to 5°C (41°F) within 6 hours. (Sec. 13)	YES
7. Food is re-heated rapidly to an internal temperature of 74°C (165°F) or higher. (Sec. 34)	YES
8. Thermometers used to verify food preparation and storage temperatures. (Sec. 13) **Provide a thermometer inside ALL refrigerators in the kitchen, servery area and basement walk-in refrigerator and prep. food refrigerator..**	NO

Food Handling Practices

9. Food protected from potential contamination (e.g. food covered, labelled, off floor, stored on racks, sneeze guard, physical hazards, during display, during transport). (Sections 6 & 28) **Do not store screws, brackets in the kitchen food preparation area - on shelving and inside food inserts as these items may be accidently mixed into the food.**	NO
10. Separate raw foods from ready-to-eat food during storage and handling. (Sec. 6)	YES
11. Food is wholesome in appearance and considered fit for human consumption and handled under sanitary conditions. (Sec. 5)	YES
12. Food contact surfaces washed / rinsed / sanitized after each use and following any operations when contamination may have occurred. (Sec. 15)	YES
13. Food dispensing utensils are stored with handle extending out of food/clean and dry/in running potable water. (Sec. 6) **Do not store utensils in quat sanitizer during use.**	NO
14. Toxic /poisonous substance (chemicals/pesticides) stored separately from food. (Sections 6 & 29) **Basement - do not hang chemicals on the food storage shelving. Bottle of lysoll hung on the shelf.**	NO
15. General sanitation is satisfactory. (Sections 11 & 32)	YES

Personal Practices and Hand washing

16. Food handler follows hygienic practices, not use tobacco in food prep/storage areas, clean outer garments and footwear, hair covering or restraint, consumes food only in designated areas. (Sec. 12)	YES
17. Foodhandlers free of communicable disease/skin disease/infectious disease to avoid likelihood of contamination of food or food contact surfaces. (Sec. 12)	YES

[redacted]

Facility Contact: [redacted]
Facility Address: [redacted]
Completed: [redacted]

Restaurant Inspection Report

18. Washing hands thoroughly before and after handling food. (Sec. 12) — YES

Equipment

19. Food storage containers made of food grade materials. (Sec. 14) — YES

20. All equipment and utensils which come into direct contact with food are in maintained, made of safe, corrosion-resistant, non-absorbent, smooth, easily cleanable material. (Sec. 14) — NO

1. 2 wooden vegetable boards must be replaced. Provide proper cutting boards that are smooth and easily cleanable. Wooden boards contain cuts, open seams and 1 board contain cracked/broken edges with black mold.
2. 2 large tweezer like utensil used for dispensing food. Tips of these utensils not smooth and easily cleanable therefore resulting in buildup on the tips. Utensils discarded by health inspector.
3. Pink and white mold inside the ice machine in the basement. Remove and discard all ice inside this unit. Thoroughly clean and sanitize inside the ice machine to remove all mold.

21. Equipment, non-food contact surfaces and linen are maintained, designed, constructed, installed and accessible for cleaning. (Sec. 14) — NO

1. Basement - clean inside the meat freezer.
2. Basement - vegetable walk in refrigerator and prep. food refrigerator - replace/resurface all rusted racks inside this unit.
3. Basement - clean inside the chest freezer (containing ice cream/buns).
4. Servery area - clean all shelving and counters in this area.
5. Servery area - Black plastic shelving next to entrance contain accumulation of spilled food/debris. Shelving has numerous holes on the structure of the shelving and not smooth and easily cleanable. Remove this shelving from this location and clean it.

22. Proper storage of clean and sanitized utensils - including single service items. (Sec. 15) — NO

1. Cooking utensils and spoons, etc. must be stored with the handles extending up, to minimize hand contact and potential contamination of the business end of the utensils.

Utensil Washing, Wiping Cloths and Sanitizer Test Kit

23. All dishes and utensils, are being cleaned, and sanitized by immersion in an approved sanitizing solution at the required concentration. (Sec. 15) — YES

24. Three compartment sink of sufficient size available to accommodate each utensil for cleaning and sanitizing utensils where conducted manually. (Sec. 15) — YES

25. Manual dishwashing procedure is correctly used: Wash, rinse, sanitize technique. (Sec. 15) (28) — YES

26. Mechanical dishwashing performing satisfactorily with respect to water temperature, timing cycles, sanitizer levels and clean scrap trays. (Sec. 36) — YES

Chemical dishwasher sanitizing at 50 ppm chlorine.

27. Wiping cloths are stored in sanitizing solution. (Sec. 15) — NO

Store wiping cloths in 200 ppm quat sanitizer for wiping down counters and equipment, changing the solution every 2 hours or more often if necessary.

[redacted]

Restaurant Inspection Report

Completed: [redacted]

37. Lighting shielded and adequate for food preparation work and cleaning purposes. (Sec. 16) — NO

1. Provide shatterproof lighting inside the basement beer keg refrigerated storage area.

38. Adequate protection against the entrance of insects, vermin and rodents. (Sec. 7) — NO

Back entrance door - close up the opening under the entrance door to prevent the entry of rodent and insects.
Wall next to back entrance door - large hole on the floor/wall juncture. Repair and refinish to be smooth and easily cleanable.

39. No room within food establishment used for sleeping purposes. (Sec. 32) — YES

40. Adequate facilities for the storage of personal apparel of the staff. (Sec. 10) — YES

41. Liquid wastes handled and collected in sanitary manner. (Sections 5, 37 & 38) — YES

42. Frequency of garbage removal is adequate to maintain the premises in a sanitary condition. (Sec. 8) — NO

Public washrooms -
1) all garbage cans are overflowing in the washrooms at the time of inspection and littered with paper towels. Ensure garbage is emptied at the end of each day and as often as necessary to maintain the washrooms in a clean condition.

Food Source and uninspected foods

43. All potentially hazardous foods originate from a government inspected food processing plant or other approved source. (Sec. 5 & 17) — YES

Meats and seafood purchased from DeLucas, Pratts, Independent Fish Co.

44. The operator excludes home prepared foods from the premises. (Sec. 5) — YES

45. Use of pasteurized milk or milk products in food handling establishment. (Sec. 17) — YES

Permits, Approvals, Certified Food Handlers

46. Possession of a valid permit posted in a conspicuous location. (Sec. 3) — YES

47. New construction/extensive remodel or new operator of food handling establishment registered. (Sec. 2) — YES

48. Certified Food Handler Training — NO

2 certified food handlers at this facility. Kevin Castro and Dustin Pajak. Please provide a copy of the certified food handler certificates on site.