ASSESSMENT OF FOOD SAFETY HAZARDS AMONG DAY CARE CENTRES IN MBOMBELA, REPUBLIC OF SOUTH AFRICA.

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DECLARATION

I declare that this dissertation is my own, unaided work. It is being submitted for the Degree of Master of Technology at the University of Johannesburg, Johannesburg. It has not been submitted before for any degree or examination in any other Technikon or University.

_____ 10/02/2020

(Signature of Candidate) Date

ABSTRACT

Day care centres have become an integral part of today's society and while they provide necessary and important services, they may also serve as a focal point for certain foodborne diseases. Food provided in these centres has an important role to play in the growth and development of children and in the developments of future eating habits. However microbial hazards are considered to be a challenge to food safety in day care centres due to potentially harmful microorganisms that have the capability to multiply from extremely small amounts in food or in the human body after consumption. Each day millions of children eat food prepared and served in day care cantres. Young children are at risk of foodborne diseases because of their less developed immune systems, lower weight and limited control over food risks. Children in day care centres may further be exposed to pathogens through secondary sources such as ill classmates and contaminated food. Literature has shown that children who attend day care centres are three times more at risk of food borne diseases than children who are not attending day care centres.The aim of the study was to assess food safety hazards in day care centres in Mbombela. Evaluation of food handlers' knowledge and behaviour at day care centres was conducted using a questionnaire; a literature review was conducted on common microbial hazards and health risk associated with the identified hazards. An inspection checklist was also used to observe hygiene practices and cleaning procedures used in the food preparation areas, and lastly experimental studies were conducted by taking microbial swabs from food preparation areas which were later analysed for bacterial presence by means of graphs and numerical techniques. Although food handlers had adequate knowledge of food safety, they have not received any food safety training and their knowledge concerning aspects of food safety such as food poisoning and types of microorganisms is poor and this has a negative impact on their behaviour regarding to food safety. This lack of knowledge contributes to unhygienic behaviours. 73% of Mbombela day care centres' food preparation areas do not comply with minimum requirements of the regulations for kitchen compliance, personal hygiene compliance and storage compliance. Not complying with the requirements of the regulations poses a health threat to the children. *Streptococcus (29.2%), micrococcus (9.2%), S.aureus (38.4%), GNB (41.5%) and GPB (63%), E. coli (17%), salmonella (3%), S. aureus(4.6%), E. coli (64.60%), Salmonella (44.60%), shigella (15.3%),* and *Compalobacter Jejuni* was present in the food preparation areas of Mbombela day care centres. This study highlighted the need for food handlers' training on food safety and the importance of compliance.

Key words: food safety, microbes, day care centres, compliance, food handlers, food handlers behaviour, food handlers knowledge, hygiene, food safety training.

DEDICATION

The study is dedicated to my Late Grandmother Koko Anna Mothokoa (Seabela), Mosadi gare ga Basadi. My Mother, her love for education made us who we are today. To my sister Katlego Seabela for always being a wonderful and loving sister, you are loved. To all my family members your support during my studies was everything I needed. To all my friends, with God by your side you can achieve more than your capabilities.

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ABBREVIATIONS

WHO World Health Organization

FDA Food and Drug Administration

CDC Centers for Disease Control and Prevention

DBMD Division of Bacterial and Mycotic Diseases

DOH Department of Health

DSD Department of Social Development

CDF Chemically Defined Foods

MOH Ministry of Health

EHP Environmental Health Practitioner

MBA Master of Business Administration

FSA Food Standards Agency

SANS South African National Standards

GPB Gram-positive Bacteria

GNB Gram-negative Bacteria

CFU Colony Forming Units

CHAPTER 1: BACKGROUND OF THE STUDY

1.1 INTRODUCTION

Food safety is a central importance concept in public health function (World Health Organisation [WHO], 2000). Food safety is important to child-care facilities as well as any food premises as children are being fed daily in these facilities. However, food preparation is at high risk of microbial contamination, possibly from the food handlers and preparation surfaces.

According to Brunetti (2013), there are three basic types of child-care facilities, namely (1) day care centres, (2) family day care homes, and (3) preschools. Accordingly some day-care centres allow for short, hour-to-hour care, while most provide either half- or full-day care that includes activities, meals, naps, and possibly outings (Brunetti, 2013). In a day-care centre, it is generally required that children in full day programmes be provided with a good source of minerals such as iron and vitamin C every day for energy (National Minimum Standards for Regulated Child Care, 2012). Kuratko et al (2000) highlight that day-care facilities in the United States of America often provide unique food service operations. However, common foods that are served in day care centres include milk, bread, fruits and/or vegetables and meat (including meat products).

As a result of the need for food preparation in day-care centres, the safety and wellbeing of children remain a conundrum that is subject to the hygiene practices and the conscience of food handlers (Meysenburg, Albrecht, Litchfield & Ritter-Gooder, 2013).

This remains a major challenge, given that human hands are in regular contact with the surrounding environment and a myriad of contaminants, including potential pathogens, i.e. mucous membranes in the mouth, nose, eyes and genitals. Thus, the potential for food contamination, resulting in foodborne illness outbreaks in day-care centres, is high (Hawker, Begg, Blair, Reintjes, Weinberg, & Ekdahl, 2012). Food can be contaminated by dirty hands if there is a lack of proper hand hygiene practices among food handlers (Gorman et al 2002; Dharod et al, 2009). Aycicek et al,posted that poor hand hygiene may contribute to high levels

of *Staphyloccocc Aureus* (*S. Aureus*) and *Escherichia coli (E. coli)* on the hands of food handlers (Ayciceket al, 2004). In that context it is clear that these microorganisms are dangerous and may have a propensity to cause food contamination, resulting in potential food poisoning. Pursuant to that such microorganisms may survive on wooden and plastic preparation areas, providing an opportunity for cross-contamination of ready-to-eat food (Wanyenya, Munyanja & Nasinyama, 2004). Tanet et al, (2013) highlight that food handlers' adherence to good manufacturing practice and standard sanitation operating procedures is insufficient to completely prevent food safety hazards ensuing from these microorganisms. Rosmawatiet al, (2014) conducted a study in primary school canteens and found that 52.6% of positive microbiological analyses were from food handlers' hands.

In consonance with American Department of Health (DoH) (2012), keeping food safe in child-care environment is arduous, since people perceive food safety as a summertime concern, however, foodborne illness can occur at any time of the year. On that breath food contaminated by harmful microorganisms may quickly spread the microorganisms among children through toys, food, toilet facilities, mats, other articles and/or come in contact with sick children (DoH, 2012). In that context infants and toddlers have high hand to mouth activity and are therefore at high risk of cross contamination, which may cause foodborne diseases.

Buzby (2001) and Adeline et al, (2013), posit that young children are at risk of foodborne diseases because of their less developed immune systems, lower weight and limited control over food risks. In view of that, children in day care centres may further be exposed to pathogens through secondary sources such as ill classmates and contaminated food (Riggins & Barrett, 2008). A study conducted at Clemson University demonstrated that children between the ages of 37 and 54 months enrolled in day care centres are three times more likely to experience an acute gastrointestinal illness than children cared for in their own home (Chen, 2013). In one hand, wherever there are children in diapers, the spread of diarrheal diseases may readily occur as the result of inadequate hand washing, diaper changing and sanitation measures. Microbiological analysis study conducted by Cosby et al (2008) in six child care facilities, revealed that positive coliform samples were detected, 48.4% of the positive results were in the food preparation area whilst 26.9% in the food serving area and the remaining

24.7% in the diaper changing area . In general, the spread of bacteria is likely to be from person to person through poor hygiene of workers and inadequate sanitation (CDC, 2006; Lee & Grieg 2008). These factors make infections in day care environments common and fast spreading (DoH, 2013).

Pursuanant to that, the Centers for Disease Control and Prevention (CDC) reported that approximately 20% of food related illnesses is mainly due to food handlers (Michaels et al, 2004). This implies that microbial hazards are considered to be a great challenge to food safety due to the potentially harmful microorganisms that have the capabilities of multiplying rapidly (Tan et al, 2013).

Harmful microorganisms are part of the main cause of child deaths in the world, particular in South Africa. According to the Department of Health (2011), South Africa's under-five mortality rate is unacceptably high. According to Bourne et al., (2013), the major global causes of childhood deaths are diarrhoeal diseases, lower respiratory tract and neonatal conditions.

The World Health Organization reported that 1.8 million deaths in 2005 alone resulted from diarrheal diseases, most of which were attributed to the ingestion of contaminated food and drinking water (WHO, 2007). WHO (2016) also reported that exposure to contaminated food worldwide resulted in 600 million episodes of illness, 420 000 deaths and 33 million disability-adjusted life years. The 29% of the 11 key bacterial, protozoa and viral causes of diarrhoea were foodborne. Food contaminated with these 11 agents resulted in 548 million episodes of diarrheal and 200 000 deaths. Of these 217 million infections were children younger than 5 years of age (Kirk et al., 2016). Every year 220 million children contract diarrheal diseases and 96 000 die (WHO, 2015).

Therefore child care facilities have become an integral part of today's society (Cosby et al., 2008). While child care facilities provide necessary and important services, they may also serve as a focal point for certain types of infectious diseases (Cosby et al., 2008). Food provided in child care facilities has an important role to play in the growth and development of children

and in the development of future eating habits (Better Health Chanel, 2016). Microbial hazards are considered to be a challenge to food safety due to potentially harmful microorganisms that have the capability to multiply from extremely small amounts in food or in the human body after consumption (Tan et al., 2013). Each day millions of children eat food prepared and served in child care facilities were hygiene practices should be first priority during food preparation and handling.

1.2 HYGIENE PRACTICES IN DAY CARE CENTRES

Bacteria in the diarrheal stools of infected persons can be transmitted from person to person if hand washing is inadequate (CDC 2004). This in turns affect toddlers within child care facilities who are not toilet trained.whereas such children typically shed the organism in their faeces and may not perform adequate hand washing afterwards, other children, as well as child care workers, attending the child care facility are at high risk of exposure to infection. This, thus implies that the need for food preparation in day care centres, the safety and wellbeing of children remain a conundrum that is subject to the hygiene practices and conscience of food handlers (Meysenburg et al., 2013). Three major factors associated with food-borne disease outbreaks in day care centres are outlined in this dissertation below.

1.3 FOOD-BORN RELATED OUTBREAKS IN DAY CARE CENTRES

During 2001 and 2006, diarrheal episodes caused hospitalizations in 50 per 10,000 children younger than five years, each year in the United States of America (Cortes et al, 2009). According to the Centers for Disease Control and Prevention (CDC, 2005), food -borne illnesses cause approximately 5000 deaths each year, of which one-third of these deaths involve children. Previous studies on foodservice workers in the United States have shown that many food handlers engage in unsafe food handling practices thatmay put the “customers” health at risk (Pivarniket al, 2012). Childcare related illnesses and outbreaks are often airborne, sanitary or food related. Nesti & Goldbaum (2007) demonstrated that children who attend childcare facilities have an increased risk of contracting respiratory infections, diarrheal and bacterial disease. Similarly, Simkiss et al (2010) study have shown that whenever outbreaks occur in a community, attack rates tend to become higher in employees and attendants of childcare facilities (Simkiss, Ebrahim & Waterston, 2010). Each day millions of children eat food

prepared and served in day care facilities (Risica, Ankoma & Lawson, 2016) and often come home with episodes of diarrhoea and gastroenteritis (Olaitan & Adeleke, 2007).

With good hygiene in childcare facilities being essential for reducing the risk of contamination, illnesses, cross-infection between children and adults (Tansey, 2010; Ronnqvist, Aho, Mikkela, Ranta, Tuominen, Ratto & Maunula, 2014), there is still a need for an in-depth study that would investigate the aspects and issues that affect children's health and wellbeing within such facilities; including that of childcare food handlers. Microbial hazards are considered to be a great challenge to food safety given that capability to multiply rapidly (Tan et al., 2013). According to the Department of Health (2011), South Africa's under-five mortality rate is unacceptably high.

Figure 1.1 indicates incidences of foodborne illness is relatively higher for children than healthy adults because of their underdeveloped immune systems and lower body weight. Lower body weight means fewer pathogens are necessary to cause illness (Buzby, 2001).

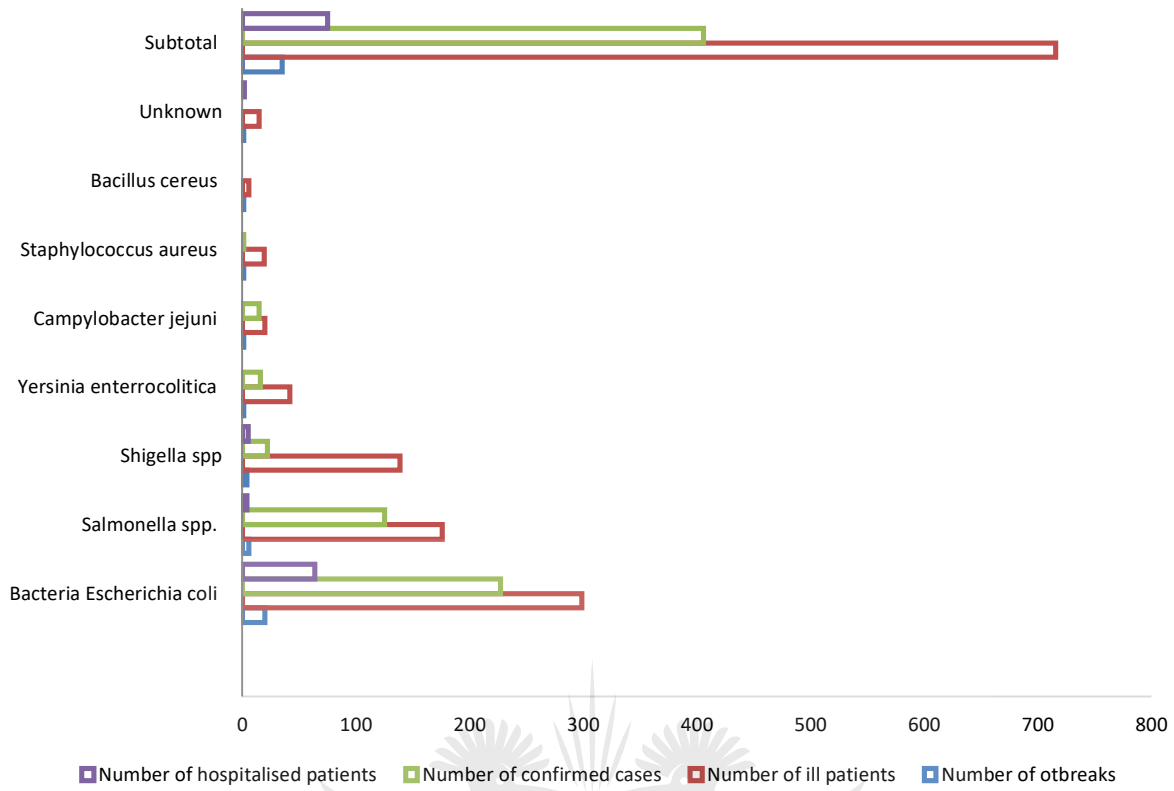

Figure1.1: Foodborne incidences associated with day care centers

Source: Adapted from Lee and Greig (2008)

The above table shows that there are diarrheal disease outbreaks at day care centres caused by harmful microorganisms such as *E coli, S. Aureus, B. cereus, Salmonella, Y. Enterrocolitica, C. Jejuni*. The total number of diarrheal out breaks were 35 and which consisted of 20 *E coli* outbreaks, 6 *Salmonella*, 4 *Shigella* and 1 outbreak for other microorganisms and unknown. The number of hospitalized patients consisted of 75 people and 64 of them was due to *E coli* outbreak, 4 was *Salmonella*, 5 was *Shigella* and 2 was caused by unknown microorganisms. Number of confirmed cases were 406 and 227 of those were caused by *E coli* while 125 was *Salmonella*, 22 *Shigella*, 15 *C. Jejuni*. 716 patients were ill during the outbreaks and 15 of the cases were caused by unknown microorganisms while 299 was caused by *E coli*, 139 by *Shigella* and 176 by *Salmonella*.

1.4 PROBLEM STATEMENT

There are many facilities in historically disadvantaged communities such as townships, rural and urban squatter areas that provide day care services to children. Some of these day care centres do not have access to proper food preparation areas, facilities and sanitation. (Simkiss et al., 2010). Food handlers in these facilities are unskilled and have not received higher education and training opportunities (Browning et al., 1996; Meysenburg et al., 2013). Thus, their food safety knowledge, skills and sensitivity is often basic (Browning et al., 1996; Meysenburg et al., 2013). A number of these conditions are prevalent in the Mbombela Local Municipality. However, no assessment has yet been conducted to establish the food safety hazards associated with selected child care facilities in Mbombela, Mpumalanga. Therefore, there was a need for this study to be conducted at day care centres of Mbombela in order to establish food safety hazards prevalent.

1.5 AIM AND OBJECTIVES

The aim of this study is to assess food safety hazards associated with day care centres in Mbombela, South Africa. To achieve the main aim of the study, the following objectives will be addressed:

1. To determine compliance levels of food preparation areas of day care centres
2. To evaluate food safety behaviour and knowledge of food handlers at the day care centres
3. To conduct microbial analyses of food preparation areas in the day care centres

1.6 CHAPTER LAYOUT

Chapter 1: This chapter presents the introduction and background for the entire study, the broad research aim, objectives and the breakdown of the remaining chapters.

Chapter 2: This chapter discusses the literature reviewed for this study.

Chapter 3: This chapter discusses the methodology used for the study.

Chapter 4: This chapter discusses the results for food safety hazards in Mbombela day care centres.

Chapter 5: This chapter presents the summary, conclusion and recommendations of all the previous chapters.

CHAPTER 2: LITERATURE REVIEW

2.1 INTRODUCTION

Child care facilities have become an integral part of today's society (Cosby et al., 2008). While child care facilities provide necessary and important services, they may also serve as a focal point for certain types of infectious diseases (Cosby et al., 2008). The World Health Organization reported that 1.8 million deaths in 2005 alone resulted from diarrheal diseases, most of which were attributed to the ingestion of contaminated food and drinking water (WHO, 2007).

Previous chapter outlined the background and introduction of this study. This chapter will discuss all the literature reviewed for this study. It outlines what other researchers have to say about food safety, food safety at day care canters, food hygiene and requirements of the regulations. This chapter will again give us a clear understanding of what is meant by food safety, including the different types of microorganisms that can be found in food where basic hygiene principles are not practiced.

2.2 COMPLIANCE OF FOOD PREPARATION AREAS AT DAY CARE CENTRES

Millions of people in the world fall ill and many die as a result of eating unsafe food (WHO, 2000). WHO (2000) recognized food safety as an essential public health function. Arcording to the requirements of South Australia child care centres, in order to protect vulnerable people in the community, including older persons and people who have weakened immune systems due to illness, businesses that serve potentially hazardous food to vulnerable persons need to comply with additional legislative requirements to further manage risks (SA Health, 2012).

Safe storing, preparing, and serving of foods is just as important in child care programs as serving a balanced diet. Many children and adults get sick from eating foods that are not properly handled. It's important to follow food safety guidelines carefully whenever you buy,

store, prepare, or serve food. Guidelines for food safety begin with food purchasing and continue through storing, preparing, serving, and cleaning up afterwards (Extension, 2015).

A study conducted by Wohlgenent et al., 2014 showed that approximately 60% of U.S. children aged five and younger spend time in child-care settings. Such environments increase the risk of diarrheal disease, including diseases caused by enteric pathogens to describe adherence to sanitation standards in classrooms and food preparation areas in child-care facilities, the authors conducted site visits in 40 North Carolina and South Carolina child-care facilities. Audits in up to two classrooms (rooms providing care for infants and toddlers) and the kitchen were performed using a form similar to a regulatory inspection form. Audit data were used to calculate indices to describe adherence to sanitation standards and were based on state environmental health regulations for child-care centers, the Food and Drug Administration's Food Code 2009, and guidance from food safety experts. Most facilities participating in the authors' study adhered to sanitation standards within the classroom; however, deficiencies with regard to sanitation in food preparation areas and refrigerator operating temperatures were noted. These results provided insight into possible risk factors for enteric disease transmission in child-care facilities (Wohlgenent et al., 2014).

Health and safety inspection reports of 300 South Carolina licensed center-based child-care facilities were evaluated to identify gaps in current foodhandling practices by documenting the frequency of food safety violations. Based on the South Carolina child care licensing policy manual, 13 food safety violation categories were established, with each category containing individual food safety violations. Of the 300 health and safety inspection reports evaluated, a total of 453 food safety violations were identified. The majority (88.6%) of child-care facilities had fewer than three food safety violations. The frequency of food safety violations within each category ranged from 6 to 98. The three most prevalent food safety violation categories were “lack of labeled food & beverages” (n = 98, 21.6%), “lack of temperature controls” (n = 75, 16.6%), and “improper cleaning & sanitizing” (n = 67, 14.8%). The three least prevalent food safety violation categories were “inadequate heating & cooling of food” (n = 6, 1.3%), “evidence of pest infestation” (n = 7, 1.5%), and “lack of nutritional guidelines” (n = 10, 2.2%).

Results identified areas of food safety violations in child-care facilities that can serve to inform practitioners, educators, and researchers seeking to develop interventions that can address these gaps (Reynolds & Rajagopal, 2017b).

Table 2.1 indicates the minimum requirements for child care centres according to the Environmental health national norms and standards.

Table 2.1: Minimum requirements of child care facilities (Government Gazette, 2015)

Structural facilities	The building structure of the premises must comply with the requirements of the National Building Regulations and the Building Standards Act, 1977 (Act No. 103 of 1977) with regards to lighting and ventilation.
Water supply	Adequate supply of potable water must be available on the premises for all uses (drinking, cooking, personal hygiene, and cleaning). Potable running water must continually be available on the premises. No cross-connection between a system providing potable water and a system providing non-potable water is allowed. For premises without running water available, drinking water must be adequately stored and protected against contamination by flies, animals and humans. Water storage containers are covered at all times.
Waste Management	Approved methods of solid waste collection, storage, and disposal shall be adopted, and incompliance with the relevant By-laws of the Local Authority concerned. Refuse bins and/or a designated refuse storage area must be available on the premises for the storage of all refuse pending removal should either be burned or buried into the ground.
Food preparation facilities	A kitchen area must be provided for the hygienic preparation of foodstuffs. All facilities used in connection with the handling, preparation, storage and serving of foodstuffs must comply with the relevant Regulations, published in terms of the **Foodstuffs, Cosmetic and Disinfectants Act 1972, (Act 54 of 1972),** as amended**.**

Health Certificate for operation of a child care centre	The premises must be operated under a valid Health Certificate issued by an EHP, to the effect that the premises comply with EH norms and standards. The health certificate is displayed in a conspicuous manner on the premises, so as to be clearly visible to everyone entering the premises.
Toilets / ablution and nappy changing facilities	Adequate toilet and wash up facilities must be provided on the premises for use by the children, in line with requirements as set out in the Children's Act. For centres catering for toddlers, junior type toilets and washbasins should be provided where appropriate. Toilet and hand washing facilities must be accessible to the children.
Designated milk preparation areas for children under 2 (two) years	Where bottle- or breast-fed children are accommodated on the premises, a designated area must be provided in the kitchen for the preparation, and washing of feeding bottles and teats. An adequate supply of potable running cold and hot water is available for washing of bottles and teats.
Storage facilities	Separate storage facilities must be provided for proper storage on the premises.
Medical care for children	Adequate, timely and appropriate medical attention is provided in cases where children might require medical care, in line with the norms and standards as set out in Section 89 of the Children's Act.

Table 2.2: According to Foodstuffs, Cosmetic and Disinfectants Act 1972, (Act 54 of 1972)

Regulation governing general hygiene requirements of food premises and transportation of food. 2012

Prohibition on the handling and transportation of food	Handling food in a manner contrary to the provisions of these regulations.
Standards and requirements for food premises	Food preparation areas shall be in such a manner that food can be handled hygienically on the food premises and can be effectively protected by the best available method against contamination and spoilage by poisonous or offensive gases, vapours, odours, smoke, soot deposits, dust, moisture, insects or other vectors, or by any physical, chemical or biological contamination or pollution or by any other agent whatsoever.
Structure	All interior surfaces of walls, sides or ceiling or roofs without ceilings and the surfaces of floors or any other similar horizontal or vertical surfaces form part of or enclose the food handling area shall have no open joints and shall be made of smooth rust free, non-toxic, cleanable and non-observant materials

Ventilation and illumination	Natural ventilation through openings or openable sections which are directly connected to the outside air. Artificial ventilation must also comply with the Building regulations.
Wash up facilities	Hot and cold water must be provided. Hand wash basins must be clean and used.
Utensils	Any utensils or items which are suitable for single use only shall be stored in a dust free container until used and shall not be used more than once.
Surface areas (food preparation)	Surfaces must be cleaned and washed before food comes into direct contact with it for the first time during each work shift.
Food containers	A container shall be clean and free from any toxic substances, ingredients or any other substances liable to contaminate or spoil the food in the container.
Display, storage and temperature control	Displayed food or stored shall not be in direct contact with a floor or any ground surface. Any shelf or container used to display or store food shall be kept clean and free from dust or any other impurity. Temperature shall be controlled.
Protective clothing	No person shall be allowed to handle food without wearing suitable protective clothing Protective clothing includes: head covering, and foot wear.
Food handler personal hygiene	Fingernails, hands or clothes must be clean. Food handlers who have on his or her body a suppurating abscess or a sore or a cut or abrasion, unless such abscess, sore, cut or abrasion is covered with a moisture proof dressing which is firmly secured to prevent contamination of the food, shall not handle food. No person shall spit in an area where food is handled. Smoking and use of tobacco in any manner while handling food is prohibited.

2.3 CHALLENGES OF INFORMAL DAY CARE CENTRES

According to the by-laws of Ethekwini Municipality: Child Care facilities (2015) every child care facility which provides meals to children from a kitchen on the premises must have a separate approved area set aside, with due regards for the safety of children, as a kitchen for the preparation of food and the washing up and rinsing of crockery, cutlery, pots, pans and other kitchen utensils. The by-laws indicate that the kitchen must have a double bowl sink, hot

water supply, separate hand wash basin. The kitchen must meet the requirements of the Regulation Governing General Hygiene Requirements for food premises and transport of food made in terms of foodstuff, cosmetic and disinfectants Act 1972 (54 of 1972) published by Government Notice R962 of 23 Nov 2012.

Young children (under four years of age), with their immature immune systems, are more susceptible to many common food-borne pathogens (Buzby *et al*., 2001; Enke *et al*., 2007). Secondly, the storage, preparation, and service of foods in child-care settings may be left to relatively unskilled employees who have inadequate training in hygiene, sanitation, and safe food handling practices thus increasing opportunities for foods to become contaminated and for this vulnerable population to be exposed to food-borne pathogens (Cosby, 2005). Another concern is that child-care workers who diaper infants and assist children with toileting might handle food without following proper hygiene and sanitation practices (Cosby, 2005). Previous studies have demonstrated that many food service and serving surfaces including tables, kitchen counters, washing sinks and dinner plates in childcare facilities were contaminated with bacteria levels that exceeded public health standards (Mildred et al., 1994).

For instance, Mohle-Boetani et al., (1995) conducted a case-control study to compare the relationship of staff to the incidence of *Shigellosis* between six child-care centres with culture confirmed cases of *Shigellosis* and thirteen centres without cases of *Shigellosis*. They found that all centres with confirmed cases of *Shigellosis* had a food handler who changed diapers while only 46% (6/13) of centres without confirmed cases of *Shigellosis* had a food handler who changed diapers. Lemp et al., (1984), also reported the association between the foods preparered by food handlers who change diapers. These researchers reported the incidence rate of diarrhoea was 3.28-fold higher in child-care centres where staff were responsible for both preparing/serving food and providing care (including changing diapers) to children on a daily basis compared with centers where staff were only responsible for either food preparation or providing care (including changing diapers) to children.

According to a survey conducted in 2006 by the South African Department of Health, 45% of South African population underestimated the effectiveness of hand washing as the easiest and simplest method of fighting the spread of diseases (DoH, 2006). The survey indicated that simple hand washing is still under-rated as a very effective method of disease prevention (Schoub, 2006).

Many childcare facilities established in townships, rural and urban squatter areas are often operated on a low cost budget which leads to challenges with regards to meeting structural and other essential requirements such as water and sanitation (Simkiss et al., 2010). Limited access or poor quality of water and sanitation are the main causes of diarrheal illnesses in disadvantaged communities (Nweze, 2010). The main aim of the observations was to record real practices that occur in the food preparation areas of day care centres in order to identify potential health hazards that may be associated with each facility. The aim of this chapter was to check if day care centres of Mbombela complies with the requirements of the Regulation governing general hygiene requirements of food preparation areas, storage facilities and personal hygiene.

2.4 FOOD SAFETY BEHAVIOUR AND KNOWLEDGE OF FOOD HANDLERS AT THE DAY CARE CENTRES

According to WHO (2000), education of food handlers and consumers is considered as an effective strategy for reducing foodborne illness and economic losses associated with food borne diseases. A study was conducted evaluating food safety knowledge among food handlers in restaurants and it was found that the knowledge of food handlers was low (49.3) before they receive food safety training and high (66.6) after receiving food safety training (Park et al., 2010). Childcare duties, time and knowledge were barriers to practising food safety according to Meyenburg et al., (2013) in their research report.

Knowledge is defined as a complex process of remembering, relating or judging an idea or abstract phenomenon (Gotsch et al., 2012). Meysenburg et al., (2013) reported that two-thirds of food handlers had not received training or education related to nutrition, food preparations and food safety. A study that was conducted in the Free State Province day care centres, showed

that majority of care givers (73%) have not received formal training of food safety and hygiene practices. Improper hand washing practices where observed during the visit at Free State Province day care centres, which was a concern because proper hand washing limits the spread of disease and infections (Boaduo et al., 2016). Food safety messages that emphasise the susceptibility and severity of foodborne illness in children are needed to reach food handlers for adoption of safe food handling practices (Meysenburg et al., 2013). Low level of education among food handlers is what affects food safety (Ababio and Adi, 2012; Ababio et al., 2012; Feglo & Sakyi, 2012).

According to a study conducted by Langiano et al., (2012) on assessing food safety at home: knowledge and practices of consumers, overall they found that 39.9% were aware of the role played by microorganisms, 26.4% by the role of temperature and only 5.0% knew about the importance of temperature and light. Women were more aware of the definition of foodborne diseases, but an overall 42.1% were unable to define foodborne diseases and considered that these diseases were caused by ingestion of spoiled or expired food (27.0%) or by infection from *salmonella, botulism and hepatitis A* (30.4%). Also, the effects of foodborne pathogens on foods were not well-known: 44.6% believed that altered organoleptic characteristics of foods were due to smell (13.5%), flavour (13.6%) or colour (5.4%). About 66.7% believed that microorganisms contaminated foods during production or during the storage process. They again concluded that the majority of unsafe food hygiene practices observed in their study was associated with lack of knowledge (Langiano et al., 2012). Webb and Morancie (2015) mentioned that there is an urgent need for awareness programmes for food handlers to improve food safety knowledge.

Food handlers play an important role in food safety as they could be sources of contamination (Sala et al., 2005). Contamination from food handlers usually caused by inadequately washed hands, improper food preparations techniques as well as incorrect cleaning procedures of food preparation surfaces such as chopping boards and tables. Bacteria have been reported to survive on chopping boards and tables for more than three hours, especially when not properly cleaned (Salo et al., 2000; Sethlare et al., 2013) and fingers are probably the most important transmission route. Food can become contaminated with dirty hands if there is lack of proper hand hygiene among the food handlers when handling food (Salo et al., 2000). Centers for Disease Control and Prevention (CDC) reports that approximately 20% of food related illnesses

is due to food handlers (Michaels et al., 2004). Therefore proper hand hygiene is needed among workers in food service operations (Gorman et al., 2002; Dharod et al., 2009).

Akabanda et al., (2017) conducted a study in food safety knowledge, attitudes and practices of institutional food-handlers in Ghana and it was found that the majority of the food-handlers were between 41–50 years (39.1%). Female respondents were (76.6%). In their study, the food-handlers were knowledgeable about hygienic practices, cleaning and sanitation procedures. Almost all of the food-handlers were aware of the critical role of general sanitary practices in the work place, such as hand washing (98.7% correct answers), using gloves (77.9%), proper cleaning of the instruments/utensils (86.4%) and detergent use (72.8%). On disease transmission, the results indicates that 76.2% of the food- handlers did not know that Salmonella is a food borne pathogen and 70.6% did not know that hepatitis A is a food borne pathogen. However, 81.7% of food handlers agreed that typhoid fever is transmitted by food and 87.7% agreed that bloody diarrhoea is transmitted by food. Logistic regression analysis testing four models showed statistically significant differences ($p < 0.05$), for models in which the explanatory variable was the level of education (Akabanda et al., 2017).

Food poisoning occurs as a result of consuming food contaminated with microorganisms or their toxins, the contamination arising from inadequate preservation methods, unhygienic handling practices, cross-contamination from food contact surfaces, or from persons harbouring the microorganisms in their noses and on the skin (Barrie, 1996; Jay et al., 1999). Unhygienic practices during food preparation, handling and storage creates the conditions that allows the proliferation and transmission of disease-causing organisms such as bacteria, viruses and other food-borne pathogens (Gent et al., 1999; Fielding et al., 2001). Additionally, many reported cases of food-borne viral diseases have been attributed to infected food-handlers involved in catering services (WHO, 1999).

As Greig et al., (2007) reports, about 97% of reported food poisoning cases are due to the improper handling of foods by persons involved in catering services. The knowledge, attitudes and practices of food-handlers have been reported in studies from different countries around

the world (Ansari-Lari et al., 2010; Seaman & Eves, 2010). This is because a combination of three factors: knowledge, attitude and practice of food handlers, plays a dominant role in food safety with regards to the food service industry (Sharif & Malki, 2010).

The World Health Organization reported that 1.8 million deaths in 2005 alone resulted from diarrheal diseases, most of which were attributed to the ingestion of contaminated food and drinking water (WHO, 2007). According to the Centers for Disease Control and Prevention (CDC, 2011), 59% of foodborne disease outbreaks involved foodservice establishments. Previous reports (Hedberg et al., 2006; Kadariya et al., 2014) indicated that poor food handling practices are a leading cause of food-borne diseases.

Such improper practices have been well documented and typically include cross-contamination of raw and cooked food, inadequate cooking, and storage at inappropriate temperatures. Food handlers may also be asymptomatic carriers of food-poisoning organisms, serving as a potential source of contamination to food (FDA, 2009). However, adequate training and transfer of such training to behaviour in particular can help limit such improper food handling practices and hence reduce the resulting effects of contamination on health and economy (Pilling et al., 2008).

Lynch et al., (2003) previously found that while food safety training might increase knowledge, the knowledge might not always translate into improved behaviours (Roberts et al., 2008). Such transfer problems have been linked to a number of factors including trainee characteristics, training design, and work environment (Burke and Hutcins, 2007; Grossman and Salas, 2011). Hence, several studies conducted on the effectiveness of food safety training on behaviour in foodservice establishments yielded inconsistent conclusions; many studies found that training was effective (Cohen et al., 2001; McElroy and Cutter, 2004; Roberts et al., 2008) while others drew the opposite conclusion (Mathias et al., 1994).

According to Adesokan et al., (2015) the findings of their study suggest that refresher training and short duration trainings are essential to prevent food safety failures that often result from

poor knowledge and practices of food safety among food handlers. Though other reports stated that increased knowledge from food safety training might not necessarily translate into improved attitudes and practices of food safety (Roberts et al., 2008 and Pilling et al., 2008), their findings suggest that improved behaviour could be enhanced through the provision of regular refresher training to food handlers (Adesokan et al., 2015).

A study involving 85 food handlers working in a university located in Kuala Lumpur, Malaysia was conducted by Lee et al., (2016). Food safety among food handlers was assessed using a questionnaire, while the hand swabs were tested for the total aerobic count, coliforms, and *Escherichia coli, Staphylococcus aureus, Salmonella, Vibrio cholerae and Vibrio parahaemolyticus*. It was found that the food handlers had moderate levels of food safety knowledge (61.7%) with good attitude (51.9/60) and self-reported practices (53.2/60). It is noteworthy that the good self-reported practices were not reflected in the microbiological assessment of food handlers' hands, in which 65% of the food handlers examined had a total aerobic count _20 CFU/cm^2 and *Salmonella* was detected on 48% of the food handlers' hands. In conclusion, the study revealed that the food handlers had adequate food safety knowledge, but perceived knowledge failed to be translated into practices at work (Lee et al., 2016).

In 2014, Malaysia recorded 49.79 cases of food poisoning per 100,000 population (MOH, 2014a). More than 50% of the total food poisoning cases were attributed to improper food handling by food handlers (MOH, 2007). The outbreaks in academic institutions contributed 43% of the total foodborne poisoning incidents in Malaysia (MOH, 2014b). Food handlers play an important role in ensuring food safety and prevention of food poisoning. Michaels and others reported that infected food handlers were able to transmit agents of gastrointestinal infectious diseases via poor personal hygiene practices (Michaels et al., 2004). A previous study successfully isolated *Salmonella* from seafood (Lunestad et al., 2009) but *Salmonella* is not a common carrier. This was thought to be a result of cross-contamination by infected food handlers (Lunestad et al., 2009).

Moreover, many reports have demonstrated similarities between the pathogens isolated from patients and food handlers, clearly indicating that food handlers were the vehicles of transmission for the foodborne pathogens (Quiros et al., 2000 and Olsen et al., 2001).

Angelillo et al., (2000) postulated that food handlers who had good knowledge of proper food handling practices could help to control food poisoning cases as they were in direct contact with food, particularly ready-to-eat foods. Poor personal hygiene, primarily ineffective hand washing, has been recognized as a significant risk factor of food contamination that leads to food poisoning (Scarborough, 2002; Curtis & Cairncross, 2003). Hand hygiene is the most basic yet critical criterion for ensuring safe food handling by food handlers. In fact, hand washing has long been known to be a fundamental precautionary measures in health care settings (WHO, 2009), as well as in the kitchen, for preventing the spread of infectious disease through human to human or human to food contact (Gibson et al., 2002; Perez-Rodriquez et al., 2008). Therefore, it is thought that hand hygiene could serve as an indicator of food handlers' adherence to safe food practices during food preparation.

Reynolds & Rajagopal (2017) conducted a study to identify if childcare food handling employees' (n = 278) perceived barriers and motivators to follow recommended food safety practices. Six important barriers and 14 key motivators to following recommended food safety practices were identified. Important barriers pertained to time restraints, workloads, and lack of understanding of the importance of following proper food safety practices. Key motivators were focused on children's safety, available supplies, communication, and food safety training/information. Employee and facility characteristics were shown to influence perceived importance of barriers and motivators to following food safety practices.

Childcare directors should review scheduling and job duties of employees as the majority of identified barriers focused on "work pace" and "time restraints." Directors should also attempt to increase food safety communication through practical situational training, written food safety policies, and use of food safety signage to increase understanding of the importance of proper food safety practices. Ensuring proper supplies are available is necessary (Reynolds & Rajagopal, 2017a).

The Objective for chapter is to address the food safety behaviour and knowledge of food handlers in day care centres of Mbombela.

2.5 MICROBIAL ANALYSES OF FOOD PREPARATION AREAS IN THE DAY CARE CENTRES

Food contact surfaces are a major concern for food services facilities in controlling the spread of foodborne pathogens (Cosby, 2005). Food surface areas within day care centres are considered critical to health, and therefore the microbial quality of these surfaces within child care centres food service areas must be sampled and assessed. The cleanliness and sanitation of food contact surfaces within day care centers pose health risks to children due to their potential contribution to foodborne illness. Although many cases of foodborne illness have been attributed to inadequate cooking, temperature abuse, and the use of contaminated raw ingredients, cross-contamination between raw and cooked foods via food contact surfaces has also been identified as a significant risk factor (DeCesare et al., 2003).

According to a study conducted by Cosby et al., (2008) in six child care centres for Microbiological Analysis of Food Contact Surfaces, it was discovered that Coliform were detected on 283 of 1149 (24.7%) samples with counts ranging from 1 to 2000 CFU/50 cm2 while *E.coli* was detected on 18 of 1149 (1.6%) samples with counts ranging from 1 to 35 CFU/50 cm^2. They further demonstrated that microbial contamination is present on food contact surfaces of child care facilities. Due to high risk of foodborne illness associated with children, the possibility of cross contamination food contact surfaces to non-food contact surfaces to foods is an aspect of food safety that requires more attention (Cosby, 2005).

According to the study assessing bacteriological quality and food safety practices of a Valley, Brazil conducted by Trindade et al., (2014) it was discovered that nine (81.8%) establishments were classified as poor quality and two (18.2%) as medium quality. *Escherichia coli* and *Staphylococcus aureus* were detected in 36 (52.9%), 1 (1.5%) and 22 (32.4%) of the food samples and in 24 (40.7%), 2 (3.3%) and 13 (22.0%) of the food contact surfaces, respectively. The counts of coliforms and *Staphylococcus aureus* ranged from 1 to 5.0 and 1 to 5.1 log CFU/g of food, respectively. Coliforms, *E. coli* and *S. aureus* were detected on the hands of 33

(73.3%), 1 (2.2%) and 36 (80%) food handlers, respectively. This study showed that children attending these day care centres are more at risk of diarrheal diseases.

a. Pathogens most associated with child care facilities.

***E. coli* O157:H7** and its link to food became well known to the public as a result of the 1993 *E. coli* O157:H7 outbreak caused by contaminated hamburgers, where over 700 people became ill from this outbreak and 4 children died (Buzby 2001). *E. coli* O157:H7 can be found on cattle farms and the pathogen can live in the intestines of healthy cattle. During slaughter, the pathogen can be passed to the beef thus contaminating the meat. *E. coli* O157:H7 may be acquired through the consumption of meat that has not been sufficiently cooked, unpasteurized milk, and person-to-person transmission can occur via the faecal-oral route (Belongia et al., 1993). *E. coli* O157:H7 can be found in the diarrheal stool of infected persons. The pathogen can then be spread if personal hygiene and hand washing procedures are inadequate. Young children typically shed this organism in their faeces between one to two weeks after their illness; therefore, precaution and appropriate personal hygiene measures must be taken in order to ensure the prevention of this pathogen even if symptoms have receded (Belongia et al., 1993).

Salmonella is a genus of Gram-negative bacteria that was discovered over 100 years ago by an American scientist named Salmon, for whom they are named. There are a number of different strains of *Salmonella;* however, *Salmonella* serotype Typhmurium and *Salmonella* serotype Enteritidis are the most common in the United States. Concerning food poisoning, *Salmonella* Enteriditis is of particular concern because this strain causes gastroenteritis and other problems because of several virulence factors the organism is armed with (CDC 2004). *Salmonella* spp. are typically found in animals, especially in poultry and swine. There are various environmental sources that include water, soil, factory surfaces, kitchen surfaces, and animal faeces. Foods associated with *Salmonella* spp. include poultry, eggs, red meat, dairy products, processed meats, cream-based desserts, and salad-type sandwich filling (such as tuna salad or chicken salad) as these are prime targets for colonization by species of *Salmonella* (FDA, 2004).

Salmonella may also be found in the faeces of some pets, such as reptiles. This is of concern for child care centres as they may keep these animals in their facilities for children's enjoyment. Children and adults should always wash their hands after handling a reptile or any other animal to eliminate the risk of illness from *Salmonella*. *Salmonella* are transmitted through the faecal matter of people or animals, and are usually transmitted to humans by eating foods that have been contaminated with faecal matter by cross-contamination (FDA, 2004).

It is estimated that approximately 40,000 cases of salmonellosis are reported each year in the United States (FDA, 2004). Infants have the highest risk of contracting salmonellosis, and the second highest risk group are children under the age of 10 (CDC, 2004). Most people infected with salmonellosis develop nausea, diarrhoea, fever, and abdominal cramps and normally recover without treatment; with symptom incubation period of 5 to 7 days depending on host factors, such as age and susceptibility, ingested dose and strain characteristics. In some patients, such as children and infants, prolonged diarrhoea is dangerous, as the body can be depleted of fluids and salts that are vital for the proper functioning of organs and tissues. The resulting shock to the body can be lethal to infants and there is a possibility that the bacteria can spread from the intestinal tract to the bloodstream, leading to infections in other parts of the body. If this occurs, a person must be treated immediately for the infection because at this stage it may cause death (CDCDBMD, 2004).

In 2002, the Ohio Department of Health reported that 2 children were infected with *Salmonella* from consuming raw milk from a combination dairy-restaurant-petting zoo (Mazurek et al., 2004). In 1996, the Minnesota Department of Health detected an increase in the number of reports of *Salmonella* cases. A study conducted by Simmons and others *Salmonella* Enteritidis infections (Hennessy et al., 1996).

Campylobacter is the most common cause of bacterial diarrhoea in the United States with more occurrences than S*almonella* (CDC 2004). According to active surveillance via Food Net, approximately 15 cases of campylobacteriosis are diagnosed each year per 100,000 persons in the population; however, due to undiagnosed or unreported cases, it is estimated that over 1

million persons are infected every year (CDC-DBMD 2004). Unlike other pathogens, such as *E. coli* O157:H7 and *Salmonella*, *Campylobacter* is not usually spread from person-to-person; however, this can happen if the infected person is a small child or producing a large volume of diarrhoea. Smaller outbreaks of *campylobacteriosis*, which are more common, are typically associated with handling raw poultry or eating raw or undercooked poultry; whereas, larger outbreaks typically occur from drinking unpasteurized milk or contaminated water (CDC, 2004).

In 87% of food establishments sampled by Wanyenya *et al* (2004), the same work area was used for preparation of raw and cooked chicken, and in 68% of these establishments the same cutting boards were used for raw and cooked chicken. None of the establishments applied disinfectants or sanitizers when washing contact surfaces. *Campylobacter* spp. survived on wooden and plastic but not on metal cutting boards after 3 h of exposure. The handling practices in food preparation areas provide an opportunity for cross-contamination of *Campylobacter* spp. to ready-to-eat foods (Wanyenya et al., 2004).

Staphylococcus aureus (staph) is a kind of bacteria that is commonly found on the skin or in the noses of healthy people without causing infection. These bacteria occasionally get through the skin barrier and cause a skin or soft tissue infection. Although most of these infections are mild, such as impetigo, staph can cause more serious illness including blood, bone, or respiratory infections (Bobbie, 2009).

Shigella is a Gram-negative bacterium that is similar in behaviour and habitat to *Escherichia coli*. This pathogen was discovered over 100 years ago by a Japanese scientist named Kiyoshi Shiga, for whom they are named. There are several different species of *Shigella* including: *Shigella sonnei*, also known as "Group D" *Shigella, Shigella flexneri,* or "Group B" *Shigella*. There are other types of *Shigella* that are rare in the U.S. but important in developing countries. For example, *Shigella dysenteriae* type 1 causes deadly epidemics in developing countries (CDC-DBMD, 2004). *Shigella* is rarely found in animals and is principally a disease of humans and other primates such as monkeys and chimpanzees. The pathogen is frequently found in

water that has been polluted with human feces. *Shigella* are mostly associated with salads such as potato, tuna, macaroni, or chicken, raw vegetables, dairy products and poultry. Contamination of these foods is usually via the fecal-oral route and is most commonly due to fecally contaminated water and unsanitary handling by food handlers (CDC-DBMD, 2004).

The CDC's Preliminary FoodNet Data reports that in 2003, there were 15,600 diagnosed cases of foodborne illness caused by bacterial pathogens and of that total, 6,017 cases were attributed to *Salmonella*, 5,215 to *Campylobacter*, 3,021 to *Shigella*, 443 to *Escherichia coli*, and 138 to *Listeria* (CDC, 2004). The CDC estimated in 2000, that there were 3,513,694 cases of foodborne illness among children, with 33,711 children hospitalized and 1,604 deaths. Comparing the latter figure to the total deaths attributed to foodborne illness in 2003, approximately one-third of all deaths caused by foodborne illness are children.

b. Food Preparation Surfaces

Numerous researchers have studied the survival of foodborne pathogens on stainless steel and other surfaces and their contribution to cross-contamination (Kusumaningrum et al., 2003; Moore et al., 2003). A study by Kusumaningrum et al., (2003) indicated that pathogens, such as *Salmonella* Enteritidis, *Staphylococcus* 30 *aureus*, and *Campylobacter jejuni* are capable of surviving for hours or days after contamination on stainless steel surfaces. In addition, the presence of residual food debris, such as milk or chicken residues on the surface is an important factor in the increased survival of these pathogens on the surface. Prolonged survival presents a longterm cross-contamination hazard since the pathogens were readily transferred from the kitchen sponges to stainless steel surfaces and then to foods. Moore et al., (2003) studied the transfer rate of *Salmonella* Typhimurium and *Campylobacter jejuni* from stainless steel to Romaine lettuce and found that 3 to 4 log, of *S.* Typhimurium or *C. jejuni* may be transferred to ready-to-eat foods at least one to two hours after surface contamination has occurred.

While day care centers provide a necessary and important service they may serve as a focal point for certain types of infections (Todd et al., 2007). For example US Department of Labor, 2004 suggested that day care centers were particularly vulnerable to food borne illness outbreaks because care givers were often involved in food preparation, serving and cleaning

up after infants and young children. Kitchens are important contamination points for food and should be kept free from possible contaminants. Hygiene practices among food handlers have been reported to be below standard by Tomlins et al., 2002; Afoakwa, 2005; Addo et al., 2007; Feglo and Sakyi, 2012.

Traditionally, methods such as swabbing and plating on microbiological media or agar contact plates have been used to detect bacteria on food contact surfaces. The most commonly used methods for food contact surface assessment in food operations are the Swab/Swab-Rinse Method and the Contact Plate Method (Jay et al., 2005). The swab-rinse method developed by W.A. Manheimer and T. Yabanez is the oldest and most widely used method for the microbiological examination of surfaces in the food and dairy industry and in hospitals and restaurants (Jay et al., 2005).

The swab-rinse method utilizes either cotton or calcium-alginate swabs to examine a defined area of a surface. This method should be used for surfaces with cracks, corners, or crevices, areas where the swab will be more effective in recovering organisms. With this method, a sterile template is placed over the surface to be sampled and the area is swabbed thoroughly with the moistened swab in horizontal and vertical directions, reversing direction between strokes. The exposed swab is then returned to its holder containing the appropriate buffer solution and the buffer solutions is surface or pour plated to enumerate the microorganisms (Jay et al., 2005).

2.6 CONCLUSION

There are not enough studies conducted in food safety related to child care facilities in South Africa, therefore more studies need to be headedso that all the hazards can be known. Health education to food handlers regarding food safety should be conducted in order to reduce number of outbreaks caused by improper hygiene. Most studies have shown that lack of knowledge and good behaviour in food safety can cause outbreaks of food safety diseases. The food safety regulations are clear on what is required from the owner of a food safety premises and food handlers.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 INTRODUCTION

This chapter presents the detailed description of the methodology that was used in this study. It provides information concerning the methods that was used in undertaking this research as well as justification for the use of this method. This chapter also give clear understanding of the study area and design, the sample population and research data collection methods used, how data was collected and analysed.

Research can be defined as the systematic process of collecting and logically analysing data for a given purpose (McMillian & Schumacher, 2010). According to Denzin and Lincoln (2005) a research methodology or strategy is determined by the nature of the research question and the subject being investigated. This study has the main aim as to assess food safety hazards among day care centres in Mbombela, South Africa. This study was never conducted in this area before. The results of this study can contribute to improving policies, by laws and actions of Mbombela municipality regarding food safety of day care centres.

3.2 RESEARCH APPROACH

There are three basic components of a research approach which are Philosophical world view, research design and methods of research (Grover, 2015). Grover further said when choosing a research approach it is necessary for it to match the study design and the methods as well.

On the basis of different world views Mertens (2009) found that there are three approaches that are termed as independent approaches, which are qualitative (constructivism and transformative), quantitative (positivism and post positivism) and mixed methods (pragmatism).

The research approach that was chosen for this study is the quantitative approach. Quantitative research is much more scientific and therefore is much better that the qualitative research

because a large amount of data is gathered and then analysed statistically. This allows for very little bias, and if 100 researchers ran the analysis on the data they will always end up with the same numbers at the end of it. The researcher also has more control over how the data is gathered (Numbers & Psychology, 2011).

3.3 THE STUDY AREA

The study area is the interdisciplinary fields of research and scholarship pertaining to particular geographical, national or cultural regions. In this study Mbombela which is the capital of the Mpumalanga Province, Located on the Crocodile River about 110 kilometre to Mozambique and about 82 kilometres to Swaziland is chosen as the study area.

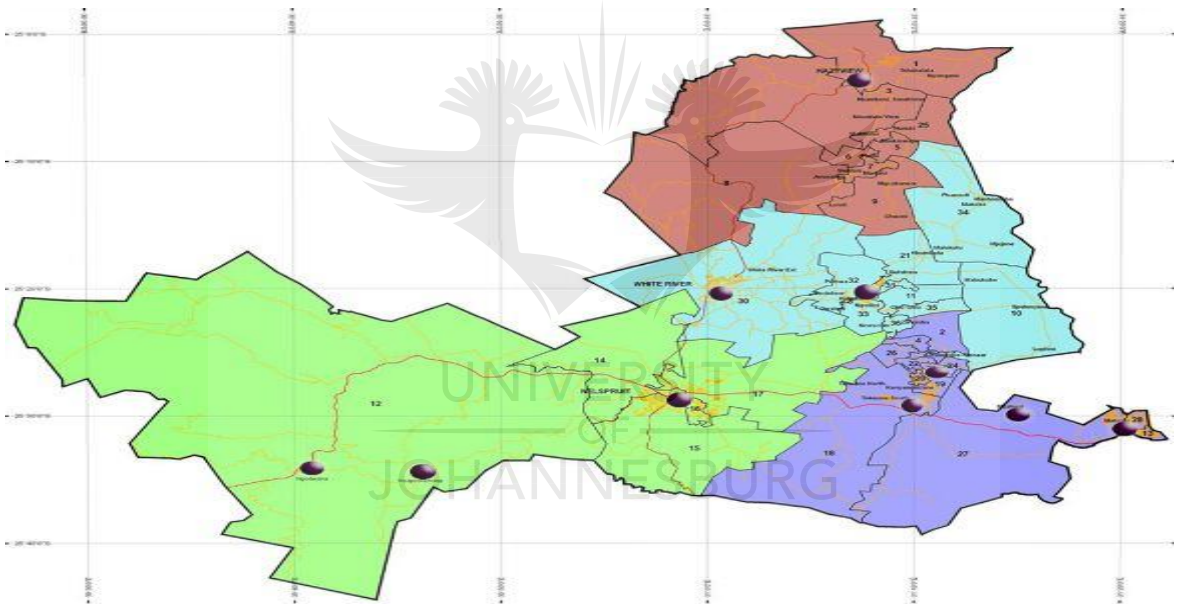

Figure 3.1: Map of Mbombela (Nelspruit) **(City of Mbombela, 2007)**

3.4 RESEARCH DESIGNS

The research design refers to the overall strategy that one choose to integrate the different components of the study in a coherent and logical way, by ensuring effectively address the research problem; it constitutes the blueprint for the collection, measurement and analysis of data (De Vaus, 2001 & William, 2006). This study is a quantitative research. The quantitative research is mainly concerned with the measurements of phenomenon in teams of quantity. An

example of a quantitative would be a study where a researcher is carrying senses for collecting population, social, economic statistics of a particular area. They are subjected to statistical analysis. It relays mainly on primary data like survey methods and questionnaire method (Pavan & Nagarrekha, 2014).

According to MBA Knowledge Base (2010) quantitative research is generally made using scientific methods which includes the following:

1. The generation models, theories and hypothesis.
2. The development of instruments and methods for measurements.
3. Experimental control and manipulation of variables.
4. Collection of empirical data.
5. Modelling and analysis of data.
6. Evaluation of results.

According to (Freeman & Julious, 2010) appropriate figures are useful as they can be read quickly and are particularly helpful when presenting information to an audience. They further said, "plotting data is an extremely useful first stage to any analysis, as this could show extreme observations (outliers) together with any interesting patterns". It is for these reasons that the current study adopted qualitative research approaches in investigating the phenomenon in question.

Descriptive study was used to describe phenomenon of interest to estimate certain population parameters. Thompson (2008) defines descriptive statistics as numbers that summarize the data with the purpose of describing what occurred in the sample and inferential statistics as numbers that allow the investigator to determine whether there are differences between two or more samples and whether these differences are likely to be present in the population of interest.

Descriptive statistics is also used in this study to compare samples from one study with another. Descriptive statistics also helped with sample characteristics that influenced the conclusions. Thus, the primary statistical analysis followed in the presemtation of this study results is descriptive.

3.5 POPULATION AND SAMPLING

Population sampling is the process of taking a subset of subjects that is representative of the entire population. I have chosen to focus my research on the food safety of day care centres in Mbombela as I am currently working in this area as Environmental Health Practitioner. Although the Day care centres are not my area of responsibility I saw it a need as this will be the first study of this type in Mbombela. A population is defined as a group of individuals, with at least one common characteristic which distinguishes that group from other individuals (Best & Kahn, 2006). For the purpose of this study 65 day care centers were chosen randomly to participate. The criterion that was used was to sample day care centers that prepare food for children on a daily basis.

The Mbombela municipality has 204 day care centres (total population) and 85 day care centres are fully registered and 119 day care centres are conditionally registered by the (Department of Social Development, 2017). A list of the facilities was obtained from the department of Social Development, from which the 65 day care centres (n=65) of the total population was targeted for the study as Determined by the sample size calculator giving a 10% confidence interval (Martines-amaesa, Gonzalez-China, Bastos, Bonamigo & Duquia, 2014). The sample size was also selected checking on the manageability of data collection and costs.

3.6 DATA COLLECTION TOOLS AND TECHNIQUES

This study was conducted at day care centres therefore it was necessary for the researcher to obtain permission from the respective departments (Department of Social Development and Department of Health) prior to beginning data collection (see appendix C and D). An application to conduct research was submitted to the departments. As part of this application the proposal and ethics that was approved by the University of Johannesburg, included the copies of questionnaires, information letter and consent form was also submitted. Therefore the application was successful and permission was granted to conduct the study (see appendix N and O).

3.6.1 Questionnaire data collection

The questionnaire (Appendix A) was reviewed by an expert consultant on questionnaire design at STATKON (Appendix G) and assessed the food safety knowledge and behaviour of food handlers in child care facilities. The questionnaire which was used is based in part on those used in previous studies by several researchers including Ansari-Lari, Soodbakhsh & Lakzadeh. (2010), and Soares et al (2012). This questionnaire was compiled and further applied in a study performed in Haiti (Samapundo et al, 2015). The questionnaire was modified in order to suit this study context. The questionnaire was completed by the food handlers at the day care centres. The researcher was present to explain where they required clarity when food handlers were filing in the questionnaire.

The questionnaire was classified into four primary sections including demographic information, food safety knowledge and food safety behaviours and Rating of food provision by food handlers. When participants were not literate enough to fill in the questionnaire themselves, they were aided by the researcher.

In more detail the demographic information consists of gender, age, educational level and if food handlers did receive food safety training. The knowledge section was designed to evaluate the food safety knowledge of food handlers about pathogens, food poisoning, food hygiene,

high risks and proper cleaning. This section contains about 8 questions where other questions need explanations and others choosing the correct answer. On the other hand, the food safety behaviour questionnaire was organized to test if food handlers correctly practice food safety behaviour. are a total number of 10 questions with true or false answers in which all this questions will be able to give information regarding the behaviour of the food handlers during the food preparation. Only one food handler from each day care centre participated in the study.

3.6.2 Observation checklist data collection

During the research the researcher identified 65 day care centres that prepare food for children daily and asked them to voluntary participate in the study. Site visits was conducted in 65 selected day care centre to observe food handling practices, i.e. hygiene practices and cleaning procedures used in the food preparation areas. Observed practices were recorded in a standardised checklist (Appendix B) (Mouton, 2001) that was created by the researcher looking at the requirements of the regulation governing general hygiene for food premises and transport of food.

The main aim of observations was to record real practices that are observable in the food preparation areas of day care centres in order to identify potential health hazards that may be associated with each facility. Pictures were taken in some of the day care centres as evidence of the real practices. The checklist comprises three main sections which is storage facility compliance which comprises of four factors, kitchen compliance which comprises of six factors and personal hygiene compliance which comprises of six factors. These three compliances are very important in accordance with the Regulations 638. If these three areas are not compliant a lot of harmful organisms may cross contaminate food that is being prepared for children.

Experiments

Surface swabs was collected using gamma irradiated biocide free cellulose sponge (Hygiena Sponge'n Bag) **See Figure 3.2.** The researcher received training from the Water and Health Research Centre (by who) of the University of Johannesburg with regard to sampling and use of Higena stick-sponges before she can start with data collection. Swabs were collected in 65

Day care centres of Mbombela and transferred to sterile Whatmann bags for transport to the laboratory at 4°C.

The Water and Health Research Centre assisted with the purchase of the Hygiene sponges and analysis of the samples. The liquid containing the bacteria was squeezed from the sponge and used for the isolation of the specific bacteria. The researcher was wearing double gloves and the outer pair of gloves was discarded after each sample is completed. Hand sanitizers were used by the researcher before she could wear gloves in order to prevent contamination of the samples and to find the true results. A sample was taken in food preparation area, the food handlers were informed to clean the area before a swab can be taken in order to check also the effectiveness of cleaning. Samples were then transported in a cooler box with ice to the Health and Research Laboratory to be analysed.

Bacterial species that was tested for included:

1. Blood Agar Medium was used to test: *Staphylococcuss species, Micrococcus, Streptococuss,* Gram Positive Bacteria (GPB) and Gram Negative Bacteria (GNB)
2. MacConkey Agar Medium was used to test: *Salmonella, Shigella spp, E coli, Enterobacter, Klebsiella, Enterococci and* GPB
3. De oxycholate CI trate Agar was used to test: *E.coli, Salmonella, Shigella*
4. Mannitol Salt Agar medium was used to test: *S. aureus and Epidermidis*
5. Thiosulfate- Citrate-Bile (TCBS) Agar medium was used to test: *V. Cholerae, V. parahaemolyticus, Pseudomonas/Aeromonas and E. coli*
6. Campy Agar 02 medium was used to test: *Campylobacter jejuni and White colonies*
7. Campy Agar CO2 medium was used to test: *Campylobacter jejuni and White colonies*

The SANS method used were *Bacillus cereus* (SANS 7932:2005), *Campylobacter jejuni* (SANS10272-1:2009), *Salmonella* species (SANS6579:2003), *Shigella* species (SANS6195:2006), *Clostridium perfringens* (SANS7937:2007) and *Staphylococcus* species (SANS6888-1:1999) and tested using the relevant South African National Standards (SANS) method as indicated. All tests were performed as described by the methods and relevant blank,

negative and positive controls were included to ensure validity and reliability of the results. Dimethylsuloxide (80µl) was added to 1 ml overnight cultures of all the positive strains isolated and frozen at -80°C for future studies (Roskams & Rodgers, 2002).

All microorganisms that were tested are represented in the result as present for positive and not present in case where they are negative sample.

Figure 3.2. Hygiena Stick Sponges

Figure 3.3. Researcher collecting a swab sample.

3.7 DATA QUALITY

Piloting the data collection tools

This study used three data collection tools. All data collection tools were piloted in 2 day care facilities and amendments were made before final data was collected to ensure content validity. The pilot study did not form part of the final results in the study. A pilot study can be defined as a small study to test research protocols, data collection instruments, sample recruitment strategies and other research techniques in preparation for a larger study (Hassanet al., 2006). This stage is important in a project to identify potential problem areas and deficiencies in the research instruments and protocol prior to implementation during full study (Lancaster et al, 2004; Kraemer et al, 2006).

The following became apparent for the researcher, from the pilot study.

- Two questions were changed due to food handlers not understanding the terminology that was used.
- The questionnaire addressed all the relevant questions the researcher wanted to find out.
- Not all food handlers were able to write and understand the language that was used clearly.
- Two questions were removed from the checklist due to day care owners not feeling comfortable.

Reliability and validity

Reliability is related to the dependability, fairness and accuracy of the data and methods used that led to the conclusion of the study (Messick, 1989). Validity can be seen as the core any assessment or study that is trustworthy and accurate (Bond et al., 2003). Validity according to Messick (1989) refers to the degree to which empirical evidences and theoretical rationales support the adequacy and appropriateness of interpretations and actions based on test scores. This study is valid because if various researchers where to do analysis on the same study results

the results will be the same. The reliability and validity was determined through the pilot study for questionnaires, checklist and swabs samples.

The checklist used in this study was derived from the Regulation 638, the regulation governing general hygiene requirements for food premises. Therefore the factors that were checked for compliance are found in this regulation. If the checklist were to be used in the same day care facility for checking of compliance level the results will be the same with this study. The questionnaire that was used for this study have been used before by several researchers including Ansari-Lari, Soodbakhsh & Lakzadeh. (2010), and Soares et al (2012). However the population was different to the one that was used in this study, thus it is unclear if the same level of consistency will be found when used on South African sample. This is reported in the results section of the study. Microbial swabs was tested for several times and the results came back the same.

3.8 DATA ANALYSIS METHODS

Quantitative data was collected, in the form of interval, nominal and ordinal data using questionnaire, and observation checklist and laboratory analysis. Quantitative data was analysed through explanatory method (Creswell, 2009). Descriptive and inferential statistics was used to organise, summarise and present data in a convenient and informative way using graphs and numerical techniques, calculation of central and variability measures, and inferential statistics to draw inferences about the results. Microsoft Excel 2013 and SPSS version 24 was used for statistical analysis of the quantitative data.

Descriptive statistics method was used to analyse the questionnaires. This method helped to summarize data that have been collected or manipulated in a study. These statistics ranges from a simple reporting of group membership to measures of central tendency of variance. Frequencies and presentation always provide simple nominal level data. Data is typically described in two ways. One involves measures of central tendency (e.g. Mean, median, mode), and the other is more closely related to the distribution or dispersion of scores (e.g. variance, range, standard deviation, percentages). Means and variance are used not only to summarize

characteristics of data but also to estimate relationships among variables within the population. Morgan et al., (2002) concluded that descriptive statistics are important to include in the report of your results because they provide meaningful information to the reader.

3.9 ETHICAL CONSIDERATIONS

A research that involves human subjects or participants raises unique and complex ethical, legal, social and political issues. Research ethics is specifically interested in the analysis of ethical issues that are raised when people are involved as participants in research. (Walton, 2006) There are three objectives in research ethics, namely

- To protect human participants
- To ensure that the research is conducted in a way that serves interests of individuals, groups and society as a whole.
- To examine specific research activities and projects for their ethical soundness, looking at issues such as the management of risk, protection of confidentiality and the process of informed consent.

For this study the research was submitted to the University of Johannesburg, Faculty Academic Ethics Committee and Higher Degrees Committees for review and was approved (see appendix N and O).

Access to day care centres

Written approval was obtained from Mpumalanga Provincial Health Department (see appendix C) and Social Development (see appendix D) to access day care centres and conduct the study and it was approved.

Obtaining informed consent

Participation in this study was completely voluntary and participants were informed that they can withdraw from the study at any point with no consequences.

All participants were informed about the aim and objectives of the research and permission was requested from each child care centre (owner) and each food handler to participate in this research by signing of an informed consent.

Right to equity, human dignity and protection against harm

All premises were classified as day care centres and all participants as food handlers. Participants were informed that they will not be exposed to any form of harm in this research and will take approximately thirty minutes to complete the questionnaire.

Right to anonymity, confidentiality and privacy

Confidentiality and anonymity were discussed with the participants. They were assured that the Day care centres and their names will not be printed. The questionnaire was completed on an anonymous basis to allow the child care minders to express themselves freely and the names of the day care centre will not be disclosed to anyone but the researcher and supervisors. All data collected is stored under lock and key for five years after which it will be destroyed, with access allowed only for members of the research team.

Right to community and community science

The participants were informed that the data collected may be used in scientific papers and/or conference and seminar presentations.

3.10 CONCLUSION

This chapter described the methodology and designs of the research study. The chapter began by restating the aim of the research and the description of the research design. The study took the form of quantitative research which was interpreted in the nature. Data collection methods were outlined. As such a multi-method approach was utilised and data was collected by means of a questionnaire, checklist and experimental analysis. The chapter further presented a summary of how data would be presented and analysed. With the view of conducting this study in an ethical manner, ethical clearance was sought and granted.

CHAPTER 4: DISCUSSION OF RESULTS

4.1 INTRODUCTION

Chapter 3 discussed how data was collected, captured and analysed for the assessment of food safety at Day care centres of Mbombela. This chapter will focus on the findings of compliance levels with the Regulation 638: Governing General Hygiene Requirements for Food Premises, the Transport of Food and Related Matters. The findings will be presented in 3 compliances factors including kitchen compliances, personal hygiene compliance and storage compliances. The number of children attending day care centers will also be discussed in this chapter.

This chapter will also focus more on the behaviour and knowledge of food handlers in the food preparation areas, and will focus on weather food handlers are or not trained on food safety. If is not food handlers behaviour and knowledge that affect the compliance levels or not. This chapter also outlines weather the food handlers understands the risks of not complying with the regulations. This chapter will discus 5 topics named; Demographic information, food handlers' knowledge, food handlers' behaviour, rating of food provision and Influence of education on food safety behaviours. The microorganisms that are present at the surface areas of the day care centers will also be discussed. This chapter will discuss the harmful microorganisms that were found in the surface areas where they prepare food.

4.2 DISCUSION OF COMPLIANCE LEVEL IN DAY CARE CENTRES OF MBOMBELA

4.2.1 KITCHEN COMPLIANCE

Kitchen compliance consists of six compliance factors that were assessed (Figure 4.1).

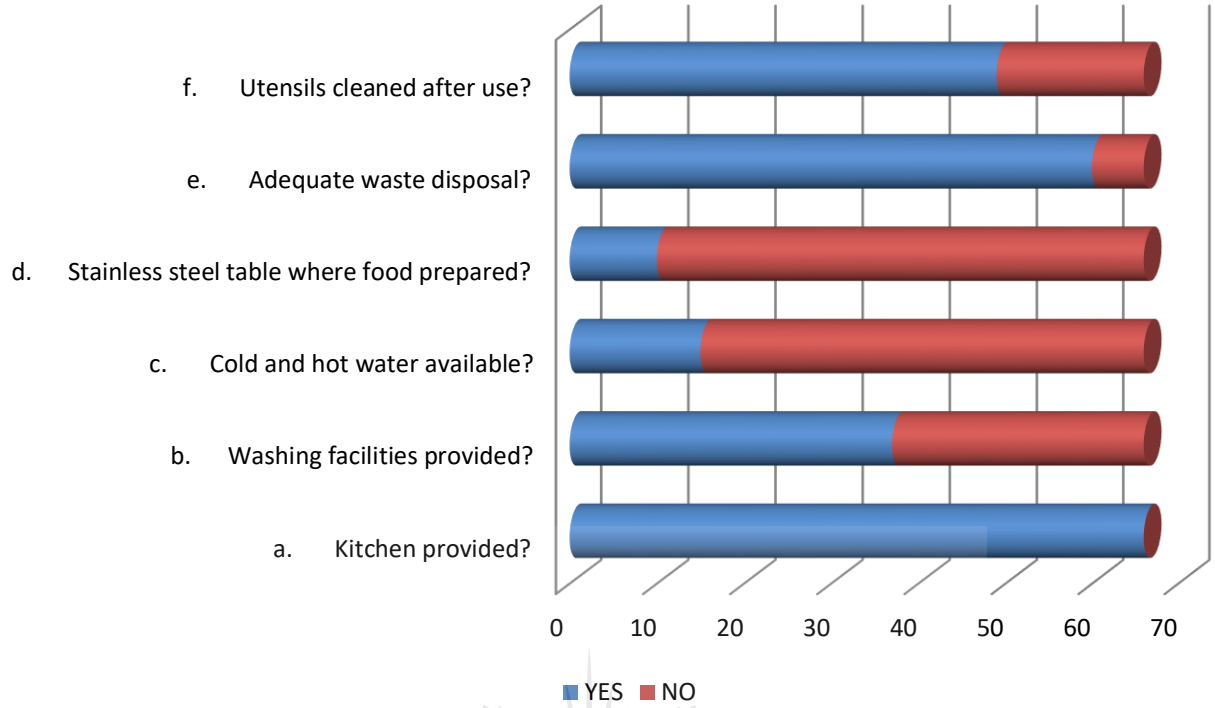

Figure 4.1: Six kitchen compliance factors according to R638

Based on the results above, it is evident that all the 65 (100%) sampled day care centres had kitchens within their premises and the kitchens are used to provide food for children on a daily basis. However, only 37 (%) day care centers had hand wash basins or facilities provided in their kitchens. Hand wash facilities included hand wash basin, soap and towel. The other day care centres did not have full hand wash facilities as required by the legislation. And some day care facilities were using the sink used for washing their dishes as a hand washing basin.

According to R638 washing facilities consist of hand wash basin, soap and towel and this station must only be used to wash hands by food handlers, and this area must be accessible to food handlers. The regulation further separates the dish washing facilities from hand wash facilities because using the dish washing basin as their hand wash facilities causes cross-contamination.

When the food handlers wash their hands with water used to wash utensils and then go to prepare food cross contamination may take place. A separate basin for food preparation was not provided in all day care facilities. Food handlers normally use the sink to thaw their meat or they use bowls. In other day care centres buckets are used to wash their hands. Even though

these buckets may be solely used for hand washing, the water is left in the bucket for long hours and it is used several times by more than one food handler. After being used once this water becomes contaminated and it should not be used again. Regulation emphasises that hand washing must be done with running water.

Although 37% day care centres have hand wash facilities only 15 % of them have hot running water. Water is an essential commodity in food preparation areas. It is used for drinking, cleaning and preparation of food, washing up, and washing hands, equipment, utensils, containers, clothes, among others. It is required by the regulation that all food preparation areas must have an adequate supply of potable water for all operations in the kitchen especially for food preparation and washing hands. Water can be a major source of contamination and infections leading to water-related diseases such as diarrhoea, typhoid, and cholera and *Salmonella typhimurium*. Water that is used for washing food eventually becomes part of the food. The source of the water was from the local municipalities. Hot water was a challenge in 85% of day care centres, especially the ones that are not situated in town. Eighty five percent (85%) day care centres boil their water if a need arises to use hot water. Although for washing of hands food handlers use cold water which may not remove all the dirt and micro-organisms that can cause diseases. Regulations require kitchens to have hot and cold water for their wash up facilities to prevent improper washing [R638 Section 5(3) (c)].

According to the regulation 638 Section 6(1), the surface of a counter, table or working surface on which unwrapped food is handled or any equipment, utensil or basin or any other surfaces which come into direct contact with food, must be made of smooth, rust proof, non-toxic and non-absorbent material that is free of open joints or seams but wooden chopping blocks, cutting boards and utensils are not prohibited if such items are kept in a condition that dirt does not accumulate. Only 51(%) day care centres use wooden tables for food preparations. Other day care centres have covered their tables where food is prepared with a cloth; the cloth is filthy, causing direct contamination of the food prepared on such surfaces. Fifteen day care centres were preparing food on stainless steel, a very good surface as this is easy to clean.

Waste, if not properly removed, would potentially result in contamination of food, equipment and water and also attract breeding of pests. According to regulation 638, waste needs to be disposed off designated containers with covers for temporary collection of waste and garbage. The containers are to be properly identified and made of durable impervious materials. Besides, the containers need to be kept in a sanitary condition. During the course of preparation, waste products are generated in the kitchen, either organic (waste food, used cooking oils) or inorganic (papers, plastics, cans). These waste products become breeding grounds for microbes and serve as potential sources of contamination when allowed to accumulate, or become centres of attraction for rodents, pests and flies if not disposed of properly. Adequate waste disposal was done in 60 (%) out of 66 day care centres. The local municipality collects wastes two times in a week and during the evaluation of this study waste was managed well and waste areas (waste bins) were clean. Forty (40 %) of the day care centres did not dispose off their waste regularly as required by the regulation.

The FSA (2000) particularly recommended that all sections of the premises where food-related activities were carried out had to be kept clean, in good repair and well maintained. Seventeen (17%) day care centres were not cleaning their utensils and equipment immediately after use. Utensils were left in a washing basin for long time. This can harbour microorganisms as well as pests; pests may also cause contamination of food that is being prepared.

4.2.2 PERSONAL HYGIENE COMPLIANCE

Personal hygiene compliance consists of six compliance factors that were assessed (Figure 4.2).

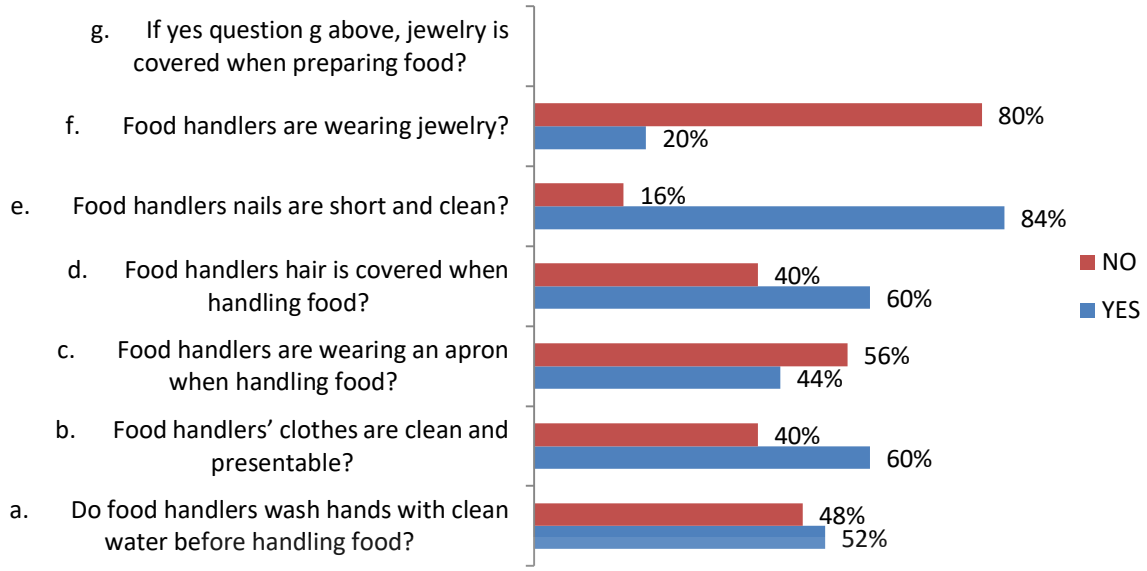

Figure 4.2: Six personal hygiene compliance factors according to R638

Regulations 638 state that every person working in a food handling area shall maintain a high degree of personal cleanliness and wear suitable clean and appropriate protective clothing.

The first compliance factor is washing of hands properly by food handlers before handling food. 48% of food handlers failed to wash their hands as required especially where hand washbasins were not provided. Though hand washing took only few seconds, food handlers rarely practiced it.

Hand wash basins were significantly not available in 31 day care centres. In other (15) day care centres a sink was labelled as a hand wash basin, but totally used for a different purpose and seemingly, it was the only sink available in the kitchen. This was an indication that hands were never washed before and during the operation in a designated area. Hand washing is said to be the most critical aspect of personal hygiene and Green (2006) noted that food handler's hand washing practice is critical because pathogens from the hands to food were a major contributing factor in food-borne illnesses. Proper hand washing is very important in the prevention of transfer of staphylococcus from one surface area to another.

Forty (40%) of food handlers' clothes were not clean and presentable, as such their filthy clothes will contaminate food that is being prepared for the children. Wandolo (2016) mentioned that personal hygiene of food handlers is the most important aspect in the prevention of food poisoning. 58% of food handlers were preparing food without wearing clean aprons. All of the 40% of food handlers whose clothes were not clean and presentable did not wear aprons when handling food. 40% of food handlers' hair was not covered; this is risky as hair can easily contaminate food that is being prepared. 15% of food handlers' nails were not short and some had nail polish during the evaluation. Nails can be the source of microorganisms and especially as proper hand washing is not taking place in most of these day care centres long nails can store dirt and contaminate food that is being prepared. Only 20% of food handlers are preparing food wearing jewellery such as earrings, rings and watches which can harbour microorganisms even when proper hand washing takes place. Much of this jewellery is not of good quality, and liable to peel off and remain in food during preparation. Ipsofacto, the earrings accidentally get into the food during preparation and contaminate the food or cause illness or injury to children who will consume the food.

It was observed that most day care centres that do not comply with personal hygyne compliance are non-compliant with kitchen compliance and food storage compliance as well. Food handlers who are wearing jewellery are the same individuals who are preparing food with long or polished nails. Inadequate personal hygiene can be a source of cross contamination –any food that comes into contact with dirty hands or clothes will become contaminated with microorganisms. Regulation 638 stipulates that a person may not handle or be allowed to handle food without wearing suitable protective clothing. The protective clothing, including head and other coverings and footwear, of a person handling food must be clean and neat, be designed of material that cannot contaminate food and be designed so that the food cannot come into direct contact with any part of the body excluding the hands. Therefore more that 40% of day care centres did not comply with the regulation during evaluation.

4.2.3 FOOD STORAGE COMPLIANCE

Non pre-packed, ready to consume foods, including food that is served as meals and displayed in an open container, must be protected in accordance with the best available method, against droplet contamination or contamination by insects, dust or bare hands (R638, 2018).

Food storage compliance consists of four compliance factors that were assessed:

a. In all the day care centres cooked food products and raw foods were stored separately. Day care centres of Mbombela complied with the requirements of the regulation in this regard. It is important to store food separately to prevent cross contamination from raw foods to cooked foods especially if they are stored in the same refrigerator.

b. Eight percent (8%) of day care centres did not comply with the requirement of keeping previously cooked food cool in a refrigerator. This 8% of day care centres do not have a refrigerator or a box of ice in their day care centre. It is important not to store cooked food at room temperature as micro-organisms multiply at room temperature and this food, if consumed, can cause food poisoning or other food related diseases.

c. R638 stipulates that that any food that is displayed or stored must not be in direct contact with the floor, ceiling, wall or any ground surfaces. A shelf or display used for storing food or any container must be kept clean and free from dust or any other impurity. In (n=11)17% of day care centres, foods were directly stored on the floor during evaluation, a risk factor for food contamination by microorganisms and dirt, and subsequent food-borne diseases or outbreaks of food poisoning.

d. Figure of findings

Figure 4.3: Food storage.

The above figure shows that one of the day care centres stored their food directly on the floor and this causes contamination to the food during storages.

Figure 4.4: An example of compliant food storage at a day care centre.

e. The refrigerator, irrespective of it is whether a walk-in or standard upright, is an important component in planning the storage of food items. Most fresh foods must be stored in the refrigerator to delay their deterioration and decomposition. In accordance

with R638 refrigerators must be maintained below 7 degree Celsius. Only 8% of day care centres did not have refrigerators to store food and/or their refrigerators were not working, or purpotedly still waiting for repairs during evaluation. About 92% of day care centres complied with maintaining their refregirators below 7 degree Celsius.

Table 4.1 number of children attending day care centres and funding sources

Statistics	Number of children
Mean	64
Median	53
Mode	20, 40
Minimum	7
Maximum	340
Funded day care centres = 7	Not funded =58

According to table 4.1 on average there are 64 children attending at one day care centre in Mbombela. The maximum number of children enrolled per year is 340 and the minimum is 7 children. In all of the 65 day cares that were sampled only 7(10.7%) are funded by the Department of Social Development and 58(89.3%) are relying on the school fees payable by parents. Some of the day cares are struggling to buy essentials as the money that they are charging is not enough. The above results have shown that 73% of day care centres do not comply with the minimum requirements. This puts about 7 to 340 children at risk of contracting food-borne illnesses as they are eating food prepared in these non-compliant day care centers daily.

4.3 DISCUSSION OF RESULTS FOR BEHAVIOUR AND KNOWLEDGE OF FOOD HANDLERS IN DAY CARE CENTRES OF MBOMBELA

4.3.1 DEMOGRAPHIC INFORMATION

All food handlers working at the 65 day care centres that were assessed are females. On average, food handlers from the selected day care centers were aged 43 years. Half of the food handlers were below 42 years of age (Table 4.2). Most of the sampled food handlers were 30 years, and their age ranged from 22 to 64 years.

Table 4.2: Age profile of food handlers from selected day care centres

Statistics	Age profile of food handlers
Mean	43
Median	42
Mode	30
Standard deviation	10
Minimum	22
Maximum	64

Only 5% (3 food handlers) of the food handlers have received formal food safety training out of all the day care centres that were sampled. Only one of these three food handlers received a certificate for attending food safety training and the other two received training as part of nutrition classes at high school. This makes it difficult for them to practice and comply with food safety regulations as they were not formally trained on food safety aspects such as keys to safe food.

Figure 4.5 shows that 62 food handlers in the day care centres do not have higher education such as tertiary level education. 24 food handlers have completed their primary school and 30 food handlers have completed their high school. 8 food handlers do not have formal education

at all. Therefore these members do not know and understand anything about food safety as the previous results have shown that they have not received food safety training.

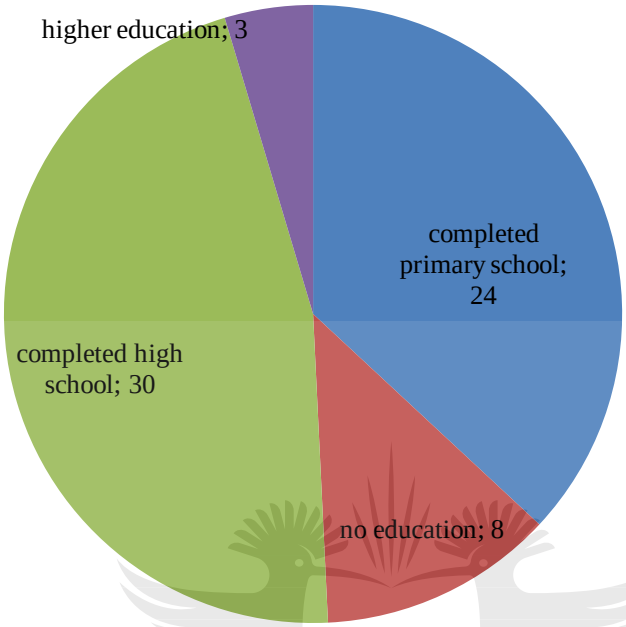

Figure 4.5: Highest educational level

It is difficult for someone with no education and no food safety training to practice good hygiene in food safety or be expected to have a certain level of knowledge in food safety. Food handlers at these facilities need food safety training in order to prevent food-borne diseases.

4.3.2 FOOD HANDLERS' KNOWLEDGE ON FOOD SAFETY

In appendix J most of the answers correspond with the definition of food safety which refers to the proper handling, preparing, storing of food in a way to best reduce the risk of individuals becoming sick from food borne illnesses (WHO, 2017). Appendix J shows that five food handlers did not know the meaning of food safety. The responses show that food handlers' knowledge on what is food safety is satisfactory. Appendix K shows 63 food handlers out of 65 know and understand that when preparing food they must always wash their hands to prevent contamination and food borne illnesses. 58 food handlers, shown from appendix I know why it is important to wash hands when working with food. Although the other 7 members did not answer this question.

Figure 4.6 represents the response of food handlers on the illness or diseases that are not food borne related.

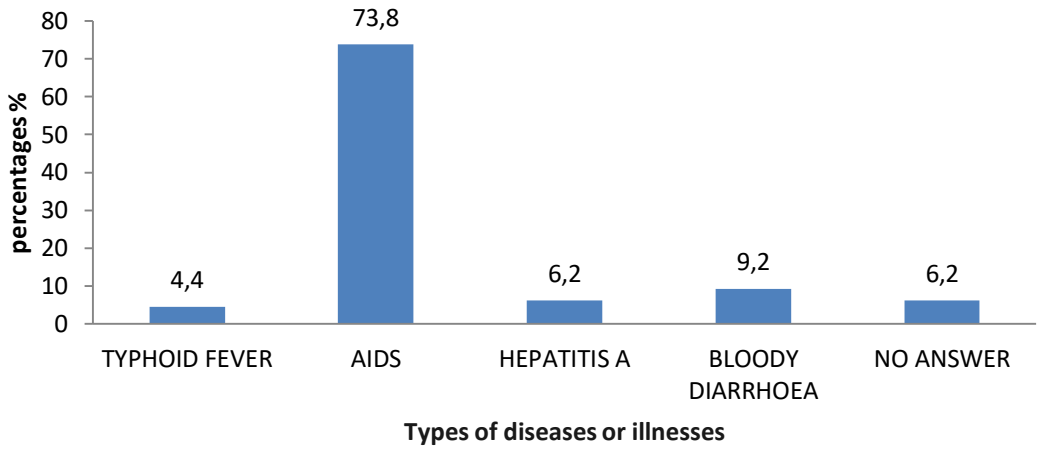

Figure 4.6: Types of diseases reported

Only 74% of food handlers knows that typhoid fever, hepatitis A and bloody diarrhoea are food-borne diseases and 16 % of food handlers do not know that aids is not a food-borne illness or disease. Knowledge of food-borne diseases is important as a food handler because these illnesses are serious and can be fatal. Therefore if food handlers understand signs and symptoms of the food borne illnesses they can be able to help in prevention of spread or cross contamination.

Figure 4.7 represents the response of food handlers on the areas where microbes are found

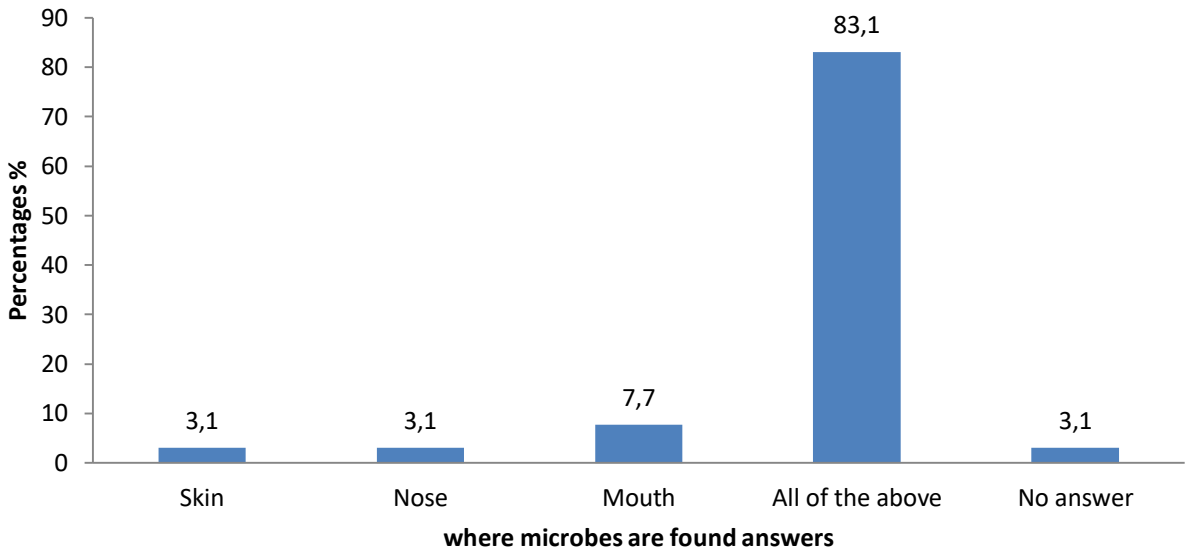

Figure 4.7: Areas where microbes are found

Microbes are found everywhere therefore food handlers are required to know and understand that in all parts of our bodies we can find most harmful microorganisms that can cause illnesses. This can help in bettering their ways in personal hygiene. This will also help them to know that when preparing food if they happen to touch their nose, skin, or mouth they must immediately wash their hands to prevent microbes entering the food. 83% of the food handlers know that microbes can be found in the mouth, nose and skin.

The other 14% have answered either one of the options, either skin, nose or mouth, which means that they only know about microorganisms found in one part of our body, mostly (8%) in the mouth. The other 3% do not know where microbes can be found in our body.

Appendix L shows the response to the question that was asked with regard to the cleaning of their preparation areas. Most of the answers received were answering where they are cleaning and how they are cleaning. Proper cleaning is the removing of unwanted substances, such as dirt, infectious agents and other impurities from an object or environment. Department of Health and public health mentions that proper cleaning can be achieved by using warm water and a detergent. 94% of food handlers know how to clean their preparation areas.

Food handler's knowledge on food poisoning is essential in order to be able to prevent it. Referring to the answers in appendix M 21 food handlers believe that food poisoning occurs when you have eaten expired foodstuffs, others believe that food poisoning is caused by dirty food or foods that contain bacteria or food that causes illness. Few of the food handlers say food poisoning is food that is not refrigerated or not closed. Therefore only 2 food handlers know that food poisoning is an illness or disease that is caused by eating food that contain bacteria. The other 97% of food handlers do not know what food poisoning is, but do know what can cause food poisoning.

Figure 4.8 represents the response of food handlers if reheating of cooked food can contribute to food poisoning.

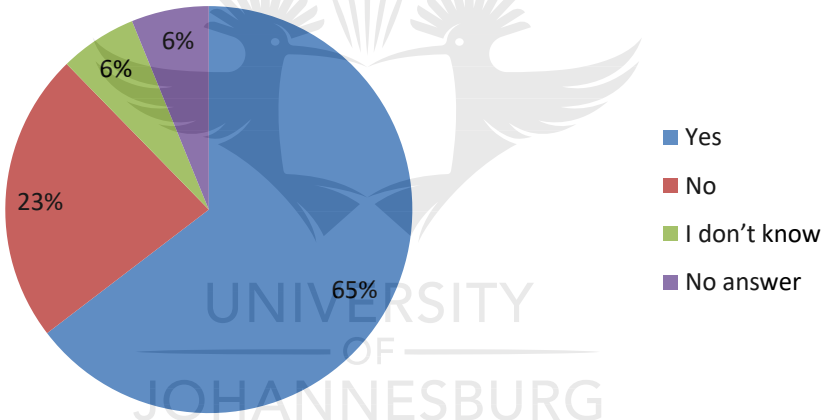

Figure 4.8: Re heating of cooked foods

65 % of food handlers' responded yes reheating cooked food can contribute to food poisoning while 23% said No, 6 % don't know and the other 6% did not answer the question. Appendix N shows **65**% of food handler's say that reheating cooked foods can contribute to food contaminations while the other 15% says this cannot contribute to food contamination. 6% of food handlers do not know and the other 6% have not answered the question.

Table 4.3. Food related bacteria or pathogen food handlers know of:

Table 4.3. Represents responses of food handlers when they had to name any food related bacteria or pathogen you know of:

Food related bacteria answers	Frequency	Percentage
Types of food (chicken,fruits and veg), insects and diarrhoea	14	22
Don't know	38	58
None	13	20

The results show that food handlers do not know any type of food related bacteria. 38(58%) food handlers have answered that they do not know any of the bacteria and 13(20%) food handlers have left blank space on this question. The other 22% of food handlers who have answered they have mentioned the types of food such as potatoes, chicken, tomatoes and other fruits and vegetables. Others have mentioned mosquitoes, diarrhoea and flies.

4.3.3 FOOD HANDLERS' BEHAVIOUR ON FOOD SAFETY

Table 4.4 represents the food handlers' behaviour during to food safety handling.

Table 4.4. Food safety behaviour questionnaire results

Food handling behaviour questions		True	False	Don't know	Total
Well-cooked foods are free of contamination.	Count	55	7	3	65
	%	84.6%	10.8%	4.6%	100.0%
Proper hand hygiene can prevent food-borne diseases.	Count	62	3		65
	%	95.4%	4.6%		100.0%
A closed can/jar of cleaning product can be stored together with closed cans and jars of food products	Count	26	33	6	65
	%	40%	50.7%	9.2%	100.0%

Raw and cooked foods should be stored separately to reduce the risk of food contamination.	Count	39	8	18	65
	%	60%	12.3%	27.6%	100.0%
It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination.	Count	35	7	23	65
	%	53.8%	10.7%	35.3%	100.0%
Defrosted foods can be refrozen.	Count	23	36	6	65
	%	35.3%	55.3%	9.2%	100.0%
The health status of workers should be evaluated before employment.	Count	31	24	10	65
	%	47.7%	36.9%	15.4%	100.0%
The best way to thaw a chicken is in a bowl of cold water.	Count	40	22	3	65
	%	61.5%	33.8%	4.6%	100.0%
Wearing masks, gloves and a cap is an important practice to reduce the risk of food contamination.	Count	55	8	2	65
	%	84.6%	12.3%	1.5%	100.0%
The ideal place to store raw meat in the refrigerator is on the bottom shelf.	Count	44	14	7	65
	%	67.7%	21.5%	10.7%	100.0%

Looking at figure 13 the behaviour of food handlers at day care centres is good. Table 3 shows that 95.4% understand that proper hand washing can prevent food borne diseases while 85% of food handlers have answered that wearing protective clothing in the kitchen is important to reduce the risks of contamination and well cooked foods are free from contamination. 67.7% know that raw meat should be stored at the bottom of the freezer and 61.5% use cold water to thaw chicken. However 49.3 % behaviour is poorer as they say it is not important to separate cleaning chemicals from food. 52.3% mentioned that it is not important to check the health status of workers before they are hired to cook for children at day care centres. 44.6% are saying defrosted food can be frozen while 46.1% said it is not necessary to check the temperature of the refrigerators. There are still 14% of food handlers that do not see wearing protective clothing such as apron and hair nets as necessary and this behaviour may put children at those day care centers at risk of contracting food borne diseases through cross-contamination.

Figure 4.9 shows the correct and incorrect behaviours of food handlers at day care centres.

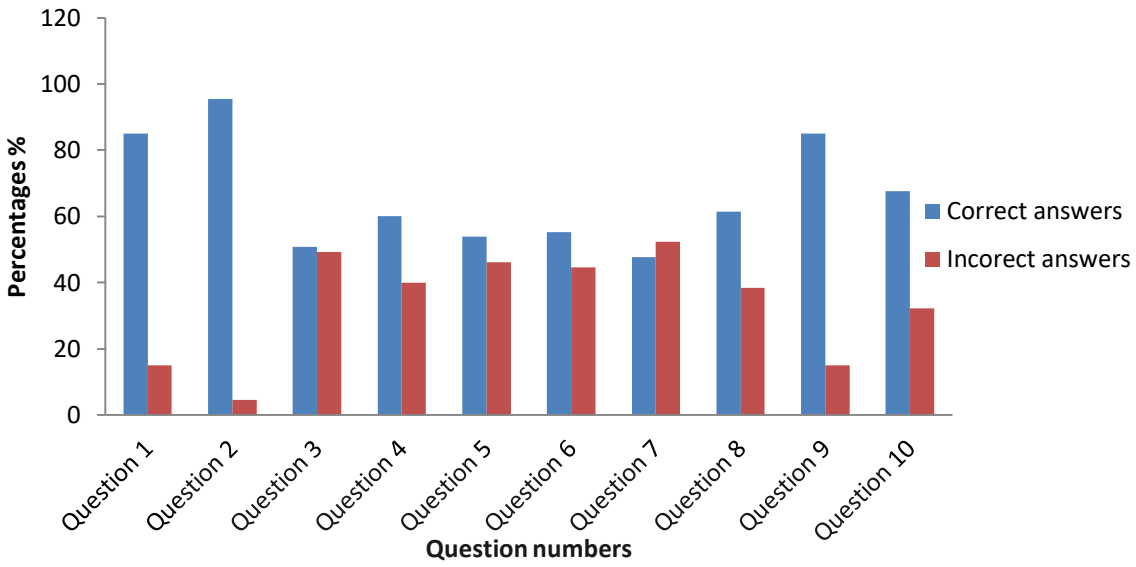

Figure 4.9: The results of food safety behaviour of food handlers in percentages.

Figure 4.10: represents the average percentages of food safety behaviours test written by food handlers.

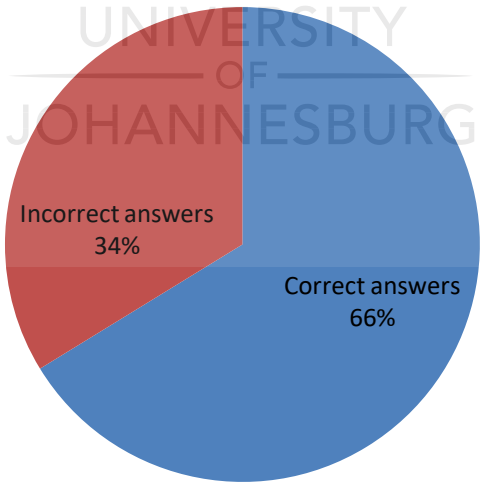

Figure 4.10: The average percentages of food safety behaviours test

Figure 4.10 shows that the behaviour of food handlers at day care facilities is satisfactory but not excellent as there are 34% of food handlers whose behaviour with regard to food safety is very poor and this can put children attending those day care centres at risk of becoming ill with food-borne diseases.

4.3.4 RATING OF FOOD PROVISION BY FOOD HANDLERS

Food handlers were given the opportunity to rate the food provision in the different kitchens they are working in. The responses are shown in table 4.5.

Table 4.5. Rating of food provision

Factors of rating food provision		Very poor	Poor	Average	Good	Excellent	Total
Quantity of food prepared	Count			7	44	11	62
	%			11.3%	71.0%	17.7%	100.0%
Quality of food prepared	Count			3	29	30	62
	%			4.8%	46.8%	48.4%	100.0%
Variety of food prepared	Count			6	22	33	61
	%			9.8%	36.1%	54.1%	100.0%
Amount of time for food preparation	Count	1		8	31	22	62
	%	1.6%		12.9%	50.0%	35.5%	100.0%
Schedule for when children get their food	Count	1		4	20	36	61
	%	1.6%		6.6%	32.8%	59.0%	100.0%
Experience of staff preparing food	Count	1	1	4	33	23	62
	%	1.6%	1.6%	6.5%	53.2%	37.1%	100.0%
Working conditions for staff preparing food	Count	1	2	5	23	31	62
	%	1.6%	3.2%	8.1%	37.1%	50.0%	100.0%
Communication between staff involved in preparing and delivering food	Count		2	4	31	25	62
	%		3.2%	6.5%	50.0%	40.3%	100.0%

On the quantity of food prepared 71% mentioned the quantity was good, 11% said average while 18% said excellent. Quality of food prepared was rated average (4.8%), good (46.8%)

and excellent (48.4%). The amount of time food handlers are given to prepare food was rated very poor by 1.6%, good by 50%, average by 12.9% and 35.5% excellent. Variety of food prepared was rated 9.8% average, 36.1% good and 54.1% excellent. Schedule for when the children get their food was very poor 1.6%, average 6.6%, good 32% and excellent 59%. The experience of staff preparing food was rated very poor by 1.6%, poor by 1.6%, average by 6.5%, good by 53.2% and excellent by 37.1%. Working conditions for staff preparing the food was rated at very poor (1.6%), poor (3.2%), average (8.1%), well (37.1%) and excellent (50%). The communication between the staff involved in preparing food was rated poor by 3.2%, average is 6.5%, good by 50% and excellent by40.3%. These results shows that food handlers are satisfied with the type of food preparation areas they are working at and there is nothing that needs to be improved in terms of food provision.

Figure 4.11 Represents the percentages of Food provision rating in day care centres.

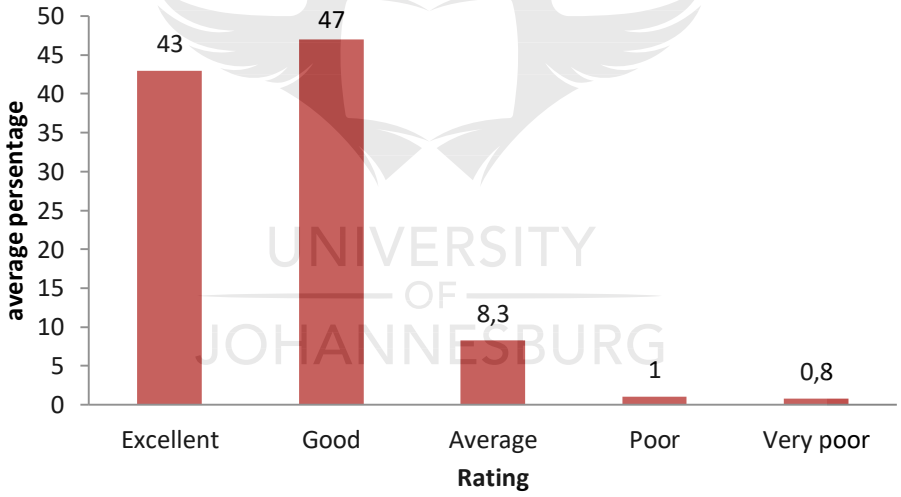

Figure 4.11: Food provision rating

The above table represents the average percentages of food provision in day care centres. 47% of food handlers have rated their kitchen to be good while 0, 8% (very poor) and 1% poor. 8.3% is on average 43% is on good. This shows that most of the kitchens the food handlers are working at are in good condition and the provision of food is also good.

4.4 DISCUSSION OF RESULTS OF MICROBIAL ANALYSES OF FOOD PREPARATION AREAS IN THE DAY CARE CENTRES

Microbes require sufficient amounts of nutrients and suitable growth conditions for their optimal growth. Based on the requirements culture media can be designed and prepared by targeting a specific type of microorganism or a specific category. A culture medium is defined as a solid or liquid preparation designed to support the growth of microorganism. A wide variety of culture media is available to isolate and identify microorganisms in laboratories. For this study blood agar and MacConkey agar were used.

Figure 4.12 represents the microorganisms that were present in food preparation areas of day care centres while using a Deoxycholate citrate agar medium. Deoxycholate Citrate Agar is a modification of Leifson formula and is recommended for the isolation of Salmonella and Shigella sp. Gram positive bacteria and coliforms are inhibited by the addition of sodium desoxycholate and sodium citrate to the formula. (Salfinger & Tortorello, 2015; US Biological Life Science, 2015). Therefore this medium was used for checking presence of *E.coli, Salmonella and Shigela species (pp).*

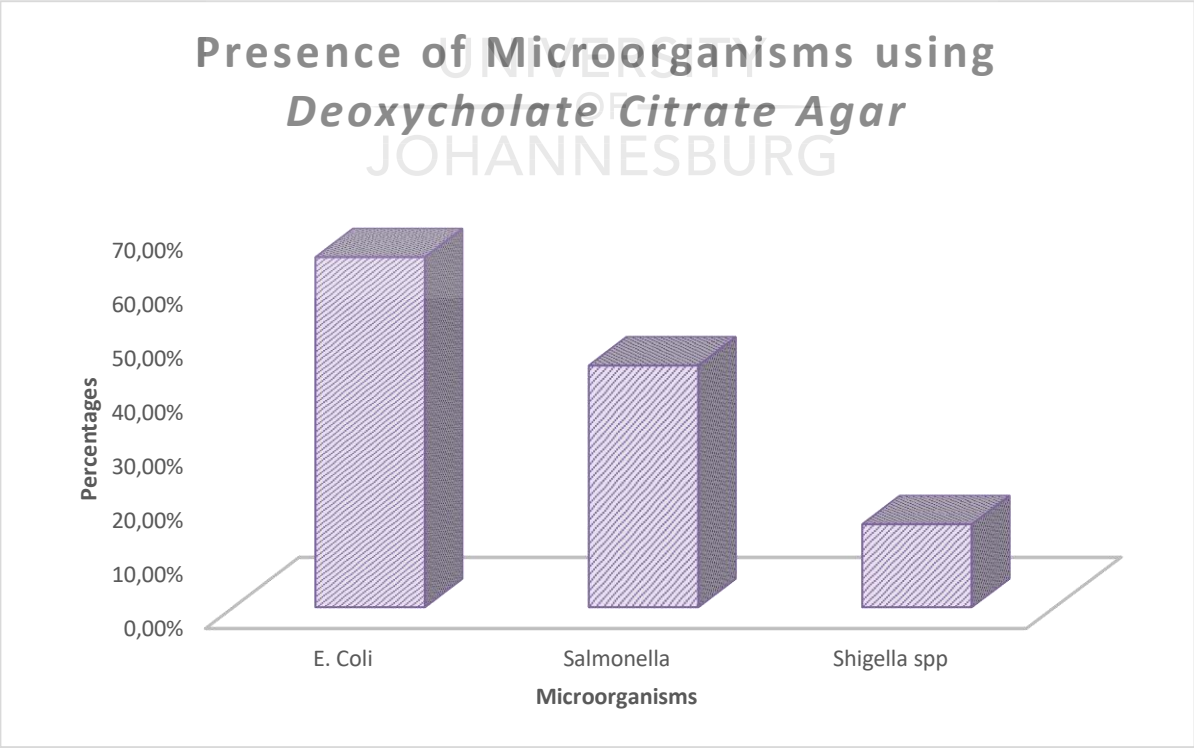

Figure 4.12: Microorganisms that were found using Deoxycholate citrate Agar

The above figure shows that E. coli was present in 64.6% day care centres, salmonella was present in 44.6% day care centres and shigella spp was present in 15.30% day care centres. According to US Department of Health and Human Services (2014), E. coli is the name of a type of bacteria that lives in your intestines. Most types of E. coli can make you sick and cause diarrhea. One type causes travelers' diarrhea. The worst type of E. coli causes bloody diarrhea, and can sometimes cause kidney failure and even death. These problems are most likely to occur in children and in adults with weak immune systems. (DOH, 2014). You can get E. coli infections by eating foods containing the bacteria.

Salmonella Symptoms include fever, diarrhea, abdominal cramps and headache. Salmonella symptoms usually last 4 - 7 days. Most people get better without treatment. It can be more serious in the elderly, infants and people with chronic conditions. If Salmonella gets into the bloodstream, it can be serious, or even life-threatening. (DOH, 2014). Infection with *Shigella* generally is self-limited; the average duration of gastrointestinal symptoms in untreated *Shigella* gastroenteritis is approximately seven days. In the absence of specific antibiotic treatment, children with *Shigella* gastroenteritis shed the organism for up to four weeks; children with immune deficiency shed for much longer periods, even if their symptoms have resolved (Angulo & Swerdlow, 1995; Baer, 1999; Ashkenazi, 2004). To help avoid food poisoning and prevent infection, handle food safely. Cook meat well, wash fruits and vegetables before eating or cooking them, and avoid unpasteurized milk and juices (DOH, 2014).

Figure 4.13 represents the micro organisms that were present when Blood agar medium was used. Blood agar is an enriched, bacterial growth medium. Fastidious organisms, such as streptococci, do not grow well on ordinary growth media. Blood agar is a type of growth medium (*trypticase soya agar enriched with 5% sheep blood*) that encourages the growth of bacteria, such as streptococci, that otherwise wouldn't grow. (Medical Microbiology guide, 2019). Medical Microbiology guide (2019) also mentioned that the blood contains inhibitors for certain bacteria such as *Neisseria* and *Haemophilus* genera and the blood agar must be heated to inactivate these inhibitors and to release essential growth factors (e.g., V factor).

Heating of blood agar converts it into chocolate agar (heated blood turns a chocolate colour) and supports the growth of these bacteria.

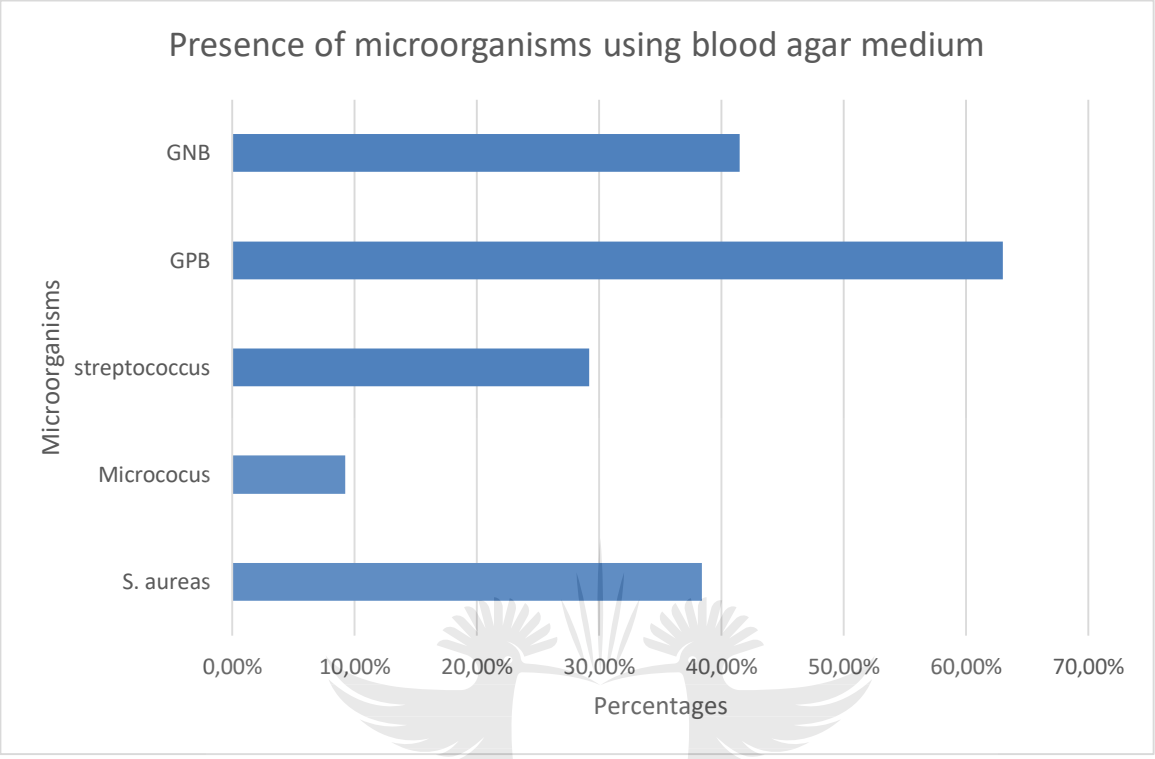

Figure 4.13: Microorganisms that were present using blood agar medium

The Figue show that microorganisms were present in the food preparation areas of day care centres. There was 41.5% of GNB, 63 % GPB, 29.2 % streptococcus, 9.2% Micrococcus and 38.4% of *S. aureus*. These microorganisms are harmful and they can cause illness to children attending day care centres.

S aureus is the most common pathogen causing skin and soft tissue infections (SSTIs) as well as some invasive infections such as osteomyelitis and septic arthritis in children. *S aureus* is also 1 of the most common organisms isolated from children with health care–associated infections, regardless of whether these infections had their onset in the community or were acquired in the hospital (Sheldon, 2016).

Figure 4.14 represents microoganisms that were present in cooking surfaces of day care centres when using a MacConkey medium agar. A MacConkey Agar is used as a selective and

differential medium for the isolation of gram-negative bacilli including coliform organisms and enteric pathogens, on the basis of lactose fermentation. (American Public Health Association, 2004). MacConkey Agar was one of the earliest culture media for the cultivation and identification of enteric organisms and is a modification of Neutral Red Bile Salt Agar developed by MacConkey. It has also been used in the isolation of pathogens from foods and coliforms in water samples. The MacConkey Agar formulation presently in use is a modification where in addition to sodium chloride, the modified formula has a lowered agar content and an adjusted concentration of bile salts and neutral red (American Public Health Association, 2004).

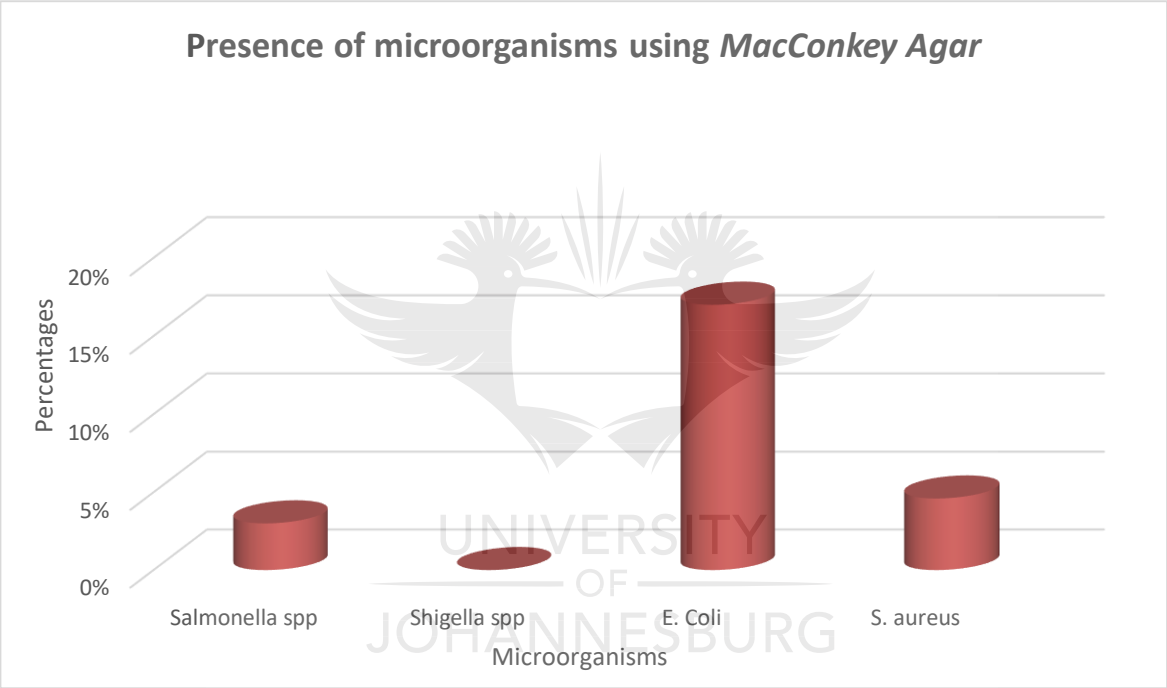

Figure 4.14: Microorganisms that were present using MacConkey Agar

Figure 4.14 shows that the microorganisms that were present while using McConkey agar medium is *Salmonella pp* in 3% of day cares, 17% of day cares contained *E. Coli* and 4.6% of day care centres *S. aureus* was present. Shigella spp were not present in all day care centres of Mbombela when they were using MacConkey agar medium.

Figure 4.15 represents the presence of *C. jejuni* when using oxygen and carbon dioxide.

C. jejuni is a true microaerophilic bacterium; thus, on the one hand it requires oxygen, but on the other hand it cannot grow under normal atmospheric oxygen tension conditions

(Kelly, 2008). The studies indicated that atmospheres containing 5% to 10% oxygen and 1.0% to 10% carbon dioxide are suitable for growth of the various biotypes of thermophilic campylobacters. (Bolton & Coates, 1983). *Campylobacter spp*. are fastidious bacteria, sensitive to desiccation, high/low temperatures and with specific growth requirements (Bolton & Coates, 1983). Therefore in this study the C. Jejuni was analised in the presence of O2 and CO2.

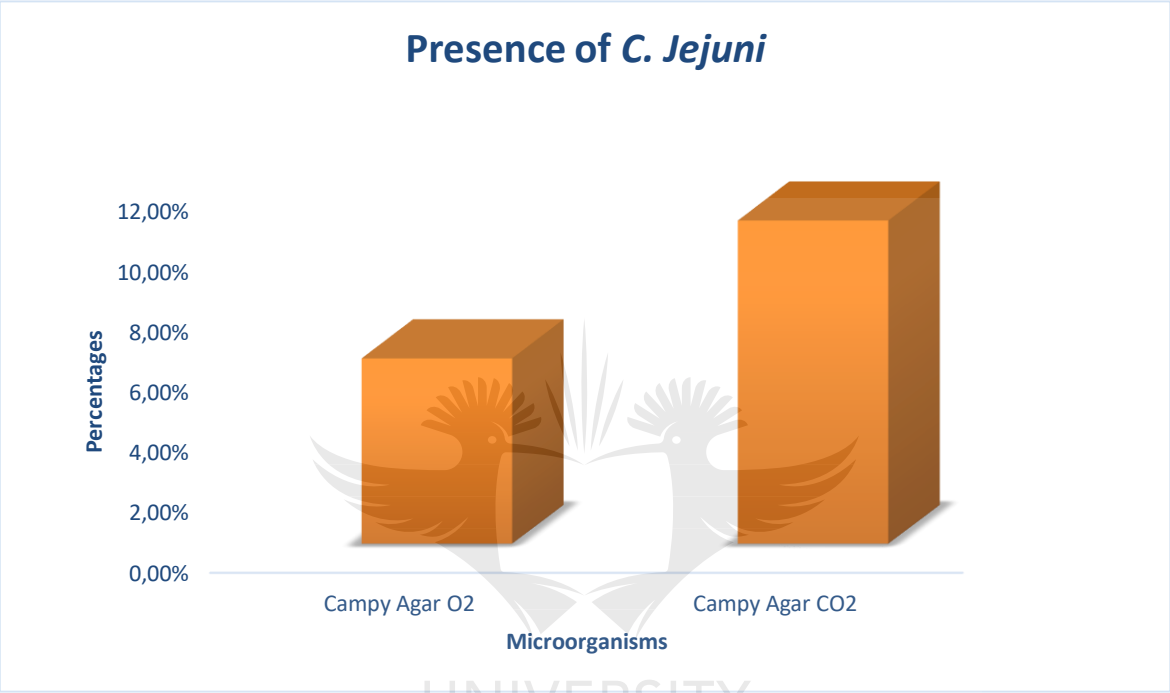

Figure 4.15: Presence of C. jejuni

Figure 4.15 shows that *C. jejuni* was present when tested in the presence of oxygen and in the presence of carbon dioxide. Campy agar O2 was present in 6.15 % day care centres and campy agar CO2 was present in 10.70% day care centres. *Campylobacter* food-borne infections are the most prevalent bacterial enteric infections in humans in industrialized and developing countries (Allos**,** 2001). *Campylobacter jejuni* is a major food-borne pathogen. Despite causing enteritis in humans, it is a well-adapted intestinal microorganism in animals, hardly ever generating disease symptoms.

4.5 CONCLUSION

The first objective was to record real practices that occur in the food preparation areas of day care centres in order to identify potential health hazards that may be associated with each facility. The aim of this objective was to check if day care centres of Mbombela complies with the requirements of the Regulation governing general hygiene requirements of food preparation areas, storage facilities and personal hygiene. It was found that only 17 out of 65 day care centres have complied with all the factors that they were evaluated on. The other 48 (73%) do not comply with all the factors. Only 26% of day care centres of Mbombela are food safety compliant. For kitchen compliance 15 day care centres comply while the other 50 day care centres does not comply. For personal hygiene compliance 40 day care centres complied with all the factors. Only 11 day care centres complied with all factors of storage compliance. This means that children who are attending all the other day care centres are at high risk of contracting food-borne diseases. Mbombela day care centres are at high risk of food poisoning outbreaks as food safety is not taken seriously. This chapter was able to prove its objective of assessing if Mbombela day care centres comply with the requirements of the regulations when coming to kitchen, personal hygiene and storage compliances. Seven to 340 children are at risk of contracting food-borne diseases daily. Environmental Health Practitioners of Mbombela either do not visit these facilities regularly to do inspections to help them comply with the minimum requirements of the regulation, or the people running the day care centres do not understand the risks of compromising food safety.

Food handlers in many settings have been responsible for food-borne disease outbreaks for decades (Greig et al, 2007). Food handlers' knowledge on washing of hands is good. The results also prove what the literature indicates: that food handlers at day care centres did not received any food safety training and their knowledge regarding aspects of food safety such as food poisoning or types of microorganisms is poor. 17% of food handlers are not aware that microorganism can be found in their skin, nose and mouth, while 16% believes that AIDS is a food-borne disease. 12% of food handlers at these day care centres do not have any education at all. The behaviour of food handlers also indicated that there is a high risk of food-borne diseases at 34% of the day care centres. Food safety training is important to help in increasing their level of food safety knowledge and behaviour when cooking for children. There is an urgent need for awareness programmes for food handlers to improve food safety knowledge.

Diarrheal disease contributes substantially to illness and death in children in low-income countries (Lozano et al, 2012; Walker, 2012). Salmonella is the second most common cause of bacterial foodborne disease of known ecology and the single most common cause of death from foodborne illnesses associated with viruses, parasites and bacteria world-wide. (Olsen et al, 2001). These results show that harmful microorganisms that can cause diseases are present in food preparation surfaces of day care centers of Mbombela. *E. coli* was present in 64% of the day care centres that were tested. The test continued showing that *Shigella* spp was not present in the MacConkey agar medium but it was present when Deoxycholate agar medium was used on 15.3% samples. *E. coli* must never be present in food preparation areas as it causes a lot of diarrheal outbreaks and deaths among children. *E. coli* was found to be the highest present microorganism when MacConkey Agar medium was used. 17 % of day care centres' surface areas tested positive for *E. coli*. *E. coli* was again found to be the highest pathogen found when Deoxycholate Agar medium was used (64% of day care centres preparation areas). Therefore children attending day care centres are at high risk of gastro-intestinal diseases and these areas are prone to food-borne disease outbreaks. All the dangerous microorganisms that were tested were present.

CHAPTER 5: SUMMARY, CONCLUSION AND RECOMMENDATIONS

5.1 INTRODUCTION

Previous chapters presented an overview of findings of this study. This chapter will provide the conclusions derived from the findings of this study and the recommendations for the day care centres, food handlers and EHPs to ensure compliance with food safety at all times. These recommendations will also be helpful in preventing foodborne diseases or outbreaks in day care centres of Mbombela.

5.2 SUMMARY OF RESEARCH FINDINGS

a. Objective 1: Evaluation of compliance level in day care centres

The study evaluated the level of compliance of food preparation areas in day care centres. The day care centres were evaluated to ascertain whether they complied with Regulation 638. The intention was to check if their food preparation areas are free from risk and they are hygienically clean. This was checked with three criteria stated in the regulation: kitchen compliance which included the appliances utilized in the kitchen; personal hygiene compliance which included observations during the food preparation time; and food storage compliance which included all the methods that were used during food storage. Therefore it was found that only 26% of day care centres that were evaluated complied with the minimum requirements of the regulation. The other 73% of the day care centres do not comply with all the factors as required by the regulation.

b. Objective 2: Evaluation of food handlers' behaviour and knowledge

This objective was to evaluate the knowledge of food handlers working in day care centres of Mbombela regarding food safety and their behaviour when in the kitchen, this went further to evaluate the provision of food in day care centres. The findings highlight that there is deficiency in terms of food safety training in day care centres as the food safety knowledge was found to

be poor. Only three food handlers had received food safety training; for two of these the training was during their high school days. Twelve percent (12%) of food handlers at these day care centres do not have formal education at all. In areas such as proper cleaning and washing of hands food handlers were found competent. The behaviour of food handlers at day care facilities is satisfactory but not excellent as there are 34% of food handlers whose behaviour regarding food safety is very poor. Food handlers are satisfied with the type of food preparation areas they are working at and there is nothing that needs to be improved in terms of food provision.

c. Objective 3: Evaluation of microbes present in day care centres

Microbes were evaluated in 65 day care centres of Mbombela and microbial swabs were taken from each and every day care centre food preparation areas to analyse for microbes that are present in three medium that were used. The following microbes were present:

1. Blood agar showed *Streptococcus (29.2%), Micrococcus (9.2%), S. aureus (38.4%), GNB (41.5%) and GPB (63%)*
2. MacConkey agar showed *Shigella (0%), E. coli (17%), salmonella (3%), S. aureus (4.6%)*
3. Deoxycholate citrate agar showed *E. coli (64.60%), Salmonella (44.60%) and shigella (15.3%)*
4. *Campylobacter Jejuna* was present with both campy agar O_2 and CO_2

5.3 SIGNIFICANCE OR CONTRIBUTIONS OF THE STUDY

a. Knowledge

This study helped in gaining knowledge about the food safety with regard to compliance level of day care centres, the food safety knowledge and behaviours of food handlers working in day care centres and also the microorganisms that are present in the food preparation areas of the day care centres.

b. To environmental health professionals

There are limited studies that looked into the food safety in day care centrers in South Africa, this study adds to the literature on food safety in day care centres. This study highlights what could be the causes of food related outbreaks in Mbombela and also South Africa.

The findings of microbes present in day care centres add to the literature for future studies. This study can also help to trace the causes if there are outbreaks of food-borne diseases in under 5 children. This study highlights to EHPs that there is a need to be veracious with regard to enforcement of laws in day care centres as the food handlers that are in day care centres do not have sufficient knowledge on food safety.

EHPs of Mbombela will be alerted on how the food preparation in Mbombela day care centres rate in terms of compliance by sharing the results of the study.

5.4 CONCLUSION

This study showed that the Mbombela day care centres that were sampled had an average attendance of 64 children. The maximum number of children enrolled per year is 340 (Table 2.1). In all of the 65 day cares that were sampled only 7 (Figure 7) are funded by the Department of Social Development and 58 are relying on the school fees payable by parents. Some of the day care centres are struggling to buy essentials as the money that they are charging is not enough.

This study achieved the main aim of assessing food safety in day care centres of Mbombela. The three objectives, namely checking compliance levels of food preparation areas in day care centes, evaluating the knowledge and behaviour of food handlers on food safety, and analysing presence of microorganisms in food surface areas in day care centres of Mbombela was also achieved. Although food handlers had adequate knowledge on food safety, they have not received any food safety training and their knowledge regarding aspects of food safety such as

food poisoning and types of microorganisms is poor. This has a bad impact on their behaviour regarding food safety and contributes to unhygienic practices.

Mbombela day care centres' food preparation areas do not comply with minimum requirements of the regulations. Non-compliance with the requirements of the regulations poses a health threat to the children as their immune system is weak and any unhygienic conditions can make them sick easily. All food preparation areas of South Africa must comply with the requirements of the regulations. Unhygienic practices by food handlers must be evaluated and monitored. Harmful microorganism were present in the food preparation areas of Mbombela day care centres. This shows that the standard of hygiene is not good since their cleaning is not done properly. These harmful microorganisms can cause diseases from food poisoning or even death. Outbreaks will continue to happen if the food safety behaviour and knowledge of food handlers in day care centres of Mbombela is not improved.

5.5 FUTURE RESEARCH

The following future research can be considered:

a. An analyses of microbial presence in ready-to-eat foods in day care centresr to evaluate the risk of food-borne pathogenic bacteria.

b. An assessment of the microbiological quality of potable water used in day care centres as water is a potential source of contamination during the preparation of foods.

c. Evaluation of hygiene and sanitation in day care centres.

5.6 RECOMMENDATIONS

Tan et al., (2013) highlighted that food handlers' adherence to good manufacturing practice and sanitation standard operating procedures is insufficient to completely prevent food safety hazards. Sala et al., (2005) mentioned that food handlers play an important role as they could be sources of contamination. They could also cross-contaminate food during its preparation and distribution (Sala et al., 2005). Food can be contaminated by dirty hands if there is lack of proper hygiene practices among food handlers (Gorman et al., 2002; Dharod et al., 2009). Food handlers must adhere to practicing safe food always to prevent contamination and food safety hazards.

The following recommendations are made based on the findings of the study:

- Food hygiene can be best promoted by educating the food handlers and day care owners about personal hygiene and the importance of food safety on a quarterly basis.
- Environmental Health Practitioners must evaluate all the day care centres to check if they meet the minimum requirements and, if not, reports can be generated about the aspects that need to be corrected, within the relevant time frame.
- Regular follow-up of day care centres not meeting the requirements is essential as a way of monitoring aspects that needs to be corrected.
- Educating food handlers on proper cleaning procedures can also help to minimize the harmful microorganisms that are present in their food preparation areas.
- Awareness programmes for food handlers to improve food safety knowledge and behaviour.
- Issuing of certificates after training conducted to be able to track when day care centres hire a new food handler.
- Ehlanzeni Municipality to draft Bylaws for day care centres and make sure all day cares abide by them.

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APPENDIX A

FOOD SAFETY KNOWLEDGE QUESTIONNAIRE

Section A: Demographics

1. Gender: Female ☐ Male ☐

2. What is your age in years?: __ __ years

3. Have you had any formal food safety training?: Yes ☐ No ☐

4. If 'Yes' A3 briefly describe this formal training (What training? Where? How long?):

_____

5. What is your highest educational level achieved?

No education ☐ Completed primary school ☐ Completed high school ☐ Higher education ☐

Section B: Food safety

1. In your opinion what is meant by 'food safety'? _____
   _____
   _____
   _____
   _____

2. Does washing hands before preparing food reduce the risk of food contamination?

   Yes ☐ No ☐

   Please explain._____
   _____
   _____
   _____

3. Which of the following illnesses/diseases is NOT food borne? (circle your choice)

A: Typhoid fever

B: AIDS

C: Hepatitis A

D: Bloody diarrhoea

4. Where can microbes be found? (circle your choice)

   A: Skin

   B: Nose

   C: Mouth

   D: All of the above

5. In your opinion what does 'proper cleaning' refer to? _____

   _____

   _____

   _____

   _____

6. What is food poisoning? _____

   _____

   _____

   _____

7. Can reheating cooked foods contribute to food contamination and why? _____

   _____

   _____

   _____

   _____

8. Name any food related bacteria or pathogen you know of: _____

   _____

   _____

C: FOOD SAFETY BEHAVIOUR	TRUE	FALSE	DO NOT KNOW
1. Well-cooked foods are free of contamination.			
2. Proper hand hygiene can prevent food-borne diseases.			
3. A closed can/jar of cleaning product can be stored together with closed cans and jars of food products			
4. Raw and cooked foods should be stored separately to reduce the risk of food contamination.			
5. It is necessary to check the temperature of refrigerators/freezers periodically to reduce the risk of food contamination.			
6. Defrosted foods can be refrozen.			
7. The health status of workers should be evaluated before employment.			
8. The best way to thaw a chicken is in a bowl of cold water.			
9. Wearing masks, gloves and a cap is an important practice to reduce the risk of food contamination.			
10. The ideal place to store raw meat in the refrigerator is on the bottom shelf.			

Rating of food provision

Please rate this kitchen on each of the following:	Very poor	Poor	Average	Good	Excellent
Quantity of food prepared					
Quality of food prepared					
Variety of food prepared					
Amount of time for food preparation					

Schedule for when children get their food					
Experience of staff preparing food					
Working conditions for staff preparing food					
Communication between staff involved in preparing and delivering food					

APPENDIX B

OBSERVATION CHECKLIST FOR COMPLIANCE IN TERMS OF REGULATION 638

Funding sources : _____

1. Number of children:_____

1. KITCHEN COMPLIANCE	YES	NO
a. Kitchen provided?		
b. Hand wash basin provided?		
c. Cold and hot water available?		
d. Stainless steel table where food prepared?		
e. Adequate waste disposal?		
f. Utensils cleaned after use?		
Remarks		

2. PERSONAL HYGIENE COMPLIANCE	YES	NO
a. Do food handlers wash hands with clean water before handling food?		
b. Food handler‘s clothes are clean and presentable?		
c. Food handlers are wearing an apron when handling food?		
d. Food handler’s hair is covered when handling food?		
e. Food handler’s nails are short and clean?		

f. Food handlers are wearing jewellery? g. If yes question above, jewellery is covered when preparing food?		
Remarks		

3. FOOD STORAGE COMPLIANCE	YES	NO
a. Raw, partially cooked and cooked food products are stored separately?		
b. Previously cooked food is kept cool (ice box or refrigerated)?		
c. Foods are stored directly on the floor?		
d. The refrigerator is maintained below 7 degree Celsius?		
Remarks		

APPENDIX C

health
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

MPUMALANGA
THE PLACE OF THE RISING SUN

No.3, Government Boulevard, Riverside Park, Ext. 2, Mbombela, 1200, Mpumalanga Province
Private Bag X11285, Mbombela, 1200, Mpumalanga Province
Tel I: +27 (13) 766 3429, Fax: +27 (13) 766 3458

Litiko Letemphilo | Departement van Gesondheid | UmNyango WezeMaphilo

Letter of Support Signed by Chief Director (CD)/CEO/District Manager (DM)/Programme Manager (PM)

1. Name & contact no. of Applicant	DILELEDI SEABELA 072 285 1948		
2. Title of Study:	ASSESSMENT OF FOOD SAFETY HAZARDS AMONG DAY CARE CENTRES IN MBOMBELA, RSA.		
3. Aim and population target:	TO ASSESS FOOD SAFETY HAZARDS ASSOCIATED WITH SELECTED DAY CARE CENTRES IN MBOMBELA.		
4. Period to undertake the study	**From:** 2017/07/01 **to:** 2018/07/01		
5. Resources Required from Facility/Sub-district/Community			
5.1: Facility Staff Required to assist with the Study	**Yes** **How many:** Nurses: Doctors: Other, please specify:		**NO** X
5.2: Patient Records/Files	**Yes**		**NO** X
5.3: Interviewing Patient at Facilities	**Yes**		**NO** X
5.4: Interviewing Patients at Home	**Yes**		**NO** X
5.5: Resource Flow (Are there benefits to Patients/community)	**Yes** Please list:		**NO** X
5.6: Resource Flow (Are there benefits to Facility/District)	**Yes** ✓ Please list: FOOD SAFETY HAZARDS		**NO**
6. Availability of Required Clearance			
6.1: Ethical Clearance	**Yes** Clearance Number:	**Pending** X	**NO**
6.2: Clinical Trial	**Yes** Clearance Number:	**Pending**	**NO**
6.3: Vaccine Trial	**Yes** Clearance Number:	**Pending**	**NO**
6.4: Budget	**Yes** Source of fund:		**NO** X

Declaration by Applicant:
I Mr/Ms/Dr/Prof/Adv. M.D.L SEABELA agree to submit/present the result of this study back to the CEO/Institution/District.

Comment by CEO/CD/DM/PM: **Supported / Not Supported**
conducting of the study is supported and the results should be shared c Dept of Health.

Signature of CEO/CD/DM/PM
Name: D MPHAHLELE

Stamp/Date: 22/06/2017

DEPARTMENT OF HEALTH
EHLANZENI DISTRICT
2017 -06- 22
PRIVATE BAG X 11278
66 ANDERSON STREET, NELSPRUIT, 1200
MPUMALANGA PROV GOVERNMENT

Please email completed form to: JerryS@mpuhealth.gov.za **or** ThembaM@mpuhealth.gov.za

MPUMALANGA
THE PLACE OF THE RISING SUN

APPENDIX: D

social development
MPUMALANGA PROVINCE
REPUBLIC OF SOUTH AFRICA

Building 3, NO. 7 Government Boulevard, Riverside Park, Mbombela, 1200
Mpumalanga Province, Private Bag X 11213, Mbombela, 1200
Tel: +27 (13) 766 3428, Fax: +27 (13) 766 3456/57

Litiko Letekutfutfukisa Tenhlalakahle | UmNyango WezokuThuthukiswa KwezokuHlalokuhle | Departement van Maatskaplike Ontwikkeling

Enq : MS DS MALINGA
Te : 013 7663627
Ref : 11/8/3/3R

TO : **ALL ECD CENTRE MANAGERS MBOMBELA MUNICIPALITY**

FROM : **MS DS MALINGA MANAGER ECD AND PARTIAL CARE**

DATE : **21 JUNE 2017**

SUBJECT : **PERMISSION TO CONDUCT RESEARCH IN MBOMBELA**

The bearer of this letter is an employee of the South African Defense Force, working for military environmental health. She has been granted permission to conduct research on food safety at the Day Care centre as part of her Masters degree. You are therefore requested to cooperate with her and grant her permission to accesss the food preparation rooms and answer all her questions. Any information collected will be kept as confidential as possible by her.

Note that the purpose for the research is soley for her educational studies.

Your cooperation will be highly valued.

Doreen Malinga
ECD and partial care Manager

MPUMALANGA
THE PLACE OF THE RISING SUN

APPENDIX E

RESEARCH STUDY INFORMATION LETTER

07 June 2017

Good Day

My name is DIKELEDI SEABELA **I WOULD LIKE TO INVITE YOU TO PARTICIPATE** in a research study on assessing food safety hazards among day care centres in Mbombela, Mpumalanga.

Before you decide on whether to participate, I would like to explain to you why the research is being done and what it will involve for you. **I will go through the information letter with you and answer any questions you have.** This should take about 30 minutes. The study is part of a research project being completed as a requirement for a Master's Degree in Environmental Health through the University of Johannesburg.

THE PURPOSE OF THIS STUDY is to assess food safety hazards among day care centers of Mbombela.

Below, I have compiled a set of questions and answers that I believe will assist you in understanding the relevant details of participation in this research study. Please read through these. If you have any further questions I will be happy to answer them for you.

DO I HAVE TO TAKE PART? No, you don't have to. It is up to you to decide to participate in the study. I will describe the study and go through this information sheet. If you agree to take part, I will then ask you to sign a consent form.

WHAT EXACTLY WILL I BE EXPECTED TO DO IF I AGREE TO PARTICIPATE? Complete or mark with a cross where applicable and write eligibly in the case of open-ended

questions. Participants will be expected to answer the questions truthfully and are discouraged from consulting colleagues, the internet or any source of information.

WHAT WILL HAPPEN IF I WANT TO WITHDRAW FROM THE STUDY? If you decide to participate, you are free to withdraw your consent at any time without giving a reason and without any consequences. If you wish to withdraw your consent, you must inform me as soon as possible.

IF I CHOOSE TO PARTICIPATE, WILL THERE BE ANY EXPENSES FOR ME OR PAYMENTDUE TO ME: you will not be paid to partake in the study and you will not bear any expenses.

RISKS INVOLVED IN PARTICIPATION: There are no risks associated with the study. The only inconvenience might come from the time you will spend completing the questionnaire.

BENEFITS INVOLVED IN PARTICIPATION: There are no direct benefits to be gained from this study immediately; the data from this study will be used only for the purpose of the study. (Master dissertation)

WILL MY PARTICIPATION IN THIS STUDY BE KEPT CONFIDENTIAL? Yes. Names on the questionnaire/information sheet will be removed once analysis starts. All data and back-ups thereof will be kept in password protected folders and/or locked away as applicable. Only I or my research supervisor will be authorised to use and/or disclose your anonymous information in connection with this research study. Any other person wishing to work with your anonymous information as part of the research process (e.g. an independent data coder) will be required to sign a confidentiality agreement before being allowed to do so.

WHAT WILL HAPPEN TO THE RESULTS OF THE RESEARCH STUDY? The results will be written into a research report that will be assessed. In some cases, results may also be published in a scientific journal. In either case, you will not be identifiable in any documents, reports or publications. You will be given access to the study results if you would like to see them, by contacting me.

WHO IS ORGANISING AND FUNDING THE STUDY? The study is being organised by me, under the guidance of my research supervisor at the Department of Environmental Health in the University of Johannesburg. This study has not received any funding.

WHO HAS REVIEWED AND APPROVED THIS STUDY? Before this study can be allowed to start, it will be reviewed in order to protect your interests. This review will be done first by the Department of Environmental Health, and then secondly by the Faculty of Health Sciences Research Ethics Committee at the University of Johannesburg. In addition, the Mpumalanga Department of Health Research Committee will approve that the study take place in Mbombela.

WHAT IF THERE IS A PROBLEM? If you have any concerns or complaints about this research study, its procedures or risks and benefits, you should ask me. You should contact me at any time if you feel you have any concerns about being a part of this study. My contact details are:

Dikeledi Seabela

072 2851948/013 756 2458

dkseabela@gmail.com

You may also contact my research supervisors:

Ms Charlotte Mokoatle 082 461 0034

Chalottem@uj.ac.za

If you feel that any questions or complaints regarding your participation in this study have not been dealt with adequately, you may contact the Chairperson of the Faculty of Health Sciences Research Ethics Committee at the University of Johannesburg:

_____Name_____

_____Contact Number____

_____Email_____

FURTHER INFORMATION AND CONTACT DETAILS: Should you wish to have more specific information about this research project information, have any questions, concerns or complaints about this research study, its procedures, risks and benefits, you should communicate with me using any of the contact details given above.

APPENDIX F

RESEARCH CONSENT FORM FOR DAY CARE OWNER

Assessment of Food safety hazards among day care centers in Mbombela, Republic of South Africa

Please initial each box below:

☐ I confirm that I have read and understand the information letter dated 07 June 2017 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐ I understand that my participation is voluntary and that I am free to withdraw from this study at any time without giving any reason and without any consequences to me.

☐ I agree to take part in the above study.

Name of Participant	Signature of Participant	Date
Name of Researcher	Signature of Researcher	Date

APPENDIX G

RESEARCH CONSENT FORM FOR DAY CARE FOOD HANDLERS

Assessment of Food safety hazards among day care centers in Mbombela, Republic of South Africa

Please initial each box below:

☐ I confirm that I have read and understand the information letter dated 07 June 2017 for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

☐ I understand that my participation is voluntary and that I am free to withdraw from this study at any time without giving any reason and without any consequences to me.

☐ I agree to take part in the above study.

_____	_____	_____
Name of Participant	Signature of Participant	Date
_____	_____	_____
Name of Researcher	Signature of Researcher	Date

APPENDIX H

DEPARTMENT OF ENVIRONMENTAL HEALTH
DEPARTEMENT OMGEWINGSGESONDHEID

RESEARCH STATISTICS

This serves to confirm that the following student has discussed the research methodology with me as the supervisor, and as such may consult with STATKON regarding the statistical analysis of the research.

Research Title: ASSESSMENT OF FOOD SAFETY HAZARDS AMONG DAY CARE CENTRES IN MBOMBELA, SOUTH AFRICA.

Student Name: MOSIMA DIKELEDI LAWRENCIA SEABELA

Supervisor: CHARLOTTE MOKOATLE

Contact number: 072 285 1948

Signed: Seabela. Date: 7/08/2017.

This serves to confirm that the abovementioned student has discussed the relevant statistical analysis of the data that will be collected during the proposed research, with STATKON.

Statistician Name: DR RICHARD DENEY

Signed: Date: 7/08/2017

OFFICIAL ADDRESS I Cnr Kingsway and University Road Auckland Park
PO Box 524 Auckland Park 2006 I Tel +27 11 559 4555 I www.uj.ac.za
Auckland Park Bunting Campus I Auckland Park Kingsway Campus
Doornfontein Campus I Soweto Campus

APPENDIX I

Supplimentary data 1: Responses from food handlers: In your opinion what is meant by 'food safety'?

Responses from food handlers: In your opinion what is meant by 'food safety'?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Clean foods	1	1.5	1.7	1.7
	Beans potatoes and carrots	1	1.5	1.7	3.3
	Clean	3	4.6	5.0	8.3
	Clean and healthy food	1	1.5	1.7	10.0
	Clean food	5	7.7	8.3	18.3
	Clean food that does not have germs	1	1.5	1.7	20.0
	Clean food wash hands before you come to work	1	1.5	1.7	21.7
	Clean foods	1	1.5	1.7	23.3
	Cooked right	1	1.5	1.7	25.0
	Food prepared in a clean place	1	1.5	1.7	26.7
	Food safety is cooking food that is fresh and clean see that the food is not expired	1	1.5	1.7	28.3
	Food safety is food that is safe and does not has poison	1	1.5	1.7	30.0
	Food safety is where we kept our food clean all the time and look expiry day of the food always before we cook	1	1.5	1.7	31.7
	Food safety means good dietic food with vitamins which keeps the children healthy an d the children to grow	1	1.5	1.7	33.3
	Food safety most stay in a clean place check expirying date check if the place is cool where its placed	1	1.5	1.7	35.0

Food safety to me is basically clean and healthy food	1	1.5	1.7	36.7
Food that are clean and healthy	1	1.5	1.7	38.3
Food that are safe	1	1.5	1.7	40.0
Food that are safe and have vitamns and are healthy	1	1.5	1.7	41.7
Food that are safe to eat and are healthy	1	1.5	1.7	43.3
Food that is good for children and healthy e.g. beans	1	1.5	1.7	45.0
Food that is safe	1	1.5	1.7	46.7
Fresh food	1	1.5	1.7	48.3
Healthy food fruits and vegetables	1	1.5	1.7	50.0
Healthy food that is clean	1	1.5	1.7	51.7
How to handle your kitchen and the cleanliness of your kitchen I must also know the food I cook each and everyday	1	1.5	1.7	53.3
If you cooked food must cover your hair wash hands use clean propart clean that place you use that time	1	1.5	1.7	55.0
Wash hands, cut nails and wear on your head	1	1.5	1.7	56.7
In my opinion I prefer healthy food and cleanliness in the kitchen and good safety	1	1.5	1.7	58.3
Is clean and healthy food	1	1.5	1.7	60.0
Is the food that are good for the children	1	1.5	1.7	61.7
Is to make sure that everything that I use before cooking is clean and make sure of my food expiry date	1	1.5	1.7	63.3
Iseationg fresh food which are clean and healthy	1	1.5	1.7	65.0
It is basically clean and healthy food	1	1.5	1.7	66.7
It is clear and safe food	1	1.5	1.7	68.3

It is how you place your food how you prepare and how is the environment you work in or the kitchen safety	1	1.5	1.7	70.0
It is to cook clean healthy and nice food	1	1.5	1.7	71.7
It is when you make sure that food are in safe condition and do not have poison	1	1.5	1.7	73.3
It means that you must always put your food up to standard	1	1.5	1.7	75.0
It means you must cook healthy food because children always need healthy food	1	1.5	1.7	76.7
It meant to be in a good place and health environment	1	1.5	1.7	78.3
You must wash hands when dishing food for childrend and wear on your head	1	1.5	1.7	80.0
Making sure that food are in a safe place	1	1.5	1.7	81.7
Refrigerated fresh and clean	1	1.5	1.7	83.3
Sigeza ntandla sijobe tigalo kanye nekugcoka ehloko	1	1.5	1.7	85.0
Storing food in a right way e.g. in refrigerator preparing food in a clean area	1	1.5	1.7	86.7
To keep food clean fresh not mixing with poisonous substances	1	1.5	1.7	88.3
To make sure that the fod is clean and to check the expiry date on the food	1	1.5	1.7	90.0
Wash and clean food	1	1.5	1.7	91.7
We must wash our hands before eating or preparing cover the food store the food in the right place	1	1.5	1.7	93.3
When preparing food in a safe and proper manner	1	1.5	1.7	95.0
When we put food in a safe place	1	1.5	1.7	96.7

	You must first wash your hands before preparing food cover your head with your hat you must always keep your kitchen clean	1	1.5	1.7	98.3
	Your food must be clean and pot dish kitchen plates	1	1.5	1.7	100.0
	Total	60	92.3	100.0	
Missing		5	7.7		
Total		65	100.0		

APPENDIX J

Supplimentary data 2: Why does washing of hands important responses

Why does washing of hands important responses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Because if you dont wash your hands you can touch food and that thing is wrong always hands must be clean	1	1.5	1.7	1.7
	Because is the first thing to do for preventing diseases and illnesses	1	1.5	1.7	3.4
	Because sometimes you go to the toilet after using toilet you must wash hands	1	1.5	1.7	5.2
	Because we get more germs when we go to toilets or when Iam cleaning outside	1	1.5	1.7	6.9
	Because we must always wash hands before or after preparing food	1	1.5	1.7	8.6
	Because we must wash our hands before preparing food it is good for hygiene	1	1.5	1.7	10.3
	Because when you dont wash your hands you may put germs in the food when you cook	1	1.5	1.7	12.1
	Because when you start cooking you must wash hands because dirty hands are not healthy	1	1.5	1.7	13.8
	Because when you wash hands using soap all germs are washed away	1	1.5	1.7	15.5
	Because you touch lot of things that has bacteria and may infect people	1	1.5	1.7	17.2
	Coming from toilet	1	1.5	1.7	19.0
	Every time wash hands before preparing food is very important because reduce sickness or diseases	1	1.5	1.7	20.7
	Germs are washed away and the food like vegetables needs also to be washed	1	1.5	1.7	22.4

I must always wash my hands before starting cooking not just to wash but always do it when I touch my food	1	1.5	1.7	24.1
I must be a good cooking in to the place because children a must be health and strong	1	1.5	1.7	25.9
I use warm water and soap always even when I came from the toilet	1	1.5	1.7	27.6
If you do not wash hands you will get bacteria and get sick due to many infections	1	1.5	1.7	29.3
If you dont wash hands nails especially carry more than million of germs	1	1.5	1.7	31.0
If you wash your hands before preparing food you reduce the risk because all your stuff would be clean	1	1.5	1.7	32.8
It is good to wash our hands before preparing our food all the time because the risk of germs become lower	1	1.5	1.7	34.5
It is important to wash hands so that when you touch many things that has germs you do not transfer to other people	1	1.5	1.7	36.2
It is important to wash your hands due to the fact that you touch lot of materials that is containminated so you have to wash your hands to reduce the spread	1	1.5	1.7	37.9
It will help reduce bacteria from increasing and will reduce sicknesses	1	1.5	1.7	39.7
It will help to reduce the danger of getting sickness like cholera to people	1	1.5	1.7	41.4
Its always right to wash hands before handling food to avoid spreading germs	1	1.5	1.7	43.1
Its importantto be safe to prevent diseases	1	1.5	1.7	44.8
So that children can be safe from illnesses	1	1.5	1.7	46.6

Many diseases are found on materials that are touch and can pass to other people by hands	1	1.5	1.7	48.3
No germs	1	1.5	1.7	50.0
No germs and keep them clean	1	1.5	1.7	51.7
Not to take dirt from toilet to the mouth and eat them	1	1.5	1.7	53.4
Preventing germs	1	1.5	1.7	55.2
Remove germs	1	1.5	1.7	56.9
So food does not get germs	1	1.5	1.7	58.6
So kids cannothave diseases	1	1.5	1.7	60.3
So that germs and bacteria do not get into food	1	1.5	1.7	62.1
So that you do not get sick and you do not transfer dirt to other people	1	1.5	1.7	63.8
So that you prepare healthy and clean food	1	1.5	1.7	65.5
Washing hands when cooking food and cleaning properly	1	1.5	1.7	67.2
There would be diseases through the food which are been eaten by the children	1	1.5	1.7	69.0
To avoid dirt from getting to other people	1	1.5	1.7	70.7
To be able to touch food one must wash hands continuously	1	1.5	1.7	72.4
To keep clean	1	1.5	1.7	74.1
To kill germs	2	3.1	3.4	77.6
To make sure food is clean and no poison	1	1.5	1.7	79.3
To prevent diseases especially after toilet	1	1.5	1.7	81.0
To prevent germs	1	1.5	1.7	82.8
To prevent germs when coming from toilets	1	1.5	1.7	84.5
To prevent illness	1	1.5	1.7	86.2
To protect children from germs and bacteria	1	1.5	1.7	87.9
To protect germs	2	3.1	3.4	91.4

	We have germs to prevent them	1	1.5	1.7	93.1
	When we coming from toilet so kids does not eat dirty food	1	1.5	1.7	94.8
	Yes because clean hands will not transfer bacteria to food	1	1.5	1.7	96.6
	Yes because it prevent people from getting any diseases	1	1.5	1.7	98.3
	Yes due to the fact that when you touch dirty things will get bacteria and you have to wash hands	1	1.5	1.7	100.0
	Total	58	89.2	100.0	
Missing		7	10.8		
Total		65	100.0		

APPENDIX K

Supplimentary data 3: In your opinion what does 'proper cleaning' refer to?

In your opinion what does 'proper cleaning' refer to?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	A proper cleaning always must be neat we must keep our place clean always we must always used things to clean like Domestos	1	1.5	1.6	1.6
	By cleaning properly using clean water	1	1.5	1.6	3.3
	By proper cleaning I refer to cleaning dusting dusting dust and disinfecting the area	1	1.5	1.6	4.9
	Cean floor dishes and pots	1	1.5	1.6	6.6
	Clean all places	1	1.5	1.6	8.2
	Clean windows fridges dishes glasses pots and rinse	1	1.5	1.6	9.8
	Cleaning all areas	1	1.5	1.6	11.5
	Cleaning all areas in the kitchen	1	1.5	1.6	13.1
	Cleaning all the places	1	1.5	1.6	14.8
	Cleaning clean and removing all dirt	1	1.5	1.6	16.4
	Cleaning cupboards dishes floors etc	1	1.5	1.6	18.0
	Cleaning cupboards on top of tables everywhere and the floor	1	1.5	1.6	19.7
	Cleaning properly using detergents	1	1.5	1.6	21.3
	Cleaning your kitchen with germ killers clean food shelves clean stove keep your kitchen utensils clean and dry cleaning drills	1	1.5	1.6	23.0
	Dust wash dishes mopping	1	1.5	1.6	24.6
	Dusting and moping washing dishes	1	1.5	1.6	26.2
	First start with dust and sweep the floor after take water soap and mop and moping all over and that is the proper cleaning	1	1.5	1.6	27.9

Good care and healthy	1	1.5	1.6	29.5
I don't know	2	3.1	3.3	32.8
I must always clean myself before I make the childrens food every time	1	1.5	1.6	34.4
Is when you clean dust and wash the walls and floors	1	1.5	1.6	36.1
It is cleaning the entire place using detergents like soap and bleach to kill germs	1	1.5	1.6	37.7
It means cleaning properly using clean water and clean utensils	1	1.5	1.6	39.3
It means sweeping dusting and scrubing the floor washing dishes and cleaning cupboards	1	1.5	1.6	41.0
It refers to a healthy environment and safety place	1	1.5	1.6	42.6
It refers to cleaning thoroughly everyday	1	1.5	1.6	44.3
It refers to cleaning thoroughly scrubing sweeping and polishing	1	1.5	1.6	45.9
It refers to cleaning washing and dusting the entire area	1	1.5	1.6	47.5
It refers to cleanliness and hygienic	1	1.5	1.6	49.2
It refers to that you must always clean your surroundings	1	1.5	1.6	50.8
It refers to the cleaning which have been prepared e.g. spring cleaning	1	1.5	1.6	52.5
Its when everything is spick-and-span	1	1.5	1.6	54.1
Keeping the place clean moping dusting washing windows	1	1.5	1.6	55.7
Kitchen and kitchen utensils	1	1.5	1.6	57.4
You must wet the floors with water and mop	1	1.5	1.6	59.0
We must clean proper everywhere in the kitchen, pots, floors	1	1.5	1.6	60.7

You must wash hands before cooking and feeding children and wear something on your head	1	1.5	1.6	62.3
Moping	1	1.5	1.6	63.9
Proper cleaning is cleaning making sure that place is completely clean and no leaving dirty	1	1.5	1.6	65.6
Proper cleaning is when you use detergent and clean water to clean utensils and floors	1	1.5	1.6	67.2
Proper cleaning refer to always make sure that the place you are using is always clean all the time	1	1.5	1.6	68.9
Proper cleaning refer to cleaning the whole house and dusting and making sure that all surface is clean	1	1.5	1.6	70.5
Proper cleaning refers to cleaning everywhere everytime spring cleaning	1	1.5	1.6	72.1
Proper cleaning refers to good healthy place	1	1.5	1.6	73.8
Spring cleaning	1	1.5	1.6	75.4
Spring cleaning on the windows	1	1.5	1.6	77.0
Spring cleaning washing dishes and mopping floors	1	1.5	1.6	78.7
Sweeping moping	1	1.5	1.6	80.3
Sweeping wash with soap and dry them	1	1.5	1.6	82.0
To always keep my kitchen clean and always cover your hair when cooking and wash your hands always	1	1.5	1.6	83.6
To clean all reas with soap and mop	1	1.5	1.6	85.2
To clean everyday with detergents like soap and bleach	1	1.5	1.6	86.9
To clean floor dishes cupboards and pots	1	1.5	1.6	88.5
To clean food with salty water to scrub floors with water and detergent and to clean dishes and all utensils in the kitchen to stay clean always	1	1.5	1.6	90.2

	To make sure that I must always clean the kitchen to avoid germs	1	1.5	1.6	91.8
	To point where you have to cook where its clean	1	1.5	1.6	93.4
	Toielets must be hygienic clean and also my kitchen and floor also	1	1.5	1.6	95.1
	Use Domestos and handy andy	1	1.5	1.6	96.7
	Use soap and jik and wipe in the cupboard	1	1.5	1.6	98.4
	When cleaning the area everyday and keeping it clean	1	1.5	1.6	100.0
	Total	61	93.8	100.0	
Missing		4	6.2		
Total		65	100.0		

APPENDIX L

Supplimentary data 4: What is food poisoning?

What is food poisoning?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Anything that can harm after been eaten	1	1.5	1.8	1.8
	As I understand myself is the food that has expired and mostly the tinned foods	1	1.5	1.8	3.6
	Bacterica found in food	1	1.5	1.8	5.4
	Dirty and expired food	1	1.5	1.8	7.1
	Don't know	1	1.5	1.8	8.9
	Eaten food that is not right rotten	1	1.5	1.8	10.7
	Eating expired food	1	1.5	1.8	12.5
	Expired food	11	16.9	19.6	32.1
	Expired food and dirty food	1	1.5	1.8	33.9
	Expired foodthat can make kids sick	1	1.5	1.8	35.7
	Food poisoning a food that is not right maybe it expired you must check a date before cooking	1	1.5	1.8	37.5
	Food poisoning ikts the food which causes illness and could cause death	1	1.5	1.8	39.3
	Food poisoning is a contamination of unhealthy or dirty food or food that has expired	1	1.5	1.8	41.1
	Food poisoning is when you have consume food that was not supposed to be eaten	1	1.5	1.8	42.9
	Food poisoning ks the food that stays for a long time without checking it or looking the sell by date	1	1.5	1.8	44.6
	Food poisoning with my knowledge is the food that you cook today so when its not finish you put in the fridge after that you give children I think is food poison	1	1.5	1.8	46.4
	Food that contain bacteria due to expiry date	1	1.5	1.8	48.2

Food that contain bacteria that will make you sick	1	1.5	1.8	50.0
Food that contain germs and bacteria	1	1.5	1.8	51.8
Food that contain poison and have bacteria that kill	1	1.5	1.8	53.6
Food that has expired and have germs and bacteria	1	1.5	1.8	55.4
Food that has poison and has expired	1	1.5	1.8	57.1
Food that has poison and is not good to eat	1	1.5	1.8	58.9
Food that have been poisoned e.g. if there are drugs etc in it	1	1.5	1.8	60.7
Food that is not good to be taken maybe old	1	1.5	1.8	62.5
Food that not kept in the refrigerator not covered in a proper way not well cooked	1	1.5	1.8	64.3
I don't know	3	4.6	5.4	69.6
Is food that has expired and are not in a condition to be eaten	1	1.5	1.8	71.4
Is the food that expired	1	1.5	1.8	73.2
Is the food that is not closed	1	1.5	1.8	75.0
Is when food are having poison due to expiry or being rotten	1	1.5	1.8	76.8
Is when food has expired	1	1.5	1.8	78.6
Is when food has poison because of bacteria and being old	1	1.5	1.8	80.4
It is contaminated food or even food with expired date	1	1.5	1.8	82.1
It is food tat has bacteria because has expired	1	1.5	1.8	83.9
It is something that makes people to be sick of life	1	1.5	1.8	85.7
It is the food that is not good or is not health for the body	1	1.5	1.8	87.5

	It sometimes is when you cook expired food for the children	1	1.5	1.8	89.3
	Its bacteria found in expired food	1	1.5	1.8	91.1
	Jik and toilet clean spirit must not be stored with food because is dangerous	1	1.5	1.8	92.9
	Jik, toilet cleaner, spirit, parafin and cockroach killer	1	1.5	1.8	94.6
	To cook food on dirty pots	1	1.5	1.8	96.4
	When you eat food that has been prepared long time before being eaten	1	1.5	1.8	98.2
	When you touch your food without washing your hands and without washing your vegetables then you get food poison	1	1.5	1.8	100.0
	Total	56	86.2	100.0	
Missing		9	13.8		
Total		65	100.0		

APPENDIX M

Supplimentary data 5: Can reheating cooked foods contribute to food contamination and why?

Can reheating cooked foods contribute to food contamination and why?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes, YOU must not give kids yesterdays food	1	1.5	1.6	1.6
	I don't know	1	1.5	1.6	3.3
	Cook what is essential	1	1.5	1.6	4.9
	I don't know	3	4.6	4.9	9.8
	It is not healthy to children	1	1.5	1.6	11.5
	It wont contribute food contaimination because the food will be completely cooked well and covered	1	1.5	1.6	13.1
	No	6	9.2	9.8	23.0
	No because I have put in a safe place it will be heat again	1	1.5	1.6	24.6
	No because in my opinion I think warm food is very good only if you can keep it covered in a safety place	1	1.5	1.6	26.2
	No kids must eat warm food	1	1.5	1.6	27.9
	No must throw away its poison	1	1.5	1.6	29.5
	No we always cook fresh food	1	1.5	1.6	31.1
	No we do not reheat food	1	1.5	1.6	32.8
	No!	1	1.5	1.6	34.4
	None	1	1.5	1.6	36.1
	Reheating cooked foods contribute to food contaminations because folod looses vitamins and its tastes	1	1.5	1.6	37.7
	Yes We only cook flood that is fresh	1	1.5	1.6	39.3
	Yes, food may be rotten	1	1.5	1.6	41.0
	Yes	7	10.8	11.5	52.5

Yes because heat can cause bacteria to live again	1	1.5	1.6	54.1
Yes because is no health	1	1.5	1.6	55.7
Yes because is not fresh food and its reheat food	1	1.5	1.6	57.4
Yes because it does not taste like fresh	1	1.5	1.6	59.0
Yes because it is dangerous and it may kill germs	1	1.5	1.6	60.7
Yes because it is not healthy to do so	1	1.5	1.6	62.3
Yes because it will be as good as cooked now	1	1.5	1.6	63.9
Yes because reheating cooked foods needs to be cooked all and served at that time before getting germs because some of the lids are not well	1	1.5	1.6	65.6
Yes because some bacteria may gain life	1	1.5	1.6	67.2
Yes because sometimes is overcooked	1	1.5	1.6	68.9
Yes because that food becomes overcooked	1	1.5	1.6	70.5
Yes because the bacteria may regain life by reheating	1	1.5	1.6	72.1
Yes because the food has been refrigerated and when you reheat you bring bacteria to be alive	1	1.5	1.6	73.8
Yes because the food have been cold then when you reheat the bacteria dies	1	1.5	1.6	75.4
Yes because we lived some food outside	1	1.5	1.6	77.0
Yes because when you reheat the bacteria will die	1	1.5	1.6	78.7
Yes because you may find that the food was already in not good condition	1	1.5	1.6	80.3
Yes food may be very cold and bacteria will be alive again when you reheat them	1	1.5	1.6	82.0
Yes if you heat food that is a day or more not in the refrigerator	1	1.5	1.6	83.6

	Yes it does because you get sick and its easy to get most bacteria because the food will be reheated	1	1.5	1.6	85.2
	Yes it will kill germs	1	1.5	1.6	86.9
	Yes it will let germs live again	1	1.5	1.6	88.5
	Yes kids must eat fresh food	1	1.5	1.6	90.2
	Yes only when it was not stored correctly or expired	1	1.5	1.6	91.8
	Yes some of bacteria may be multiplied due to heat	1	1.5	1.6	93.4
	Yes the food has been cold and to reheat them will make them have bacteria	1	1.5	1.6	95.1
	Yes the food was cold and reheating may kill vitamins	1	1.5	1.6	96.7
	Yes the food will be contaminated because bacteria which was dead in cold area will be cooked	1	1.5	1.6	98.4
	Yes to kill bacteria we have to reheat food	1	1.5	1.6	100.0
	Total	61	93.8	100.0	
Missing		4	6.2		
Total		65	100.0		

APPENDIX N

HIGHER DEGREES COMMITTEE LETTER

UNIVERSITY OF JOHANNESBURG

FACULTY OF HEALTH SCIENCES

HIGHER DEGREES COMMITTEE

HDC-01-80- 2017

30 October 2017

TO WHOM IT MAY CONCERN:

STUDENT: **SEABELA, M**
STUDENT NUMBER: **201012570**

TITLE OF RESEARCH PROJECT: Assessment of Food Safety Hazards Among Day Care Centres in Mbombela, South Africa

DEPARTMENT OR PROGRAMME: **ENVIRONMENTAL HEALTH**

SUPERVISOR: **Mrs C Mokoatle** **CO-SUPERVISOR:** **Dr F Machete**

The Faculty Higher Degrees Committee has scrutinised your research proposal and concluded that it complies with the approved research standards of the Faculty of Health Sciences; University of Johannesburg.

The HDC would like to extend their best wishes to you with your postgraduate studies

Yours sincerely,

Prof BS Shaw
Chair: Faculty of Health Sciences HDC
Tel: 011 559 6891
Email: brandons@uj.ac.za

APPENDIX O

RESEARCH ETHICS COMMITTEE LETTER

UNIVERSITY OF JOHANNESBURG

FACULTY OF HEALTH SCIENCES

RESEARCH ETHICS COMMITTEE

NHREC Registration no: REC-241112-035

REC-01-130- 2017

3 November 2017

TO WHOM IT MAY CONCERN:

STUDENT: **SEABELA, M**
STUDENT NUMBER: **201012570**

TITLE OF RESEARCH PROJECT: Assessment of Food Safety Hazards Among Day Care Centres in Mbombela, South Africa

DEPARTMENT OR PROGRAMME: ENVIRONMENTAL HEALTH

SUPERVISOR: Mrs C Mokoatle **CO-SUPERVISOR:** Dr F Machete

The Faculty Research Ethics Committee has scrutinised your research proposal and confirm that it complies with the approved ethical standards of the Faculty of Health Sciences; University of Johannesburg.

The REC would like to extend their best wishes to you with your postgraduate studies.

Yours sincerely

Prof C Stein
Chair : Faculty of Health Sciences REC
Tel: 011 559 6564
Email: cstein@uj.ac.za

APPENDIX P

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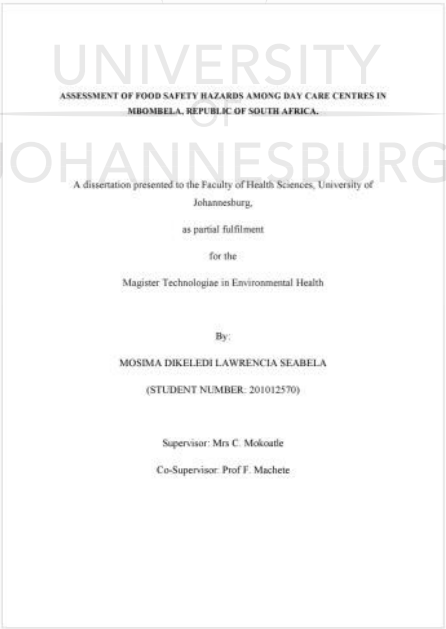

ASSESSMENT OF FOOD SAFETY HAZARDS AMONG DAY CARE CENTRES IN MBOMBELA, REPUBLIC OF SOUTH AFRICA.

A dissertation presented to the Faculty of Health Sciences, University of Johannesburg,

as partial fulfilment

for the

Magister Technologiae in Environmental Health

By:

MOSIMA DIKELEDI LAWRENCIA SEABELA

(STUDENT NUMBER: 201012570)

Supervisor: Mrs C. Mokoatle

Co-Supervisor: Prof F. Machete

APPENDIX Q

EDITORS LETTERS

To whom it may be consent:

This is Dr MM Mokoena writing to confirm that I have a pleasure to read and critical review the study of the Mosimo Dikeledi Lawrencia Seabela , study title, "Assessment of food safety hazards among day care centres in Mbombela, Republic of South Africa." The work was initial written in article format in which I have critical reviewed the each chapter as article format to be submitted for publication, then the work was changed into chapter format in which I have advised the student on formatting the document from article format to chapter format.

My remark on the work which I reviewed is that the student has defended the research question by addressing the aim and objectives with the results and discussed the challenges which is happening in the day care centres. In my opinion the work is ready to be submitted for marking, however, the document need to be edited for first English language by the professional language editor, for final print out which will be published online and for the library purposes.

Yours sincerely

Dr MM Mokoena

0721252022

Michaelmok1@yahoo.com

Marion 25 Mar

to me

Hello Dikeledi

I have finished editing your dissertation and have saved it with the changes indicated in red.

In your references, I think you need to check how you've written the names and details of the Journals. They should all be written in one style.

As you will see, there was quite a lot of work involved so I will have to charge you R 800.00.

Here are my banking details:

Account name : ME HERTZ
Bank: NEDBANK
Branch: Balfour Park
Acc No: 1756005192

If you need any more assistance, please let me know - I will be happy to read through it again at no extra charge.

Good luck with the submission.

Best regards