The influence of training on food handlers' hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa

By

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DECLARATION

I, Hayley Kimberlynn Langley, declare that the contents of this dissertation represent my own unaided work, and that the dissertation has not previously been submitted for academic examination towards any qualification. Furthermore, it represents my own opinions and not necessarily those of the Cape Peninsula University of Technology.

30 January 2026

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ABSTRACT

In South Africa, the National School Nutrition Programme (NSNP) provides meals to approximately 9.7 million learners. Children are more vulnerable to environmental risks than adults, making them particularly susceptible to foodborne diseases, especially when food is not prepared under hygienic conditions. Literature indicates that South African schools have experienced various foodborne disease outbreaks over the years. However, limited research has been conducted on the hygiene knowledge and practices of food handlers responsible for preparing meals in the NSNP. The aim of the study is to determine whether food hygiene training interventions at schools offering the NSNP will improve food handlers' knowledge and practices regarding food hygiene and safety. The objectives of the study were to: (a) determine the hygiene knowledge and practices of food handlers involved in the NSNP at a selected sub-district of the Cape Winelands District Municipality (CWDM) before receiving training, (b) provide food hygiene- and safety training to food handlers involved in the NSNP at a selected sub-district of the CWDM after the first round of questionnaires and observations, and (c) determine whether hygiene knowledge and practices of food handlers regarding food hygiene and safety in the NSNP at a selected sub-district of the CWDM improved after having received training.

One sub-district within the CWDM was purposively selected for this research study due to logistical feasibility. The target population comprised all volunteer food handlers working at the purposively selected schools who were responsible for preparing and serving meals to learners in the sub-district. A total of 10 schools were included in the study. A longitudinal pre-test post-test intervention study design was employed to assess the food hygiene knowledge and practices of the food handlers before and after receiving training. Data collection instruments included a structured questionnaire designed to capture quantitative data, and an observation checklist aimed at collecting qualitative data. The training material was developed based on the World Health Organization's "Five Keys to Safer Food" (WHO, 2006) and the requirements outlined in Regulation 638 of 2018 (South Africa. Department of Health, 2018).

Pre-training results indicated that the majority of the food handlers had a high baseline knowledge of food hygiene requirements. However, during pre-training observations the food handlers did not practice what is required from them to ensure food safety. Due to the food handlers' high baseline knowledge, no statistical significance difference was found when pre-

and post-training questionnaire results was compared. Post-training observations revealed significant improvements, highlighting the positive impact of training on both the knowledge and practices of the food handlers.

Eight schools lacked resources such as soap, paper towels, and proper storage, making it difficult for food handlers to apply the knowledge they have or gained. The study highlights the need to strengthen compliance and food handlers' hygiene knowledge, with greater prioritisation of food safety by the Department of Basic Education (DoBE) through collaboration with Municipal Health Services (MHS). Routine inspections, continuous training and practical guidance on applying the best available methods in resource-limited settings are essential. Future studies should also explore behavioural and attitude changes among food handlers to ensure the long-term sustainability of food safety within the NSNP.

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DEDICATION

To my parents, Beulah and Hylton Langley, and my sister, Stacey Langley, thank you for your unwavering love, constant support, and encouragement throughout this journey. Your belief in me has been a source of strength and inspiration every step of the way.

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DEFINITION OF TERMS

Best Available Method – means a method which is practicable and necessary for the protection of food against contamination or spoilage, having due regard to: (a) local conditions and circumstances whether at or on food premises or elsewhere; (b) the prevailing extent of established practice and the financial implications thereof (South Africa. Department of Health, 2018).

Clean – means free of any soil. food residues, dust, dirt, dung, impurity, grease or other objectionable matter or contamination to the extent that a state of hygiene is attained and "cleaning ", "keep clean" and "cleaned" has a similar meaning (South Africa. Department of Health, 2018).

Contaminate – means the effect exerted by a biological or chemical agent (excluding allergens used as ingredients), foreign matter, or other substances present in food so that the food - (a) does not meet a standard or requirement determined by law; does meet standards; or (c) is unfit for human consumption. and "contamination" has a corresponding meaning (South Africa. Department Health, 2018).

Core temperature – means the temperature reading taken in the estimated centre of the food (South Africa. Department of Health, 2018).

Cross contamination- means the process by which contaminants, allergens or bacteria are unintentionally transferred from food, substances, objects, facilities to other food, substances, objects, or facilities, with a potential harmful effect (South Africa. Department of Health, 2018).

Food handler – means a person who during his or her normal routine work on food premises, directly handles or comes into contact with packaged or unpackaged food, food equipment and utensils, or food contact surfaces and is therefore expected to comply with food hygiene requirements (South Africa. Department of Health, 2018).

Food hygiene – means the conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain (South Africa. Department of Health, 2018).

Food premises- means a building, structure, stall or other similar structure, and include a caravan, vehicle, stand or place used for or in connection with the handling of food (South Africa. Department of Health, 2018).

Food safety – means the assurance that food will not cause harm to the consumer when it is prepared or eaten according to its intended use (South Africa. Department of Health, 2018).

Foodborne disease outbreak – defined as the occurrence of two or more cases of a similar illness resulting from the consumption of a common food (Mead et al., 1999).

Handle – includes manufacture, process, produce, pack, prepare, keep, offer, store, transport or display for sale or for serving; and "handling" has a corresponding meaning (South Africa. Department of Health, 2018).

ABBREVIATIONS

CDC	Centre of Disease Control
CWDM	Cape Winelands District Municipality
DoBE	Department of Basic Education
EHP	Environmental Health Practitioner
FFE	Food for Education
MHS	Municipal Health Services
NIP	National Integrated Program
NSLP	National School Lunch Program
NSNP	National School Nutrition Programme
PSFA	Peninsula School Feeding Association
PNAE	Programa Nacional de Alimentação Escolar
UNICEF	United Nations International Children's Emergency Fund
WFP	World Food Program

CHAPTER 1

INTRODUCTION

1.1 Background

The growth of children is closely connected to proper and nutritious food. As children grow, adequate nutrition supports their intellectual and physical development (Cupertino et al., 2022). Nutrition during school years is essential for the physical, mental and psychosocial development of children and adolescents aged 6 to 19 years. It is estimated that in developing countries 66 million learners attend classes each day without adequate food, including 23 million learners in Africa. Hunger during school can significantly hinder learners' ability to learn, thrive and reach their full potential (Cupertino et al., 2022). School feeding schemes are established to provide nutritious meals to learners daily. These programmes offer several benefits such as hunger alleviation, reducing deficiencies in essential nutrients and anaemia, preventing overweight and obesity, improving school enrolment and attendance, and enhance academic performance (Wang & Fawzi, 2020). According to the World Food Programme (WFP) statistics, 418 million children benefit from school meals (World Food Programme, 2022).

Literature indicates a major concern as to whether a feeding scheme ensures that the food handlers have the required hygiene knowledge and practices to ensure proper food hygiene practices. For example, previous studies were done on foodborne outbreaks at schools in several countries, including Brazil (Machado et al., 2014), Ghana (Malm et al., 2015), Sweden (Hergens et al., 2017) and South Africa (Madlala, 2022), specifically focussed on foodborne outbreaks at schools, due to poor hygiene knowledge and practices by food handlers. According to the World Health Organisation foodborne disease is an illness caused by consuming food that contains harmful microorganisms or toxins (WHO, nd; Madlala, 2022). Foodborne illnesses arise from the contamination of food and can happen at any point in the food production, distribution, and consumption process. This may be caused by various types of environmental pollution, such as contamination of water, soil, air as well as improper food storage and handling (WHO, nd). The WHO stated that not all food handlers understand the importance of adopting good hygiene practices when they prepare food (WHO, 2020). Most studies conducted on food hygiene knowledge and practices of food handlers are commonly focussed on private catering and fast-food outlets (Mashuba, 2016) and do not focus on the effect and influence of training on the food handlers. Effective food safety training is crucial

for reducing the frequency and overall rates of foodborne disease outbreaks. Although it is compulsory for food handlers to undergo adequate food safety training, this training is sometimes not provided or its effectiveness is not always measured (McFarland et al., 2019).

In South Africa the government implemented an initiative named the National School Nutrition Programme (NSNP), to provide meals to learners in quintile 1 to 3 primary, secondary and special public schools. The aim of this initiative was to support learning and wellbeing. The programme focusses on improving attendance, concentration and healthy eating. In 2023/24 the NSNP reached over 9 million learners in South Africa's poorest schools (South Africa, 2026). The programme is funded through a conditional grant from National Treasury, with meals prepared by volunteer food handlers. Although the food handlers are volunteers, classified under the Expanded Public Works Programme they are appointed on annual contracts and receive a monthly stipend. The school principals, nutrition committees and education departments must work together to manage, monitor and ensure the programme runs effectively (South Africa, 2026).

1.2 Statement of the Research Problem

Approximately 418 million learners, including 9.7 million South African learners, are served by feeding schemes (World Food Programme, 2022; Western Cape Government, 2024). In the Western Cape 527 234 learners in 1051 institutions, benefitted from the NSNP in the 2023/2024 financial year (Western Cape Government, 2024). The district municipality that is investigated in this study has 52 schools with at least 45 of these schools partaking in the NSNP (Western Cape Government, 2021). These programmes, while critical for addressing food insecurity, pose a risk for foodborne disease outbreaks. Foodborne diseases cause considerable morbidity and mortality globally, impacting individuals of all ages, with a particularly high burden among populations in low-and middle-income countries, as well as children under the age of five (National Institute of Communicable Diseases, 2021). Foodborne disease arises from the consumption of food contaminated with a range of pathogenic microorganisms, including viruses, bacteria, parasites and fungi. Contamination can occur at any point in the food production, distribution, consumption, and storage, or as a result of environmental contamination. Additionally, many foodborne pathogens can be transmitted through non-food routes, such as contaminated water or contact with infected animals, pets, and humans. According to the WHO (2022) not all food handlers fully grasp the significance of adhering to proper hygiene practices during food preparation. It is essential for food handlers to prevent foodborne outbreaks in food outlets and preparation areas (Madlala, 2022). In 2024, the

Department of Basic Education (DoBE) noticed an increase of food poisoning among school-aged children. These incidents disrupted education. Despite investigations that concluded that the cause of the outbreak was due to the snacks these children bought from vendors and spaza shops near their schools, certain media reports had incorrectly linked the food poisoning incidents to the NSNP (South Africa, 2024). In light of the increasing reports of food poisoning among school-aged children, there is a need to assess the influence of training on food handlers' hygiene knowledge and practices in the NSNP to ensure all food handlers adhere to the "Five keys to safer food" and Regulation 638 of 2018 to prevent an outbreak in the NSNP. The regulation governing hygiene requirements for food premises, the transport of food and related matters (South Africa. Department of Health, 2018) mandates that those in charge of a food premises must ensure their food handlers receive training on the principles and practices related to food safety and hygiene. Regulation 391 of 2012, the regulation defining the scope of the profession of Environmental Health Officers outlines the key focus areas for EHPs, with one of the functions being food control (South Africa. Department of Health, 2009). In terms of food control, the EHPs are responsible to sample food for microbial and chemical purposes, conduct health education programmes for food handlers, assist in foodborne illness investigation and inspecting all food premises (South Africa. Department of Health, 2012b). Additionally, it is the responsibility of the person in charge to ensure regular assessment of this training. Therefore, this study aims to evaluate the impact of such training on food handlers' knowledge and practices regarding food hygiene in the NSNP.

1.3 Significance of the Study

The NSNP provides food for more than 9 million children in South Africa. According to the WHO (2017) children are more vulnerable than adults to environmental risks. By implication, children are more suspectable to foodborne diseases, specifically when there are no or limited control over food handlers or where children are exposed to pathogens through food contamination. Currently, there are few documented information regarding the knowledge and practices of food handlers within the NSNP. Therefore, this study will provide valuable insights into food handlers' knowledge and practices regarding food hygiene and safety to assist in providing safe food for the school children within the programme.

1.4 Research Questions

- What are the hygiene knowledge and practices of food handlers involved in the NSNP at a Cape Winelands sub-district municipality?

- How does training affect the hygiene knowledge and practices of food handlers involved in the NSNP at a Cape Winelands sub-district municipality?

1.5 Aims and the Objectives of the Study

The aim of the study is to determine whether food hygiene training intervention at schools offering the NSNP will improve food handlers' knowledge and practices regarding food hygiene and safety.

The objectives of the study:

- To determine the hygiene knowledge and practices of food handlers involved in the NSNP at a selected sub-district of the Cape Winelands District Municipality before receiving training.
- To provide food hygiene- and safety training to food handlers involved in the NSNP at a selected sub-district of the Cape Winelands District Municipality after the first round of questionnaires and observations.
- To determine whether hygiene knowledge and practices of food handlers regarding food hygiene and safety in the NSNP at a selected sub-district of the Cape Winelands District Municipality improved after having received training.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

Global school feeding schemes play a crucial role in addressing child hunger, improving nutrition, and enhancing educational outcomes across various regions. These initiatives are designed to tackle food insecurity among learners, thereby promoting regular school attendance and better academic performance. The World Food Programme's (WFP) school feeding programme operates in many low-income countries, providing meals to increase school participation and improve children's health (World Food Programme, 2022). In the United States, the National School Lunch Program offers free or reduced-price meals to eligible learners, aiming to support nutritional needs and educational achievements (U.S. Department of Agriculture, 2023). Similarly, in Brazil, a program exists that not only provides nutritious meals but also integrates local agricultural products, benefiting both learners and local farmers (World Food Programme, 2022). There are many global feeding scheme initiatives such as the Home-Grown School Feeding Programme – Kenya (World Food Program, 2021), the Midday Meal scheme – India (Government of India. Ministry of Education, 2023), the Food for Educational Programme – Bangladesh (Ahmed & Ninno, 2002), the School Meals Programme – Cambodia (World Food Programme, 2023), and the Ghana School Feeding Programme (Ghana School Feeding Programme, 2023).

The South African government and other stakeholders provide healthy meals for learners because they believe it encourages learning and enhances the health and development of learners (WHO, 2020). In South Africa, the National School Nutrition Programme (NSNP) provides food for learners in schools on a daily basis. However, the NSNP faces challenges such as absence of infrastructure, lack of contractual continuity, resistance from stakeholders, disregarding of infrastructure, and insufficient training (Mafugu, 2021). These struggles can cause negligent food handling or lack of good manufacturing practices at food establishments, such as using the wrong equipment, contaminating the surroundings, and storing food at incorrect temperatures that can all be linked to foodborne disease outbreaks (Da Cunha et al., 2021; Madlala, 2022). Foodborne disease outbreaks and deaths can be caused by poor food hygiene practices and food can become contaminated during any stage of preparation (Madlala, 2022). Therefore, it is important for food handlers to receive food hygiene- and safety training to ensure safe food handling practices (Madlala, 2022).

To ensure food hygiene and safety, all schools that form part of the NSNP need to comply with relevant regulations and standards. Proper training on food hygiene practices for food handlers is aimed to make food safer and reduce the occurrence of outbreaks. According to Regulation 638 of 2018 a person in charge of a food premises must ensure that - (1) (a) he or she is suitably qualified or otherwise adequately trained in the principles and practices of food safety and hygiene, as appropriate, and that the training is accredited or conducted by an inspector, where applicable; (b) any other person working on the food premises, is suitably qualified or adequately trained in the principles and practices of food safety and hygiene, as appropriate, by an inspector or any other suitable person; (c) routine assessments are conducted to determine the impact of the training; and (d) training programmes and records are kept and routinely updated as applicable and are made available to an inspector on request (South Africa. Department of Health, 2018).

2.2 Food Poisoning

Foodborne disease outbreaks have been a global challenge and have occurred recently in countries worldwide including the United States, United Kingdom, Italy, and China (Devereux et al., 2018). The first estimate done on the 'global burden of foodborne diseases' indicated that 1 in 10 people fall ill every year due to consuming contaminated food, resulting in the deaths of 420 000 persons a year. The study also indicated that children under 5 years of age were more vulnerable with 125 000 deaths reported for this age group. It is evident from the WHO that Africa and Southeast Asia have the highest mortality burden relating to contaminated food (WHO, 2015). It is well-known that the number of foodborne diseases which is reported presents only a fraction of incidents. Studies have shown that large-scale catering and food service outlets are the main sources of foodborne disease outbreaks (Martins et al., 2012). According to Martins et al. (2012) good food hygiene practices are vital to keep consumers safe. Those who handle food must have the necessary knowledge and skills to ensure they adhere to the relevant standards and regulations (Martins et al., 2012).

Food poisoning is a medical condition that is caused by bacteria, bacterial toxins, or other harmful substances, including chemicals. There are many different foodborne diseases that can occur. Most of the diseases are due to contamination by bacteria, parasites, or viruses. The Centres for Disease Control and Prevention (CDC) estimates that each year, 48 million individuals in the United States fall ill due to foodborne diseases, with 128 000 people requiring hospitalisation and approximately 3000 fatalities (CDC, 2018). People with a weakened

immune system or poor health are at a higher risk of food poisoning, though it can affect anyone that eats contaminated food (Hoyle, 2014). Food poisoning occurs due to microorganisms which can cause illness when food acts as a vehicle (Sprenger, 2008). Food handlers can play a significant role in spreading bacteria as microorganisms require a carrier to move from one surface to another, a process known as “contamination”. Hands are one of the most common means of transferring these organisms, making food handlers one of the main sources of potential contamination. Therefore, food handlers are crucial in preventing the spread of harmful pathogens by following proper hygiene practices (WHO, 2006).

A foodborne disease outbreak occurs when two or more individuals contract the same illness from contaminated food or drink (South Africa. Department of Health, 2018; CDC, 2020). In South Africa, managing food hygiene and regulating food establishments presents significant challenges, often due to inadequate supervision and monitoring. Contributing factors include insufficient training for food handlers, leading to improper storage, inadequate cooking temperatures, and unsanitary conditions. Neglecting proper hygiene and sanitation can result in foodborne illnesses among consumers, as detailed in Table 1, which outlines different types of foodborne poisoning, their onset times, sources, symptoms, and control methods (Food and Drug Administration, 2018). Such neglect can even lead to fatalities (Bisholo, 2018).

Table 1: Different foodborne poisoning types, onset times, sources, symptoms, and control methods (Food and Drug Administration, 2018)

Common name	Onset time	Duration	Signs and symptoms	Food source
Bacillus cereus				
B. cereus food poisoning	10-16 hrs	24-48 hrs	Abdominal cramps, watery diarrhoea, nausea.	Meat, stews, gravies
Clostridium perfringens				
C. perfringens food poisoning	8-16 hrs	Usually, 24 hrs	Intense abdominal cramps, watery diarrhoea.	Meats, poultry, gravy, dry or precooked foods.
Escherichia coli				
E. coli infection	1-3 days	3-7 or more days	Watery diarrhoea, abdominal cramps, some vomiting	Water or food contaminated with human faeces.
Hepatitis A				
Hepatitis	28 days average	2 weeks – 3 months	diarrhoea, dark urine, jaundice and flu-like symptoms	Raw produce, contaminated drinking water, undercooked foods, infected food handler, shellfish from contaminated water.
Listeria monocytogenes				
L. monocytogenes food poisoning	9 -48 hrs	Variable	Fever, muscle ache, nausea, diarrhoea. Pregnant woman: mild flu, infection may lead to premature delivery.	Unpasteurized milk, soft cheese made with unpasteurized milk and ready-to-eat deli meat.
Salmonella				
Salmonellosis	6-48 hours	12-60 hours	Diarrhoea, fever, abdominal cramps, vomiting	Eggs, meat, unpasteurized milk, contaminated raw fruits and vegetables

2.3 The Importance of Food Hygiene

Estimates made by the WHO revealed that 70% of diarrheal diseases in African children are due to complimentary food that was contaminated. In South Africa, such situations lead to 30 660 child deaths per year (WHO, 2017). It is known that in South Africa, foodborne illnesses are not properly reported and documented even though occurrences are common. There are various South African legislations in place that indicate that food must be handled in a hygienic manner (Nhlapo, 2013), such as the Foodstuffs, Cosmetics and Disinfectants Act, Act 54 of 1972 (South Africa, 1972), Regulation Relating to the Labelling and Advertising of Foodstuffs (South Africa. Department of Health, 2010), Regulations Relating to Foodstuffs for Infants and Young Children (South Africa. Department of Health, 2012a) and Regulations Governing General Hygiene Requirements for Food Premises, The Transport of Food and Related Matters (South Africa. Department of Health, 2018).

According to Sprenger (2008) "food hygiene is more than cleanliness; it involves safety and wholesomeness in food during the preparation, processing, manufacturing, packaging, storage, distribution, and handling". When food is not handled in a hygienic manner, food poisoning may occur. Food poisoning will normally be associated with symptoms such as abdominal cramps, fever, stomach-ache, and headaches. Food poisoning is mainly caused by bacteria such as *Salmonella spp., Clostridium perfringens, Staphylococcus aureus, Bacillus spp.* and many more. Therefore, food must be stored in a proper manner because it contributes to the hygiene of foodstuffs (Sprenger, 2008).

Food hygiene refers to all conditions and measures to ensure the safety and sustainability of food, which must be maintained at all stages. Food hygiene is concerned with the prevention of different illnesses caused by food contamination (Kilungu, 2010). Proper handling and food preservation reduce the risk of food contamination and the transmission of foodborne illnesses (Kilungu, 2010). Looking back into the history of food hygiene, most health complications are caused by poor hygiene practices or poor knowledge of hygiene practices among the kitchen staff. Two prominent events in history speaking to foodborne outbreaks are the Mary Mallon (Typhoid fever case) and the Listeriosis outbreak in South Africa in 2017. Both occurrences are related to poor hygiene practices during food processing or preparation. Mary Mallon was born in Ireland and immigrated to the United States around 1883. She worked as a domestic worker for wealthy families and ended up as a cook. She was a healthy carrier of *Salmonella typhi*. Mallon's nickname became Typhoid Mary because she spread the disease and infected the people she worked for. Mallon is proof that diseases can be passed on through poor hygiene

practices while working with food without the food handler being aware that he or she may carry a disease (Marineli et al., 2013). The Listeriosis outbreak in South Africa in 2017 was one of the biggest foodborne outbreaks in recent times. The source of the outbreak was primary due to issues in the production process and poor food safety practices. In 2017, a total of 1060 laboratory confirmed Listeriosis cases, and 216 deaths were reported in South Africa (Kaptchouang et al., 2020). Listeriosis is caused by eating food contaminated with the bacterium *Listeria monocytogenes*. *Listeria spp.* comes from a single source such as ready-to-eat foods that consumers do not heat properly before eating. The bacteria are found in poultry, unpasteurised milk as well as fruits, vegetables, and infected animals. After an investigation was conducted by epidemiologists, it was concluded that the source of the outbreak was ready-to-eat processed meat products from a production facility in South Africa which were contaminated with *L. monocytogenes* (Kaptchouang et al., 2020).

In September 2024, a total of 890 foodborne incidents was reported across various provinces of South Africa, with at least 22 children that lost their lives. In October 2024, 6 children in Naledi, Soweto, died after consuming snacks purchased from a local spaza shop or street vendor. Investigations revealed that the deaths were caused by the ingestion of a harmful chemical, Terbufos, a pesticide that is strictly prohibit for domestic use in South Africa (The Presidency: Republic of South Africa, 2024). Tests conducted on one of the chip packets found on the deceased children showed traces of Terbufos both inside and outside the packaging. Further examination by EHPs revealed that food items were stored alongside pesticides and detergents, raising concerns about improper food safety practices. Additionally, the spaza shops in question was found to lack adequate safe storage facilities, as well as proper hand- and dishwashing facilities, which could increase the risk of food contamination (The Presidency: Republic of South Africa, 2024). However, the investigation did not specifically address the potential transfer of pesticides from hands or surfaces of the food. Given the highly toxic nature of Terbufos and its presence both inside and outside of the chips packet, it is plausible that the pesticides could have been transferred to food through contamination. This highlights the urgent need for food safety education aimed at both communities and food handlers, both formal and informal, to raise awareness about food safety and effective pest-control measures (The Presidency: Republic of South Africa, 2024).

2.4 Global School Feeding Scheme Initiatives

Feeding scheme programmes are designed to provide nutritious meals to learners, helping to improve their health, boost school attendance, and enhance learning outcomes. School feeding programmes have been in existence for over a century. Early examples include programs in Europe and North America during the 19th and early 20th centuries, aimed at addressing child nutrition and supporting educational attainment (Bundy et al., 2024). The WFP has been a major player in school feeding initiatives and aim to source food locally, supporting both learners' nutrition and local agriculture. This approach helps to strengthen food security at the community level and stimulate local economies (World Food Programme, 2022). Examples of global school feeding scheme initiatives include the following:

1. **World Food Programme (WFP) School Feeding Programme**: One of the largest global initiatives, WFP provides school meals in many countries to encourage school attendance and improve child nutrition (World Food Programme, 2022).
2. **United Nations International Children's Emergency Fund (UNICEF) School Feeding**: UNICEF supports school feeding programs in various countries as part of its broader efforts to improve child health and education (UNICEF, nd).
3. **National School Lunch Program (NSLP) - United States**: This is a federal funded initiative that operates within public and nonprofit private schools, as well as childcare institutions across the United States. Its primary objective is to deliver a nutritionally balanced lunch at either reduced or no cost to learners on school days. The program was launched in 1946 serving 7.1 million learners in the first year. Over time, the NSLP has expanded its reach significantly, with participation increasing to approximately 30.4 million learners by 2016 (U.S. Department of Agriculture, 2023).
4. **Programa Nacional de Alimentação Escolar (PNAE) - Brazil**: This program has been operational since 1955. This public policy initiative is aimed at supporting the healthy development of learners, enhancing their learning and academic performance, and promoting healthy eating habits through comprehensive food and nutritional education. This program is specifically designed for learners who attend public educational institutions (Kitaoka, 2018).
5. **Home-Grown School Feeding Programme (HGSFP) - Kenya**: This initiative was launched by the Kenya government in 2009. The program provides diverse and nutritious meals sourced from small-scale local farmers. The HGSFP has expanded

significantly, growing from serving 200 000 learners in 2009 to nearly 1 million learners by 2016 (World Food Program, 2021).

6. **School Feeding Program - India**: The Mid-day Meals program, now known as Pradhan Mantri Pashan Shakti Nirman Yojna (PM Poshan) in schools has a longstanding history in India. Officially launched in 1995, the initiative aimed to boost learners' enrolment, retention and attendance while simultaneously improving the nutritional standard among learners. The program serves approximately 120 million learners in government-funded schools, making it the largest school food program globally (Government of India, 2023).
7. **School Feeding Program - China**: The National Integrated Program (NIP) was initiated in late 2011, supported by both central and local funding. As a result, NIP is now the third largest national school feeding program globally following India and Brazil. According to the State Council of China, by 2017, the NIP had provided benefits to over 36 million rural learners across 134 00 schools (Wang et al., 2023).
8. **Food for Education Program (FFE) - Bangladesh**: In 1993, the Government of Bangladesh launched the first large-scale FFE program. This initiative aimed to address the country's poverty and malnutrition issues by fostering long-term human capital development. Many children from impoverished families in Bangladesh often forgo school to contribute to their family's income. By 2000, the FFE program had reached approximately 27% of primary schools in Bangladesh. Among the 5.2 million learners enrolled in schools participating in the FFE program, approximately 40% is part of the programme (Ahmed & Ninno, 2002).
9. **The School Feeding Program - Ghana**: Ghana's initiative provides meals to students in public schools, aiming to enhance school attendance and support local farmers (Ghana School Feeding Programme, 2023).

2.5 History of the South African National School Nutrition Programme

The school feeding programme in South Africa currently known as the National School Nutrition Programme (NSNP) was introduced in the late 1940s by providing milk to learners. The programme was however not universally designed and did not include all school going children but targeted specific social groups i.e. White, Indian, and Coloured (Sanousi, 2019). Another study had shown that the NSNP can be traced back to 1916. The Transvaal Provincial Executive Committee saw the need to make funds available to feed hungry learners. Due to the initiative, 3 feeding schemes were established between 1937 and 1939 "the milk and cheese

scheme, the dried fruit scheme, and the citrus fruit scheme" (Sanousi, 2019). In 1958, the Peninsula School Feeding Association (PSFA) were established. Aware of the need, the Rotary Club of Paarden Island called a meeting and the PSFA was established. The PSFA was a non-profit organisation that directly focuses on problems in schools: hungry learners in primary- and secondary schools as well as special needs schools. The goal of this organisation was to "reduce short term hunger, enhance children's ability to learn through school feeding and increase school attendance" (Peninsula School Feeding Association, nd). It was required from schools to contact the PSFA and request to be part of the programme. When the PSFA identified the schools eligible, they provided necessary ingredients, equipment, and utensils according to the number of learners that was identified. The PSFA with the help of the schools' governing bodies recruited volunteers from the community, usually unemployed women. The PSFA provided training on how to prepare and serve food (Peninsula School Feeding Association, nd). In 1994, after the Apartheid-era, the Primary School Nutrition Programme (PSNP), currently named NSNP was introduced. The programme was supported by the late President Nelson Mandela and became one of his main focus areas. The programme was implemented within 100 days after the first democratic elections of 1994 (Sanousi, 2019). The focus of the programme was poverty alleviation and focussed on addressing education inequalities of the past (Department of Basic Education, 2019). Not only were funds made available for poverty alleviation but to provide for the constitutional rights of South Africans. More specifically, the Constitution of the Republic of South Africa, Act 108 of 1996, stipulates that all South Africans have "the right to have access to sufficient food, as well as basic nutrition and education for children" (South Africa, 1996). When the PSNP was first launched in 1994 the objectives were as follows:

- To strengthen education by encouraging active learning, improving school attendance and ensuring punctuality.
- To enhance health outcomes through the supplementation of essential micro-nutrients.
- To promote health through control and elimination of parasites.
- To contribute to wider development efforts, particularly in addressing poverty (Sanousi, 2019).

The PSNP was transferred from the Department of Health (DoH) to the Department of Basic Education (DBE) in 2004. However, the objectives remained similar but slightly modified with its main focus on hunger alleviation (Sanousi, 2019). The shift from DOH to DBE was due to:

- Limited monitoring and evaluation capacity by the DOH.
- High costs to provide nutritional meals.
- Programme moved from nutritional objectives to hunger alleviation.
- DBE had more infrastructure to implement the programme (Sanousi, 2019).

In 2009, the programme again underwent a name change and was renamed to the National School Nutrition Programme (NSNP). This was implemented to include a large number of needy schools. Therefore, the programme now includes secondary schools that form part of quantile 1 to 3 schools (Mawela & Van den Berg, 2020). Due to the name change, the objectives changed accordingly:

- To provide meals to students at selected schools to improve their learning abilities.
- To improve nutrition education through integration of the curriculum.
- To promote the establishment and growth of school food gardens.
- To develop and enhance programmes supporting orphans and vulnerable children (Sanousi, 2019).

2.6 Challenges in the NSNP

Many countries who have implemented school feeding schemes are experiencing some kind of challenge. Developed countries are struggling to reduce high calorie foods to address obesity and overweight. Brazil is struggling with logistical challenges due to long travel distances, resulting in product loss. Furthermore, control and monitoring of the programmes have become a challenge alongside poor sanitation. Nigeria struggles to provide meals due to availability of certain foods, which affects the quality of food.

Studies were conducted in South Africa and role-players indicated some challenges they are experiencing, which include the following:

2.6.1 **Absence of infrastructure -** Some schools in the Eastern Cape and Mpumalanga province does not have proper infrastructure, making it difficult for food handlers to prepare food for the learners (Bundy et al., 2018; Berejena et al., 2018). Studies reported an absence in storage, preparation, cooking, and eating facilities that meet the requirements as per South African guidelines (Mafugu, 2021).

2.6.2 **Lack of contractual continuity** - This frustrates the food handlers due to the uncertainty. It makes it difficult for food handlers to apply for work elsewhere. Due to

uncertainty food handlers are reluctant to be involved in additional duties due to the frustrations they have experienced in the past (Mafugu, 2021).

2.6.3 **Stakeholders involved** - Principals, school governing bodies, teachers and management indicated that the NSNP is a burden for them. These stakeholders have other obligations and the NSNP is an add-on to their workload which takes time away from their other functions or main priorities (Mafugu, 2021).

2.6.4 **Disregarding of safety measures** - In some schools, gas cylinders are being kept inside the kitchen and food handlers are required to prepare food in dark rooms due to a lack of windows and lights. Some food handlers cannot wash dishes, equipment, or rinse food products due to the lack of water. Studies indicated that some school kitchens were found in sub-standard hygiene conditions with stagnant water around the building (Mafugu, 2021).

2.6.5 **Lack of sufficient training** - Food handlers indicated that they do not always have transport available to attend training. Venues are normally a problem, either it is too far, or schools do not have suitable venues to accommodate training. As a result, food handlers do not receive refresher training, causing them to lack proper cooking techniques and/or a background of how to handle food in a safe and hygienic manner (Mafugu, 2021).

2.7 Food Safety Risks in School Nutrition Programmes

Food safety refers to the proper handling, cooking, and preservation to prevent foodborne pathogens including microorganisms (e.g., bacteria and viruses), parasites (e.g., protozoa and worms), and chemicals (e.g., arsenic, dioxins, and pesticides) (Food and Drug Administration, 2017). These pathogens and toxins can contaminate fresh produce through irrigation- and rinse water, dust particles, and insect faeces. Harvesting and process equipment as well as transport containers may also have the possibility to contaminate food products (Beuchat, 2002).

Food safety in schools is a serious challenge because schools provide food for children. Trends show that food safety is a problem internationally and locally. The government of Ghana initiated a Ghana primary school nutrition programme in 2005 to provide meals to public school learners. It was reported that learners were feeling ill after they had consumed food. A study was conducted to establish the source of contamination that caused the illness. The researcher of the study suspected that meat was the source of the outbreak (Malm et al., 2015). In 2016, an outbreak of gastrointestinal disease was reported among Swedish learners, in

Sweden. The outbreak was reported by medical professionals to the relevant authorities, and an outbreak control team was responsible for the investigation and concluded that the source of the outbreak was a salad buffet served at the school's feeding scheme (Hergens et al., 2017). A study done in Brazil showed that most food handlers have knowledge of food hygiene and safety, however, they do not always practice their knowledge. Reasons why food handlers do not always apply their knowledge are mostly due to behavioural aspects as well as how the food handler perceive the risks. For example, becoming sick as a result of unhygienic food handling practices is considered less of a risk to health than becoming ill from a disease that could be transmitted involuntarily (Machado et al., 2014). In South Africa, outbreaks in several schools have highlighted the need to ensure food safety in school feeding schemes. In 2011, South Africa recorded 2 560 outbreaks of foodborne illnesses, with majority occurring among primary and high school learners (Sibanyoni et al., 2017). In 2014, learners of two primary schools in the Sekhukhune District of Limpopo were examined for food poisoning when the learners fell ill with symptoms such as vomiting and abdominal pains after consuming food served at the schools. In 2016, a foodborne outbreak occurred in the Gauteng Province. Ninety learners and teachers had stomach cramps and diarrhoea after eating food from the school feeding schemes. The EHPs conducted a case investigation and concluded that *Clostridium perfringens* was the cause of the outbreak. A secondary school in Bloemhof, Northwest Province, reported the death of a learner and several other learners were hospitalised (Devereux et al., 2018). When the EHPs conducted the investigation, they found that the storerooms were infested with rats and the schools lacked the proper equipment to prepare and serve food. The EHPs discovered that the municipality did not issue a Certificate of Acceptability (COA) to these schools to serve meals - a COA must be issued to all food premises preparing food for the public (South Africa. Department of Health, 2018). These cases indicate the urgency and necessity for research on the safety of food served at schools in South Africa (Devereux et al., 2018). In 2018, the Department of Health became aware that 180 Grade 12 learners showed symptoms of food poisoning and were rushed to hospital. Health officials confirmed that it was caused by food they had eaten from their school's feeding scheme (Department of Basic Education, 2020). On the 25th of October 2019, a local district hospital notified the Department of Health of a cluster of learners suffering from food poisoning. It was reported that the learners were exhibiting symptoms 24 hours after routine meals were served by the NSNP at a local school. One hundred of the 270 learners that consumed the food at the NSNP were admitted to hospital with food poisoning symptoms. It is believed that the food was contaminated or handled in an unhygienic manner (Motladiile et al., 2019). Learners from a secondary school

in Mamelodi West had to be taken to hospital after they consumed rice and tinned fish from their school feeding programme (Pretoria Rekord, 2021). In 2021, 203 learners were rushed to a health care facility after consuming the same food from the school feeding scheme programme in Gauteng (News24, 2021). In January 2020, 250 learners of a high school in the Eastern Cape were admitted to a hospital due to a suspected case of food poisoning. They were showing signs of diarrhoea, vomiting, and stomach cramps. Health care providers suspected improper handling and processing of tinned fish was the cause of food poisoning (Department of Basic Education, 2020). In August 2023, learners fell ill after consuming food prepared at school that were served as part of the NSNP (City of Tshwane, 2023). In October 2023, the Eastern Cape Department of Health confirmed a foodborne disease outbreak at two neighbouring schools which affected 120 learners between the ages of 8 and 15 years. The learners showed symptoms of itchiness, shortness of breath, and high temperatures resulting in some learners being rushed to the hospital (News24, 2023).

2.8 Hygiene of Food Handlers and Food Premises

The hygiene practice requirements for food handlers are discussed in detail in the "5 Keys to safer food" (WHO, 2006) and the South African regulation governing general hygiene requirements for food premises, the transport of food and related matters (R638 of 2018) (South Africa. Department of Health, 2018).

2.8.1 The Five Keys to Food Safety:

Bad food hygiene practices are the main cause of transmitting pathogens. Government and the private sector share the responsibility to ensure food safety. Technologies are available that ensures food safety. However, many foodborne disease outbreaks occur due to basic errors in food preparation (WHO, 2006). Since the 1990s the World Health Organization (WHO) was aware of the need to educate food handlers regarding their responsibility to keep food safe. The WHO developed 'Ten golden rules for safe food' but it was replaced with the '5 Keys to safer food' that was officially introduced in 2001 (WHO, 2006). The core message of the '5 Keys to safer food can be linked with R638 of 2018 (South Africa. Department of Health, 2018). The Five Keys to Safer Food consist of the following key aspects:

- Keep clean.
- Separate raw and cooked food.
- Cook thoroughly.

- Keep food at safe temperatures.
- Use safe water and raw materials.

Core information that the Five Keys to Safer Food include:

Keep clean – Most organisms do not cause diseases. Dangerous organisms are found in soil, water, animals, and people. These organisms can be transferred via hands, wiping cloths, and utensils. When in contact with food, these organisms can be transferred to food. Keeping clean addresses personal hygiene, including personal protective equipment, short fingernails, and wearing clean clothes. According to the WHO (2006) people do not know the proper way to wash hands and the importance of having running water available. Hands must be washed with warm water, soap, and dried with a disposable towel. Kitchens must be kept clean to ensure unwanted pests does not enter the food preparation area. Pests can transfer unwanted organisms to food and working surfaces (WHO, 2006).

Separate raw and cooked food – Food can be contaminated by raw food such as meat, poultry, and seafood and their juices. Therefore, the second key focusses on separating raw and cooked food during all phases of food preparation. It is encouraged to use separate kitchen equipment when handling raw and cooked food (WHO, 2006).

Cook thoroughly - To kill microorganisms in food, it must be cooked to a core temperature of 70˚C to ensure food is safe for human consumption. Food items such as minced meat, rolled roast, large joints of meat and whole poultry need special attention in terms of cooking time. Food must be reheated until piping hot with a core temperature of 60˚C (WHO, 2006).

Keep food at safe temperatures – When food is stored at room temperature, microorganisms have the potential to multiply very quickly. The growth of microorganisms is slowed down or stopped at temperatures below 5˚C or above 60˚C.

Use safe water and raw materials – Dangerous microorganisms can be present in raw materials, including water and ice. Raw materials and water may be contaminated with dangerous microorganisms. Care in the selection of raw materials, and washing and peeling reduce risks (WHO, 2006).

2.9 Legislation related to Food Safety

2.9.1 **Constitution of the Republic of South Africa:** The South African Constitution itself does not explicitly address food safety. However, food safety is governed by several

laws and regulations that align with principles of the Constitution, especially those related to the right to a safe and healthy environment. Chapter 2, section 27(1)(a) guarantees the right to access health services. Adequate food and clean water are integral to maintaining good health, and this right implies that the government should ensure the availability and safety of these essentials. Chapter 2, section 27(1)(b) states "Everyone has the right to have access to sufficient food and water" (South Africa, 1996). This provision is aimed to ensure that all South Africans have access to the basic necessities for a dignified life. Section 24 of Chapter 2 provides that "everyone has the right to an environment that is not harmful to their health or well-being." This includes the right to clean and safe water and the protection of the environment from pollution and degradation that could affect food safety (South Africa, 1996).

2.9.2 **Foodstuffs, Cosmetics and Disinfectants Act (No. 54 of 1972) (South Africa, 1972):** The focus of this Act is to control the sale, manufacture and importation of foodstuffs, cosmetics, and disinfectants, and to provide for incidental matters. Its primary purpose is to ensure the safety and quality of these products for consumers. Key provisions of the Act include:

- **Prohibition of certain articles** - The Act prohibits the sale, manufacture, or importation of articles that are deemed harmful or unsafe.
- **Regulation of foodstuffs -** The Act stipulates regulations for the sale, manufacture, and importation of foodstuffs, including standards for labelling, composition, and packaging.
- **Regulation of cosmetics and disinfectants -** Similar regulations apply to cosmetics and disinfectants, ensuring that it is safe for use and comply with specific standards.
- **Enforcement -** The Act empower authorities to inspect premises, seize non-compliant products, and prosecute offenders.

By regulating products, the Act helps to protect public health and prevent the sale of harmful or substandard goods (South Africa, 1972).

2.9.3 **Regulation governing general hygiene requirements for food premises, the transport of food and related matters (R638 of 2018) (South Africa. Department of Health, 2018):** This is a set of South African regulations designed to ensure food

safety and hygiene of food handling and transportation. Key components of the regulation include:

- **General hygiene** – The regulation outlines standards for cleanliness and sanitation that food premises must adhere to. This includes maintaining clean and hygienic conditions in food preparation, storage areas, and handling practices to prevent contamination.
- **Food premises** – The regulation specify the requirements for physical infrastructure, including the design and maintenance. This ensures that facilities are suitable for food processing and handling, including proper waste management and pest control measures.
- **Transport of food** – Requirements are provided for the transportation of food to ensure it remains safe and uncontaminated. This includes requirements for the cleanliness of transport vehicles, temperature control and protection of food during transit.
- **Related matters** – The regulation covers various other aspects related to food safety and hygiene, potentially including employee hygiene practices, equipment maintenance, and training for personnel involved in food handling.

These regulations aim to minimise food safety risks and protect public health by setting out clear standards for how food should be handled from preparation to consumption (South Africa. Department of Health, 2018).

2.9.4 **Norms and Standards:** The National Norms and Standards for Environmental Health outlines monitoring standards to ensure quality Environmental Health services and acceptable requirements for surveillance of premises and prevention of environmental conditions that may cause health hazards to the public (South Africa. Department of Health, 2015).

2.9.5 **SANS 241-1:2015:** This is a South African National Standard that sets out the minimum requirements for drinking water to be considered safe for human consumption. This standard outlines the specific limits for various microbiological, physical, aesthetics and chemical properties that drinking water must meet (South African National Standards, 2015).

2.10 Regulation 638; Requirements Related to the NSNP

The following are highlights in terms of R638 of 2018 (South Africa. Department of Health, 2018) applicable to the NSNP:

2.10.1 Regulation 3 – Certificate of Acceptability (COA)

Regulation 3 outlines the requirements for obtaining a certificate of acceptability for food premises. This certificate is essential for businesses involved in the production, processing, storage, or sale of food.

Key points of Regulation 3:

- **Application:** Any person intending to establish or operate a food premises must submit an application to the local authority for a certificate of acceptability.
- **Inspection:** The local authority will conduct an inspection of the premises to assess compliance with the hygiene requirements stipulated in Regulation 638 and other relevant regulations.
- **Conditions:** If the premises are found to be compliant, the local authority will issue a certificate of acceptability. However, the certificate may be subject to certain conditions or requirements that must be met to maintain its validity.
- **Changes to Premises:** Any changes to the food premises, such as renovations or expansions, must be notified to the local authority. The certificate may need to be amended or reissued.

In essence, Regulation 3 ensures that food premises meet the necessary hygiene standards to protect public health. By requiring a certificate of acceptability, the government can monitor and regulate the food industry, promoting safe and wholesome food products.

2.10.2 Regulation 5 – Standards and Requirements for Food Premises

This regulation specifically indicates the requirements needed such as the interior design of the walls, floor, and ceiling. It also addresses the ventilation and illumination of the food premises. The premises must have washup facilities with hot and cold water, must be pest proof, have proper sanitation- and handwash facilities, proper waste removal containers and storage areas as well as storage space for hygienic storage of food products (South Africa. Department of Health, 2018).

A food premises must be designed in such a manner that is does not cause any contamination of food. Specific requirements are set out to ensure that interior surfaces can be cleaned easy and not contaminate food. All interior surfaces that surround the food handling area must be made of a material that is easy to clean, smooth, non-toxic, non-absorbent, impermeable, and rust-free. Any interior surface such as the food serving or storage area that are not enclosed by, or part of the food handling area, can be made of face-brick or similar walls that is easy to clean (South Africa. Department of Health, 2018). Each area of the food preparation area must be adequately ventilated and illuminated, either naturally or artificially (South Africa. Department of Health, 2018). It is mandatory for a food establishment to provide washrooms equipped with both hot and cold water to clean facilities. Facilities means everything that is utilized in connection with handling food, such as apparatus, appliances, equipment, working surfaces, etc. Adequate sanitation facilities must be provided and maintained in a clean manner. Clean and hygienic hand-washing facilities (preferably with hot water), soap, and clean disposable hand drying material must be provided (South Africa. Department of Health, 2018).

2.10.3 Regulation 6 – Standards and Requirements for Facilities on Food Premises

This section outlines the standards and requirements for facilities and equipment on food premises. It covers:

- **Surfaces that come into contact with food (countertops, utensils)** – Surfaces must be smooth, non-porous, and easy to clean. Wooden chopping blocks are allowed if properly maintained.
- **Cleaning and sanitation** - All surfaces and equipment must be cleaned and washed before and after food contact. They must be free of food debris, cleaning chemicals, and have a low bacterial count.
- **Temperature control** - Chilling and heating facilities must be equipped with thermometers for accurate temperature monitoring.
- **Specific requirements for milk storage and processing equipment** – This includes multiple tanks for bulk milk, proper materials, and cleaning procedures.

2.10.4 Regulation 7 – Standards and Requirements for Food Containers, Appliances and Equipment

A person handling food, may not store, display, nor sell food in containers that compromises the safety of food products. Containers, appliances, and equipment must be clean, dustproof, and liquid proof (South Africa. Department of Health, 2018). Food containers must be hygienic and free of any impurities that can cause food to deteriorate. It is the duty of the food manufacturer to ensure they purchase safe packaging material. It covers:

- **Canned food inspection:** Containers must be free from bulges, leaks, and damage that could contaminate food. Exceptions are made for aerated drinks and gas-preserved foods.
- **Container safety:** Containers must be clean and non-toxic to prevent contamination of food.
- **Prepacked food packaging:** Prepacked food must be packaged in dustproof and liquid-proof containers that protect the food from contamination.
- **Perishable food packaging:** Perishable food, when served to consumers, must be packed in containers that protect it from contamination.

2.10.5 Regulation 8 – Standards and Requirements for the Display, Storage and Temperature of Food

Controlling temperature is crucial to prevent the growth of dangerous microorganisms in food. Food can be kept extremely hot or very cold to prevent or limit growth of bacteria. The regulation makes provision for thawed food which has not exceeded 5 ˚C to be frozen, provided that it is handled in accordance with good manufacturing practices (South Africa. Department of Health, 2018). Table 2 shows specific storage temperatures for different food categories outlined in the regulation.

Table 2: The temperature requirements for the storing of perishable food (South Africa. Department of Health, 2018)

Food category	Type of food	Required core temperature
Frozen products	Ice cream and sorbet, excluding sorbet which is used for soft serve purposes and frozen fish and fishery products.	Colder or equal to -18˚C
	Any other food which is marketed as a frozen product.	Colder or equal to -12˚C
Chilled products	Raw unpreserved fish, mollusks, crustaceans, edible offal, poultry, meat, and milk.	Colder or equal to +4˚C
	Any other perishable food that must be kept chilled to prevent spoilage.	Colder or equal to +5˚C
Heated products	Any perishable food not kept frozen or chilled.	Warmer or equal to +60˚C

2.10.6 Regulation 9 – Standards and Requirements for Protective Clothing

It is mandatory for all food handlers in the food handling areas to wear appropriate protective equipment to reduce the possibility of food contamination. Depending on the tasks performed and the dangers associated with products being handled or manufactured, different criteria for clothes may apply. The person in charge bears the responsibility to clean the protective clothes on a regular basis. A person may not handle food if he/she is not wearing suitable protective clothing. The appropriate protective clothing includes headgear, aprons, and footwear. When handling food, personal protective clothing must be clean and neat (South Africa. Department of Health, 2018).

2.10.7 Regulation 10 – Duties of Person in Charge of a Food Premises

The person in charge must ensure all food handlers are adequately trained in terms of food safety and food hygiene. Employees must possess the requisite technical expertise related to the operations or processes they are in charge of and be aware of safety measures required to keep food safe. Frequent training must be conducted, and records thereof must be kept (South Africa. Department of Health, 2018). It is the duty of the person in charge to ensure the food premises is free from pests and vectors, and refuse are stored and disposed in a manner that does not cause any health nuisance (South Africa. Department of Health, 2018).

2.10.8 Regulation 11 – Duties of a Food Handler

It is legally required of food handlers to ensure that the food they handle is uncontaminated. They must therefore understand how their personal hygiene, habits, and clothing may either increase or lower the danger of food contamination. The hands of the person handling food must always be clean. The regulation specifically outlines when hands must be washed, for example after smoking or after using the bathroom. This regulation provides clear guidance on what the food handler is allowed to do or not allowed to do when in contact with food (South Africa. Department of Health, 2018).

The literature review indicates that food hygiene knowledge and practices among food handlers play a crucial role in ensuring the safety and nutritional quality if meals provided in school nutrition programmes. While various studies have explored the importance of food safety in a formal food preparation setting. A noticeable gap was seen in research specifically addressing food handlers' knowledge and practices within the context of the NSNP. The research does not adequately cover the hygiene knowledge and practices of food handlers in the NSNP who receives limited food safety training.

2.11 Conclusion

The literature review highlighted that food safety in the NSNP is seen as essential, particularly for protecting learners who are vulnerable to foodborne illnesses. Frameworks are in place such as the "5 Keys to Safer Food" (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018) that provides clear standards and legal requirements for food handlers to ensure food safety. Despite this being in place, foodborne outbreaks in schools were continued to be reported as seen in the literature. This indicated the problem does not lie in the absence of guidelines or regulations, but how it is understood, applied and practiced in the NSNP. The literature further suggest that food handlers play a critical role in food safety, yet many outbreaks are linked to inadequate hygiene knowledge, poor food handling practices and limited or inconsistent training. This highlights a critical gap between what food handlers are expected to know according to legislation and guidelines and what is actually practiced in the kitchen.

Although training is often recommended, few studies have assessed whether such training leads to meaningful improvements in food handlers' hygiene knowledge and practices, especially in the NSNP. Previous studies have demonstrated the usefulness of structured questionnaires in assessing food handlers' food safety knowledge, attitudes, and practices. Akabanda et al. (2017)

employed structured questionnaires to evaluate food safety knowledge, attitudes, and practices among food handlers in Ghana. Similarly, Al-Akash et al. (2022) conducted a study among food handlers in hotels and hospitals to assess their level of food safety knowledge and to determine the impact of a training programme. In that study, the effectiveness of the training intervention was measured using pre- and post-training questionnaires. These studies highlight the value of questionnaires as effective tools for measuring changes in knowledge following food safety training interventions. In addition, observational methods are widely recommended to assess actual food handling practices, as self-reported knowledge may not always reflect behaviour in practice (Al-Akash et al., 2022). Therefore, the present study adopted a combination of structured questionnaires, observation checklists, and a food hygiene training intervention to comprehensively assess food handlers' knowledge and practices and to evaluate the impact of the intervention in achieving the study objectives.

CHAPTER 3

RESEARCH DESIGN AND METHODOLOGY

3.1 Introduction

This chapter focusses on the methodological framework used to address the research topic. The aim of the chapter is to provide a comprehensive overview of the methods used to answer research questions presented in this study. A combination of qualitative and quantitative methods was used. Quantitative methods focussed on measuring and analysing variables to obtain results. This approach involves the use of numerical data and specific statistical techniques to address research questions (Apuke, 2017). The main aim of this approach is to evaluate the validity of predictive generalisation derived from a theory (Apuke, 2017). Qualitative research is to understand how people interpret their surroundings. While there are many different techniques related to qualitative research, they are all characterised by a disposition to be flexible and emphasises on maintaining a rich meaning while interpreting data (Ugwu & Eze, 2023). The study follows a qualitative (observation checklist) and quantitative (questionnaires) approach.

3.2 Study Design

A longitudinal pre-test post-test intervention study design was used to determine the food hygiene knowledge and practices of the food handlers. Data was collected from the same participants at multiple points in time. This allowed the researcher to assess the impact of training over time. The study made use of both qualitative and quantitative data collection technique. The questionnaire used was designed to gather quantitative data and the observation checklist designed to gather qualitative data based on “the 5 keys to safer food” (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018). The researcher aimed to pinpoint changes in food handlers’ hygiene knowledge and practices before and after training. To achieve this, a questionnaire was used to collect quantitative data. The pre-training questionnaires was in a form of a Likert scale and post-training questionnaires in a multiple-choice equation format. Additionally, observation checklists were used to collect qualitative data on the actual hygiene practices of the food handlers. This research project can be described as action research because data was collected, training was provided, and data was again collected after training to assess whether the training was effective. Action research has many advantages such as a high level of practical relevance. Also, it can be used for quantitative as

well as qualitative data. With this type of research there is a possibility to gain more in-depth knowledge of the problem at hand (Bryman & Bell, 2011).

3.3 Study Area

One sub-district of the Cape Winelands District Municipality was purposively selected for the research study due to ease of logistics. The sub-district includes an area of approximately 4517.4km^2. Estimates on the population of the sub-district indicate that it is home to 119 962 residents and 31 000 households as per the 2021 statistics (Western Cape Government, 2021; South Africa. Department of Social Development, 2019) and consists of five towns (figure 1). The sub-district has a total of 52 schools, that includes secondary and primary schools. Forty-five of these schools are no-fee schools. The sub-district has 39 primary schools, which provides food to learners on a daily basis by means of the NSNP.

Figure 1: Map of the Cape Winelands District Municipality (Cape Winelands District Municipality, 2022).

3.4 Study Population and Sampling Method

The target population included 100% of the volunteer food handlers who were part of the schools that was purposively selected and prepared and served food for learners in the selected sub-district. Although the food handlers are volunteers, they were employed under one-year contractual agreements. Therefore, the same food handlers remained employed and

participated throughout the entire duration of this study. The selected sub-district has five towns. Two schools were purposively selected in each of the five towns. A total of 10 schools were included in the study. These 10 schools were selected due to ease of logistical purposes of data collection as well as the frequency the researcher was able to visit the towns. All food handlers of the 10 schools partook in the study. A sample population of 30 food handlers completed the questionnaires.

3.5 Data Collection

Data was collected from one school each day to maintain consistency in the timing of the research visits. This approach ensured that observations occurred around the same time each day, specifically during the busy period when the food handlers were actively preparing lunch. During the initial visit, the researcher observed the daily food hygiene practices of the food handlers as they prepared lunch for the learners. Following the meal service, the food handlers were requested to complete the pre-training questionnaires.

The training was conducted on a different day, after the initial data collection. The content of the training was in accordance with the guidelines contained in the 5 Keys to Safer Food (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018). Two weeks after the initial questionnaires were completed, the food handlers convened at a central venue for training conducted by the researcher. Following a three-month interval, a subsequent round of observations and questionnaires were conducted by the researcher. According to the national environmental health norms and standards for premises and acceptable monitoring standards for environmental health practitioners (South Africa. Department of Health, 2015), it is recommended that food premises are visited by an Environmental Health Practitioner (EHP) not less than once every 3 months for high-risk food premises, not less than every 6 months for a moderate-risk food premises and not less than every 12 months for a low-risk food premises (South Africa. Department of Health, 2015).

The post-training questionnaires were administered 3 months after the training was received, following a format consistent with the initial pre-training questionnaire, employing similar questions albeit presented in a different format. The pre- and post-training questionnaires were administered by the researcher. This approach ensured continuity and facilitated comparative analysis of responses across different stages of the study. The second set of questionnaires was set up as multiple-choice questions. The pre- and post-training questionnaires were in different formats to prevent repeated exposure to the same questions that can lead to improved results

due to memorising the questions. The data collection instruments were provided in both English and Afrikaans and administered directly by the researcher. In cases where participants did not understand the questions posed in either English or Afrikaans, a translator would have been provided, or a translation tool would have been used to explain the questions in a language the participants understood. During the planning stages, the principals of all participating schools confirmed that all food handlers understood either English or Afrikaans. All questionnaire items, pre- and post-training, were verbally articulated by the researcher to ensure comprehensive understanding among all respondents.

3.6 Data Collection Tools

Two questionnaires and an observation checklist were used to collect data for this investigation. To assess the hygiene knowledge and practices of participants prior to receiving training (objective 1), a pre-training questionnaire (appendix D) was developed. The questionnaire comprised closed-ended questions designed to elicit fixed responses. Specifically, it included inquiries aligned with the principles of the five keys to safer food (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018). The questionnaire consisted of 22 questions addressing topics such as keeping clean, separating raw and cooked foods, storing food at safe temperatures, using safe water and materials, cooking food thoroughly (WHO, 2006), and adhering to general requirements stipulated for food handlers according to Regulation 638 of 2018 (South Africa. Department of Health, 2018). Responses were recorded on a 5-point Likert scale, where participants indicated their level of agreement with each statement using options ranging from "strongly disagree" (1) to "strongly agree" (5).

For objectives 1 and 3, a qualitative checklist consisting of nineteen observation areas with binary options ("Compliant" or "Non-compliant") was employed (appendix E). During two separate visits, the researcher observed the food handling practices of participants, focusing specifically on food hygiene. The aim was to assess whether participants applied their knowledge of food hygiene in practice. Key areas of observation included the proper use of protective clothing, personal hygiene, and adherence to handwashing protocols. Observations were conducted during two separate visits. These visits were scheduled to coincide with the busy lunch preparation period, when food handlers were actively preparing meals. Each observation session lasted approximately 60 minutes; a duration determined during the earlier pilot study. The pilot study helped to identify the optimal observation period needed to capture the food handling practices accurately, while minimising disruption to the workflow. The observations focused on food hygiene practices, including key areas such as proper use of

protective clothing, hygiene, and personal hygiene such as handwashing protocols. To classify school-level compliance, the performance of all food handlers in a school was considered collectively. In schools with multiple food handlers, if 50% or more of the food handlers were observed to be non-compliant / compliant in a particular area, the school was marked as non-compliant / complaint for that area. The approach allowed the study to account for variation in individual practices, while maintaining a clear, standardised criterion for school-level compliance. To minimise observation bias, the researcher conducted the observations discreetly, avoiding interaction with participants. Observations were recorded in real-time using the observation checklist to ensure accuracy and reliability.

After the training session, a post-training quantitative questionnaire (appendix D) was designed to assess participants' understanding and application of hygiene practices (objective 3). The questionnaire featured closed-ended questions designed to prompt specific responses and was structured in accordance with the principles outlined in the five keys to safer food (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018). It consisted of 12 questions addressing topics such as hygiene upkeep, proper handling of raw and cooked foods, correct food storage methods, safe use of water and materials, thorough cooking practices (WHO, 2006), and adherence to the general requirements specified for food handlers in accordance with Regulation 638 of 2018 (South Arica, 2018). Each question was presented in a multiple-choice format, requiring participants to select the most appropriate answer from the options provided.

The data collection instruments were available in both Englis and Afrikaans and administered directly by the researcher. During the planning stages, the principals of all participating schools confirmed that the food handlers understood either English or Afrikaans, however their home language was Afrikaans. The translation of questionnaires was done by the researcher. All question was also read out loud by the researcher to ensure comprehensive understanding among all respondents.

3.7 Training Intervention

The intervention consisted of a structural, standardised training programme. The intervention was delivered to the same food handlers who completed the pre-training questionnaires and undergone the pre-training observations. Ensuring the same participants attended the training was essential to accurately measure changes in knowledge and practices. The training was conducted two weeks after completion of the pre-training questionnaires and observations was

competed. The session took place at a central school hall, selected for its accessibility to all participating food handlers and its capacity to accommodate the group comfortability. Thirty food handlers attended. The session was administered by the researcher, who is proficient in Afrikaans, the language requested by all participants. Conducting the training in Afrikaans ensured that participants could fully understand the content and engage effectively with the material. The content of the training was developed in accordance with the "5 Keys to Safer Foo" (WHO, 2006) and Regulation 638 of 2018 (South Africa. Department of Health, 2018). A visual-based training approach was employed to enhance comprehension and retention. In addition to visual aids, a brief educational video, produced by the World Health Organisation was screened, which lasted 5 minutes. The video illustrated the core principles of the "5 Keys to Safer Food" (WHO, 2015). The psychologist, Jerome Bruner's research findings further supported this approach, indicating that individuals retain approximately 80% of visually presented information, in contrast 10% from auditory stimuli and 20% from textual information (Yadav & Jabeen, 2013). Complementing these visual tools, a structed PowerPoint presentation was meticulously crafted, encompassing 38 slides aligned with the stipulations of Regulation 638 of 2018 (South Africa. Department of Health, 2018) and outlining the specific duties of the food handlers. Despite the comprehensive coverage, the presentation was delivered within 30 minutes. The entire session with a question-and-answer session, was efficiently concluded within one hour. No additional training sessions were provided during the follow-up period to ensure that any changes observed could be attributed to this single, standardised intervention.

3.8 Data Analysis

Data from the quantitative questionnaires were analysed using descriptive statistics (frequencies and percentages) and inferential statistics (chi-square tests) to compare food hygiene knowledge scores before and after the training intervention. Data analysis was performed using the Statistical Package for Social Sciences (SPSS) software. Statistical support was provided by a statistician from the Cape Peninsula University of Technology.

3.9 Pilot Study

A pilot study was conducted to refine the research design and ensure the feasibility of data collection. Through this pilot study, the researcher assessed the time required to administer the questionnaire to participants and allocated sufficient resources for data collection. The pilot study identified any questions that were confusing to participants, allowing for necessary revisions to improve clarity and understanding. For the pre-training questionnaire 1 question

was rephrased, 2 questions were changed due to incorrect temperatures indicated on the questionnaire, and 7 questions was removed that did not align with the objectives of the study. In the post-training questionnaire 4 questions were changed due to the options provided being incorrect and 2 questions' options were rearranged to avoid confusion. Additionally, it evaluated the effectiveness of the questionnaires in addressing the research questions, including assessments of validity (whether the questionnaire measures what it purports to measure) and reliability (the consistency of the questionnaire's results). By identifying these issues with the questionnaires during the pilot study, the researcher was able to make necessary adjustments to enhance the accuracy and reliability of the data collected in the main study. During the pilot study the researcher could establish that 1 hour should be allocated for the training, including the question-and-answer session. It was estimated that the researcher would spend between 45-60 minutes per school based on the results of the pilot study. The pilot study was conducted in a different district municipality that does not fall under the CWDM, with one town school selected for participation. All food handlers at the school were included in the study. Results of the pilot study was not used in the main study.

3.10 Ethical Considerations

Data collection permission was obtained from the Department of Basic Education (Reference number: 16375E04C0007EB-20230508) and the relevant district municipality (Reference number: SP L/2 (R)) (appendix A). The proposal was approved by the University's faculty ethics committee (Reference number: 217089593/06/2023) (appendix B). Privacy and anonymity were protected, e.g. the identity of participants remained anonymous, and each participant was assigned with a unique number to further protect their identity. The research was conducted in compliance with the Protection of Personal Information Act (Act 4 of 2013) (South Africa, 2013). Study participants participated voluntarily after completing and signing an informed consent form (appendix C). Participants could withdraw their consent to participate at any time.

The questionnaires were completed at the different schools' food preparation areas where the food handlers were comfortable and familiar with the environment. The questionnaires were handed out and collected by the researcher. The data was captured, by the researcher, on an MS Excel spreadsheet and were loaded onto the CPUT data repository, eSango.

3.11 Delineation

The study was limited to schools within the purposively selected sub-district municipality. Only the food handlers involved with the NSNP were selected and requested to complete the questionnaires before and after receiving training. No microbiological analysis or work on the health effects of improper food handling was done. The learners receiving and consuming the food were excluded from the study. The teachers, principals, and supporting staff were also excluded from the study. Only the kitchen area and food handlers where food was being prepared was focussed on. All other premises on the school grounds were excluded.

CHAPTER 4

RESULTS

4.1 Keep Clean

In table 4.1a the pre-training results of the respondents are presented based on the first key, "keep clean". The majority of participants (90%) "strongly agreed" and 10% "agreed" with the statement, "it is important to wash hands before handling food and when preparing it". 93.3% of respondents "agreed" that one's hands must be washed after using the toilet. Respondents (86.7%) "strongly agreed" on the appropriate handwashing procedures. The majority of respondents (56.7%) "strongly agreed" and 30% "agreed" that wiping cloths have the ability to transmit organisms. Furthermore, 66.7% of respondents "strongly agreed" that kitchen surfaces have to be kept clean.

Table 4.1a: Pre-training results of respondents based on key 1, "keep clean" (n=30).

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
It is important to wash hands before handling food and often during food preparation	0(0%)	0(0%)	0(0%)	3(10%)	27(90%)
It is important to wash hands after going to the toilet.	0(0%)	1(3.3%)	0(0%)	1(3.3)	28(93.3%)
A wiping cloth can spread organisms.	0(0%)	2(6.7%)	2(6.7%)	9(30%)	17(56.7%)
Kitchen food preparation surfaces do have to be kept clean.	0(0%)	4(13.3%)	1(3.3%)	5(16.7%)	20(66.7%)
Hands must be washed with running water and soap for a minimum of 20 seconds and also dried with a clean dry towel.	0(0%)	1(3.3%)	0(0%)	3(10%)	26(86.7%)

Figure 4.1a shows responses of food handlers post-training. 86.7% of food handlers chose the "all of the above" option, which means that hands should be washed "at the beginning of a day's work", "after using the toilet", and "after hands became soiled / contaminated". Only 3.33% chose "none of the above".

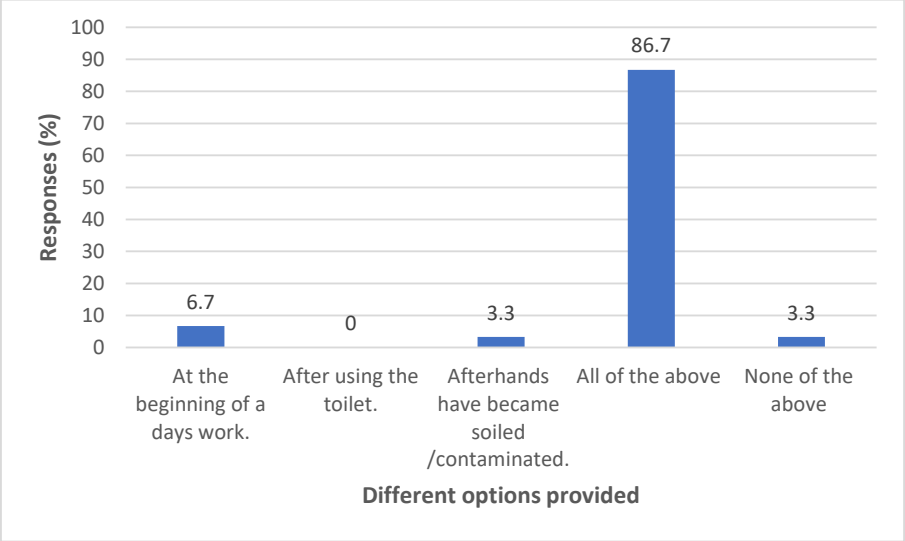

Figure 4.1a: Post-training questionnaire responses to question 1, key moments to wash hands (n=30).

Figure 4.1b is showing the post-training responses of food handlers on the issue of hand washing. The majority (83.3%) indicated that washing of hands with running water and soap for 20 seconds, followed by drying is correct. A smaller percentage (13.3%) indicated that handwashing with soap and water is correct. None of the respondents indicated that "hands must be washed with water and soap for 20 seconds" is correct. Only 3.3% of respondents indicated that "none of the above" options were correct.

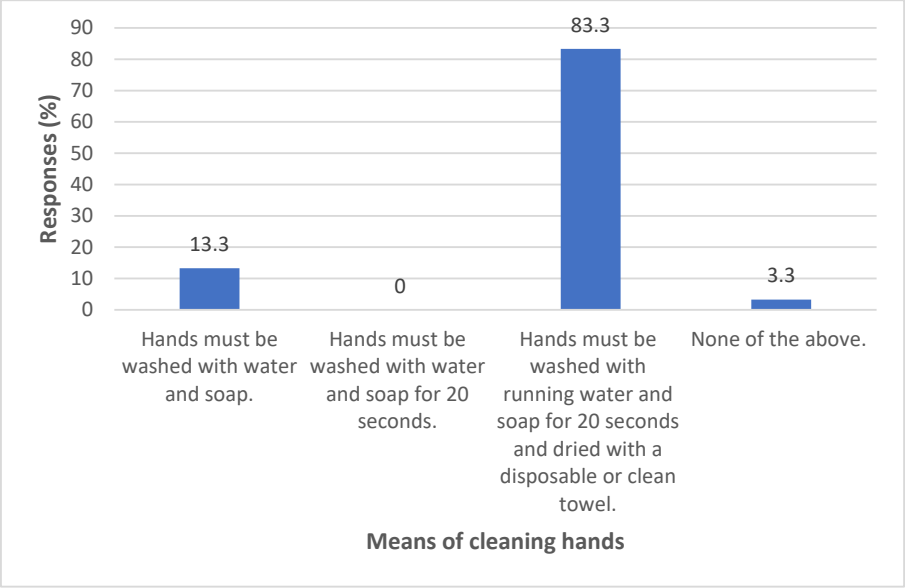

Figure 4.1b: The responses to the post-training question on the means of washing hands. Note: Respondents had to choose the correct statement (n=30).

Post-training responses regarding the cleaning of certain items related to food handling are shown in figure 4.1c. By choosing the "none of the above" option, most of the respondents (80%) indicated that the food preparation areas as well as wiping cloths must be kept clean.

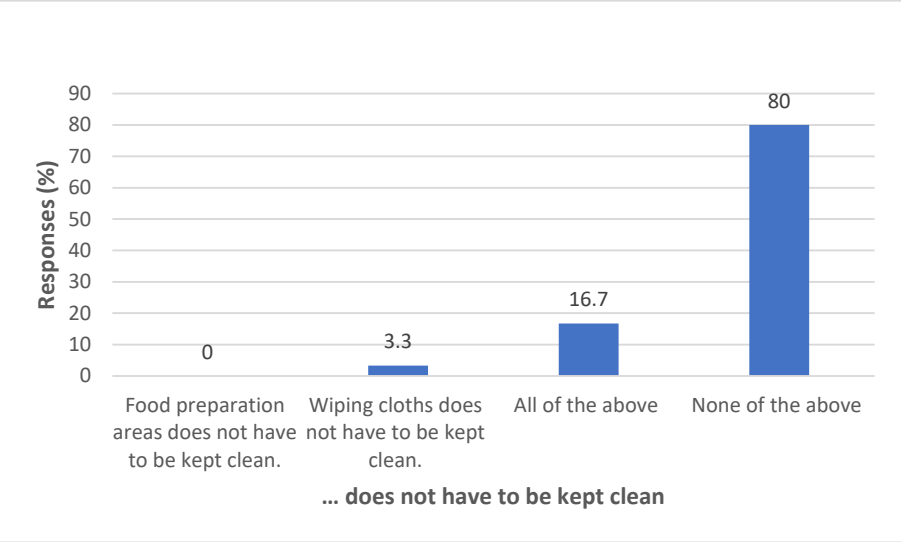

Figure 4.1c: The responses to the post-training question: "… does not have to be kept clean" (n=30).

Table 4.1b shows results of observations done pre- and post-training, per school. There were improvements in most observation criteria related to "keep clean", particularly in the frequency of handwashing and cleanliness of the food preparation area. However, no change was seen for "hands are washed with soap and running water for 20 seconds and dried". Pre-training only 2 schools used clean cloths. Following training, an improvement of 9 schools using clean cloths were observed.

Table 4.1b: Pre- and post-training observations based on key 1, "keep clean", per school (n=10).

	Pre-training		Post-training	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Hands are washed regularly.	2	8	10	0
Hands are washed with soap and running water for 20 seconds and dried.	2	8	2	8
Food preparation area is clean.	8	2	10	0
All cloths used are clean.	2	8	9	1
Continuous cleaning is done.	8	2	10	0
Dishes and kitchen equipment are washed.	9	1	10	0

No significant difference (p = 1) was found between pre- and post-training questions, “it is important to wash hands before handling food and often during food preparation” vs. the post-training question stating it is important to wash hands at the beginning of a day’s work, after hands become contaminated or soiled and after using the toilet.

It is important to wash hands after going to the toilet vs. the post training question stating the importance of handwashing (different options provided), showed no significant difference (p=1) according to the Pearson chi-square test.

No significant difference was found for pre-and post-training questions based on wiping cloths that has to be kept clean. The Pearson’s chi-square indicated p=1.

The Pearson’s chi-square test revealed no significant difference (p=1), for questions based on means of handwashing.

Pearson chi-square analysis on questions on the issue of kitchen surfaces and kitchen food preparation areas that must be kept clean, indicated no significant difference (p = 0.329) between pre- and post-training.

A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

4.2 Separate Raw and Cooked Food

Table 4.2a provides pre-training responses of food handlers on their knowledge with regards to separating raw and cooked food. For the statement that raw and cooked food must be stored separately, the majority of respondents “strongly agreed” (76.7%), and 16.7% “agreed” that raw and cooked food must be stored separately, although 6.7% of respondents “disagreed”. Responses were more varied concerning the storage of raw food on the top shelves of refrigerators: 16.7% “strongly disagreed”, 23.3% “disagreed”, 16.7% were “neutral”, 16.7% “agreed”, and 26.7% “strongly agreed”. Food handlers responded with 33.3% “strongly disagreeing” and 23.3% “disagreeing” with the statement that cooked food does not have to be stored on the top shelves. Other food handlers responded with 20% “neutral”, 10% “agreeing” and 13.3% “strongly agreeing” with this statement.

Table 4.2a: Pre-training results of respondents based on key 2, "separate raw and cooked food" (n=30).

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Raw and cooked food must be stored separately.	0(0%)	2(6.7%)	0(0%)	5(16.7%)	23(76.7%)
Raw food should be stored on the top shelves of the refrigerator.	5(16.7%)	7(23.3%)	5(16.7%)	5(16.7%)	8(26.7%)
Cooked food does not have to be stored on the top shelves of the refrigerator.	10(33.3%)	7(23.3%)	6(20%)	3(10%)	4(13.3%)

Figure 4.2a is showing post-training responses of food handlers on the issue of separation of raw and cooked food. 16.7% of respondents indicated that the option "raw and cooked food must be stored separately" is incorrect. 40% of respondents indicated that the option "raw food must be placed on the top shelves of the fridge" is incorrect, while 43.3% indicated that the option "raw and cooked food may not be stored in the same container" is incorrect.

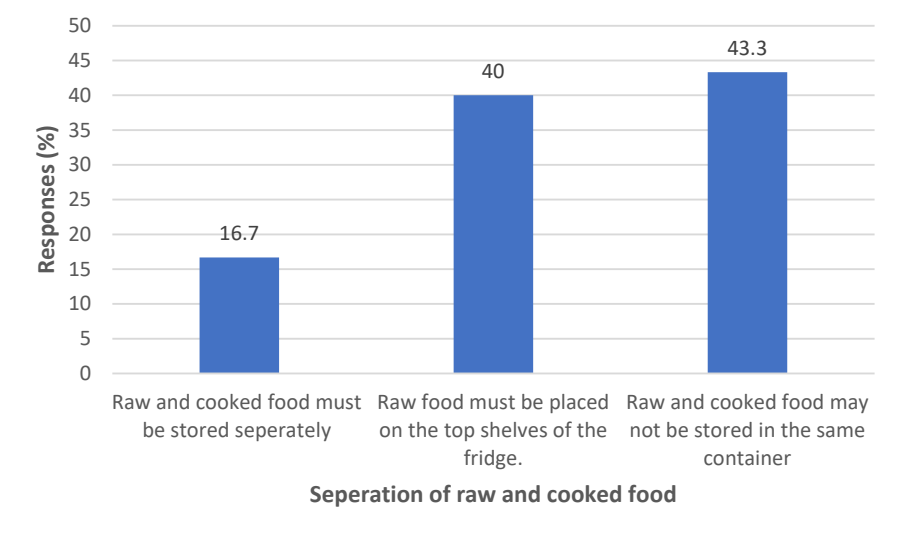

Figure 4.2a: The responses to the post-training question on separating raw and cooked food. Note: Respondents had to choose the incorrect statement (n=30).

Table 4.2b is showing the degree of compliance regarding the "separation of raw and cooked food" pre- and post-training, per school, as observed by the researcher. The adherence to "raw and cooked food are kept separate" increased from 7 schools to 10 schools after training.

Table 4.2b: Pre- and post-training observations based on key 2, "separate raw and cooked food", per school (n=10).

	Pre-training		Post-training	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Raw and cooked food are kept separate.	7	3	10	0

A statistically significant difference ($p<0.05$) was observed when comparing pre-and post-training responses to questions regarding the storage of raw and cooked food in the refrigerator. However, no significant difference ($p=1$) was found when comparing pre- and post-training responses to questions regarding storing raw and cooked food separately. A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

4.3 Cook Food Thoroughly

Pre-training responses showed that the majority of respondents "agreed" (40%) and "strongly agreed" (36.7%) with the statement that cooked meat should achieve a core temperature of 40°C. Regarding the recommended practice of boiling soups and stews at 60°C to ensure food safety, 40% "strongly agreed" and 50% "agreed" (table 4.3a).

Table 4.3a: Pre-training results of respondents based on key 3, "cook thoroughly" (n=30).

Variables	**Frequency (%)**				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Meat must be properly cooked so that it reaches 40°C at the core of the thickest part of the meat.	4(13.3%)	3(10%)	0(0%)	12(40%)	11(36.7%)
Soup and stews should always be boiled / reheated at 60°C to ensure safety.	2(6.7%)	0(0%)	1(3.3%)	15(50%)	12(40%)

Figure 4.3a is showing the post-training results on issues related to the thorough cooking of food. 79.3% of respondents indicated that food must be reheated to a temperature of 60˚C, 13.8% indicated 40˚C, and 6.9% indicated 50˚C. One respondent did not answer this question.

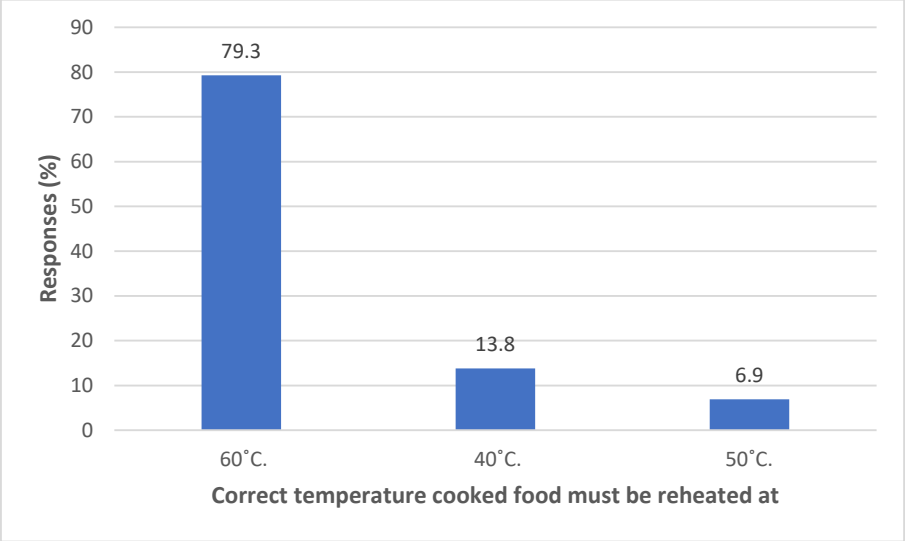

Figure 4.3a: The responses to the post-training question on the correct temperature at which food must be reheated (n=29).

Table 4.3b presents pre- and post-training observations of compliance related to the practice of cooking food thoroughly at a temperature of more than 60°C. All 10 schools complied, pre- and post-training.

Table 4.3b: Pre- and post-training observations based on key 3, "cook food thoroughly", per school (n=10).

	Pre-training		Post-training	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Food is cooked to a core temperature of warmer or equal to +60˚C.	10	0	10	0

No significant difference was found for pre- and post-training regarding reheating meat ($p=0.089$), soup and stews ($p=0.167$). A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

4.4 Keep Food at Safe Temperatures

Table 4.4a shows pre-training results of the respondents on matters related to keeping food at safe temperatures. The majority (46.7%) "strongly agreed" that leftover cooked food must be refrigerated within 2 hours of cooking. A total of 30% "strongly disagreed" and 23.3% "disagreed" with the statement that cooked meat can be left at room temperature overnight to cool before refrigerating. Most respondents "strongly agreed" (36.7%) and "agreed" (33.3%)

that frozen food should be defrosted at room temperature, while 20% “disagreed”. Most of the respondents “strongly agreed” (40%) and “agreed” (20%) that the temperature of the refrigerator should be kept at 4˚C, while 23.3% “disagreed”. 36.7% “strongly agreed” and 23.3% “agreed” that the temperature of the freezer should be -12˚C, while 20% “disagreed” and another 20% were “neutral”.

Table 4.4a: Pre-training results of respondents based on key 4, “keep food at safe temperatures” (n=30).

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Leftover cooked food must be refrigerated within 2 hours of cooking.	6(20%)	2(6.7%)	6(20%)	2(6.7%)	14(46.7%)
Cooked meat can be left at room temperature overnight to cool before refrigerating.	9(30%)	7(23.3%)	1(3.3%)	5(16.7%)	8(26.7%)
Frozen food should be defrosted at room temperature.	1(3.3%)	6(20%)	2(6.7%)	10(33.3%)	11(36.7%)
The temperatures of a fridge must be at 4°C.	3(10%)	7(23.3%)	2(6.7%)	6(20%)	12(40%)
The temperature of the freezer must be -12°C.	0(0%)	6(20%)	6(20%)	7(23.3%)	11(36.7%)

Post-training responses with regards to safe temperatures to keep food is shown in Figure 4.4a. 46.7% of respondents indicated “all of the above”, 26.7% chose “none of the above”, 13.3 % indicated “to keep food at safe temperatures do not leave food at room temperatures for more than 2 hours”, and 13.3% chose “thaw frozen food at room temperatures”.

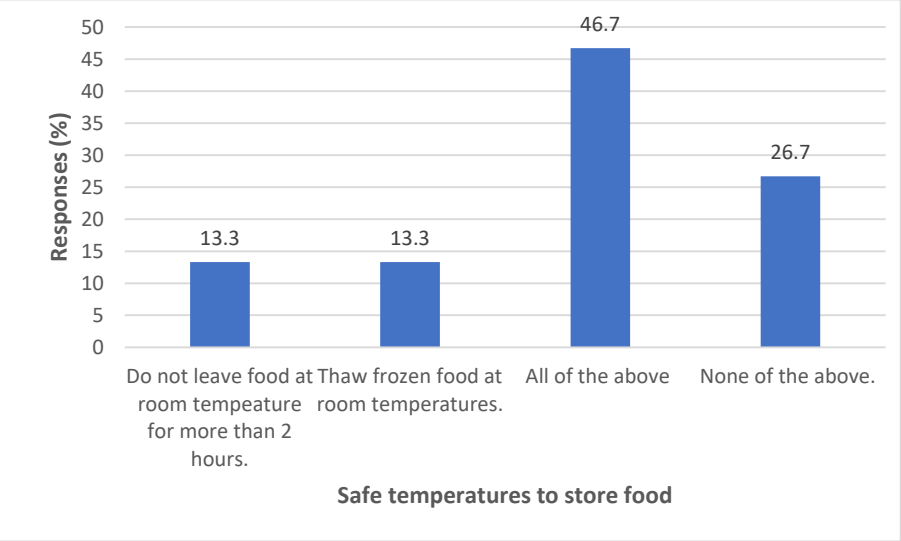

Figure 4.4a: The responses to a post-training question on the correct temperatures at which food can be safely stored (n=30).

Figure 4.4b shows the post-training responses on the correct temperature at which food should be frozen. The majority of respondents (66.7%) indicated that food products should be frozen at temperatures colder or equal to -12˚C. However, 30% chose warmer or equal to +60˚C.

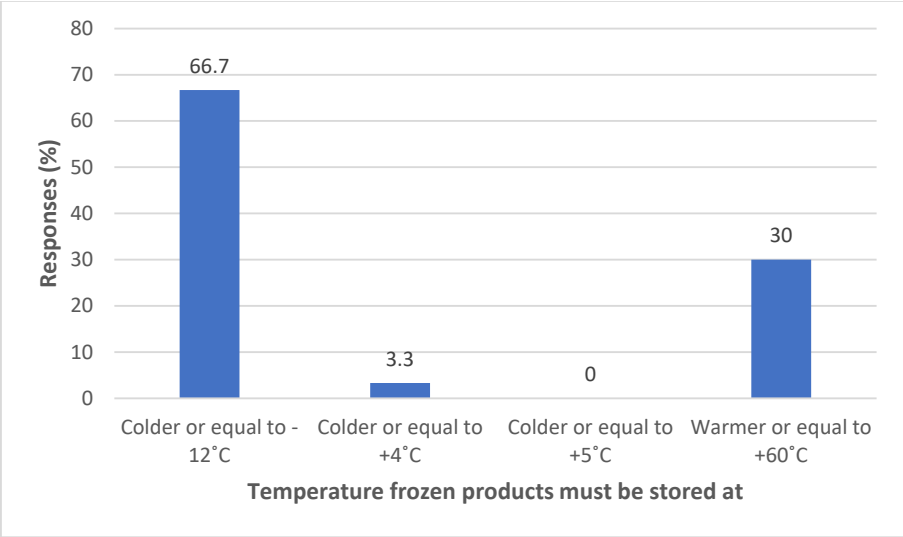

Figure 4.4b: The responses to the post-training question on the correct temperatures at which frozen products must be kept (n=30).

Figure 4.4c illustrates the post-training responses on the correct temperature to keep perishable food. The majority chose colder or equal to -12°C (60%), followed by colder or equal to +4°C (20%), warmer and equal to +60°C (16.7%) and colder or equal to +5°C (3.3%).

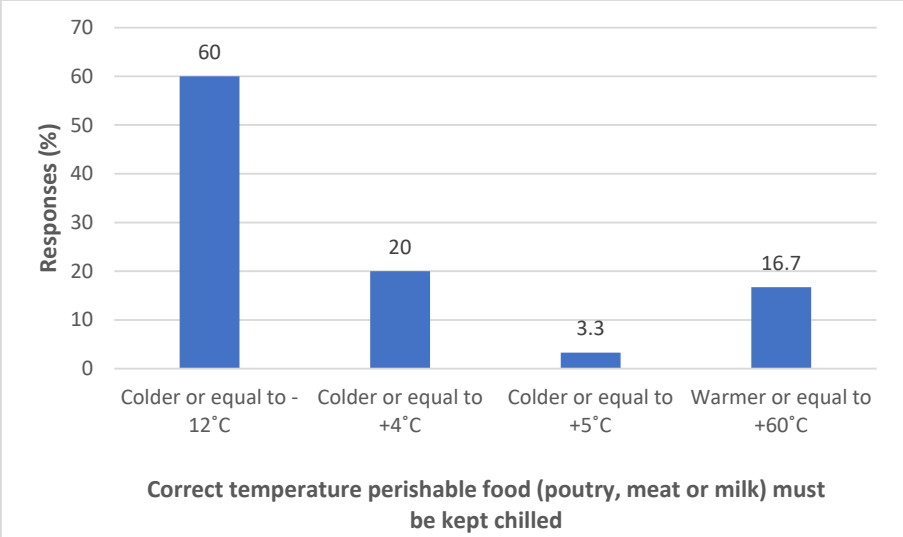

Figure 4.4c: The responses to the post-training question on the correct temperatures at which perishable food (poultry, meat and milk) must be kept chilled (n=30)**.**

Table 4.4b shows the pre- and post-training observations made on issues related to safe temperatures to keep food at. All schools kept food at safe temperatures, achieving 100% compliance both pre- and post-training in areas such as "food is kept chilled at +5˚C or colder than", "frozen products are stored at -12˚C or colder than", and "thawing process are as short as possible". However, none of the schools complied pre-training with displaying and/or monitoring freezer or refrigerator temperatures. Following the training, only 2 schools achieved compliance in this regard.

Table 4.4b: Pre- and post-training observations based on key 4, "keep food at safe temperatures", per school (n=10).

	Pre-training		**Post-training**	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Food is kept chilled at colder or equal to +4˚C.	10	0	10	0
Frozen products are stored at colder or equal to -12˚C.	10	0	10	0
Temperatures are displayed / monitored.	0	10	2	8
Thawing process is as short as possible.	10	0	10	0

A statistically significant difference (p=0.008) was found between the pre-training question "leftover cooked food must be refrigerated within 2 hours of cooking" and the post-training questions assessing the safe temperatures to store food.

No significant difference (p=0.140) was found between the pre-training question, "cooked meat can be left at room temperatures over night to cool before refrigerating" and the post-training questions assessing the safe temperature to store food.

No significant difference (p = 0.053) was found between the pre-training question "frozen food should be defrosted at room temperature" and the post-training questions assessing the safe temperatures to store food at.

No significant difference was found between pre- and post-training questions regarding temperatures of the refrigerator and keeping perishable food chilled at +4˚C or colder (p=0.122).

No significant difference (p = 0.550) was found between pre-and post-training responses to the question "temperatures of the freezer must be -12˚C" and the questions assessing the correct

temperatures to store frozen food products at. A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

4.5 Use Safe Water and Raw Materials

Table 4.5a shows pre-training responses on the key related to the use of safe water and raw materials. 66.7% "strongly agreed" and 30% "agreed" that food must be checked for freshness and quality, with only one respondent "disagreeing". Mixed responses were seen to the statement "vegetables should first be chopped and then washed", with 30% of respondents choosing "strongly agree", followed by "disagree" (also 30%), "strongly disagree" (26.7%), and "agree" (13.3%). A total 43.3% respondents "strongly agreed" that damaged cans cannot be used, followed by "strongly disagree" (33.3%), "agree" (10%), and "disagree" and "neutral" (6.7% each).

Table 4.5a: Pre-training results of respondents based on key 4, "use safe water and raw materials" (n=10).

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Food should be checked for freshness and quality.	1(3.3%)	0(0%)	0(0%)	9(30%)	20(66.7%)
Vegetables should first be chopped up and then washed.	8(26.7%)	9(30%)	0(0%)	4(13.3%)	9(30%)
Damaged cans cannot be used.	10(33.3%)	2(6.7%)	2(6.7%)	3(10%)	13(43.3%)
Do not use food that reached their expiration date.	4 (13.3)	0 (0%)	0 (0%)	8 (26.7%)	18 (60%)

Post-training responses on the use of safe water and raw materials are shown in Figure 4.5a. The majority of the respondents (93.3%) identified "damaged canned products may be used" as the incorrect statement.

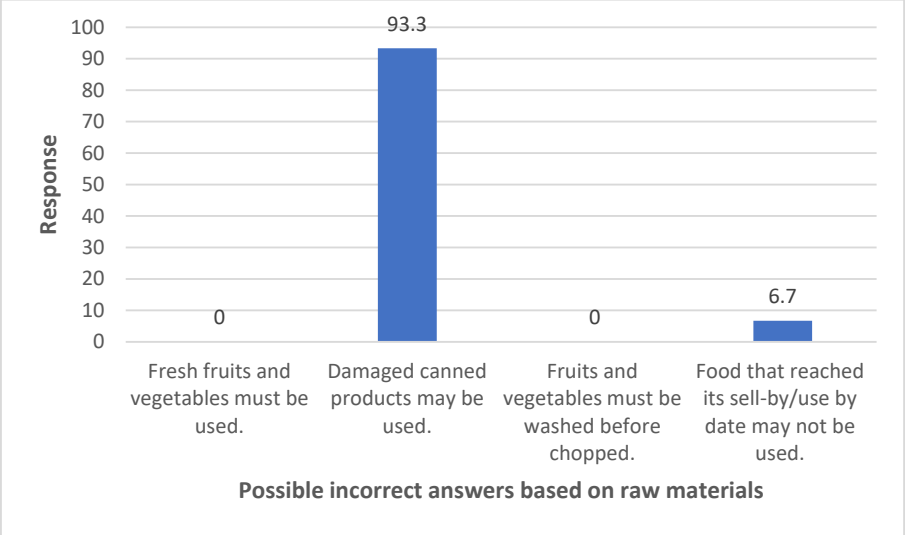

Figure 4.5a: The responses to the post-training question on possible incorrect statements related to raw materials (n=30).

Table 4.5b shows the pre-and post-training observations for schools regarding the key, "use safe water and raw materials." All schools were 100% compliant with most observations, except the criterion "fruit and vegetables are washed before used or eaten." Initially, none of the schools met the requirement, but after training, 9 out of 10 schools achieved compliance.

Table 4.5b: Pre- and post-training observations based on key 5, "use safe water and raw material", per school (n=10).

	Pre-training		**Post-training**	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Safe / clean water is used.	10	0	10	0
Fresh foods are used.	10	0	10	0
Fruits and vegetables are washed before used / eaten.	0	10	9	1
No products are used that reached its expiry date.	10	0	10	0

The Pearson chi-square tests indicated no significant difference between food handlers' knowledge regarding food must be checked for freshness and quality ($p = 1$), expired food products may not be used ($p = 1$), vegetables must first be chopped and then washed ($p=0.179$), and damaged cans cannot be used ($p=1$), involving pre-training vs. post-training questions, assessing which of the statements is incorrect (figure 4.5a). A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

4.6 Additional Questions Based on Regulation 638 of 2018

Table 4.6a presents pre-training responses based on questions related to Regulation 638 of 2018. The majority of the respondents "strongly agreed" (80%) and "agreed" (13.3%) that refuse bins must be covered with a lid. Only 20% of respondents "strongly agreed" and 10% "agreed" that personal protective clothing may not be worn outside of the food preparation area. 46.7% of respondents "strongly disagreed" with this statement. The majority of respondents "strongly agreed" (76.6%) with the statement, "there is no need to wear protective clothing such as hairnets and gloves other than work uniform".

Table 4.6a: Pre-training results of respondents based on Regulation 638 of 2018 (n=30).

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Neutral**	**Agree**	**Strongly Agree**
Refuse bins do have to be covered with a lid.	1(3.3%)	1(3.3%)	0(0%)	4(13.3%)	24(80%)
Protective clothing may not be worn outside of the preparation areas.	14(46.7%)	5(16.7%)	2(6.5%)	3(10%)	6(20%)
There is no need to wear protective clothing such as hairnets and gloves other than work uniform.	2(10%)	1(3.3%)	1(3.3%)	2(6.7%)	23(76.6%)

The post-training questionnaire revealed that the majority of respondents (76.7%) identified the statement, "PPE does not include hairnets and non-slip shoes" as incorrect (figure 4.6a).

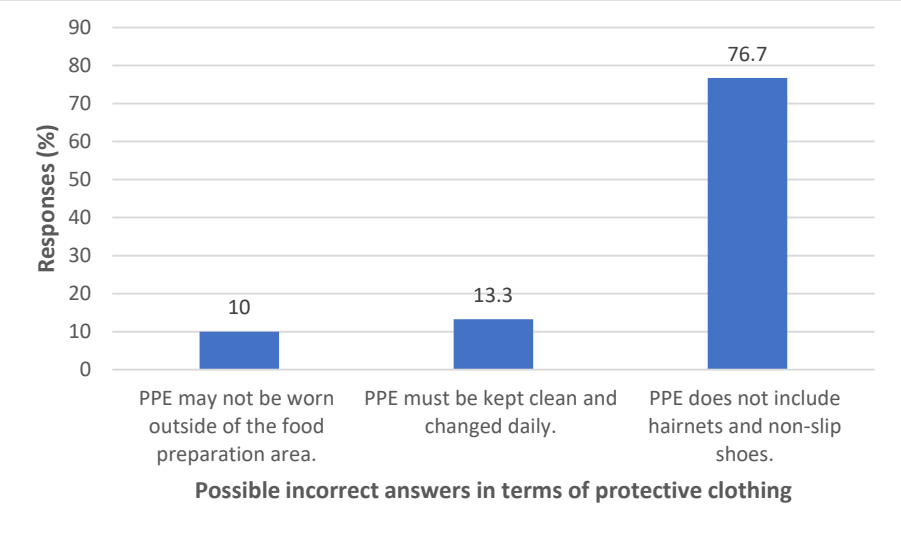

Figure 4.6a: The responses to the post-training question on the possible incorrect answers in terms of protective clothing (n=30).

In the post-training responses to the question related to refuse bins, the majority of respondents (96.7%) chose the "all of the above" option, implying that refuse bins must be covered at all times, as well as cleaned and removed regularly (figure 4.6b).

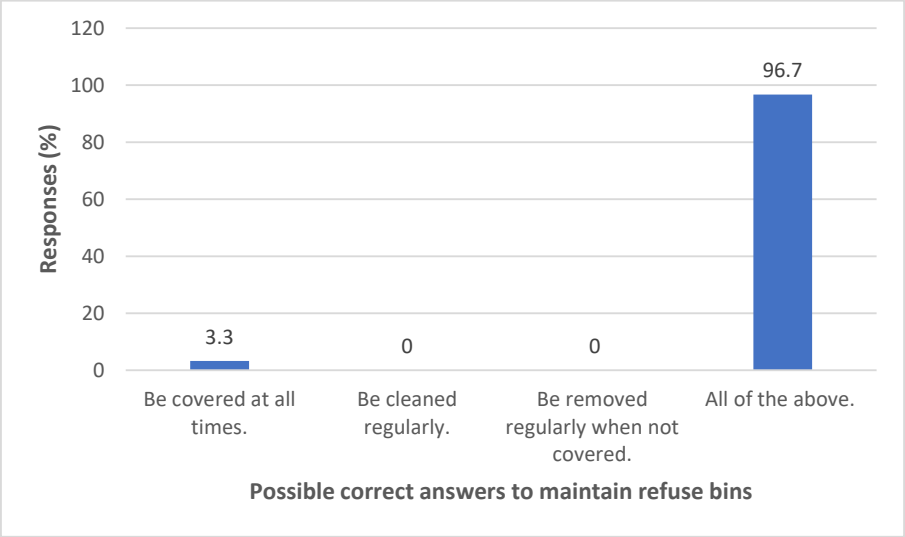

Figure 4.6b: The responses to the post-training question on the possible correct answers to maintain refuse bins in the food preparation area (n=30).

Table 4.6b shows pre-and post-training observations on issues related the R638 of 2018. Pre-training, none of the schools' refuse bins was covered. Post-training, 6 schools complied with covering their refuse bins. For the use of the correct personal protective clothing, 4 schools were compliant pre-training, which improved to 9 schools post-training. Additionally, all schools achieved compliance in keeping personal protective clothing clean post-training, compared to the 4 schools being compliant pre-training.

Table 4.6b: Pre- and post-training observations based on questions related to R638 of 2018, per school (n=10).

	Pre-training		**Post-training**	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Bins are covered.	0	10	6	4
Correct PPE provided and used correctly.	4	6	9	1
PPE are kept clean.	4	6	10	0

The Pearson chi-square test indicated no significant difference ($p = 1$) when comparing the pre-training question "refuse bins do not have to be covered with a lid" to the responses to the post-training multiple-choice questions based on maintaining refuse bins.

Responses to the pre-training question regarding wearing personal protective clothing outside of the food premises vs. the responses to the post-training questions assessing the food handler's knowledge regarding PPE (figure 4.6a) shows no significant difference ($p=0.194$).

There is no significant difference ($p=1$) between the pre-training responses to "there is no need to wear protective clothing such as hairnets, and gloves other than a uniform" vs. the post-training responses to the question assessing the food handlers' knowledge regarding PPE.

A p-value of less than 0.05 ($p < 0.05$) was considered statistically significant.

CHAPTER 5

DISCUSSION

5.1 Keep Clean

Respondents correctly agreed with most of the statements of the pre-training questions based on the first key, keep clean. Most respondents (90%) strongly agreed (table 4.1a) with the pre-training statement, “it is important to wash hands before handling food and often during food preparation”. These findings align with the existing literature, emphasizing that proper hand hygiene is critical to prevent foodborne illness transmissions (Kirchner et al., 2023; WHO, 2006). Moreover, 93.3% of respondents strongly agreed with the statement “it is important to wash hands after going to the toilets”. Post-training results (figure 4.1a) indicated that 86.7% of respondents correctly answered “all of the above” which includes washing hands at the beginning of a day’s work, after using a toilet, and after hands became soiled. These finding reflects persistent misconceptions about hand hygiene practices. Despite the training, analysis identified no statistically significant difference between pre-and post-training responses. This may suggest a ceiling effect due to high initial awareness levels, as indicated in similar studies where knowledge improvements post-training was not statistically significant due to high baseline scores (Kirchner et al., 2023). Table 4.1a shows that the majority of respondents correctly strongly agreed with the statement, “hands must be washed with running water and soap for a minimum of 20 seconds and also dried with a clean dry towel”. Figure 4.1b illustrates similar results as the pre-training results. No statistically significant difference was found for pre- and post-training questions assessing the means of cleaning hands.

56.7% of respondents strongly agreed and 30% agreed correctly with the statement, “a wiping cloth can spread organisms” and 16.7% of respondents agreed and 66.7% respondents strongly agreed with the statement, “kitchen food preparation surfaces do have to be kept clean”. Post-training, 80% of respondents correctly answered that wiping cloths and food preparation areas must be kept clean. Statistical analyses of the pre- and post-training results indicated no significant difference.

While changes in knowledge were observed, no statistically significant difference was observed. Pre- and post-training observations (table 4.1b) indicated an increase of compliance in schools’ food handler practices in terms of keeping the food preparation area and equipment clean and frequency of handwashing. This improvement can be linked to the effectiveness of the training provided. This demonstrates that even in the absence of statistically significant

differences, behavioural changes in keeping clean, support findings from previous research that practical observations may provide a more accurate measure of training effectiveness than knowledge assessments alone (Mohamed & Evans, 2024). These results highlight the importance of incorporating both theoretical and practical assessments when evaluating food safety training programs.

Post-training observations (table 4.1b) found that all 10 schools complied with handwashing and the cleaning of preparation areas, cloths and equipment. However, no improvement was observed regarding the means of handwashing. Only 2 schools' food handlers washed their hands with soap and running water. This occurred due to handwashing supplies not being made available by the schools nor the NSNP. It was noted during observations that food handlers were not provided with soap to wash their hands. A study done by Muharnis & Dewi (2021) found that more than half of food handlers that partook in their study (54.2%) did not use soap when washing their hands, mainly due to the unavailability of soap at handwashing stations. For effective hygiene, it is essential that hands are washed with liquid soap (Muharnis & Dewi, 2021). From the post-training observations, it can be concluded that the training improved the practices of the food handlers.

5.2 Separate Raw and Cooked Food

Most respondents (76.7%) correctly strongly agreed with the statement, "raw and cooked food must be stored separately". Table 4.2a further shows mixed responses regarding whether "raw food should be stored on the top shelves of the refrigerator" with responses spread across all options. Most respondents correctly strongly disagreed (33.3%) and disagreed (23.3%) with the statement "cooked food does not have to be stored on the top shelves of the refrigerator". Figure 4.2a indicated that only 40% of the respondents correctly answered the post-training question regarding separating raw and cooked food. These findings suggest that the training did not significantly improve conceptual understanding, as no statistically significant difference was found between pre- and post-training questionnaire results. This indicates no change in the respondents' knowledge.

The results of the pre-training observations (table 4.2b) found that 7 of the 10 schools' food handlers separated raw and cooked food. Post-training observations found that all schools' food handlers practiced separating raw and cooked food. In a study done among food handlers in Zimbabwe participants reported high knowledge and positive attitudes. However, observations indicated food handlers does not practice what they know, such as thawing techniques and

using sinks meant for cleaning equipment to wash hands. This study found that high knowledge does not translate correct or safe food hygiene practices (Ncube at al., 2020). This reinforces the idea that behavioural observations may provide a more accurate measure of training effectiveness than written assessments alone, particularly in settings where food handlers rely more on routine and visual cues than formal education. Da Cunha et al. (2019) found that self-reporting, such as questionnaires can be influenced by personal bias, overestimation of one's abilities, and other psychological factors. Due to these limitations, observing food handlers directly is often more reliable when studying their hygiene practices. Observations tend to reflect what people actually do.

5.3 Cook Food Thoroughly

Results presented in table 4.3a shows that most of the respondents incorrectly agreed and strongly agreed with the statement that "meat must be properly cooked so that it reaches 40˚C at the core of the thickest part of the meat". According to WHO (2006), meat must be cooked to a temperature where meat juices are clear, and meat is no longer pink. These visual cues, while traditional, are not as reliable as specific internal temperature measurements. Regulation 638 of 2018 stipulates that food must be heated or warmed to a core temperature equal to or warmer than 60˚C (South Africa, 2018). Despite this misconception from the respondents, Table 4.3a also shows that the majority of respondents either agreed or strongly agreed with the statement "soup and stews should always be boiled/reheated at 60˚C to ensure safety". Post-training results (figure 4.3a) indicated that 79.3% of the respondents correctly answered that food must be cooked to a core temperature of 60˚C, keeping in mind that one respondent did not answer the question. Although no statistically significant difference was found, an improvement was seen in the number of respondents answering the post-training questions correctly based on cooking temperatures compared to the respondents' answers in the pre-training questionnaire.

Notably, pre- and post-training observations (table 4.3b) revealed that all 10 schools cooked food to a core temperature of 60˚C or warmer, regardless of questionnaire scores. This shows strong compliance with correct cooking practices, even when knowledge responses suggest gaps. A study conducted by Sheehama & Singh (2025), found that food handlers demonstrated moderate food safety knowledge, but observations found a slightly higher compliance. In this study, food handlers also had a negative attitude towards food safety. This shows that food handlers may not understand food safety principles, but habitual factors can lead to compliance when observations are made. This discrepancy may suggest that food handlers rely more on

established workplace protocols or supervision than formal understanding of food safety regulations. Additionally, a study surveyed 210 food handlers in a hospital regarding their knowledge of internal cooking temperatures for meat, poultry, seafood, eggs and ground beef. The results found that most of the food handlers were unaware of key internal temperature requirements for food (Teffo & Tabit, 2020).

Other literature similarly identifies knowledge of safe cooking temperatures as one of the most poorly understood areas in food safety education. For example, a study done by the United States Department of Agriculture (USDA), found that many food handlers rely on sensory cues (colour, smell, texture) rather than thermometers when preparing food such as meat, poultry and seafood. This can result in undercooked food and increased foodborne illness risks (Cota et al., 2023).

5.4 Keep Food at Safe Temperatures

Pre-training results presented in table 4.4a shows that 46.7% of respondents strongly agreed with the statement "leftover cooked food must be refrigerated within 2 hours of cooking". Table 4.4a also shows that the majority of respondents correctly disagreed and strongly disagreed with the statement "cooked meat can be left at room temperature overnight to cool before refrigerating". Comparing pre-and post-training results (figure 4.4a), a statistically significant difference was observed, indicating an improvement in knowledge of food handlers for this particular statement. According to the WHO (2006), cooked food may not be left at room temperature for more than 2 hours. Microorganisms grow rapidly if food is not stored at the correct temperatures. When food is kept below 5˚C and above 60˚C, the production of microorganisms slows down (WHO, 2006). However, most respondents incorrectly agreed and strongly agreed with the statement "frozen food should be defrosted at room temperature" (table 4.4a). Post-training results (figure 4.4a) shows that only 46.7% of respondents correctly answered the questions assessing safe temperatures to store food which included storing food at room temperature and thawing temperatures of food products. The "5 keys to safer food" manual states that frozen food must not be thawed at room temperature (WHO, 2006). According to Regulation 638 of 2018, the thawing process of food must be as short as possible and the core temperature must not exceed 5˚C (South Africa, 2018). These results found no statistically significant difference, indicating no change in respondents' knowledge pre-and post-training. Pre- and post-training observations found that all 10 schools' food handlers did not thaw frozen food products at room temperature and kept the thawing process as short as possible. The food handlers were not required to thaw meat or fish products; only vegetables

are kept in the freezers and defrosted before use. A study done by Teffo & Tabit (2020), assessing food handlers' knowledge based on the safe thawing process of meat found that only a few food handlers had knowledge regarding safe thawing processes.

Table 4.4a also indicated that the majority of the respondents correctly strongly agreed (40%) and agreed (20%) with the statement "temperature of the refrigerator must be at 4˚C". Post-training questionnaire answers (table 4.4c) found that only 20% of the respondents correctly answered that perishable food must be stored at 4˚C. Table 4.4a illustrates that most respondents correctly strongly agreed and agreed with the statement "the temperature of the freezer must be -12˚C". -12˚C was used as the monitoring temperature because during the observations the NSNP only stored chopped frozen vegetables in their freezers. Figure 4.4b also shows that post-training 66.7% of the respondents correctly answered the question assessing the correct temperatures frozen products must be stored at. Both the pre-and post-training questions assessing correct temperatures to store food showed no statistically significant difference. A study conducted at a catering facility in Ghana had similar findings, highlighting the limited food safety knowledge among food handlers. The study identified concerns to improve storage of food within the danger zone, repeated freeze-thaw cycle and the practice of thawing frozen food at room temperature (Teffo & Tabit, 2020). A study conducted in Turkey found that food handlers scored the lowest in knowledge about critical storage temperatures (Zelalem et al., 2021). Pre-and post-training observations (table 4.4b) found that the food handlers stored food at safe temperatures before and after training was received. However, temperature monitoring was conducted by only two schools following the training intervention. These monitoring devices were implemented by the schools in response to requests made by the participating food handlers after the training was received. Regular temperature monitoring, ideally at least once daily, is crucial, as time-temperature abuse is a leading cause of foodborne illness outbreaks in food service establishments (Teffo & Tabit, 2020).

5.5 Use Safe Water and Raw Material

Table 4.5a shows that most of the respondents correctly strongly agreed and agreed with the statement "food should be checked for freshness and quality". Furthermore, 56.7% of respondents correctly responded to the statements "vegetables should first be chopped up and then washed" and "damaged cans cannot be used". Post-training questions assessing the use of safe raw materials found that 93.3% of the respondents correctly answered the questions (table

4.5a). After statistically comparing these results, no statistically significant differences were observed between pre-and post-training responses.

Literature suggest that ensuring freshness and quality of food before use is critical in maintaining food safety standards. Fresh produce, including processed fruits and vegetables remains the leading cause of foodborne illness outbreaks and are often associated with pathogens such as *E. coli*, Salmonella, Listeria and human parasites like Hepatitis A. Historically, these outbreaks were predominately linked to leafy greens, tomatoes, cantaloupes, papayas and cucumber (Murray et al., 2017). A similar study revealed that approximately 32.7% of respondents did not agree that thorough washing of fruits and vegetables is mandatory to prevent food poisoning, indicating a significant lack of awareness among food handlers about essential food safety practices (Hamed & Mohammed, 2020).

The results from the observation checklist indicate a notable improvement in food safety practices. Pre-training observations (table 4.5b) found that only certain practices were fully compliant, while other required significant improvement. For instance, both pre-and post-training observations found that all schools' food handlers used safe and clean water and ensured that no expired products were used. Water used for food preparation is provided to town schools by the local municipality (South Africa, 1997) and rural schools make use of water tanks. Water for human consumption is regularly tested for compliance to SANS 241:2015 (South African National Standards, 2015) by the local EHP (South Africa, 2009). Similarly, the practice of using fresh foods remained fully compliant pre- and post-training observations. This shows that some basic food safety practices were already being followed before training was received. An improvement was observed in the practice of washing fruits and vegetables before use or consumption. Pre-training observations showed non-compliance for all 10 schools, highlighting a major gap in hygiene practices. Post-training compliance increased significantly, with 9 schools washing fruits and vegetables. This improvement demonstrates the positive impact of the training.

5.6 Additional Questions Related to Regulation 638 of 2018

Results as set out in table 4.6a show that most respondents correctly agreed (13.3%) and strongly agreed (80%) with the statement that refuse bins must be covered. Although the post-training results for maintaining refuse bins (figure 4.6b) showed that 96.7% of respondents answered correctly, no statistically significant difference was observed. Regulation 638 of 2018 requires that refuse bins must be cleaned regularly, covered and waste must be removed

frequently (South Africa, 2018). Even though the majority of respondents boasted the knowledge before training, none of the schools' refuse bins were covered. Post-training observations (table 4.6b) showed an improvement of 6 schools that had bins or containers to store waste in that was provided by the schools. However, 4 schools had bins but it was not covered by a lid or proper refuse bins were not available or not in a usable condition.

Pre-training responses (table 4.6a) illustrated mixed responses to the statement "protective clothing may not be worn outside of the preparation area", with the majority of respondents (40%) incorrectly disagreeing with the statement. The same was noticed for the statement assessing the correct protective clothing that should be worn. Only 13.3% of respondents correctly disagreed and strongly disagreed with the statement "there is no need to wear protective clothing (such as hairnets and gloves) other than work uniforms". Post-training results (figure 4.6a) found an improvement, with 76.7% of respondents correctly answering the question related to personal protective clothing.

Requirements of Regulation 638 of 2018 stipulates that personal protective clothing includes head covering, an apron, and appropriate footwear to ensure that food does not become contaminated. Personal protective clothing must be kept clean before the food handlers begin to handle or prepare food (South Africa, 2018). Studies have shown that wearing personal protective clothing reduces the risk of food contamination. Therefore, it is essential that personal protective clothing is worn, and regular checks are done on food handlers' protective clothing (Chen et al., 2025). Post-training observation results (figure 4.6b) indicated an improvement from 4 schools to 9 schools being compliant by wearing personal protective clothing. During the post-training observations, respondents wore personal protective clothing that was supplied by themselves, as neither the schools nor the NSNP provided protective attire. A study done by Madlala (2022), found that some schools in the NSNP are not provided with appropriate personal protective clothing (Madlala, 2022). This is a potential problem that may arise and needs to be monitored by local authorities.

The impact of training on food handlers' hygiene knowledge and practices revealed that while measurable gains in knowledge were limited and not always statistically significant, the training nonetheless had a meaningful impact on the actual food handling practices of school food handlers. Improvements were particularly evident in critical areas comprising the "5 keys to safer food". The discrepancy between theoretical knowledge and observed practice underscores the importance of integrating hands-on training with regular monitoring and

support. The practical improvements observed suggest that food handlers responded positively to the training content and were able to implement safer food handling procedures despite limitations in equipment, such as the lack of soap or temperature monitoring equipment. Furthermore, partial compliance with Regulation 638 of 2018 improved post-training, although challenges related to resource availability persist.

CHAPTER 6

CONCLUSION & RECOMMENDATIONS

This study aimed to determine the influence of food hygiene training intervention on the knowledge and practices of food handlers volunteering in the NSNP in a selected sub-district of the CWDM. The study assessed pre-training knowledge and practices, implemented training intervention, and re-assessed knowledge three (3) months post-training. The findings demonstrated that while the training intervention did not show statistically significant improvement in most of the knowledge areas, improvements was seen in the actual hygiene practices throughout all the schools. These results are similar related to literature suggesting that the behavioural or practice observations may provide a more accurate indication of the effectiveness of training than a written assessment (Da Cunha, 2019).

The first objective was to determine the hygiene knowledge and practices of food handlers in the NSNP in a selected sub-district of the CWDM. The pre-training results revealed a high baseline knowledge among the food handlers. Food handlers had knowledge in hand hygiene practices and the importance of keeping the food preparation area clean. However, uncertainty or misconceptions were observed particularly regarding keeping food at safe temperatures and cooking food thoroughly.

The second objective was to provide training to the food handlers in the NSNP in a selected sub-district of the CWDM. The training included the “5 Keys to safer food” (WHO, 2006) and Regulation 638 of 2018 (South Africa, 2018). Post-training observations found positive changes in the practices of food handlers such as separating raw and cooked food, keeping food at safe temperatures, cooking food thoroughly, keeping the food preparation area and equipment clean and making use of clean and safe water and raw materials.

The third objective was to determine the knowledge and hygiene practices of the food handlers in the selected sub-district of the CWDM three (3) months after training was received. While the post-training questionnaire results did not always show a statistically significant difference compared to the pre-training questionnaire, the food hygiene practices improved in areas such as keeping clean, separating raw and cooked food and using clean and safe water and raw material. Improvement in practices were more evident than improvement in theoretical knowledge. This highlights the effectiveness of practical and visual training components. Lack

in significant change in knowledge pre-and post-training may be due to a ceiling effect, where food handlers already possessed high baseline knowledge.

The study was limited to a relatively small number of participants, with only 30 respondents across 10 schools. This small sample size reduces the statistical power of the analysis. This may have contributed to the lack of statically significant differences observed between the pre- and post-training questionnaire results, even though improvements in knowledge and practices were evident. A larger representative sample size would be necessary to generalise the findings to a wider population of food handlers in the NSNP or other similar settings. However, results provided the hygiene knowledge and practices of food handlers, and the influence training has on the practices of food handlers in the NSNP in the selected sub-district of the CWDM.

The interpretation and communication of temperature requirements as stipulated in Regulation 638 of 2018 (South Africa. Department of Health, 2018) was problematic. Terms such as "greater than" or "less than" a specific temperature were difficult for some of the food handlers to understand, particularly those with limited formal education. Words like "warmer than" or "colder than" was used to make it easier for the food handlers to understand, since it is very easy to misinterpret the temperature requirements stipulated in Regulation 638 of 2018. However, this could have still affected the knowledge retention regarding keeping food at safe temperatures. This is also an indication that, while food handlers may read the regulations, if they misunderstand key terms, they are unlikely to comply effectively with the legislation. Misinterpretation of terminology may thus present a significant barrier to legislative compliance and food safety practices.

The findings of this study are limited to food handlers participating in the National School Nutrition Programme within the selected Cape Winelands sub-district municipality and therefore cannot be generalised to other settings or populations.

Recommendations:

- Many limitations in results were linked to the lack of basic supplies, such as provision of soap, paper towels or thermometers. The provision of these resources must accompany training to enable proper implementation of hygiene practices and compliance with regulations.
- The relevant authorities, such as the Department of Basic Education, should address structural and equipment challenges. The absence of covered bins, lack of handwashing equipment, temperature monitoring devices and lack of proper space affects the overall

compliance with Regulation 638 of 2018 (South Africa. Department of Health, 2018) and the “5 Keys to safer food” (WHO, 2006) and may contribute to improper food safety, causing foodborne outbreaks in schools.

- The relationship between the DoBE and MHS should be strengthened to be able to work together to meet the requirements of legislation and to ensure food safety is a priority in schools.
- Local authorities, including Environmental Health Practitioners, must regularly ensure monitoring and training of the food handlers in the NSNP is prioritised to ensure compliance.
- For some schools, especially those in rural areas, it is challenging to fully implement Regulation 638 of 2018 (South Africa. Department of Health, 2018) due to factors such as location, limited space, and resource constraints. While the regulation makes provision for the "best available method," which allows consideration of local conditions, circumstances, and financial implications, the application of this principle remains inconsistent. Greater emphasis is needed on guiding schools and similar institutions in applying the best available method effectively to ensure food safety in settings with limited resources.
- Given that many food handlers demonstrated improved practices despite no statistically significant differences in knowledge, future studies can include and investigate behaviour change strategies or the attitude of food handlers.

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APPENDICES

Appendix A: Data collection permissions.

Western Cape Government
Education

Directorate: Research

meshack.kanzi@westerncape.gov.za
Tel: +27 021 467 2350
Fax: 086 590 2282
Private Bag x9114, Cape Town, 8000
wced.wcape.gov.za

REFERENCE: 16375E04C0007EB-20230508
ENQUIRIES: Mr M Kanzi

Ms Hayley Langley
34 Klipfontein
Vredenburg
7380

Dear Hayley Langley,

RESEARCH PROPOSAL: THE INFLUENCE OF TRAINING ON FOOD HANDLERS' HYGIENE KNOWLEDGE AND PRACTICES IN THE NATIONAL SCHOOL NUTRITION PROGRAMME OF A CAPE WINELANDS SUB-DISTRICT MUNICIPALITY, WESTERN CAPE, SOUTH AFRICA.

Your application to conduct the above-mentioned research in schools in the Western Cape has been approved subject to the following conditions:

1. Principals, educators and learners are under no obligation to assist you in your investigation.
2. Principals, educators, learners and schools should not be identifiable in any way from the results of the investigation.
3. You make all the arrangements concerning your investigation.
4. Educators' programmes are not to be interrupted.
5. The Study is to be conducted from **26 June 2023 till 30 September 2023.**
6. No research can be conducted during the fourth term as schools are preparing and finalizing syllabi for examinations (October to December).
7. Should you wish to extend the period of your survey, please contact Mr M Kanzi at the contact numbers above quoting the reference number.
8. A photocopy of this letter is submitted to the principal where the intended research is to be conducted.
9. Your research will be limited to the list of schools as forwarded to the Western Cape Education Department.
10. A brief summary of the content, findings and recommendations is provided to the Director: Research Services.
11. The Department receives a copy of the completed report/dissertation/thesis addressed to:

The Director: Research Services
Western Cape Education Department
Private Bag X9114
CAPE TOWN
8000

We wish you success in your research.

Kind regards,
Meshack Kanzi
Directorate: Research
DATE: 26 June 2023

CAPE WINELANDS DISTRICT
MUNICIPALITY • MUNISIPALITEIT • UMASIPALA

MEMORANDUM TO	:	MR RJ HUMPRHEYS ACTING EXCUTIVE DIRECTOR: COMMUNITY DEVELOPMENTAL AND PLANNING SERVICES
MEMORANDUM FROM	:	MS S GROOTBOOM DEPUTY DIRECTOR: MUNICIPAL HEALTH SERVICES
REFERENCE NUMBER	:	SP L/2 (R)
DATE	:	08 MAY 2023

PERMISSION TO USE MHS WORK RELATED CAPTURED DATA FOR FURTHER STUDY

Permission is hereby sought for Ms Hayle Langley, Environmental Health Practitioner stationed at the Langeberg office to utilize MHS work related captured data for her Master's research.

MHS Management support this application and hope that the information will be beneficial to her finishing her Master's study.

RECOMMENDED BY:

S GROOTBOOM
CHIEF: ENVIRONMENTAL HEALTH PRACTITIONER

CAPE WINELANDS DISTRICT
MUNICIPALITY/MUNISIPALITEIT/UMASIPALA
12 MAY 2023

APPROVED:

RANDALL J HUMPHREYS
ACTING EXECUTIVE DIRECTOR: COMMUNITY DEVELOPMENT AND PLANNING SERVICES

Appendix B: Ethical approval letter.

Cape Peninsula University of Technology

Statement of Permission

Data/Site permission is required for this study.

Reference no.	217089593/04/2023
Surname & name	Langley, H.K.
Student/staff/ID Number	217089593
Degree/programme	Master of Environmental Health
Title	The influence of training on food handlers' hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa
Supervisor(s)	Prof James Philander Odendaal
FRC Signature	
Date	April 24, 2023

Cape Peninsula University of Technology

P.O. Box 1906 · Bellville 7535 South Africa ·Tel: +27 21 953 8677 (Bellville), +27 21 460 4213 (Cape Town)

Provisional Ethics Approval Letter **Reference no: 217089593/04/2023**

Office of the Chairperson **Research Ethics Committee**	**Faculty of Applied Sciences**

On 24 April 2023, the Faculty Research Ethics Committee of the Faculty of Applied Sciences granted provisional ethics approval to Langley, H.K. for research activities related to a project to be undertaken for a degree (Master of Environmental Health) at the Cape Peninsula University of Technology. The study may begin once the site permit is granted by the external collaborator (Cape Winelands District Municipality).

Title of project:	The influence of training on food handlers' hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa

Comments (Add any further comments deemed necessary, e.g. permission required)

1. Human subjects are included in the proposed study.
2. This permission is granted for the duration of the study.
3. Research activities are restricted to those detailed in the research proposal.
4. The research team must comply with conditions outlined in AppSci/ASFREC/2015/1.1 v1, CODE OF ETHICS, ETHICAL VALUES AND GUIDELINES FOR RESEARCHERS.

	28/04/2023
Prof Felix Nchu **Chairperson: Faculty Research Ethics Committee**	**Date**

Appendix C: Informed consent form.

April 2023

Department of Environmental and Occupational Studies

Programme of Environmental Health

Faculty of Applied Sciences

Cape Peninsula University of Technology

PO Box 652

Cape Town 8000

Head of Department: Dr N Malaza (malazaN@cput.ac.za)

Supervisor: Prof JP Odendaal (odendaalj@cput.ac.za)

Co-supervisor: Prof I Human (humanI@cput.ac.za)

INFORMED CONSENT FOR DATA COLLECTION: ***research project of Master of environmental health student***

Title***: The influence of training on food handler hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa***

To whom it may concern:

Introduction and Purpose of the study

I, Hayley Langley, am registered as a Master of Environmental Health student at the Cape Peninsula University of Technology. My study includes the collection of data from food handlers within the National School Nutrition Programme. The study is solely for research and academic purposes in order to obtain a better understanding of the hygiene knowledge and practices of the food handlers and the influence training has on them.

Description of the research

Data will be collected by means of questionnaires and observations and will include food handler training. Your honest response will be beneficial for the success of this research. Your participation is entirely voluntary. All data collected will be treated with the greatest measure of confidentiality.

Potential harm, injuries, discomforts and inconvenience

No negative consequences of any sort are expected. It will be made clear to the respondent before any data collection commence that this is an academic research project done for academic reasons only, and

where the participants disclose any sensitive information of harmful practices, they will not face any reprisals or identification. The questionnaires and observations will be anonymous. This exercise is strictly for study purposes and not for inspection. Any offence that may be spotted during the study will not result in any penalty. The projected time to complete the observations and questionnaires will be 20 minutes.

Potential benefits

You will not have immediate direct benefit from participating in this study, neither will there be any payment for your participation.

Confidentiality

Confidentiality will be respected and no information that discloses the identity of the participant will be released or published. Records of the questionnaires and interviews will be coded only with a number and not a person's name. No unauthorised person will have access to the data collected.

Participation

Participation in this research is voluntary. You have the right not to participate without any consequences. If you choose to participate in this study, you may withdraw at any time. There are also no right or wrong answers to your responses. Participants will be treated anonymously.

Consent

I agree that:

1. The study was explained to me and all my questions answered.
2. I have the right to participate and the right to stop at any time without any consequences.
3. I have been told that my personal information will be kept confidential.
4. There will be no likely harm or direct benefits to me by participating in this study.

Signed by: Date:

Appendix D: Pre- and post-training questionnaires.

Cape Peninsula University of Technology

Faculty of Applied Sciences

Department of Environmental and Occupational Studies

Researcher's e-mail: hlangley266@gmail.com

Researcher's contact no: 072 080 2832

The influence of training on food handler hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa

QUESTIONNAIRE

National School Nutrition Programme Food Handlers (Pre-training)

INTRODUCTION

Thank you for your willingness to participate in this research project.

The aim of the study is to determine the hygiene knowledge and practices of food handlers before and after training.

Privacy and anonymity will be protected at all means. Those who participates' identification will not be revealed at any stage of this study. Those who participate in this research study will do so voluntarily. If they choose not to participate, they may withdraw their consent to participate at any time. The study participant will not be penalised in any way should they decide to withdraw from the study.

Please circle your response in the appropriate square provided. This questionnaire will only take 10' minutes of your time.

Thank you

Researcher: Ms Hayley Langley

Supervisors: Prof. JP Odendaal

Prof. IS Human

Food Hygiene Knowledge

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1. It is important to wash hands before handling food and often during food preparation					
2. It is important to wash hands after going to the toilet.					
3. A wiping cloth can spread organisms.					
4. Kitchen food preparation surfaces do have to be kept clean.					
5. Hands must be washed with running water and soap for a minimum of 20 seconds and also dried with a clean dry towel.					
6. Leftover cooked food must be refrigerated within 2 hours of cooking.					
7. Refuse bins do not have to be covered with a lid.					
8. Raw and cooked food must be stored separately.					
9. Raw food should be stored on the top shelves of the refrigerator.					
10. Cooked food does not have to be stored on the top shelves of the refrigerator.					
11. Meat must be properly cooked so that it reaches 40°C at the core of the thickest part of the meat.					
12. Soup and stews should always be boiled/ reheated at 60°C to ensure safety.					
13. Cooked meat can be left at room temperature overnight to cool before refrigerating.					
14. Food should be checked for freshness and quality.					
15. Do not use food that reached their expiration date.					
16. Vegetables should first be chopped up and then washed.					
17. Frozen food should be defrosted at room temperature.					
18. Damaged cans cannot be used.					
19. The temperatures of a fridge must be at 4°C.					
20. The temperature of the freezer must be -12°C.					
21. Protective clothing may not be worn outside of the preparation areas.					
22. There is no need to wear protective clothing such as hairnets and gloves other than work unform.					

Thank you!

Cape Peninsula University of Technology

Faculty of Applied Sciences

Department of Environmental and Occupational Studies

Researcher's e-mail: hlangley266@gmail.com

Researcher's contact no: 072 080 2832

The influence of training on food handler hygiene knowledge and practices in the National School Nutrition Programme of a Cape Winelands sub-district municipality, Western Cape, South Africa

QUESTIONNAIRE

National School Nutrition Programme Food Handlers (Post-training)

INTRODUCTION

Thank you for your willingness to participate in this research project.

The aim of the study is to determine the hygiene knowledge and practices of food handlers before and after training.

Privacy and anonymity will be protected at all means. Those who participates identify will not be revealed at any stage of this study. Those who participate in this research study will do so voluntarily. If they choose not to participate, they may withdraw their consent to participate at any time. The study participant will not be penalised in any way should they decide to withdraw from the study.

Please circle your response in the appropriate square provided. This questionnaire will only take 5 minutes of your time.

Thank you

Researcher: Ms Hayley Langley

Supervisors: Prof. J Odendaal

Prof. I Human

Questionnaire post-training

1. It is important to wash hands…

At the beginning of a day's work.	1
After using the toilet.	2
After his/her hands have become soiled or contaminated.	3
All of the above.	4
None of the above.	5

2. _____ does not have to be kept clean.

Food preparation area.	1
Wiping cloths.	2
None of the above.	3
All of the above.	4

3. Which of the following statements are correct?

Hands must be washed with water and soap.	1	
Hands must be washed with water and soap for 20 seconds.	2	
Hands must be washed with running water and soap for 20 seconds and dried with a disposable or clean towel.	3	
None of the above.	4	☐

4. Which of the following statements are incorrect?

Raw and cooked food must be stored separately.	1	
Raw food must be placed on the top shelves of the fridge.	2	
Raw and cooked food may not be stored in the same container.	3	☐

5. What is the correct temperature to which cooked food must be reheated?

60°C	1	
40°C	2	
50°C	3	☐

6. What is the correct temperature to which products must be frozen?

Colder or equal to -12°C.	1	
Colder or equal to +4°C.	2	
Colder or equal to +5°C.	3	
Warmer or equal to +60°C.	4	☐

7. What is the correct temperature to keep perishable food chilled?

Colder or equal to -12°C.	1	
Colder or equal to +4°C.	2	
Colder or equal to +5°C.	3	
Warmer or equal to +60°C.	4	

8. Which of the following statements are incorrect in terms of the Personal Protective Equipment?

PPE may not be worn outside of food preparation areas.	1
PPE must be kept clean and change daily.	2
PPE does not include hairnets and non-slip shoes.	3

9. In order to keep food at safe temperatures…

Do not leave food at room temperature for more than 2 hours.	1	
Thaw frozen food at room temperature.	2	
All of the above.	3	
None of the above.	4	

10. Refuse binds must…

Be covered at all times.	1	
Be cleaned regularly.	2	
Be removed regularly when not covered.	3	
All of the above.	4	

11. Which of the following general statements are incorrect?

Fresh fruits and vegetables must be used.	1	
Damaged canned products may be used.	2	
Fruits and vegetables must be washed before chopped.	3	
Food that reached it expiry date may not be used.	4	

Thank you!

Kaapse Skiereiland Universiteit van Tegnologie

Fakulteit Toegepaste Wetenskappe

Departement vir Omgewingsgesondheid en Beroepstudies

Navorser se e-pos: hlangley266@gmail.com

Navorser se kontaknommer: 072 080 2832

Die invloed van opleiding op voedselhanteerder higiëne, kennis, en praktyke in die Nationale Voeding Program van die Kaapse Wynland subdistrik munisipaliteit, Wes-Kaap, Suid-Afrika

VRAELYS

Nationale Voeding Program – Voedselhanteerders (voor opleiding)

INLEIDING

Dankie vir u bereidwilligheid om aan hierdie navorsingsprojek deel te neem.

Die doel van die studie is om die higiëne kennis- en praktyke van voedselhanteerders voor en na opleiding te bepaal.

Privaatheid en anonimiteit sal in alle opsigte beskerm word. Diegene wat deelneem se identiteit sal nie in enige stadium van hierdie studie bekend gemaak word nie. Diegene wat aan hierdie navorsingstudie deelneem, sal dit vrywillig doen. Indien hulle kies om nie deel te neem nie, kan hulle enige tyd hul toestemming om deel te neem terugtrek. Die studie deelnemer sal op geen manier gepenaliseer word indien hulle besluit om aan die studie te onttrek nie.

Omkring asseblief jou antwoord in die toepaslike vierkant wat verskaf word. Hierdie vraelys sal slegs 10 minute van jou tyd neem.

Dankie

Navorser: Ms Hayley Langley

Studieleiers: Prof JP Odendaal

Prof IS Human

Kennis van Voedselhigiëne.

	Stem sterk saam	Stem saam	Neutraal	Verskil	Stem sterk nie saam nie.
1.Dit is belangrik om hande te was voordat voedsel hanteer word en gereeld gedurende voedsel voorbereiding					
2.Dit is belangrik om hande te was nadat jy die toilet gebruik het.					
3. ‘n Afdroogdoek kan organimes versprei.					
4. Die area waar voedsel voorberei word hoef nie skoon gehou word nie.					
5.Hande moet vir ‘n minimum van 20 sekondes met lopende water en seep gewas word en met ‘n skoon handoek afgedroog word.					
6.Oorskiet gaar voedsel moet in die ysksas gestoor word binne 2 ure na die kookproses.					
7.Vullisdromme hoef nie met ‘n deksel bedek te word nie.					
8.Rou en gaar kos moet apart gebêre word in die yskas.					
9.Rou kos moet op die boonste rakke van die yskas gebêre word.					
10.Dit is nie nodig om gaar voedsel op die boonste rak van die yskas te bêre nie.					
11.Vleis moet behoorlik gaargemaak word sodat dit in die middel van die dikste deel van die vleis 40ºC is.					
12.Sop en bredies moet altyd teen 60ºC gekook word om veiligheid te verseker.					
13.Gaar vleis kan oornag by kamertemperatuur gelaat word om af te koel voordat dit in die yskas geplaas word.					
14.Voedsel moet gekontroleer word vir varsheid en kwaliteit.					
15.Moenie kos gebruik wat hul vervaldatum bereik het nie.					
16.Groente moet eers gesny word en dan gewas word.					
17.Gevrieste voedsel moet by kamertemperatuur ontdooi word.					
18.Beskadige blikkies voedsel kan nie gebruik word nie.					
19.Die temperature van ‘n yskas moet 4°C wees.					
20.Die temperature van die vrieskas moet gelyk aan of kouer as -12°C wees.					

21.Beskermde klere mag buite die voedselvoorbereidingsarea gedra word.					
22.Dit is nie nodig om beskermde klere, soos haarnette en toe skoene te dra nie, maar ‘n voorskoot moet gedra word.					

Dankie!

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Die invloed van opleiding op voedselhanteerder higiëne, kennis, en praktyke in die Nationale Voeding Program van die Kaapse Wynland subdistrik munisipaliteit, Wes-Kaap, Suid-Afrika

VRAELYS

Nationale Voeding Program – Voedselhanteerders (na opleiding)

INLEIDING

Dankie vir u bereidwilligheid om aan hierdie navorsingsprojek deel te neem.

Die doel van die studie is om die higiëne kennis- en praktyke van voedselhanteerders voor en na opleiding te bepaal.

Privaatheid en anonimiteit sal in alle opsigte beskerm word. Diegene wat deelneem se identiteit sal nie in enige stadium van hierdie studie bekend gemaak word nie. Diegene wat aan hierdie navorsingstudie deelneem, sal dit vrywillig doen. Indien hulle kies om nie deel te neem nie, kan hulle enige tyd hul toestemming om deel te neem terugtrek. Die studie deelnemer sal op geen manier gepenaliseer word indien hulle besluit om aan die studie te onttrek nie.

Omkring asseblief jou antwoord in die toepaslike vierkant wat verskaf word. Hierdie vraelys sal slegs 10 minute van jou tyd neem.

Dankie

Navorser: Ms Hayley Langley

Studieleiers: Prof JP Odendaal

Prof IS Human

1. Dit is belangrik om hande te was…

Aan die begin van die dag se werk.	1	
Na die gebruik van die toilet.	2	
Nadat sy/haar hande vuil of besmet geraak het.	3	
Al die bogenoemde.	4	
Nie een van die bogenoemde.	5	☐

2. Dit is nie nodig om _____ skoon te hou nie.

Voedsel voorbereidingsareas.	1	
Afdroogdoeke/afvee lappe.	2	
Nie een van die bogenoemde nie.	3	
Al die bogenoemde.	4	☐

3. Watter van die volgende stellings is korrek?

Hande moet met seep en water gewas word.	1	
Hande moet vir 20 secondes met seep en water gewas word.	2	
Hande moet vir 20 sekondes met lopende water en seep gewas word en met ‘n weggooibare of skoon handdoek afgedroog word.	3	
Nie een van die bogenoemde nie.	4	☐

4. Watter van die volgende stellings is verkeerd?

Rou en gaar kosse moet apart gestoor word.	1	
Rou kosse moet op die boonste rakke van die yskas gestoor word.	2	
Rou en gaar kosse mag nie in dieselfde houer gestoor word nie.	3	☐

5. Wat is die korrekte temperatuur waarteen gaar kos herverhit moet word?

60°C	1	
40°C	2	
50°C	3	☐

6. Wat is die korrekte temperatuur waarteen produkte gevries moet word?

Kouer of gelyk aan -12°C.	1	
Kouer of gelyk aan +4°C.	2	
Kouer of gelyk aan +5°C.	3	
Warmer of gelyk aan+60°C.	4	☐

7. Wat is die korrekte temperatuur om bederfbare kosse te verkoel?

Kouer of gelyk aan -12°C.	1
Kouer of gelyk aan +4°C.	2
Kouer of gelyk aan +5°C.	3
Warmer of gelyk aan +60°C.	4

8. Watter van die stellings is verkeerd in terme van persoonlike beskermingstoerustig (PBT)?

PBT mag nie van die perseel af geneem word nie.	1
PBT moet skoon gehou word en daagliks vervang word.	2
PBT sluit nie haarnette in nie.	3

9. Om voedsel teen ‘n veilige temperatuur te hou…

Moenie voedsel vir langer as 2 ure teen kamertemperatuur laat staan nie.	1
Ontdooi bevore voedsel teen kamertemperatuur.	2
Al die bogenoemde.	3
Nie een van die bogenoemde.	4

10. Vullishouers moet…

Ten alle tye toe/bedek wees.	1
Gereeld skoon gemaak word.	2
Gereeld berwyder word wanneer dit nie toe is nie.	3
Al die begenoemde.	4

11. Watter van die volgende algemene stellings is verkeerd?

Vars vrugte en groente moet gebruik word.	1
Beskadigde geblikte kos mag gebruik word.	2
Vrugte en groente moet gewas word voor dit gesny word.	3
Voedsel wat die vervalde datum bereik het mag nie gebruik word nie.	4

Dankie!

Appendix E: Observation checklist.

School:	**Pre-training** **Date:**		**Post-training** **Date:**	
Observation	**Compliant**	**Non-compliant**	**Compliant**	**Non-compliant**
Hands are washed regularly.				
Hands are washed with soap and running water for 20 seconds and dried.				
All surfaces and equipment are washed and sanitized.				
Continuous cleaning is done.				
Dishes and kitchen equipment are washed.				
Cutting boards are washed after it was used for raw food.				
Raw and cooked food are kept separate.				
Food is cooked to a core temperature of ≥ +60˚C.				
Food is kept chilled at ≤ +5˚C.				
Frozen products are stored at ≥ -12˚C.				
Temperatures are displayed / monitored.				
Thawing process are as short as possible.				
Safe / clean water is used.				
Fresh foods are used.				
Fruits and vegetables are washed before used / eaten.				
No products are used that reached its expiry date.				
Bins are covered.				

Correct PPE provided and used.				
PPE are kept clean.				
Additional observations / Notes				