An investigation on food safety of the National School Nutrition Programme in Peddie, Eastern Cape, South Africa

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KEY WORDS

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ABSTRACT

Introduction: The National School Nutrition Programme (NSNP) focuses on provision of nutritious supplementary meals to learners in order to improve temporary hunger, learner's school attendance and punctuality. Food served through this programme is said to be safe for consumption and does not have any hazards that may occur along the flow of food from delivery to serving. However, a growing number of reports around South Africa have noted an increase in the incidence of hospitalization of school children due to contaminated food provided by the NSNP.

Aim: The overall aim of the study is to assess factors affecting the safety of food served by the NSNP to the primary schools in Peddie, Eastern Cape, South Africa.

Methodology: The study made use of a quantitative research methodology by assessing the availability and adequacy of food premises, equipment, the Knowledge, Attitude and Practices (KAP) of volunteering food handlers (VFHs) towards food safety and evaluating the prevalence of microbiological contamination on food contact surfaces. This was done by making use of checklists, conducting interviews with VFHs using structured questionnaires and sending swabs to the laboratory for analysis. Data was captured in Microsoft excel 2013 and imported to Statistical Package for the Social Sciences (SPSS) software Version 23 for analysis. Categorical data was analysed using frequencies expressed as percentages to establish hygiene, premises, storage and equipment variables as well as knowledge, practices and attitude variables. Chi-square testing was used to assess statistical significance differences between district and town schools with the cut off point for statistical significance set at $p<0.05$.

Results: A total of nine primary schools in Peddie with five from the district and four from the town of Peddie participated in the study. All food items served at the schools were in line with the DoE weekly menu with the exception of fruit where only 45% of schools were serving it. Additionally, all schools had either classrooms (45%), caravans (22%) or containers (33%) converted into cooking facilities. Only 45% of the schools had separate store rooms for either cleaning chemicals or foodstuff. The majority of the respondents had good knowledge on food preparation rules as well as unhygienic practices which could be the source for food contamination with food poisoning micro-organisms. They also recognised the significance of frequent hand washing and keeping kitchen surfaces clean. All respondents had good attitude towards food safety except on prevention of cross contamination by separating raw and cooked foods. In relation to practices, respondents seemed to follow food safety procedures. The study

revealed that the microbiological count was too numerous to count (TNTC) in most of the food contact surfaces.

Conclusion: The study indicated inadequate infrastructure and resources in all participating schools which increased the difficulty for VFHs in adhering to food safety procedures. However, the VFHs had sufficient information with regards to food preparation rules on food safety and hygiene with the lack of knowledge about separating raw and cooked food on both district and town schools. Therefore, continued food safety education and training are important as knowledge and skills acquired through training may change the perceptions and attitudes of VFHs towards practicing proper food safety and hygiene techniques. Laboratory swab analysis showed significant number of microorganisms in the analysed food contact surfaces. These findings suggest that food contact surfaces may be the source of contamination through cross-contamination.

DECLARATION

I, Zoe Nomakhushe Dlova, student number: 3405900, hereby declare that this Master of Public Health thesis entitled: An investigation on food safety of the National School Nutrition Programme in Peddie, Eastern Cape, South Africa, is my own independent work and has not been submitted for any degree or examination in any other university, and that all sources I have used or quoted have been acknowledged.

_____

Z. N. Dlova

2017

DEDICATION

This thesis is dedicated to my late grandfather (Maphasa Kariel Dlova) and late mother (Nonhlanhla Lucia Ngesman) for believing in me ever since I was a little girl. They were certain that I would make something of myself. To my living grandmother (Vuyiswa Winnifred Dlova) for her constant belief in the importance of education and the many sacrifices she made for me in order to be what I am today.

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ACRONYMS AND ABBREVIATIONS

DBE	Department of Basic Education
DoE	Department of Education
DoH	Department of Health
FBD	Food-borne Diseases
FDA	Food and Drug Administration
FEHD	Food and Environmental Hygiene Department
FIFO	First In First Out
GMP	Good Manufacturing Practices
HACCP	Hazard Analysis Critical Control Points
KAP	Knowledge, Attitude and Practices
MDG	Millennium Development Goal
NSNP	National School Nutrition Programme
PSNP	Primary School Nutrition Programme
RODAC	Replicate Organism Detection and Counting
SASRFP	South African Standards and Requirements for Food Premises
SETA	Sector Education and Training Authority
TNTC	Too Numerous To Count
TVC	Total Viable Count
UNICEF	United Nations International Children's Emergency Fund
USAID	United States of Agency International Development
VFHs	Volunteer Food Handlers
WHO	World Health Organization

DEFINITION OF TERMS

Quintile: is a system of ranking and funding schools taking into account the socio-economic circumstances of learners (inequality and poverty).

HACCP: is a management system in which food safety is addressed through the analysis and control of biological, chemical and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product.

Good manufacturing practices: a process that is being used in ensuring that does not get spoiled during the manufacturing processes taking into account the principles of hygiene.

Food Safety: The assurance that food will not cause harm to the consumer when it is prepared and/or eaten according to its intended use.

Food Hygiene: All conditions and measures necessary to ensure the safety and suitability of food at all stages of the food chain.

Food handling: The process of manufacturing, preparation, storage, packaging, delivering of food and managing holding food with the hands.

Food poisoning: A condition or illness caused by the consumption of contaminated food or water containing poisonous substances including pathogenic bacteria, viruses, pesticides, or toxins.

Microbial contamination: The presence of unintentional introduction of infectious micro-organisms such as yeast and mould, bacteria, fungi, virus etc.

Personal hygiene: certain techniques performed by an individual involving maintenance of personal cleanliness and health by food handling personnel.

Volunteer Food Handlers: a person who works in the NSNP with food that is not intended for his/her consumption on food premises.

Food premises: a structure or place that is used for manufacturing, preparation or packaging of food which can include a stand, caravan, class, office or caravan.

Food equipment: is anything that is appropriately used in the preparation, cooking and serving of food.

TABLE OF CONTENTS

KEY WORDS i

ABSTRACT ii

DECLARATION iv

DEDICATION v

ACKNOWLEDGEMENTS vi

ACRONYMS AND ABBREVIATIONS vii

DEFINITION OF TERMS viii

TABLE OF CONTENTS ix

LIST OF TABLES xii

LIST OF FIGURES xiii

LIST OF APPENDICES xiv

CHAPTER 1: 1

1 INTRODUCTION 1

1.1 Background to the problem 1

1.2 Problem statement 2

1.3 Purpose 2

1.4 The aim of the study 3

1.5 Objectives 3

1.6 Research question 4

1.7 Structure of thesis 4

CHAPTER 2: 6

2 LITERATURE REVIEW 6

2.1 Introduction to the National School Nutrition Programme 6

2.2 National School Nutrition Programme quintile rankings 7

2.3 National School Nutrition Programme Policy 8

2.4 National School Nutrition Programme Food Specification 8

2.5 Food safety aspects associated with the National School Nutrition Programme 12
2.6 Hazard Analysis Critical Control Points (HACCP) of Basic Food Safety Systems . 13
2.6.1 Premises in food safety 14
2.6.2 Equipment in food safety 14
2.7 Microbiological hazards 18
2.8 Volunteering Food handlers and food safety 19
2.9 KAP of volunteering food handlers on food safety 20
2.10 Conclusion 21
CHAPTER 3: 23
3 METHODOLOGY 23
3.1 Research design 23
3.2 Study settings 23
3.3 Study population and sampling 24
3.4 Data collection tool 25
3.5 Data Collection 28
3.5.1 Piloting of questionnaires 28
3.5.2 Face-to-face structured interviews 28
3.5.3 Observational assessment of facilities and practices 29
3.5.4 Microbiological contamination 29
3.6 Validity and Reliability of the study 30
3.7 Data Management, Processing and Analysis 31
3.8 Ethics consideration 31
CHAPTER 4: 34
4 RESULTS 34
4.1 Participant characteristics 34
4.2 Food items served on the NSNP 34
4.3 Availability of premises, storage facilities and equipment 35

4.4 Food safety knowledge....40
4.5 Food hygiene practices....42
4.6 Attitude of VFH participants towards food safety....44
4.7 Volunteering food handler's personal hygiene behaviour....45
4.8 Microbiological count on food surfaces....46
CHAPTER 5:....50
5 DISCUSSION....50
5.1 Introduction....50
5.2 Description of the menu served on the NSNP....51
5.3 Availability of premises, storage facilities and equipment....52
5.3.1 Premises for the NSNP....52
5.3.2 Availability of storage facilities....53
5.3.3 Availability of food equipment....54
5.4 Food safety knowledge, attitude and practices....56
5.4.1 Food safety knowledge....56
5.4.2 Attitude of participants towards food safety....57
5.4.3 Personal hygiene behaviours....57
5.5 Microbiological analysis of food surfaces....59
5.5.1 Escherichia coli count on food contact surfaces....59
5.5.2 Staphylococcus aureus count on food contact surfaces....60
5.5.3 Yeast and mould count on food contact surfaces....60
5.5.4 Differences in school type on microbial counts between district and town schools 60
5.6 Conclusion....61
5.7 Limitations....62
5.8 Recommendations....63
REFERENCES....65

APPENDICES 79

LIST OF TABLES

Table 2-1: National table of targets for the school allocation (DoE, 2015).....8
Table 2-2: Food specification for products to be served on the NSNP (DBE, 2009).....10
Table 2-3: Eastern Cape Primary Schools Weekly Menu (DoE, 2014) 12
Table 2-4: Equipment and utensils for the NSNP (DoE, 2014).....16
Table 4-1: Demographic characteristics of study participants (n=18).....34
Table 4-2: Percentage of school items served on weekly average.....35
Table 4-3: Storage facilities between district and town schools.....36
Table 4-4: Availability of cooking utensils and equipment in schools.....37
Table 4-5: Availability of hygiene and safety equipment.....38
Table 4-6: Comparison of resource availability between district and town schools 39
Table 4-7: Knowledge of volunteering food handlers and general food safety.....40
Table 4-8: Food hygiene practices of food handlers (n=18).....43
Table 4-9: Volunteering food handlers' attitude towards food safety (n=18) 44
Table 4-10: Hygiene practices reported by volunteer food handlers (n=18) 45
Table 4-11: Counts of various organisms from food contact surfaces of schools participating in the NSNP in Peddie 46

LIST OF FIGURES

Figure 3-1: A map indicating the location of the study – Peddie, Eastern Cape, South Africa (Google maps, 2017).....24
Figure 4-1: Areas where food was being stored within the school premises during the NSNP 36
Figure 4-2: Type of waste disposal containers used by the participating schools in the NSNP 39
Figure 4-3: Comparison of knowledge of food preparation rules according to the guidelines between district and town schools 42

LIST OF APPENDICES

Appendix A: Ethical Clearance Letter

Appendix B: Eastern Cape Education Permission Granting Letter

Appendix C: Information Sheet

Appendix D: Consent Forms

Appendix E: Study Questionnaires

Appendix F: Eastern Cape Primary School Menu

Appendix G: Equipment and Utensils Guidelines for the National School Nutrition Programme

Appendix H: Evidence Photographs

Appendix I: Food Preparation Rules

CHAPTER 1:

BACKGROUND

RATIONALE FOR THE STUDY

AIMS OF THE STUDY

SPECIFIC OBJECTIVES

CHAPTER 1:
1 INTRODUCTION

1.1 Background to the problem

Approximately 14% of the world's population experiences persistent hunger, 60% of them are children and their death may be attributed to poor nutrition (Insel, Ross, McMahon & Bernstein, 2013). A study conducted by the United Nations International Children's Emergency Fund (UNICEF, 2009) showed that child poverty is at an overwhelming high rate in South Africa. UNICEF (2009) describes child poverty as a lack of income to the families or households in which children live in, which creates challenges regarding food security. Leatt, Rosa and Hall (2005) assert that one of the root causes of child poverty in South Africa is the underdevelopment of the majority of black people. Such underdevelopment combined with poor education and a high unemployment rate remain the biggest determinant of poverty amongst children. This has had a significant impact on the high levels of child poverty, especially in the Eastern Cape (Leatt *et al*., 2005).

The comprehensive UNICEF framework on child poverty shows that nutritional status is influenced by multifactorial causalities such as the immediate, underlying and basic factors (e.g. food, health and care), all of which affect one another (UNICEF, 2009). The UNICEF (2014) framework on child poverty emphasise that, "Optimal nutritional status results when children have access to affordable, diverse and nutrient-rich foods. In addition, access to appropriate maternal and child-care practices; adequate health services; and a healthy environment including safe water, sanitation and good hygiene practices".

In an effort to avert child poverty in schools, the South African government developed a nutrition programme currently known as the National School Nutrition Programme (NSNP) (Department of Education (DoE), 2009). The aim of this programme was to enhance the educational experience of needy learners through the provision of healthy meals (Ntuli, 2009). The DoE (2009) assert that the aim was also to improve short-term hunger, class attendance

and participation by providing direct meals to primary school learners. This is in line with South Africa's Millennium Development Goal 1 (MDG1) with an objective of reducing the proportion of children who go to bed hungry by 50% over the 1990-2015 period (Statistic South Africa (Stats SA), 2013).

One of the guidelines of the NSNP is to ensure safety of food by avoiding food contamination (DoE, 2009). According to the World Health Organization (WHO, 2015), food safety is a scientific discipline describing handling, preparation, and storage of food by encompassing actions aimed at ensuring prevention of food-borne illnesses. WHO (2008) describes foodborne diseases (FBD) as diseases that are usually transferred through ingestion of unsafe food.

1.2 Problem statement

South Africa is witnessing increased incidences of hospitalisation of school children, owing to contaminated food provided by state feeding schemes (Health24, 2015; News24, 2012). In the first six months of 2015, for instance, four cases of food contamination were reported in the Peddie district. It is believed that this anomaly of food poisoning emanates from food suppliers; however, the latter attribute this phenomenon to volunteer food handlers (VFHs) (News24, 2015).

Empirical studies, that would partly alleviate the ambiguity regarding the source of the aforementioned health hazard, appear to be largely lacking. Accordingly, based on the fact that nutrition attitudes and practices, with regard to the safe handling of food, are crucial (UNICEF, 2009), this study investigates the factors affecting the safety of the food served by the NSNP to the country's primary schools. With a special focus on Peddie District, Eastern Cape, South Africa, it poses the following questions: What are the factors affecting the safety of the food served by the NSNP to the primary schools? What is the nature of the food served by the NSNP in primary schools? Which facilities (e.g. premises and equipment) are utilised for food preparation? How informed, vis-à-vis food safety practices, are the VFHs who participate in the NSNP?

1.3 Purpose

In order to respond to the problem of food poisoning arising from state-sponsored school feeding programmes in primary schools, this research aims to assess factors affecting the safety

of the food served by the NSNP to the primary schools in Peddie, Eastern Cape, South Africa. The rationale for the key findings could determine the factors affecting food safety and propose remedial strategies at reducing incidence of food poisoning. Recommendations from this study based on key findings could assist in the development of a framework of solutions to eradicate food poisoning especially in schools. Further, interventions based on this study could focus on issuing guidelines and suggestions on preventative measures of food-borne illnesses in the Eastern Cape districts. Once such guidelines have been proven to work effectively in the Eastern Cape District, it may then be advocated for other provinces within South Africa to adopt these solutions in order to increase food safety and hopefully prevent food poisoning in the end.

In an effort to contribute towards the safety of food served through the NSNP, the present study will be developed with a view to assess the availability of facilities for food preparation and the adequacy of premises and equipment. Furthermore, factors such as knowledge, attitudes, practises (KAP) and beliefs of VFHs on food safety practices will be analysed. Finally, the prevalence of practices of VFHs on food handling, hygiene and storage (raw & cooked) as well as the microbiological analysis of food contact surfaces with reference to primary schools in Peddie will be investigated.

1.4 The aim of the study

The overall aim of this study is to assess factors affecting the safety of food served by the NSNP to the primary schools in Peddie, Eastern Cape, South Africa.

1.5 Objectives

Based on the aforementioned problem statement, the objectives of this research are as follows:

- To describe the type of food served on the NSNP in primary schools in Peddie.
- To assess the facilities i.e. premises and equipment available for food preparation for the NSNP in primary schools in Peddie.
- To assess the knowledge and attitude on food safety practices by VFHs in the NSNP for primary schools in Peddie.
- To assess practices of food handlers regarding personal hygiene, handling and storage of raw and cooked food served on the NSNP in primary schools in Peddie.

- To assess the presence of microbiological contamination on food contact surfaces used in the NSNP in primary schools in Peddie.

1.6 Research question

What are the factors affecting safety of food served by the NSNP to primary schools of Peddie district, Eastern Cape, South Africa?

1.7 Structure of thesis

The outline of this mini-thesis will be as follows: The mini-thesis is divided into five chapters. Chapter one provides background of the research study including problem statement. Furthermore, chapter one provides the purpose, the aim and objectives of the study as well as the research question. Chapter two presents a review of the literature by giving a background on the NSNP and highlights its policies and the factors that could affect safety of food served during the programme. The third chapter describes the research methodology used to conduct this study, chosen study design and the study setting. This chapter further documents study population, followed by sampling as well as data collection and analysis techniques, including data validity and reliability and concludes by raising ethical considerations regarding the study. The fourth chapter presents the results of this research study. The fifth chapter discusses the results in a descriptive format and provides a brief summary of the study which draws conclusion from the results and makes recommendations based on the findings.

CHAPTER 2:

LITERATURE REVIEW

CHAPTER 2:
2 LITERATURE REVIEW

2.1 Introduction to the National School Nutrition Programme

In May 1994, the South African government developed a nutrition programme currently known as the NSNP with an effort to avert child poverty in schools (DoE, 2009). According to the Department of Basic Education (DBE) (2012), the NSNP was first introduced by the South African Department of Health (DoH) as the Primary School Nutrition Programme (PSNP). This Programme played a critical role in the challenges to cope with poverty, nutrition problems, and health as well as to improve education. It was implemented in primary schools that were in need of a nutritional feeding scheme (Ntuli, 2009). These were the schools that were from poverty stricken communities. The aim of the programme was to enhance the educational experience of needy learners through the provision of healthy meals (Ntuli, 2009) to improve short-term hunger, class attendance and participation by providing direct services to primary school learners (UNICEF, 2009).

By offering an early morning snack schools made sure that children of 7-10 years of age obtained about 25 percent of their recommended dietary allowance (RDA) and around 20 percent for the children from 11-14 years old (DoE, 2009). However, a major goal for the PSNP was to provide at least 30 percent of the learner's RDA. A survey performed in South African schools in 1994 among 97 790 pupils in 3300 schools showed the need of an improved nutrition situation in schools (UNICEF, 2009). The survey showed racial difference by suggesting that, coloured schools had a high rate of nutritional supplement need with 4.1% of students being wasted and 17% underweight. Black students were found to be 2.4% wasted and 9% underweight followed by a staggering lower rate of white students who were 0.8% wasted and 1.1% underweight. There were also provincial differences in the survey with a low percentage (4.6%) of underweight students from the Gauteng province compared to other provinces such as Northern Cape which had about three times (20.9 the percent of underweight pupils) (Stats SA, 2015).

Malnutrition is a major problem for many South African learners even if the provincial differences are large (World Health Organisation (WHO), 2012). The importance of health and

nutrition in schools have been shown to be important and the connection between nutrition and learning is strong. By implementing the PSNP the South African government hoped for an improved nutritional status of learners, possibly resulting in increased school attendance and learning results (DoE, 2009). According to PSC (2008), the PSNP was initially designed to develop active learning capacity by providing school meals. Since the programme's central outcome was to improve education rather than health, the responsibilities were transfer from DoH to the DoE. In 2006, the DBE (2009), established a need for the PSNP to be extended to secondary schools since there were secondary school learners coming from communities with low socio-economic status.

Upon its extension, in April 2006, the PSNP was renamed to NSNP. The objectives of the programme also changed and became: "*to alleviate poverty and enhance learning through school feeding; to promote sustainable food production and economic activities in school communities; to strengthen nutrition education in schools; to increase attendance of learners and to obliterate school dropout; to increase the pass rate; to empower poverty-stricken communities, particularly in the rural areas across all nine provinces in South Africa*" (DBE, 2009:4). Its guidelines were to ensure safety of food by avoiding food contamination (DoE, 2009). The aim of the NSNP was to contribute towards the country's MDGs, which included a reduction in child mortality, achieving universal primary education and eradication of extreme poverty and hunger by 2015 (DBE, 2012a & MDG, 2013).

2.2 National School Nutrition Programme quintile rankings

According to the DBE (2009), South African schools are ranked in quintiles according to the school quintile system. *A quintile is a system of ranking and funding schools taking into account the socio-economic circumstances of learners (inequality and poverty)* (DBE, 2009:14). Each national quintile contains 20% of all learners, with quintile one representing the 'poorest' schools, while quintile five being the 'least poor' for funding purposes. Table 2-1 shows the quintile rankings of schools which determines the amount of money that each school should receive for an individual learner. For instance, in 2017 a learner from quintile 1, 2 or 3 received R1 242 per year, whereas, quintile 4 and 5 learners received R622 and R215, respectively. These high figures mean that students in the quintile 1, 2 & 3 schools are from the poverty stricken communities and must be provided with daily meals.

Table 2-1: National table of targets for the NSNP school allocation (DoE, 2015)

National Quintiles	2015	2016	2017
NQ1	1,116	1,117	1,242
NQ2	1,116	1,117	1,242
NQ3	1,116	1,117	1,242
NQ4	559	590	622
NQ5	193	204	215

The poorest schools receive the largest amount compared to the least poor schools based on the assumption that the least poor schools require less support from government (DoE, 2009). These poverty rankings take into account the level of poverty status of communities around the school as well as, certain infrastructural factors (DBE, 2012). The majority of these children have meals provided through the NSNP as their main source of energy and nutrients (DBE, 2009). The aim of the quintile system is to address the uneven distribution of poverty across provinces, with the poorest provinces such as the Eastern Cape with 34.8% learners falling into quintile 1, as opposed to 6.5% of learners in the relatively wealthy Western Cape (Branson, Lam & Zuze, 2012).

2.3 National School Nutrition Programme Policy

The NSNP policy states that all food handlers are trained on health and hygienic standards after employment (DBE, 2012). It also provides guidelines that food handlers must adhere to during their employment at schools. These guidelines can include, but are not limited to food premises, storage and hygiene. It also states that schools should have designated areas for cooking, preparation, serving and storing of food with adequate ventilation. Furthermore, food should be stored away from the floor and the First-In-First-Out (FIFO) principle should be practiced at all times. In terms of food hygiene, schools must ensure that the cooking area is neat, hygienic and clear of any potential food contamination (DBE, 2012b).

2.4 National School Nutrition Programme Food Specification

According to the DBE (2010), the objective of the NSNP is to serve locally produced fresh food of high quality along with nutritious meals (Table 2-2). The NSNP food specification policy states that "only products that are approved by the National Consumer Forum (NCF)

such as fortified maize meal, salt and bread should be used". The policy recommends fresh fruit and vegetables rather than frozen or dehydrated fruit and vegetables as the latter do not provide the same nutritive value. The policy continues to state that labels must contain product name, expiry date, nutrient information and instructions for use and manufacturers address. The DoH requires that all decanted products should contain product name and expiry date (DBE, 2010). There is however a specific menu for each region for both primary and secondary schools. Table 2-3 shows the menu for primary schools in the Eastern Cape (DoE, 2014). Each school is required to use the provided menu for the week. It does not have to follow the exact menu sequence, as long as all food groups are covered. A detailed Eastern Cape primary school menu with potion sizes has been presented in Appendix F. DoE has developed the NSNP food preparation guidelines to enhance food safety behaviours that can lead to reduction of food-borne disease occurrence. The guidelines include cleaning of cooking and eating utensils, separation of raw and cooked food, washing of fruits and vegetables and making sure that the kitchen is clean (DoE, 2014). All contracted service providers must guarantee that their products meet the DoE requirements according to specifications. All food products should not contain any micro-organisms that may represent a hazard to health. They must be stored in clean, cool, dry, well ventilated conditions at room temperature and handled in the appropriate manner. All products should be stored in an elevated position from the floor (DBE, 2010).

Table 2-2: Food specification for products to be served on the NSNP (DBE, 2009)

Food Group	Product	Physical Requirements
Starches	Maize rice/samp, Rice, Wheat flour, Fortified bread, Potato, Sweet potato	All starch products must be suitable for human consumption and be free from offensive odours and flavours. The products must be free from heavy metals which may cause harm to human health. All products must be of indisputable hygienic standards and quality.
Protein	Peanut butter, Soya mince, Dehydrated beans, Lentils (brown/red), Pilchard in tomato sauce and UHT milk.	These protein based products must have a good flavour and aroma. They must be free from foreign, bitter, rancid or offensive taste and odour. The flavoured protein based foodstuff must be palatable and free from any astringent taste. Absence of yeast and moulds when tested.

Food Group	Product	Physical Requirements
Fresh vegetables	Carrots, Green beans, Cabbage, Pumpkin, Spinach, Onions, Tomato, Beetroot	Vegetables from each batch should have the same characteristics, good colour, firm, clean, without internal cavities, fairly uniform in size and not overripe. They shall be free from soil, insects, frost, bruising, self-heating, sunburn, decomposition and decay. Must be fresh with no signs of withering.
Fresh fruit	Apples, Bananas, Citrus fruit, Raisins, Avocadoes and Mangoes.	The fruit must be clean, free from insect infestation, insect bites, diseases and superficial bruises, other defects that may cause the fruit to decay. Virtually free from dry core rot, hail marks, sunburn, skin stains.
Other	Cooking oil, Salt and Pepper	They must have a palatable taste, a pleasant odour, and transparent appearance. The products should have no rancid, foreign flavour or odour and free from foreign material.

Table 2-3: Eastern Cape Primary Schools Weekly Menu (DoE, 2014)

Days	Meal plan	Food Item
Monday	**Lunch**	
	Protein	Chicken stew
	Starch	Maize pap
	Vegetable/fruit	Red/Yellow seasonal vegetable/fruit
Tuesday	**Lunch**	
	Protein	Cooked beans
	Starch	Cooked samp
	Vegetable/fruit	Green seasonal vegetable
Wednesday	**Lunch**	
	Protein	Sour milk/fresh milk (UHT)
	Starch	Phuthu pap
	Vegetable/fruit	Whole fruit
Thursday	**Lunch**	
	Protein	Cooked beans
	Starch	Cooked samp
	Vegetable/fruit	Green seasonal vegetable
Friday	**Lunch**	
	Protein	Pilchard stew
	Starch	Sweet potato/rice/brown bread
	Vegetable/fruit	Red/yellow seasonal vegetable

2.5 Food safety aspects associated with the National School Nutrition Programme

There are numerous types of bacteria in the environment, some are harmful others are beneficial and keep the digestive tract healthy (Caillet, Ursachi, Shareck and Lacroix, 2009). Pathogens can contaminate water and food causing it to smell and taste bad which can result to food-borne diseases (FBD) or even death (Caillet *et al*., 2009). WHO (2015) describe FBD as infections or toxins that are caused by a bacteria, virus, parasite or chemical substance which enters the body through contaminated food or water and can be detrimental to human health. According to Addis and Sisay (2015), FBD result from consumption of foods or beverages contaminated with pathogenic bacteria and this has been an important public health concern for several years. Ntuli (2009) states that, the illness, predominantly caused by diarrhoeal and infectious diseases, can contribute to child malnutrition as the child will be unable to digest foods and absorb nutrients efficiently during illness.

An investigation into FBD outbreaks by Lambrechts, Human, Doughari and Lues (2014) shows that poor personal hygiene, ineffective hand washing and inadequate temperature controls of food are important contributors to FBD. Furthermore, a food worker's unwashed hands after a visit to the toilet can transmit feacal pathogens. Bradshaw, Pillay-Van Wyk, Laubscher, Nojilana, Groenewald, Nannan and Metcalf (2010), confirm this statement by showing a trend in the rates for the commonly reported infectious diseases that are transmitted through feaces such as intestinal infections with higher death rates in old ages (about 150 cases reported per year), and the increase in meningitis and other infectious diseases.

This also corroborates with findings from a study conducted by Cheng, Kuo, Chi, Lin, Lee, Feng and Tsai (2013), in Taiwan, which showed high outbreak of infectious disease cases (82,342) from 1991 to 2010, and 15 deaths. In comparison, while FBD outbreaks may seem to be low in South Africa, the DoH has reported that this may be attributed to under documentation or reporting by officials. The DoH recognized that these outbreaks are under-reported due to the fact that most diarrhoeal illness can be resolved within 24-48 hours without any medical attention therefore, many food-related illnesses are not diagnosed (DoH, 2013). However, the DBE (2012a) declares that, on the available data from 2001 to 2006, FBD outbreaks have only been reported in the provinces of Eastern Cape, KwaZulu Natal and Limpopo, with no outbreak cases reported in other provinces.

2.6 Hazard Analysis Critical Control Points (HACCP) of Basic Food Safety Systems

According to Henroid and Sneed (2004:183), "*HACCP is a management system in which food safety is addressed through the analysis and control of biological, chemical and physical hazards from raw material production, procurement and handling, to manufacturing, distribution and consumption of the finished product*". It is an effective approach to establish good manufacturing practices (GMPs) for the production of safe food (Santana, Almeida, Ferreira & Almeida, 2009). These GMPs will include processes, facilities and equipment that will be used in place of the HACCP programme. Food and Drug Administration (FDA) (2014), suggests that GMPs focus on aspects such as the design of facilities that must be appropriate for the type of operation, adequate levels of maintenance, sanitation and transportation that must keep quality intact. VFHs must be trained on personal hygiene and on the operational procedures as they are important when applying the HACCP programme (FDA, 2014).

2.6.1 Premises in food safety

According to the NSNP policy, the food premises must comply with the local authority regulations in regards to hygiene and health standards. These premises shall be maintained in an adequate hygienic conditions (DBE, 2012b). Stevia (2013) assert that food premises are easily infested by pests because they provide them with abundant food sources. Therefore, properly designed food premises should facilitate easy cleaning, sanitizing and maintenance which could help minimize the likelihood of food contamination and prevent access to pests. Pests can either spread harmful diseases, cause food safety problems and damage to food premises. The author continues to state that appropriately designed and constructed floors can prevent access to pests in food premises. The Food and Environmental Hygiene Department (FEHD) (2009) suggest that, accumulation of food waste, dirt and grease coming from a diversity of sources such as food spills and food handlers' protective clothing are conducive to microbial growth.

The South African Standards and Requirements for Food Premises (SASRFP) policy (DoH, 2013: 8-11), clearly states that "*food sites must be positioned, designed and built without causing any health risk and must afford hygienic processing of food to avoid adulteration. Walls, ceilings and floors must be washable to avoid food adulteration, and each room must be well aerated either by artificial or natural aeration. Furthermore, there must be sufficient lighting. The policy continue to state that "Food sites must have the following: a wash- up area with both hot and cold water for washing equipment; preventative measures to guard against flies and other insects in food preparation areas; a proper water- discarding system that has been approved by the local municipality; a hand- washing facilities for employees and customers; a discrete changing area with a storeroom for staff; a separate storeroom for food and equipment; water-proof containers with tight fitting lids for garbage disposal* (DoH, 2013).

2.6.2 Equipment in food safety

Izquierdo, Alonso-Perez, Gil, La Touche, Lerma-Lara, Lerma Lara, Gonzalez, Perez, Bishop, and Fernandez-Carnero (2014:219), defines food equipment as *"food contact surfaces that come into direct contact with unprotected foods"*. These include but are not limited to food equipment, knives, cutting boards, eating and drinking utensils, containers in which food is stored and food preparation surfaces such as tables (Table 2-4). Using the same equipment for different purposes might increase the risk of cross contamination (Izquierdo *et al*., 2014).

Chipped or cracked food surface equipment poses a food safety risk because they can become difficult to be cleaned efficiently which allows the transmission of micro-organisms. Furthermore, they may contaminate food directly and injure the customers with chipped pieces that may fall into the food. Food contact surfaces should be smooth, free of cracks, crevices, easily cleaned and sanitized otherwise they have the potential to introduce harmful substances such as copper or lead into food products (FEHD, 2009).

Table 2-4: Equipment and utensils for the NSNP (DoE, 2014)

Items	Usage
Food storage equipment	
Stainless steel food storage shelve	Organizing food products. All must be labeled.
Food box storage container with lid	Beans, spice or soya food storage.
Ingredient bin heavy duty with lids and mobility dolly	Storage of dry ingredients such as mealie meal, samp, rice.
Pre-preparation equipment and utensils	
Stainless steel work table	Preparation for cutting of vegetables and platting of food.
Industrial platform scale	For measuring of dry ingredients such as mealie meal, samp and rice.
Industrial food processor, vegetable cutter	Slicing of large volumes of vegetables of fruit.
Measuring jugs, stainless steel or plastic	For measuring of fluids such as water and oils.
Measuring cups, stainless steel or plastic	Measuring of flavorings
Can opener – industrial mounted	Open cans of all shapes and sizes.
Cutting boards, polypropylene plastic material	Cutting of the following: • White – Dairy and bakery products. • Blue – Fish • Yellow – Poultry/Chicken • Green – Raw Vegetables of fruit • Red – Meat • Brown – Cooked meat
Knives	Used for peeling and chopping.
Plastic/stainless steel cooking spoons	Stirring of soft porridge, pap, samp and stews.
Basting spoons	Stirring or mixing

6 sided stainless steel grater	For multi grating of vegetables and cheese.
3 plate gas burner	Cooking of food
Gas cylinder	To be installed on the gas burner.
Stainless steel or aluminum heavy duty cooking pots	Used for cooking of porridge, rice, samp and beans and stews.
Aluminum cooking pots	Cooking of small quantities.
Serving equipment and utensils	
Stainless steel food trolley	Distribution of food.
Stainless steel chafing dishes	Food server units that keeps the temperature.
Stainless steel table spoons	Learners use to eat with it.
Stainless steel or plastic serving spoons	Vegetable serving spoons.
Stainless steel serving plates	Learners use for eating.

2.7 Microbiological hazards

Microbiological hazards refer to all hazards caused by bacteria (Lues & van Tonder, 2007) which can cause food spoilage and possibly be harmful to health directly or indirectly (WHO, 2015). There are four microorganisms that usually cause food-borne infections such as *Campylobacter jejuni, Escherichia coli (E.coli), Salmonella* and *Listeria monocytogenes.*

Campylobacter jejuni is known to be the most common cause of diarrhea and abdominal cramps and can lead to a life threatening Gullian-Barre syndrome (Taulo, Wetlesenm Abrahamsen, Narvhus & Mkakosya, 2009). It is mostly found in unpasteurized milk, contaminated water and poultry, and last between 7-10 days (Insel, Ross, McMahon & Bernstein, 2013). *E.coli* is the second most common cause of life threatening bloodstream infections and cause watery diarrhea which can progress to bloody diarrhea if it is not treated in time (Kennedy, Roberts & Collignon, 2008). The presence of *E.coli* is an indication of faecal contamination in water sources and a general lack of hand hygiene during food handling. The bacteria may be passed through contaminated hands, surfaces, containers and other equipment to raw foods or cooked foods (WHO, 2015).

Salmonella is the third most common pathogen and is found in egg, poultry and unpasteurized milk. This pathogen causes severe diarrhea, meningitis and flu-like symptoms which can last for 1-3 days with symptoms ranging from mild, severe pain to full blown diarrhea (Insel *et al*, 2013). Listeria monocytogenes is the fourth and last common pathogen that is extremely dangerous to pregnant women as it is harmful to the unborn fetus. The pathogen can grow in the refrigerator and is found in water, soil, fruits and vegetables (Kadariya, Smith & Thapaliya, 2014). Research evidence (Trickett 2000) shows that the incidence of food poisoning caused by food handlers, accounts for 70% of all bacterial food poisoning outbreaks.

Lee and Greiga (2010) asserts that school environment are more prone to epidemiological outbreaks of microbes. The risk is increased by the introduction of food as this becomes an

additional variable that supports multiplication of microbes. Taulo and co-researchers (2009), concur with this statement as they emphasize that, during food preparation and consumption, food and surfaces can be easily contaminated by a significant quantity of pathogenic microorganisms. This was confirmed by a study conducted by Nhlapho, Ryk, Kativu and Groenewald (2015), where a total viable count (TVC) was conducted to measure the general indication of the number of organisms present in food and surfaces, and the results showed that 80% of the tested samples had bacterial counts that were too numerous to count (TNTC), which is an indication of the general hygiene status of samples. Most incidents of food borne illnesses can be prevented by means of "*proper cooking and processing of food which kill bacteria such as adequate refrigeration, improve personal hygiene, heat processing of food at higher temperature and prevent holding of food in warming device at bacterial growth temperatures*" (Addis & Sisay, 2015:176).

2.8 Volunteering Food handlers and food safety

An article from the DoE (2009) describes VFHs in the NSNP as people that are volunteering their services in the preparation, cooking and serving of meals to school children that receives a minimum stipend for transport. Their responsibilities include cleaning the cooking area and the individuals are expected to maintain an outstanding level of personal hygiene. Marriott and Gravani (2006:83), describes personal hygiene as "*cleanliness of a person's body*". It is vital that food handlers practice good personal hygiene at all times as they can probably transmit micro-organisms onto food or food contact surfaces if their hands are contaminated, which can cause illnesses through the transmission of certain viruses (Taulo *et al*., 2009).

A study conducted by Ifeadike, Ironkwe, Adogul and Nnebue (2014), reported poor hygiene practices by food handlers in the workplace. The study showed that only 30.4% of respondents washed their hands properly and only 56% wore protective clothing. The authors suggest that these behaviours were caused by the irregular food hygiene training where only 32.1% of food handlers had undergone regular food hygiene training. In Australia, the Australian Food Safety Standard 3.2.2 (Food Safety Practices and General Requirements) requires that food handlers must have the proper skills and knowledge of

handling food and food safety (The Australian Food Safety Standard, undated). This is why the DoH (2008:10) asserts that, "*the main emphasis for food handler surveillance should fall on personal hygiene, clean protective clothing and effective supervision of the health of employees and appropriate action timely taken when indicated, and maintaining hygienic food handling practices*". Hence Ifeadike *et al*. (2014) suggest that establishments should conduct regular training of their VFHs on basic personal hygienic techniques, food handling and good hygiene practices.

The DoE developed the four techniques to safer foods in-order to educate VFHs about their responsibilities to food safety. These four techniques are: keep cooking and eating utensils clean, separate raw and cooked food, wash fruit and vegetables and keep kitchen clean at all times (DBE, 2009). If these guidelines can be adopted, reduction of cross contamination leading to FBD occurrence can be reduced significantly.

2.9 KAP of volunteering food handlers on food safety

Several authors have reported on issues of mishandling of food playing a crucial role in FBD (Lee, Nelson & Almanza, 2012). They emphasise that improper practices such as typical involvement of raw and cooked cross-contamination of food and inadequate cooking can lead to FBD. Knowledge is however noted to be vital in the processing of information and in the change of attitude and behaviour. Attitude assess perceptions associated with the way people think, feel and behave, implying that what you know, how you feel and what you do is all related to your attitude (USAID, 2013). Jain (2014) suggest that attitudes can influence one's aim in performing a certain task. Therefore, if a person has a positive attitude towards appropriate hand washing, they are more likely to wash their hands.

A study conducted by Husain, Muda, Jamil, Hanafi and Rahman (2016) in assessing the effectiveness of food worker training showed that there was a significant improvement in food handling practices after training. However, when another inspection was performed after 6 months of training no improvement in an individual's attitude was observed. In contrast, a continuous study conducted by Seaman and Eves in 2008 indicated a positive

impact of food handling behaviour after training. The Knowledge, Attitude and Practices (KAP) survey model developed by the United States Agency of International Development (USAID) indicates the relationship between knowledge, attitude and behavior. It indicates that knowledge alone does not translate into modification of appropriate behaviour (USAID, 2013). It is therefore, imperative to explore the KAP of food handlers on food safety issues in order to further assist in enhancing the general safety of foodstuffs served through the NSNP.

2.10 Conclusion

The Integrated Nutrition Programme (INP) aims at implementing programs that are integrated, sustainable, people and community driven and targets the most vulnerable groups in South Africa. The NSNP forms part of the INP of South Africa and was implemented as a poverty alleviation strategy introduced in 1994 by the government as part of the Reconstruction and Development Program of the newly founded democratic Republic of South Africa. The implementation of the NSNP needs to be done in a manner that ensures that there are no risks taken with possible food poisoning episodes. Special care must be taken when food handlers caters for populations considered at risk, such as learners attending primary schools.

CHAPTER 3:

METHODOLOGY

CHAPTER 3:
3 METHODOLOGY

This chapter describes the research methodology used in order to achieve the aim and objectives of the study. That is, to investigate factors that contribute to the safety of food served by the NSNP to primary schools in Peddie, Eastern Cape, South Africa. It details the chosen study design, the study setting and this study population followed by sampling as well as data collection techniques and analysis. The chapter further documents the details of validity and reliability and concludes by raising ethical considerations regarding the study.

3.1 Research design

A cross sectional analytical study design utilizing a quantitative research method was employed in this study. The purpose for using a cross sectional study design was informed by the aim to measure various aspects that contribute to poor food safety at one point in time. Zheng (2015) asserts that this type of study design is suitable for the current study as it is relatively quick and economical. Whereas, Polit and Beck (2013) assert that this type of study design is suitable when data collection is done at one particular point in time and easy to manage within a short space of time and can study several outcomes (Zheng, 2015).

3.2 Study settings

This study was undertaken in Peddie, an area in the Amathole district in the Eastern Cape Province of South Africa, about 55 km south-west of King William's Town and 67 km east of Grahamstown (Wikipedia, 2017). The chosen location is detailed below in Fig 3.1. According to Stats SA (2014) the area has a population of around 4,658 families and is a predominantly African population (98.2%). Peddie community suffers high levels of poverty due to high rates of unemployment and child headed households (Stats SA, 2014), hence most schools in Peddie falls in quintile 2 (UNICEF, 2009).

Figure 3-1: A map indicating the location of the study – Peddie, Eastern Cape, South Africa (Google maps, 2017)

3.3 Study population and sampling

A study population is a well-defined group of participants with similar characteristics including age, gender, or health issues (Polit & Beck, 2013). The study included all Peddie primary schools that were implementing the NSNP during the time of the study. According to Özdemir, St. Louis and Topbas (2011), convenience sampling is a non-probability sampling technique where participants are drawn from one part of population that is easily accessible to the researcher.

A total of nine primary schools in Peddie district and town of Peddie were selected as a convenient sample. For the purpose of this study, Peddie district refers to rural villages of Peddie that are closer to town and town of Peddie refers to Peddie urban. Participating schools were chosen on the basis of their close proximity to each other, both in the Peddie five district and four town, this made it easier for the researcher to gain access. These schools were selected to be representatives of the types of schools in the district and town areas. Each school had two volunteering food handlers (VFHs) working at the schools

during the time of study and a sample of eighteen VFHs was thus selected from the participating schools. Swabbing of tables, hands, aprons and cutting boards from each school was conducted as indicated in the literature (Polit & Beck, 2013). The samples were sent to the laboratory on ice for micro-biological analysis. All schools were given a code to preserve anonymity and avoid bias during analysis between town and district schools.

Inclusion and exclusion criteria make up the suitable criteria used to rule in or out the target population for a research study (Velasco, 2010). The author continued to state that, proper selection of inclusion criteria will improve the validity of the study, reduce ethical anxieties, minimize confounding and increase the probability of discovering a true association between exposure and outcomes. In light of this information, inclusion criteria involved a sample of schools that are beneficiaries of the NSNP national program in Peddie. Furthermore, this included all the VFHs that were working in the nine selected primary schools during the time of the study. All schools in Peddie benefited from the NSNP therefore, there was no exclusion criteria in terms of schools, and the VFHs that were on leave during the time of study were excluded.

3.4 Data collection tool

There were two data collection tools developed for the study that is, face to face structured questionnaires and observational assessment checklist. The researcher drew on the objectives of the study and developed the tools as follows:

Objective 1:

- Types of food items being offered by the schools throughout the study week were recorded.

Objectives 2 and 3:

In order to describe the resources used for food preparation, serving and premises, an observation checklist was used (Appendix E1). The checklist was adopted from a study conducted by Nhlapho (Nhlapho, 2013) and modified for the purpose of this study. An observation checklist is a process of enabling researchers to learn about the activities of observation by means of a checklist (DeWalt & DeWalt, 2002), (Zaare, 2013).

- **Observation checklist:**

A checklist comprised of twenty questions with "Yes or No" as the only possible answers was used for objective 2. The researcher recorded the presence or the lack thereof of food premises available at schools or designated spaces reserved for the kitchen to accommodate the NSNP. The checklist included items such as the availability of stoves, fridges, cutting boards to name a few. The NSNP equipment and utensils guideline was used to guide the checklist (Appendix H).

Data was collected using the observation checklist and a questionnaire. Specifically, the checklist focused on food hygiene and had two subheadings where the researcher observed things such as personal hygiene (proper and frequent hand washing) and food handling (procedures in preventing cross contamination) (Appendix E2). The researcher was interested to see whether respondents adhered to personal hygiene practices. For instance, respondents were monitored to see if they wore protective clothing or washed their hands properly. In terms of food handling, participants were monitored to see whether suitable utensils were being used to handle food and if there were any procedures in place to prevent cross-contamination.

Objectives 3 and 4:

According to Burns and Grove (2005) questionnaires are intended to discover respondents' knowledge of events, how they know about these events and their source of information. Published literature was used to develop suitable questionnaires.

Questionnaires: The questionnaires used were adapted from the questionnaire used by Nhlapho (2013), whose study showed similarities to the current research study. The questionnaires consisted of closed-ended questions, which aimed at providing a set of fixed answers to the questions. The questionnaires were divided into four different sections and comprised of thirty-nine questions. Data that was collected from these questionnaires included general information such as demographic information (Appendix E1), general food safety knowledge (Appendix E3), attitude of food handlers towards food safety (Appendix E4) and personal hygiene information (Appendix E5). A 5-point Likert scale was used where a series of questions with five response alternatives from strongly disagree (1), disagree (2), not sure (3), agree (4) and strongly agree (5). Furthermore, possible answers such as "Yes or No"; "Agree, Disagree etc. were listed where respondents were required to choose their response.

Objective 5

Sample collection: In order to determine the microbial level on food preparation surfaces, samples were collected from each school, representative samples were collected from six previously cleaned surfaces that came into contact with foodstuffs, namely tables, sinks, tray, cutting boards, aprons and hands of VHFs. This was done in the morning after the cleaning and sanitizing of the food preparation surfaces. A total of 162 (6x3=18; 18x9=162) food contact surface microbiological samples were collected by swabbing participants using a sterile swab stick following the manufacturer's instruction procedures. Each surface was sampled thrice to avoid cater for any mistakes during analyses. All swab samples were transported on ice at 4°C to the laboratory and were immediately analysed to determine the TVC.

Sample preparation for microbial analysis

All analyses were performed in triplicate to improve validity of the results. Samples were soaked in 5 ml of nutrient broth (NB) that was successively diluted. From this dilution 0.1 ml was added to 9.9 ml to make a 10^{-3} dilution. The 10^{-3} dilution was spread onto a Petri dish containing solidified sterile MacConkey agar (MCA) for *E.coli* and Baird-Parker agar medium for *S. aureus* and were incubated aerobically at 37°C for 72 h. After incubation all bacterial colonies were counted. Further identification of micro-organisms was carried out using the latex agglutination test kits StaphTEX™ Blue Latex, (Hardy diagnostics, USA) and PRO™ Latex (Hardy diagnostics, USA), respectively. In all laboratory reports, schools were given an anonymous alphabetical code to maintain anonymity.

3.5 Data Collection

Gorman and Clayton (1997) suggest that, researchers must choose the most appropriate data collection procedure in order to answer the research question. Three data collection methods were used in this study: face-to-face interviews, quantitative observations and microbiological analysis.

3.5.1 Piloting of questionnaires

The Questionnaires were also piloted at four primary schools that were benefiting from the NSNP. Two of the schools were from the district and the other two were from town schools. Piloted schools were not included in the final data analysis in ensuring accuracy of the report. The pilot study was used to test the definitions of instruments and to ensure that ambiguity, practical logistics, validity and reliability of the study was addressed (Pannucci & Wilkins, 2010). Some of the questions were not clear enough as the researcher used abundance of jargons that the respondents could not understand. Minimal adjustments were made to the questionnaires in order to improve clarity and interpretation.

3.5.2 Face-to-face structured interviews

The knowledge and attitudes of VFHs regarding food safety was determined by means of face to face interviews utilizing structured questionnaires. A structured interview is a suitable choice for this kind of study as Burns and Groves (2005), declares that, it offers a

comprehensive view of an issue and can easily be repeated to check reliability of data. Moreover, answers are easily compared and trends are observed as the respondents are required to answer the same questions. Interviews were carried out over a period of two weeks. These interviews were carried out at participating schools by the researcher. Powell (1991) assert that, the advantage of using closed-ended questions is that they rule out vague responses when structured properly. This may increase reliability since there is little variation in answers.

3.5.3 Observational assessment of facilities and practices

Data was collected to assess premises, availability of equipment and practices of food handlers on hygiene. This was done by means of an observation method. This method allows the researcher to view the environment within which participants make decisions for example, kitchen environment, allowed the researcher to generate her own perspective of the research problem. Structured observation was conducted by means of checklists (Appendices E1 and E2). The limitation to observation, however, is that people tend to alter their behaviour when they know that they are being watched (Bateson, Callow, Holmes, Redmond Roche & Nettle, 2013) and the method itself, is subjected to bias if it is not validated by another data collection method (Robson, 2011). In order to address biasness, the author used other data collection methods such as face to face interviews and microbiological analysis.

3.5.4 Microbiological contamination

Three samples were collected from each surface such as hands, tables, sinks, cutting boards, trays and exposed areas of the aprons of VHFs. These microbial samples were quantified using the 55mm Replicate Organism Detection and Counting (RODAC) plates containing agar media. The media was prepared according to ISO Method $16649^{-2}$where a colony-count technique was used at 44 °C on a solid medium containing a chromogenic ingredient for detection of the enzyme β-glucuronidase (Watkins, Rippey, Clavet, Kelley-Reitz & Burkhardt, 1988; International Organisation for Standardization (ISO), 2001; Collins & Lynes, 2013). The selected agar media were used to investigate TVC of

Staphylococcus aureus (S. aureus), E. coli and *Yeast and mould* on the dominant hand of each VHFs, apron, table, tray, sink and cutting board.

3.6 Validity and Reliability of the study

Validity is an indication of whether the instrument measures what it is intended to measure (Kimberlin & Winterstein, 2008), while reliability refers to the consistency of a measure to an extent that the procedure produces similar results under constant conditions at all times (Mertens, 2010). To ensure validity and reliability, precautions were taken throughout the study. Content validity was ensured by adopting some questions from similar published work and incorporating them in the current study. Both the questionnaires and checklists were sent to the principal investigator for approval ensuring that questions were consistent with the content of the study in order to increase validity and reliability. Food safety and research experts also played a role in reviewing the content of the questionnaires.

Validity also ensures that chance, bias and confounding factors are addressed in the study design. The validity of the study was enhanced by minimizing selection, measurement and information biases (Myer & Karim, 2007). Furthermore, the inclusion criteria guaranteed that the sample had the same characteristics as the population they represent. Myer and Karim (2007) assert that, measurement bias was addressed by using short and simple questions on the questionnaires. The quantitative questionnaires used closed ended questions that have the ability to limit the choice of participants' response, thus introducing bias. However, closed ended questionnaires are advantageous in this type of study as they can be used to provoke specific information in an efficient manner. Asking questions in a consistent way minimizes information bias (WHO, 2008).

In ensuring validity, the questionnaires were reviewed by experts in the Food Safety environment (researcher's ex-colleagues with more than 20 years working experience in the food industry) and research experts (researcher colleagues, a doctor and a professor with extensive food safety knowledge).

3.7 Data Management, Processing and Analysis

Data was captured and quantitatively analyzed in Microsoft excel 2013 and Statistical Package for the Social Sciences (SPSS) software Version 23, respectively. Variables were created sequentially into SPSS for all questions. An identity code was assigned for each questionnaire for quick reference where there were missing values in the tools. Majority of the variables were entered using numerical codes. Categorical data was analysed using frequencies expressed as percentages to establish hygiene, premises, storage and equipment variables as well as knowledge, practices and attitudes variables. Chi-square testing was used to assess statistical significance differences between district and town schools with the cut off point for statistical significance set at $p<0.05$. Fisher's exact test was used to test significance when cells were not normally distributed, for instance, when the sample size was smaller than five. Microbiological analyses were expressed as frequencies and percentages in Tables and Graphs. All the microbial results were evaluated using the British Columbia Centre for Disease Control (BCCDC) Guide for Environmental Health Officers and categorised as follows: satisfactory (<5 CFU/cm^{-2}); acceptable (5 CFU/cm^{-2} to 10 CFU/cm^{-2}); and unsatisfactory (>10 CFU/cm^{-2}). For the study purpose, counts of over 100 colonies were labelled as 'too numerous to count' (TNTC).

3.8 Ethics consideration

Ethics approval was obtained from the University of the Western Cape Ethics Committee and Senate Research Committee, January 2016, number 15/7/255 (Appendix A). Permission to undertake the proposed study was granted by the DBE in the Eastern Cape (Appendix B). All the procedures required by the DBE for conducting research and accessing schools were followed accordingly. These procedures included but were not limited to, not disturbing the learning and teaching which are the core business of the schools. Also, making sure that throughout the research both the staff and students were protected and not harmed in any way.

The participants were provided with a participant information sheet (Appendix C) and consent form (Appendix D), which outlined what the study was all about and explained the

rationale. Consent forms and participant information sheets were translated into IsiXhosa (Appendices C1 and D1) to ensure that all participants fully understood what the study was all about, given that they were native Xhosa speakers. The translation was done by the researcher as IsiXhosa is the researcher's native language. The interviews were also conducted in the participant's native language in-order to allow the participants to express themselves properly (Moore, 2014). For participants who had problems reading, questionnaires were read and explained to them. This helped the researcher in overcoming the limitations that would most probably have been encountered when using a foreign language.

The researcher respected the right of the participants to withdraw their consent to participate in the study at any point during the course of data collection. Participants were informed that there will be no direct benefits however, that learners might benefit from the study through food handler's improved understanding of food hygiene as a results of participation. Participants were informed that there will be no risk of job losses due to participation in the study. To assure both the schools and the participants' right to privacy, participants were informed that the surveys will not contain any personal information about them and the schools. The schools and participants were given anonymous alphabetical codes to ensure anonymity, for example, town schools could be given the code A, with the first school being named A1 and the second A2 until all schools were allocated a code. Participants were also assured that all data collected will be locked in filing cabinets and password-protected computer files. Furthermore, findings will be disseminated to the community and the DoE, hence the privacy and anonymity of the information was paramount.

CHAPTER 4:
RESULTS

CHAPTER 4:

4 RESULTS

4.1 Participant characteristics

The demographic characteristics of study participants are presented in Table 4-1.

Table 4-1: Demographic characteristics of study participants (n=18)

Variable	Frequency (n=18)			
Age (years)	20-30	31-40	41-50	>50
	33 %	33%	17%	17%
Marital status	single		married	
	50%		50%	
Education	informal	primary	secondary	
	33%	44%	22%	
Year of experience	less than 1	1-3	more than 3	
	50%	39%	11%	
Official training	trained		not trained	
	0		100%	

The entire inclusive study population was obtained. Thirty-three percent of the respondents were between 20-30 years and 31-40 years, and 17% were between the ages of 41 and over 50 years of age respectively. The level of education was generally spread across the variables with the majority having primary school education. None of the respondents received official hygiene and food safety training before commencing their duties by the DBE.

4.2 Food items served on the NSNP

Two types of schools from Peddie district and town were selected, five of these schools were from Peddie district and the other four were from Peddie town. All these schools used exclusive hot menu, consisting of cooked food (Table 4-2).

Table 4-2: Percentage of district and town school items served on weekly average

Food group	Products	Weekly average percent for district schools (n=5)	Weekly average percentage for town schools (n=4)
Starches	Maize meal Samp & beans Rice	40% 20% 40%	50% 0% 50%
Protein	Soya mince Pilchard in sauce Chicken	20% 40% 40%	0% 0% 100%
Vegetables	Carrots Cabbage Spinach Onions Potato	100% 100% 0% 60% 100%	100% 25% 75% 100% 75%
Fruit	Apples	0%	100%

Table 4-2 shows the average percentage of the total items served from both district and town schools on the study week to learners as part of the NSNP. It illustrates that the school's weekly menu was composed both of maize meal and rice as the main source of starch. Chicken also came as the main source of protein in all the town schools. Other sources of starch and protein such as samp and beans were seldom served in the schools and were not popular. All schools in Peddie town were serving an apple as their daily fruit during the time of the research whereas none of Peddie district schools were serving any type of fruit.

4.3 Availability of premises, storage facilities and equipment

The types of food premises used by the NSNP participating schools is shown in figure 4-1.

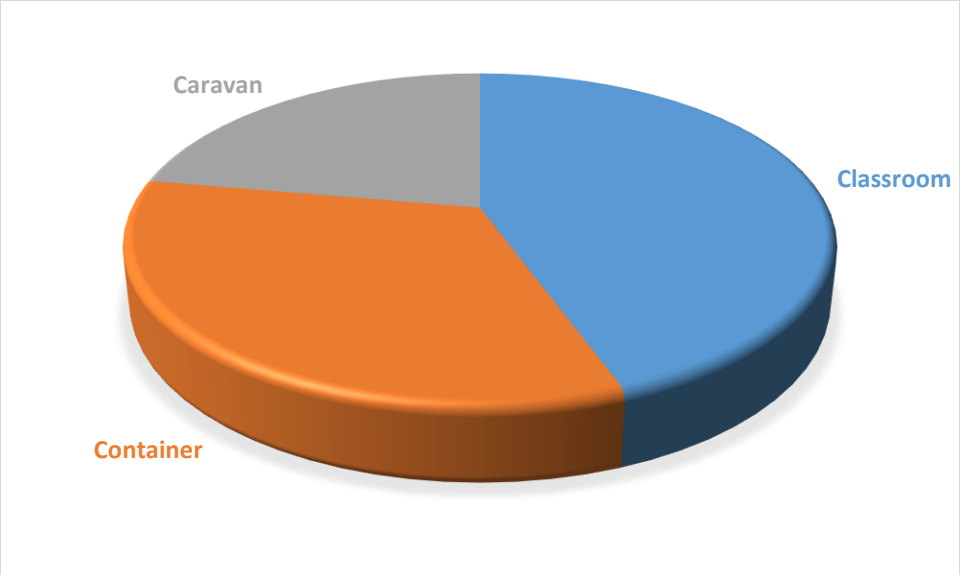

Figure 4-1: Areas where food was being stored within the school premises during the NSNP

None of the schools received food production facilities from the DBE when the NSNP was introduced. The schools stored and prepared food in various places with 45% storing and preparing their food in classrooms, (33%) in containers and (22%) in caravans. Appendix H1 shows both a classroom and an old caravan that were converted to a food preparation area.

Table 4-3 shows the comparison on the availability of storage facilities between district and town schools.

Table 4-3: Storage facilities between district and town schools

Facilities	District (n=5)	Town (n=4)
Separate storing space	0%	100%
Fridge	40%	100%
Freezer	0%	50%
Lockable cupboard	60%	50%
Food containers to store decanted food	60%	100%
Book storage used to store food	60%	0%

Town schools were the only schools that stored their food and chemicals separately. The majority (60%) of the district schools were using the book storage to store along with cleaning chemicals (Appendix H2) as storage and food preparation places. Only two schools from the Peddie district had fridges and none had freezers. All schools had cupboards, however, only half of the town schools had lockable cupboards as most were broken. Most schools had food containers for storage of decanted food.

The availability of food equipment which was guided by the NSNP equipment and utensils guideline (Appendix G) is indicated in Table 4-4.

Table 4-4: Availability of cooking utensils and equipment in schools

Preparation and serving equipment	Number of schools	Percentage
Total cutting boards in schools	9	100%
Colour coded cutting boards	0	0%
Knives	9	100%
Spoons	9	100%
Plates (plastic/enamel)	9	100%
Gas stoves	9	100%

During observation, all schools had either plastic or wooden cutting boards. There was no usage of colour coded cutting boards that was indicated on any of the schools. No standardized utensils were found in schools for preparation, portioning and serving of food. All schools were using the same knife for cutting of meat and vegetables. With regards to plates, all the nine schools had either plastic or metal plates however, some learners used their lunchboxes for serving. Table 4-4 indicates that gas stoves and gas cylinders were supplied to all schools by the DBE. Only five (56%) of these schools kept the gas cylinder in the same room as the gas stove while the other four schools (45%) kept the cylinder outside the room.

Table 4-5 summarises the number of hygiene and safety equipment that was available in both district and town schools.

Table 4-5: Availability of hygiene and safety equipment

Hygiene and safety equipment	Number available	Percentage
Water availability in kitchen		
Cold water	9	100%
Hot water	4	45%
Bucket system for washing dishes	9	100%
Cleaning material/equipment		
Broom	9	100%
Mop	9	100%
Bucket	9	100%
Liquid dish wash soap	9	100%
Sanitiser	4	45%
Personal hygiene and uniform items		
Protective clothing	9	100%
Protective shoes	6	67%
Apron	9	100%
Bandana	9	100%
Hand towel	9	100%
Dish towels	9	100%

Table 4-5 indicates that all nine schools had cold water, and out of the nine schools, only four schools (45%) had hot water. All schools made use of a plastic buckets system as there was no water supply in the food preparation areas with no separate basins for hand and dish washing. All schools had cleaning materials except for sanitiser as only four of the schools (45%) indicated to be using it in their kitchens. The DBE provided uniform items to all schools and all were available except for the protective shoes with only (67%) of respondents that were wearing them during the time of study.

Types of waste disposals used by the participating schools are shown in figure 4-2.

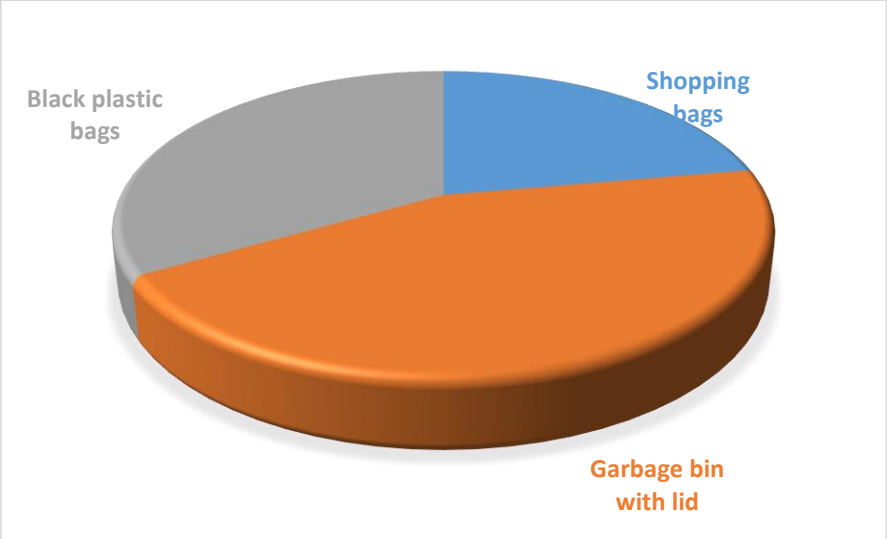

Figure 4-2: Type of waste disposal containers used by the participating schools in the NSNP

According to the DoE (2012a), all participating schools in the NSNP received bins with lids specifically to be utilized by the VFHs. However, schools had different types of waste disposal containers with the majority (45%) using garbage bins with lid, followed by 33% using black plastic bags and 22% shopping bags. All Peddie town schools had closed garbage bins with lids.

The difference in the availability of resources between district and town schools is presented in Table 4-6.

Table 4-6: Comparison of resource availability between district and town schools

Variables	District schools	Town schools	p-value
Availability of storage facilities	0 (0%)	4 (44%)	.003
Availability of fridge	0 (0%)	4 (44%)	.003
Lockable cupboards	1 (11%)	4 (44%)	.016
Availability of food containers	0 (0%)	4 (44%)	.003
Gas cylinder inside kitchen	1 (11%)	4 (44%)	.016
Availability of warm water	0 (0%)	4 (44%)	.003
Soap dispenser with soap	3 (33%)	2 (22%)	.764
Chemicals stored away from food	3 (33%)	3 (33%)	.635
Chemicals labelled	1 (11%)	2 (22%)	.343

A comparison was made on the availability of the variables mentioned in Table 4-6 between district and town schools. Data showed that there was an association on the adequacy of resources between the above mentioned variables between district and town schools. There was no statistically significant association in the availability of lockable cupboards, labelled chemicals, gas cylinders inside the kitchen, soap dispenser, labelled and stored away chemicals between district and town schools ($p \geq 0.05$). However, when the same statistical test was performed on the availability of food storage facilities, fridges and warm water and schools, it revealed that there was no significance ($p \leq 0.03$).

4.4 Food safety knowledge

The general knowledge of respondents towards food safety is provided in Table 4-7.

Table 4-7: Knowledge of volunteering food handlers and general food safety (n=18)

Variables	Frequency (%)				
	Strongly disagree	**Disagree**	**Not sure**	**Agree**	**Strongly agree**
Food handlers with unhygienic practice could be the source for food contamination with food poisoning pathogens.	0 (0%)	3 (17%)	2 (11%)	9 (50%)	4 (22%)
Frequent hand washing during food preparation is worth the extra time.	0 (0%)	0 (0%)	0 (0%)	8 (44%)	10 (56%)
Keeping kitchen surfaces clean reduces the risk of Illness.	0 (0%)	0 (0%)	0 (0%)	9 (50%)	9 (50%)
Wiping Cloths can spread microorganisms.	0 (0%)	0 (0%)	3 (17%)	8 (44%)	7 (39%)
Cooked foods should be kept very hot before serving.	0 (0%)	4 (22%)	3 (17%)	6 (33%)	5 (28%)
Eating covered leftover cooked food, kept at room temperature for more than 6 hours, is at high risk to cause food poisoning.	8 (44%)	8 (44%)	0 (0%)	2 (11%)	0 (0%)
Cooked food leftover should be re-heated thoroughly.	5 (28%)	5 (28%)	0 (0%)	4 (22%)	4 (22%)

Variables	Frequency (%)				
	Strongly disagree	Disagree	Not sure	Agree	Strongly agree
Vegetables should be placed on higher shelf in refrigerator than meat and poultry.	0 (0%)	0 (0%)	1 (6%)	12 (67%)	5 (28%)
Fruits and vegetables should be washed before eating/preparing.	0 (0%)	0 (0%)	0 (0%)	15 (83%)	3 (17%)
Keeping raw and cooked foods separate helps to prevent illness.	0 (0%)	6 (33%)	9 (50%)	3 (17%)	0 (0%)
Healthy food handlers might carry foodborne pathogens.	0 (0%)	10 (56%)	5 (28%)	3 (17%)	0 (0%)
It is important to throw away foods that have reached their expiry date.	0 (0%)	7 (39%)	3 (17%)	8 (44%)	0 (0%)

The majority (50%) of respondents believed that unhygienic practices may be the source for food contamination by food poisoning pathogens (Table 4-7), while (58%) disagreed with the notion that healthy food handlers can carry food-borne pathogens. All respondents recognised the significance of frequent hand washing and keeping kitchen surfaces clean. Table 4-1, shows that none of the respondents received official hygiene and food safety training. This was confirmed by the level of food safety knowledge that the respondents had as the majority (28%) did not believe in re-heating left over food thoroughly. Eighty-nine percent of the respondents reported that eating covered left over food six hours post cooking at room temperature could cause food poisoning. Fifty percent of respondents did not have knowledge on food poisoning, cross-contamination and they disagreed with throwing away expired food. Figure 4-3 indicates the knowledge levels between five district and fur town schools towards food preparation rules. The explanation of the food preparation rules is found in Appendix I.

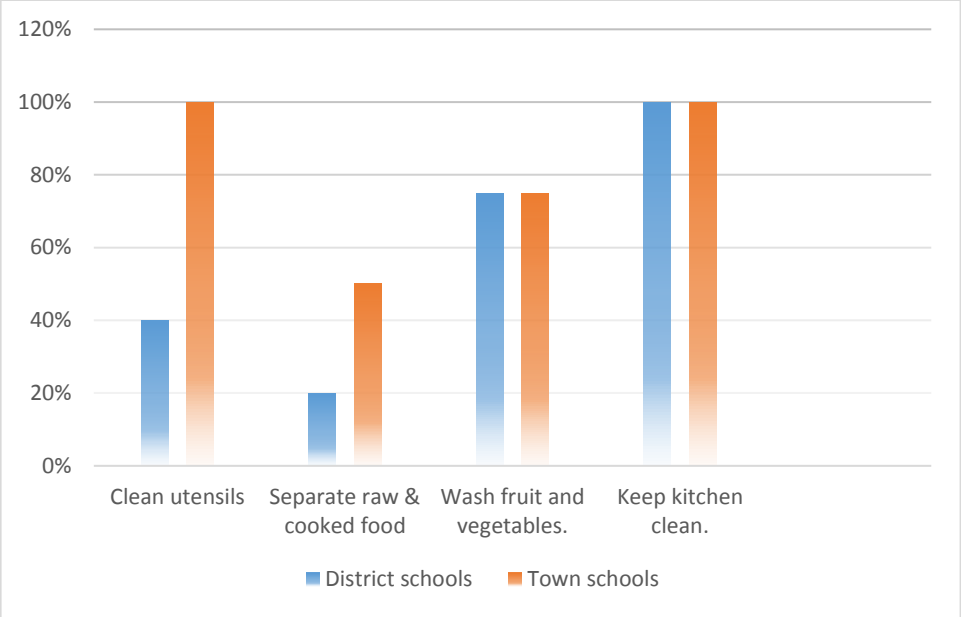

Figure 4-3: Comparison of knowledge of food preparation rules according to the guidelines between district and town schools

Figure 4-3 shows that only (56%) of food handlers were aware of the four food preparation rules, (44%) of food handlers were from schools found in the developing town of Peddie. The difference in awareness between these two types of schools was substantial. None of the respondents from district schools had knowledge of raw and cooked food needing to be separated when being stored. In addition, the respondents from district schools had no knowledge regarding washing of fruit and vegetables. All respondents from both district and town schools were aware that the kitchen must be kept clean at all times.

4.5 Food hygiene practices

The observed behaviour of respondents towards food hygiene is presented in Table 4-8.

Table 4-8: **Food hygiene practices of food handlers**

Variables	Frequency	
	Yes	No
Personal hygiene (n=18)		
Wore clean and protective clothing.	12 (67%)	6 (33%)
Wore safety shoes.	0 (0%)	18 (100%)
Fingernails are short, unpolished, and clean.	18 (100%)	0 (0%)
Hands washed properly and frequently.	0 (0%)	18 (100%)
Kitchen is kept clean.	14 (78%)	4 (22%)
Handwashing reminder sign is posted.	0 (0%)	18 (100%)
Food handling (n=9)		
Procedures in place to prevent cross-contamination	4 (45%)	5 (56%)
Food handled with suitable utensils	7 (78%)	2 (22%)
Both cooked food and raw food is covered	5 (56%)	4 (45%)
Fruit wiped before it is given to the students*	0 (0%)	4 (45%)

*only four schools served fruit

The majority (67%) of respondents wore protective clothing with no protective shoes, but had their personal closed shoes instead. The remaining (33%) wore their personal clothing with their closed shoes instead as they claimed that the DoE did not provide them with protective clothing. The three schools (33%) that had no protective clothing reported wearing overalls and bandanas as the hair band. Proper hand washing was not done frequently in all nine schools. All respondents had clean, short and unpolished nails during the period of the study when preparation food. There were no visible signs of hand washing (posters) on the wall. The respondents changed in the food preparation area as there were no cloakrooms provided for their personal garments and had no choice, but to hang them at the back of the door. The majority (56%) of schools left their raw and cooked food uncovered. Only four (45%) schools had procedures in place to prevent cross-contamination. None of the schools which gave fruit as a snack to the learners washed them before giving the participants.

4.6 Attitude of VFH participants towards food safety

The attitudes of VFHs towards food safety is provided in Table 4- 9.

Table 4-9: Volunteering food handlers' attitude towards food safety (n=18)

Variables	Frequency		
	Disagree	Not sure	Agree
Safe food handling is an important part of my job responsibilities.	0 (0%)	0 (0%)	18 (100%)
Learning more about food safety through training courses is important to me.	0 (0%)	0 (0%)	18 (100%)
Before handling food, rinsing your hand with cold water is enough to get rid of the bacteria on your hands.	0 (0%)	0 (0%)	18 (100%)
Frequent hand washing during food preparation is necessary.	0 (0%)	0 (0%)	18 (100%)
Raw vegetables and meat should not be cut on the same cutting board.	6 (33%)	9 (50%)	3 (17%)
Wiping off the cutting board with a clean paper towel between food items (raw meat and bread) will prevent spreading of foodborne pathogens.	10 (56%)	2 (11%)	6 (33%)
The freshness and appearance of food upon delivery is important.	0 (0%)	0 (0%)	18 (100%)
Storage practices have an impact on food safety.	0 (0%)	0 (0%)	18 (100%)

All respondents viewed safe food handling as an important part of their job responsibility. They recognised that training is needed in order for them to learn more about hygiene and food safety. Further, respondents believed that frequent hand washing was important, more specifically that using warm water to wash their hands would help destroy the bacteria. They had a positive knowledge and attitude around frequent hand washing, and this attitude coincided with the respondents' practices towards frequent hand washing in Table 4-8. Fifty percent of respondents believed that wiping off the cutting board with a clean paper towel between food items (raw meat and bread) will prevent spreading of foodborne pathogens. The need to prevent cross contamination by separating raw and cooked foods was an attitude that only (17%) of respondents possessed. The importance of freshness and appearance of food upon delivery was an attitude that all respondents had.

4.7 Volunteering food handler's personal hygiene behaviour

Hygiene practices of VFHs is shown in Table 4-10.

Table 4-10: Hygiene practices reported by volunteer food handlers (n=18)

Variable	Frequency	Occurrence %
How often do you wash your hands?		
Few time a day	2	11%
When they're dirty	4	22%
After using the toilet	5	28%
When handling food	7	39%
What do you use to wash your hands?		
Water and soap	10	56%
Water, soap and hand sanitizing liquid	8	44%
How do you dry your hands after washing them?		
With tissue paper	5	28%
With a dry cloth	4	22%
On whatever I am wearing	9	50%
What do you do when you have a cold/illness?		
Continue working as normal	18	100%
What do you do when you have wound (e.g. cut)?		
Wash it and continue working.	6	33%
Get it cleaned, covered and continue working.	6	33%
Wear gloves and continue working.	5	28%
Nothing, just continue working.	1	6%
Do you wear an apron while preparing food?		
Yes	18	100%
No	0	0%
How often do you wash it?		
Weekly	15	83%
Only when it is dirty	3	17%
Do you properly wash, rinse and sanitize food equipment utensils, and food contact surfaces?		
Yes	18	100%
No	0	0%
How often do you clean and sanitize them?		
After use	18	100%
Do you use separate utensils and cutting boards when handling raw and cooked food?		
Yes	0	0%
No	18	100%

The majority (39%) of the respondents reported to have no prior knowledge of the importance of frequent hand washing and drying with half (50%) of the respondents reporting to dry their hands on whatever they are wearing. Additionally, more than half of respondents (56%) used water and soap to wash their hands and the other (45%) declared to utilise hand sanitizer instead. All respondents indicated that they continued to report for work as normal even when they suffered from cold/other illnesses. In addition, 33% of respondents reported to just wash a cut/wound and continue working, and the same number of respondents claimed that they would just clean, wash and cover their wound before they continue working. All respondents reported to only sanitise the food equipment utensils and food contact surfaces after use and they attested that they did not separate utensils and cutting boards when handling raw and cooked food.

4.8 Microbiological count on food surfaces

The microbiological count was compared to the British Columbia Centre for Disease Control (BCCDC) guide, as shown in Table 4-11 and reported as total viable count (TVC) of microbes.

Table 4-11: Counts of various organisms from food contact surfaces of schools participating in the NSNP in Peddie

Town Schools	Clean surface	Bacterial counts (CFU.cm^{-2})				
		TVC	***E.coli***	***S. aureus***	***Yeast & Mould***	***Total coliforms***
B	Hands Cutting board Apron	TNTC TNTC TNTC	ND 5.62 0.88	4.00 1.00 0.70	0.50 1.00 TNTC	0.40 ND 1.44
C	Hands Tray Apron	TNTC TNTC TNTC	0.50 1.25 0.60	0.40 0.60 ND	TNTC TNTC TNTC	1.00 1.17 1.44
H	Hands Sink Apron	0.83 TNTC TNTC	ND 1.00 1.00	1.00 5.20 3.57	0.50 ND 1.80	ND 2.75 1.10
I	Hands Table Apron	0.17 TNTC 1.00	ND 1.00 ND	ND 1.13 0.86	ND TNTC 0.88	ND 6.13 ND

District Schools	Clean surface	Bacterial counts (CFU.cm^{-2})				
		TVC	***E.coli***	***S. aureus***	***Yeast & Mould***	***Total coliforms***
A	Hands	TNTC	0.50	0.50	1.33	2.50
	Table	TNTC	4.13	1.47	3.31	9.88
	Apron	12.50	1.00	1.57	2.73	3.17
D	Hands	TNTC	0.50	3.67	7.00	1.00
	Sink	TNTC	7.00	12.19	TNTC	TNTC
	Apron	TNTC	ND	2.60	TNTC	9.19
E	Hands	TNTC	2.58	4.80	2.25	7.93
	Tray	TNTC	4.56	5.88	3.94	4.75
	Apron	TNTC	0.29	2.38	TNTC	1.42
F	Hands	TNTC	2.59	1.25	2.33	4.00
	Table	TNTC	7.69	4.31	TNTC	13.75
	Apron	TNTC	ND	1.33	0.78	2.00
G	Hands	TNTC	1.00	2.20	3.71	1.50
	Cutting board	TNTC	TNTC	TNTC	TNTC	TNTC
	Apron	4.06	1.40	2.77	TNTC	1.70

TNTC: Too numerous to count (>100 colonies); ND: Not detectable using the current method.

All schools had both hands and aprons tested for microbes along with food preparation surfaces. The vast majority (81%) of all surfaces sampled had counts that were too numerous to count (TNTC). For *E.coli*, 67% of the counts obtained from both hands and aprons were satisfactory, and the remaining counts were not detectable. Fifty six percent (56%) of the counts for the preparation surfaces were unsatisfactory. *S. aureus* counts for hands were (67%) satisfactory, while 89% of the counts on aprons were satisfactory and 56% counts of preparation surfaces were unsatisfactory. For hands, 67% counts of yeast and mould were satisfactory whereas (56%) of the counts obtained from aprons were satisfactory but food preparation surfaces were TNTC. For total coliforms, 56% of the count for hands were satisfactory, while (78%) of the count for both aprons and preparation surfaces were satisfactory. Of the three surfaces analysed, preparation surfaces had the highest counts of all the micro-organisms that were tested. School B, C, H and I were from the Peddie town and the rest of the remaining schools were from Peddie district. There was a significant difference between the two types of schools where all schools from Peddie town had satisfactory counts on all micro-organisms as oppose to the schools from Peddie

district. Two schools from Peddie town had unsatisfactory results on preparation surfaces with one school having a high count on both yeast and mould and total coliforms.

CHAPTER 5:

DISCUSSION

CONCLUSION

LIMITATIONS

RECOMMENDATIONS

CHAPTER 5:
5 DISCUSSION

5.1 Introduction

This chapter discusses the key results of this study in relation to the objectives. The findings are discussed and compared to published literature. Furthermore, these findings provide information on factors that contribute to safety of food served by the NSNP to the primary schools in Peddie. The study describes the type of food served by the VFHs. It specifically focused on the availability of facilities, food preparation equipment and assessed the level of the microbiological contamination on the food surfaces in Peddie schools.

Previous studies have reported details of the survey that was performed in South African schools in 1994 (UNICEF, 2009). Specifically, the survey showed micro-nutrient malnutrition as a public health concern in rural areas and the need to improve nutrition situation in schools (Stats SA, 2015). Currently, malnutrition is a major problem for many South African learners with larger provincial differences (DoE, 2014 and Stats SA, 2015). The coloured schools had a high rate of malnutrition with wasted and underweight students followed by the black students and a staggering lower rate in white students. Health and nutrition in schools has proven to be important hence the strong connection between nutrition and learning (Frisvold, 2012). The South African government implemented the NSNP to help improve nutrition in schools hoping it might influence an increase in school attendance and learning results. Since many of the school children have food security problems at home, the NSNP fills an important task by offering safe food (DoE, 2008).

Of all participating respondents, the majority were females between the ages of 20-40 years, of these women 44% had at least attended primary school education and 50% had a years' experience working on the NSNP. None of the VFHs attended food safety and hygiene training before commencing the duties. The fact that 33% of respondents had no formal education and did not attend any food safety training was hazardous to the NSNP and health of the learners. Snelling and Yezek (2012) assert that illiterate VFHs find it more

difficult to acquire adequate knowledge and the skills required to handle microbiological food safety hazards and personal hygiene. A study by Husain, Muda, Jamil, Hanafi and Rahman (2016) indicated that only 5% of VFHs had been exposed to formal training during the time of their study. In another study, the number of trained VFHs was a bit higher at 15% (Husain *et al*., 2016; Webb & Morancie, 2015). Lack of VFHs training on food safety issues does not reflect the training requirements of the DBE that all food handlers are expected to attend health and hygienic standards training workshops (DBE, 2009). Caillet *et al*. (2009) assert that, staff must be trained in good personal hygiene, use of correct hand washing techniques and follow the correct procedures in preparing, cooking, serving and cleaning procedures in the kitchen to prevent the spread of bacteria and infection.

5.2 Description of the menu served on the NSNP

According to the FDA (2014), a food menu is a prerequisite document required in the planning phase for any food safety management programme, as it provides guidance on the types of foodstuffs, storage along with food equipment needed for preparation of food. When the Primary School Nutrition Programme (PSNP) was introduced in 1994, it was only serving fortified biscuits in the Eastern Cape and later on served brown bread sandwiches with either peanut butter or jam (DBE, 2009). Ever since it became the NSNP, it added more items to the menu with the inclusion of hot food stuffs that are rich in starch and protein as well as vegetables and fruits.

The Eastern Cape schools only served hot menus as indicated in Appendices F and H. On average, maize (56%) was used as the main source for starch, chicken (64%) as the source for protein, vegetables (25%) were also served in addition to apples (100%) in some schools. In regards to chicken, studies have shown that improperly stored or raw chickens are likely to be contaminated with campylobacter bacteria, salmonella or clostridium perfringens bacteria. Therefore, raw chicken juices can cause FBDs due to cross contamination. This year alone, in the United States, the Centre for Disease Control and Prevention (CDC) investigated ten separate salmonella outbreaks on human beings linked to live poultry from several hatcheries (CDC, 2017).

The DBE (2009), suggested that all schools that fall under the NSNP should have fruit and vegetable gardens to supplement their food requirements. In fact, South African government supply schools as well as poverty stricken communities with seeds and gardening equipment to allow them to have sustainable gardening projects. Of the schools which participated in this study, five of them had gardens during the study. Those with gardens had vegetables such as spinach, carrot, cabbage and onion which was harvested from their own produce. These findings contradict the study conducted by Santana *et al*. (2009) which shows the majority (76%) of schools that participated in the NSNP had food gardens with a variety of vegetables. Nonetheless, Van Cauwenberghe, Maes and Spittaels (2010) expresses the opinion that, school gardening is one of the most effective interventions in promoting a healthy diet in primary school children.

5.3 Availability of premises, storage facilities and equipment

The South African Standards and Requirements for Food Premises (SASRFP) policy is a standard regulation governing general food hygiene, premises and transport (DoH, 2002). The policy requires that, all schools participating in the NSNP must have a designated food preparation area with proper storage facilities and adequate food equipment (DoH, 2013).

5.3.1 Premises for the NSNP

None of the NSNP participating schools had designated spaces for food preparation areas as required by the SASRFP policy. This meant that schools had to find or create designated areas for cooking, preparation and serving of meals with adequate ventilation. This was a concern especially in the Eastern Cape as they were facing a space shortage problem. All schools that were visited during the time of study had food preparation areas for their daily meals, with the majority (45%) of the schools converted their classrooms, followed by 33% that converted old containers and 22% converted old caravans to food preparation areas. Appendix H1 shows the conditions of these food preparation areas converted by the schools. The standard of the converted spaces were not adequate. The caravans or containers were not spacious enough for safe and proper food handling and food storage purposes (Appendix H3). There was insufficient ventilation along with inadequate openings on the containers. This is critical as it has a potential to encourage mould

formation and pest activities. Fredericks and Henriksen (2012) reported that Dawn foods products had to recall large amounts of food because of excessive amounts of salmonella found in the food preparation area caused by mould, rodents and cockroaches.

During the course of this study, the district schools were serving their meals outside while the town schools had a designated eating area consisting of an open space with desks. The VFHs advised that, when it rains the learners have their meals in the classrooms. Consumption of food in open spaces made the learners vulnerable to micro-organisms entering their food especially when the wind was blowing. The Ghana school feeding programme (2011) stated that, wind and dust can carry the *S. aureus* bacteria found in faeces to the food. Therefore, consuming food especially in a dusty area can lead to FBDs from contaminated air.

A circular that was issued by the DoE in 2009 stated that the government was intending to build kitchen facilities for all schools that were participating in the NSNP (DoE, 2009). None of the schools in Eastern Cape, especially in Peddie, had their food preparation facilities built by the government during the time of study. Polity (2007) and Woldow (2008) reported that the South African feeding programmes are experiencing a major problem of being unable to guarantee that food will be served to school learners at the guaranteed time due to lack of infrastructure, monitoring and evaluation. It is evident that there is an urgent need for proper infrastructure such as food preparation areas to best manage safe food handling.

5.3.2 Availability of storage facilities

Only 45% of the schools had chemical storerooms that were separate from the kitchen and these schools were from the town areas with classrooms as their kitchens. Most of the district schools had no separate areas for chemicals and some stored their chemicals in the book storage rooms, which was better than schools that stored chemicals in the same place where they stored their food. WHO (2015) assert that, chemical contamination of food may lead to acute poisoning or long-term diseases, such as cancer.

A study by Khin (2015), confirms that chemicals that cause most health concerns are naturally occurring toxins and environmental pollutants. The DoH (2013) recommended that schools must store foods in areas that are easy to clean in order to control hygiene and have adequate ventilation. Further, the DoH continued to state that, food must not be placed on the floor, but on elevated palettes or unused desks to avoid food contamination. During observation some schools stored their food directly on the floor next to the cleaning chemicals (Appendix H3). This is a food safety concern, as it has the potential to contaminate food, which can lead to FBDs. Poor food storage could also compromise the quality of food. WHO suggest that there must be visible guidelines for storage spaces that specify separate storage areas for food items and non-food items such as equipment for food preparation (WHO, 2015).

5.3.3 Availability of food equipment

In order for the NSNP to be effective, it requires necessary infrastructure and equipment at schools (DoH, 2013). According to the study findings, all schools had basic food preparation equipment such as stoves, gas cylinders, knives, plates and cleaning equipment which included brooms, mops and buckets for cleaning of floors. However, some of the equipment were not adequate to enable the expected quality service delivery of the NSNP as per the Equipment and Utensils Guidelines for the NSNP (Appendix G) (DoE, 2011). For instance, some of the district schools had no cold room storage areas or deep freezers. This posed a high risk on food safety as perishable foods gets spoiled easily. At the same time, chicken was found to be the most used source of protein in all schools. This poses a food safety concern for the schools that do not have refrigerators, since salmonella is mostly passed through poultry products.

All studied schools had cutting boards, however, none of them were colour coded and all were plastic. Cutting boards are said to be the carriers of micro-organisms when not properly cleaned and have the potential to contaminate other foodstuff (van Asselt, de Jong, de Jonge, & Nauta, 2008). A study by Ravishankar, Zhu & Jaroni (2010) shows the percentage in which Salmonella was transferred from poultry to lettuce by knives and cutting boards. Van Asselt, de Jong, de Jonge and Nauta (2008) demonstrated how plastic

cutting boards contaminated food with bacteria more than wooden cutting boards. This was a concern, as the NSNP currently uses plastic cutting boards instead of wooden cutting boards, which means that there is a high chance of food contamination through cross contamination.

The majority of schools reported that they served food on plastic plates. This posed a risk as plastic plates are easily scratched or may have small cracks making it difficult to clean properly, raising the possibility of cross contamination (Miles, Gerba, Pepper and Reynolds, 2009). This is confirmed by a study conducted by de Jong *et al*. (2008) in which microbes were found in between spaces of cracked plastic plates. Another physical observation indicated that, none of the schools had washing basins, soap or sanitizer dispensers. This was in conflict with the SASRFP policy which states that every food preparation area should have a wash-up area with running hot and cold water (DoH, 2013). Ibeneme *et al*. (2017) reports that poor infrastructure such as unavailability of washing basins and soap dispensers can act as a barrier to proper implementation of hand hygiene practices and behavioral orientation. In terms of waste disposal, the DoE (2012b) reported that all participating schools in the NSNP received bins with lids specifically to be utilized by the VFHs. However, the schools had different types of waste disposal containers with the majority using garbage bins with lid, followed by 33% using black plastic bags and lastly 22% using shopping bags. The town schools used closed garbage bins with lids. During the course of study some bins were not properly closed with exposed waste in the plastic bags (Appendix H4). According to the Food Safety and Standards Authority of India (FSSAI, 2014), waste should not come in contact with food, either directly or indirectly, through flies, insects or serious contaminants such as sewages. Cross contamination from flies and insects that have come in contact with waste and sewages is one way that food can get contaminated by microbes.

There was a statistically significance between district and town schools when comparing the adequacy of food equipment, with town schools having more equipment than district schools. However, there seemed to be no statistical difference ($p \geq 0.05$) in the availability of lockable cupboards, labelled chemicals and soap dispensers, labelled and stored away

chemicals between district and town schools. Nonetheless, there was no statistical significance ($p \leq 0.03$) between the availability of storage facilities, fridges, freezers, warm water and lockable cupboards and both school types.

5.4 Food safety knowledge, attitude and practices

5.4.1 Food safety knowledge

All VFHs recognised the need for frequent hand washing during food preparation. Furthermore, all VFHs were aware that both fruit and vegetables needed to be washed before eating. A study conducted by Abdalla, Suliman and Bakhiet (2009) on street food venders revealed that 38% of street food vendors washed their hands before and after food handling, 92% indicated that they washed their hands after using the toilet, while 78% indicated that hands should be washed with soap and water. Findings from another study conducted by Machado, Monego and Campos (2014), concurred with findings from the current study where more than 80% of food handlers had high satisfactory knowledge on washing fruit and vegetables before consumption. The majority of the VFHs had poor knowledge regarding safe handling of left-over food, which may have resulted in food poisoning if kept at room temperature for more than six hours. Eighty-eight percent of VFH volunteers were unaware of the consequences of storing food at room temperature for extensive periods of time. From a food safety perspective, this is concerning as food poisoning reports increases everyday especially in the NSNP (Herald Live, 2016). Contaminated NSNP meals served to learners may easily result in illnesses given the weakened immune systems of some learners in the program (Abdalla *et al*., 2009).

The NSNP food preparation rules (DoH, 2013) are documented as a standard way of producing and maintaining safe food produced by the NSNP. The DoH assert that full adoption of these food preparation rules and their associated behaviours ensures protection against food health hazards (DoH, 2013). The VFHs from town schools seemed to have good knowledge of these principles as opposed to the district schools with poor knowledge. For example, regarding principle 1 (clean utensils) and 4 (keep kitchen clean) town schools showed excellent (100%) knowledge, whereas district schools only showed excellent

knowledge on principle 4 and very poor knowledge on principle 3 (separate raw and cooked food). Adesokan, Akinseye and Adesokan (2015) assert that, adequate hygiene and food safety training for food handlers and transfer of such training to behaviour may assist in limiting improper practices and potentially reduce the negative impact on health and the economy. Continuous training on food safety might translate to positive change in attitude and behaviour (Lee & Greiga, 2010), which may then lead to improved food handling practices (Adesokan *et al*., 2015).

5.4.2 Attitude of participants towards food safety

Lee and Greiga (2010) assert that employees with good attitude are more likely to produce correct actions. In this study, all respondents showed excellent attitude towards food safety. There was a satisfactory knowledge and attitude on safe food handling by all respondents, specifically, all respondents recognized training as being needed for good food safety practices. Latif, Elkarmalawy and Esmail (2013) suggest that, unsatisfactory knowledge may lead to poor attitude and behaviour towards food safety. However, all respondents had good attitude around frequent hand washing and believed that washing hands with cold water alone was not going to destroy bacteria on their hands. A study that was conducted by Ibeneme *et al*. (2017) corroborates with findings from the present study where the most prevalent microbe was *S. aureus* when employees' hands were tested after hand washing. The majority of the respondents believed that cleaning the cutting board with a paper towel between food items such as raw meat and bread will prevent dispersion of foodborne pathogens. This is concerning as cutting boards can act as the medium for cross contamination of microbes (van Asselt *et al*., 2008). An excellent attitude can translate to improved food handling practices such as personal hygiene behaviours (Lee & Greiga, 2010).

5.4.3 Personal hygiene behaviours

Personal hygiene is the most effective control measure for prevention of pathogen transmission to food service establishments (Latif *et al*., 2013). As a result of poor personal hygiene and cross-contamination, the hands of VFHs may be potential transmitters of food-borne diseases (Lee & Greiga, 2010). For example, the spread of bacteria by VFHs who do

not wash their hands properly after visiting the toilet might cause food-borne illnesses (Latif *et al.*, 2013). The results of this study shows that, only 39% of the respondents reported to wash their hands several times when handling food. This is not surprising as there were no facilities in place to help facilitate a smooth process of hand washing. Infrequent hand washing practice for food handling is one of the main contributing factors to cross-contamination, putting learners at risk of FBDs. This finding differs from a study by Tan, Cheng, Soon, Ghazali and Mahyudin (2013), which reported hand-washing as the most familiar practice performed by the respondents. Another study, Sharif, Obaidat and Al-Dalalah (2013) identified hands, fingernails, nose, mouth and throat as habitats of *S.aureus*, *Salmonella* and *Shigella*, which can be harmful to health directly or indirectly. These bacteria may be removed and destroyed by following proper hand-washing procedures. A study by Lee and Greiga (2010) reported a reduction in bacterial count when food handlers practiced effective hand-washing techniques and received food safety training. Most respondents expressed that they dried their hands on whatever they were wearing. The consequence of this practice could be catastrophic as drying hands on clothing that might be contaminated with micro-organisms might result in cross contamination (Taulo *et al*., 2009).

All VFHs expressed that they continued working even when they had cold/illness. Guidelines stipulate that food handlers should refrain from handling food when suffering from communicable diseases to avoid transmission of micro-organisms to food (WHO, 2015). A study by Pepple (2017), indicate that only 52% of individuals in the study cohort exempted themselves from work when sick, with 42% of the respondents reporting to use hand sanitizer frequently. All respondents indicated that they properly wash, rinse and sanitize food equipment utensils, and food contact surfaces after they have been used. The main reason for the lack of adequate food safety knowledge by the VFHs could be the lack of prior training on food safety and hygiene before commencing employment (Quinlan, 2013). Therefore, VFHs should be trained in the proper food safety and hygiene procedures to eliminate the possibility of transmitting FBDs (Quinlan, 2013).

5.5 Microbiological analysis of food surfaces

Microbial contamination is one of the leading threats to an individual's health with a proven association between FBD and poor food safety. Microbiological analyses was conducted to determine the TVC, the presence and prevalence of *S. aureus, E.coli* and *Yeast and Mould* on six previously cleaned surfaces that came into contact with foodstuffs, namely, tables, sinks, trays, cutting boards, aprons and hands of VHFs. The purpose of the TVC was to indicate the level of contamination in samples, in that way, it provided a general indication of hygiene status of the sample. Specifically, the TVC on 81% of the tested samples were too numerous to count (TNC) and this may have been influenced by inadequate cleaning and sanitation of food contact surface areas (Miles *et al*., 2009). This is a concern as Lues and van Tonder (2007) suggest that, the presence of coliforms in food is an indication of the existence of pathogens which raises concerns on the effectiveness of the existing ways of cleaning especially in the NSNP.

5.5.1 Escherichia coli count on food contact surfaces

Findings showed that *E. coli* count obtained from food handlers hands ranged between 0.50 and 2.59 CFU.cm^{-2} and deemed to be satisfactory, while food preparation surfaces had 1.00 and 7.69 CFU.cm^{-2} and deemed to be unsatisfactory. Consumption of *E.coli* contaminated foods can cause severe food-borne diseases such as haemorrhagic colitis and haemolytic uremic syndrome (Chien, Sheen, Sommer, & Sheen, 2017). In contrast to findings reported in this study Taulo *et al*. (2009), reported unsatisfactory bacterial count from the hands that ranged between 0.6-4.3 CFU.cm^{-2}. However, Taulo *et al*. (2009) reported satisfactory bacterial count from food preparation surfaces which ranged between 0.9 and 3.2 CFU.cm^{-2}. Miles *et al*. (2009). suggest that, presence of *E. coli* on food or surfaces is an indication of feacal contamination and also an indication that other harmful organisms such as *Salmonella, Shigella, Campylobacter* could be present (Meyer, Morin, Rödger, Holah & Bird, 2010). In another study, Samadi, Abadian, Bakhtiari, Fazeli, and Jamalifar (2009) imply that the use of contaminated water may attribute to contamination of food preparation surfaces.

5.5.2 Staphylococcus aureus count on food contact surfaces

According to Lambrechts *et al*. (2014), humans are the natural carriers of *S. aureus* and this type of bacteria can be found in healthy humans. For the current study, *S. aureus* count for both hands and aprons were satisfactory and unsatisfactory only for food preparation surfaces. Consumption of food contaminated with *S. aureus* such as meat and dairy products can cause gastroenteritis (Lues & van Tonder, 2007), especially to school children with an already compromised immune system. These findings conflicted with a study conducted by Chan and Wiedman (2009), who found that *S. aureus* counts ranging between 2 cfu.cm^{-2} and 7 cfu.cm^{-2} and mostly found on hands of a food handlers. Abban, Jakobsen and Jespersen (2012) assert that *S. aureus* was involved in an outbreak of food poisoning in that study due to food handlers carrying entero-toxigenic staphylococci on their skin and nails contaminating food.

5.5.3 Yeast and mould count on food contact surfaces

All schools had at least one of the three clean surfaces with yeast and mould count that were TNTC. However, for overall hand counts, 67% of yeast and mould were satisfactory whereas 56% of the counts obtained from aprons were acceptable and for food preparation surfaces were TNTC. Auspiciously, yeast and mould does not cause FBDs, however, it can cause spoilage of food which may lead to illnesses in some people, especially those with a compromised immune system (Meyer *et al*., 2010). A study by Nhlapo *et al*. (2015) had the similar yeast and mould microbial count for hands, with satisfactory (60%), acceptable (20%), unsatisfactory (10%) and not detectable (10%). Samadi *et al*. (2009) assert that the main sources of yeast and mould contamination is the environment, predominantly the air. Moreover, food preparation areas of some of the participating schools were exposed to dust due to lack of proper food preparation facilities and ventilation hence they were prone to microbial contamination.

5.5.4 Differences in school type on microbial counts between district and town schools

There was a significant difference is microbial load between district and town schools. All but one school in Peddie town had satisfactory counts on all micro-organisms, the one school had a table that had high counts (6.13cfu.cm^{-2}) of total coliforms. The inadequacy

of proper infrastructure, food preparation equipment and service facilities may have contributed to the high microbial counts in district schools. The water facilities in district schools were located outside the food preparation areas which enacted VFHs' lack of hand washing. Ineffective cleaning and sanitizing of food contact surfaces from district schools as reflected on their lack of food hygiene practices of VFHs could have contributed to microbial cross-contamination. Therefore, effective cleaning and sanitizing of food contact surfaces before, during, and after food preparation may minimise the likelihood of microbial cross contamination (Chan & Wiedman, 2009). In addition to adequate cleaning, effective and efficient implementation of HACCP and Good Manufacturing Practices (GMP) could be adequate for schools taking part in the NSNP, especially schools with poor resources such as those in Peddie district. HACCP focuses on safety and hygiene practices with an aim to reduce the incidence of microbial contamination throughout the organization (Sibanyoni & Tabit, 2016).

5.6 Conclusion

All participating respondents were females with the majority of them between the ages of 20-40 years. None of the VFHs attended food safety and hygiene training before commencing their duties. The fact that most of the respondents had primary schooling and did not attend any food safety training was hazardous to the NSNP and health of the learners. However, the study has indicated that VFHs had sufficient information with regards to food preparation rules on food safety and hygiene. The lack of knowledge about separating raw and cooked food on both district and town schools requires further investigation. Moreover, food safety education and training are important as knowledge and skills acquired through training changes the perceptions and attitudes of VFHs towards practicing proper food safety and hygiene techniques (Webb and Morancie, 2015). The VFHs showed an excellent attitude towards food safety procedures. In general, the study suggest that the VFHs were aware of the basic importance of food safety practices such as hand washing even though they might not have been able to adhere to these practices due to infrastructural challenges. Observations indicated inadequate infrastructure and resources in NSNP participating schools, which increased the difficulty for VFHs in adhering to food safety procedures. Laboratory analyses of microbes revealed significant

contamination by micro-organisms on different food contact surfaces. Lack of proper hygiene was confirmed by the presence of *S. aureus, E.coli*, yeast and mould on food contact surfaces. These findings confirm the presence of micro-organism contamination on food contact surfaces of the NSNP and suggest that these food contact surfaces may be the sources of cross-contamination to food. To prevent cross contamination and significantly reduce microbial contamination, all food equipment and contact surfaces must be thoroughly washed with hot water, anti-bacterial detergent before and after being used to prepare raw or cooked foods.

5.7 Limitations

- The major limitation to this study was the small sample size. The subject matter on the safety of food served by the NSNP is broad, and the sample size was too small to postulate results from this study as conclusive evidence for all primary schools benefiting from the programme.

- The study made use of a quantitative approach in order to describe the KAP of VFHs as mentioned in the methods. Knowledge and attitudes can be better described and explored by utilizing an exploratory qualitative approach.

- Both self-reported and observation behaviour have their limitations. Observation causes people to alter their behaviour and self-reporting is regarded as subjective. The researcher might not get the true reflection of the VFHs' practices. In addition, food sample microbial analyses for pathogenic contamination could have substantiated the observed and self-reported behaviors of VFHs.

- The last objective was to assess the presence of microbiological contamination on prepared served food and foodstuff in NSNP. The analyses of food served in the NSNP may not have provided tangible results due to limited funding from the Sector of Education Training and Authority (SETA), which had initially promised to fund the study before it was conducted. However, the food samples were replaced

by the food contact surfaces instead. Therefore, removal of the food samples served in the NSNP in objective 5 did not affect the quality of data because it did not speak to the aim, but was supplementing the data.

5.8 Recommendations

From the results of this study, the following is recommended:

- Eastern Cape primary schools participating in the NSNP are recommended to use standard menus provided by the DBE. The standard menus should follow the South African Food based dietary guidelines (FBDGs) with more emphasis on dairy.

- In order for the NSNP to be effective, the DBE must provide food preparation areas, proper food preparation equipment and enough food and cleaning chemical storages to all schools participating in the programme.

- To implement a basic food safety and hygiene program in all primary schools participating in the NSNP, all VFHs are to be trained prior to and during the course of the programme and be compelled to keep to the food preparation guidelines. Pre-requisite standard operation procedures should be established by the government in all schools participating in the NSNP in relation to food safety. Once all VFHs have been trained, investigation on the influence of training on their knowledge, attitude and behaviour and assessment of its effectiveness can also be done as follow ups.

- A similar study can be carried out in other provinces, hospitals, prisons and hotels with more emphasis on training, comparing findings and highlighting the need to incorporate food safety programmes on training. Further research can also be conducted in determining the microbial load in food samples and also to either support and refute findings of this study.

- The VFHs should be trained on how to adequately use cleaning chemicals and sanitizing materials to clean and sanitize food contact surfaces to effectively remove incidence of micro-organisms in contaminating food.

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APPENDICES

APPENDIX A: ETHICAL CLEARANCE LETTER

APPENDIX B: EASTERN CAPE EDUCATION PERMISSION GRANTING LETTER

APPENDIX C: INFORMATION SHEET

APPENDIX D: CONSENT FORMS

APPENDIX E: STUDY QUESTIONNAIRES

APPENDIX F: EASTERN CAPE PRIMARY SCHOOL MENU

APPENDIX G: EQUIPMENT AND UTENSILS GUIDELINES FOR THE NATIONAL SCHOOL NUTRITION PROGRAMME

APPENDIX H: EVIDENCE PHOTOGRAPHS

APPENDIX I: FOOD PREPARATION RULES

APPENDIX A: ETHICAL CLEARANCE LETTER

UNIVERSITY *of the*
WESTERN CAPE

DEPARTMENT OF RESEARCH DEVELOPMENT

18 January 2016

To Whom It May Concern

I hereby certify that the Senate Research Committee of the University of the Western Cape approved the methodology and ethics of the following research project by:
Ms Z Dlova (School of Public Health)

Research Project:	An investigation on food safety of the National School Nutrition Programme in Peddie, Eastern Cape, South Africa.
Registration no:	15/7/255

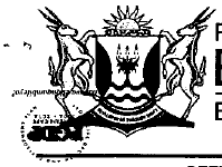
Any amendments, extension or other modifications to the protocol must be submitted to the Ethics Committee for approval.

The Committee must be informed of any serious adverse event and/or termination of the study.

Ms Patricia Josias
Research Ethics Committee Officer
University of the Western Cape

Private Bag X17, Bellville 7535, South Africa
T: +27 21 959 2988/2948 . F: +27 21 959 3170
E: pjosias@uwc.ac.za
www.uwc.ac.za

APPENDIX B: EASTERN CAPE EDUCATION PERMISSION GRANTING LETTER



Province of the
EASTERN CAPE
EDUCATION

OFFICE OF THE DISTRICT DIRECTOR
45 Eales Street, King William's Town, 5600, Private Bag X74445, KWT, 5600
REPUBLIC OF SOUTH AFRICA, Website: www.ecdoe.gov.za

Tel: 043 6050 106

Email: lelethu.magele@edu.ecprov.gov.za

Ms Z. Dlova

TO WHOM IT MAY CONCERN

Dear Sir/ Madam

1. This is to confirm that **Ms Z. Dlova** is hereby certify that the Senate Research Committee with the **University of the University of the Western Cape** in the **School of Public Health**. The topic for her research is **AN INVESTIGATION ON FOOD SAFETY OF THE NATIONAL SCHOOL NUTRITION PROGRAMME** in **Peddie schools.**
2. Kindly assist and co-operate with him in ensuring that this research is done and completed.
3. Thanking you in advance for your co-operation.

Yours faithfully

E. KATSHAZA
(A)DISTRICT DIRECTOR

building blocks for growth

Ikamva eliqaqambileyo!

APPENDIX C: INFORMATION SHEET

Project Title: An investigation on food safety of the National School Nutrition Programme in Peddie, Eastern Cape, South Africa

What is this study about?

This is a research project being conducted by Zoe Nomakhushe Dlova as part of the requirement for a Master's degree in Public Health from the School of Public Health (SOPH) at the University of the Western Cape. We are inviting you to participate in this research project because you are more involved with the handling of the food with the hope of gaining a better understanding of food safety of the NSNP from your answers. The purpose of this research project is to determine the factors that contribute to food safety of the NSNP in Peddie, Eastern Cape. Information will be gathered by making use of interviews and observation in schools that have been chosen for the purpose of the study.

What will I be asked to do if I agree to participate?

1. You will be asked to participate in an interview.
2. The interview will led by a facilitator at your workplace (school)
3. There are no right or wrong answers.
4. You will also be requested to complete a questionnaire.
5. The duration of the interview should be between 30 – 45min.
6. Food samples will be collected from the pots after cooking on the day of the study.
7. Swabs will be taken from all cleaned food surfaces including your hands.
8. The interviewer will also observe the premises and equipment including your practices around food safety.

Would my participation in this study be kept confidential?

The researchers undertake to protect your identity and the nature of your contribution. To ensure your anonymity, the surveys will not contain any personal information about you and the school except for your views and opinions. In ensuring your confidentiality, all schools will be alphabetically labelled in order to uphold confidentiality. Data collected will be locked in filing cabinets that only I will have access to them. Electronic data will be password protected and only the researcher has access. If we write a report or article about this research project, your identity will be protected.

What are the risks of this research?

All human interactions and talking about self or others carry some amount of risks. We will nevertheless minimize such risks and act promptly to assist you if you experience any discomfort, psychological or otherwise during the process of your participation in this study. Where necessary, an appropriate referral will be made to a suitable professional for further assistance or intervention.

What are the benefits of this research?

This research is not designed to help you personally, but the results may help the investigator learn more about factors that contribute to poor food safety of the NSNP and the results will be used to make recommendations regarding food handling and food safety in the NSNP.

Do I have to be in this research and may I stop participating at any time?

Your participation in this research is completely voluntary. You may choose not to take part at all. If you decide to participate in this research, you may stop participating at any time. If you decide not to participate in this study or if you stop participating at any time, you will not be penalized or lose any benefits to which you otherwise qualify.

What if I have questions?

This research is being conducted by Zoe Nomakhushe Dlova from the School of Public Health at the University of the Western Cape. If you have any questions about the research study itself, please contact: Zoe Nomakhushe Dlova

9553 N.U.3

Mdantsane

5219

043 706 9289 or 076 985 4932

nomakhushe.dlova@gmail.com

Should you have any questions regarding this study and your rights as a research participant or if you wish to report any problems you have experienced related to the study, please contact:

Prof Helen Schneider
School of Public Health
Head of Department
University of the Western Cape
Private Bag X17
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Prof José Frantz
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This research has been approved by the University of the Western Cape's Senate Research Committee (REF: 15/7/255).

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ISAHLUKO C1: IPHEPHA LENGCAZELO

Isihloko Nkqubo: Uphando ngokhuseleko lokutya (izidlo) zesebe lesizwe kwinkqubo yesibonelelo lokutya ezikolweni kwingingqi yaseNgqushwa, kwiMpuma Koloni apha eMzantsi Afrika.

Zingantoni na ezizifundo?

Le yinkqubo-phando eyenziwe yi SOPH kwi Dyunivesithi yase Ntshona Koloni. Siyanimema ukuba nibenendima emandla eniyidlalayo kulenkqubo-phando kuba nina ningabantu esithi sincance kuni inkcukacha nolwazi ngaleNkqubo, ndithemba kananjalo ukuba ndothi ndizuze ngokukhulu nangokuphangaleleyo ngokhuseleko lokutya ngokweNkqubo yeSizwe yezibonelelo zoKutya eziKolweni kwimpendulo eniyakuthi nisinike zona. Ezona njongo nalenkqubo yophando kukufumananokufuna ukwazi malunga nezinto ezithi zibenomthelela kukhuseleko lokudla kwiNkqubo yeSizwe kubonelelo lokudla ezikolweni zaseNgqushwa kwiMpuma Koloni. Ulwazi neenkcukacha zothi ziqokelelwe ngokuthi sithethe nabantu ngabantu sibuza imibuzo ukujonga nokuqaphela phaya ezikolweni eziye zachongwa zichongelwa ezizifundo zophando.

Zeziphi na izinto eziyakulindeleka kum xa ndivuma ukuthatha inxaxheba?

1. Uyakucelwa ulindeleke ukuba uthathe inxaxheba ngokubuzwa imibuzo ngemibuzo.
2. Imibuzo le iyakuba ichotshelwe yenye intloko kwizisebenzi zalenkqubi esikolweni.
3. Akukho mpendulo eyiyo nengeyiyo.
4. Uyakuthi kwakhona ucelwe ugcwalise ngokubhala impendulo kwiphetshana lemibuzo.
5. Inkqubo yembuzo kufaneleke ukuba ithabathe malunga ne 30 ukuya kwi 45 yemizuzu.
6. Ukutyana kuza kuthathwa ezimbizeni emva kokupheka ngosuku lwesifundo.
7. Incindi yokungcola iya kuthathwa ezityeni ezicocekileyo kwakunye nase zandleni zakho.

8. Umbuzi mibuzo uza kuqaphela isikolo ne zixhobo ezi setyenziswayo xa kuphekwayo kwakunye nendlela oku gcinwa ngayo ukutya kukhuselekile.

Ingaba ukuthatha kwam inxaxheba kwezi zifundo kuzakuba yimfihlo na?

Abaphandi bayazibophelela ngokukhusela nokuba ubeyimfihlo wena negalelo lakho. Ukuqinisekisa ngemfihlo nokhuselo lwabathathi nxaxheba ufundo phando olu aluzukubanazo inkcukacha zomthathi-nkxaxheba kwanezesikolo ekuphandwe ngaso, ngaphandle kwembono nengcxinga zakho. Ukuqinisekisa ngokhuseleko lwabathathi nxaxheba, zonke iZikolo zakudweliswa ngokuqala ku a ukuya ku z ngenjongo zokuqinisekisa ukhuselo lwabathathi nxaxheba. Okuthe kwacholwa-cholwa koqokelelwa kuve kufakwe kwikhabhathi zokugcina amaxwebhu zitshixelwe, ibendim ngedwa onelungelo kuzo. Inkcukacha namacwecwe akwi Komputha iyakuthi iqhotyoshwe .ngeziqhoboshi zeKomputha. Ukuba sibhala ingxelo malunga nenye kwezi zifundo zophando wonke umntu uyakuselwa ngokumandla.

Yeyiphi imicela mngeni kolufundo phando.

Lonke igalelo nokusebenza kuluntu, ukuthetha ngam nokuthetha ngabanye abantu kungumceli mngeni nxe kukodwa. Kodwa ke nangona kunjalo sothi siwacuthe amathuba lomathuba sense nonako nakoukunceda nokuncedisa othi angafumani kuzola emzimbeni nase ngqondweni, kungenjalo ngexa ubuthatha inkxaxheba kule nkqubo yezizifundo. Apho kuthe kwayimfuneko kothi kuchongwe onguchwepheshe nengcali koku ukuze angenelelo ngoncedo nezisombululo.

Iyintoni inzuzo ngezi zifundo-phando?

Olophando alwenzelwanga ukunceda wena buqu, Kodwa inceda abaxhasi ngemali ukuba bafunde lukhulu ngemeko zomgangatho wokutya ekumele kukhuselwe kwe NSNP. Siyathemba ukuba kwixa elizayo, abafundi bazakufunda lukhulu koluphando baze baphucule nendlela abaphatha ngayo uktya.

Ndinyanzelekile ukuba ndibeyinxenye yoluphando-izifundo, kwaye ndingacela ukohlukana nolo nanini na?

Ingxenye yakho koluphando uyenza ngokuthanda kwakho. Ukuba uyinxalenye yolu phando ungakhetha nanini na ukohlukana nolo xa ufuna. Ukuba uye awafuna

ukubanxalenye noluphando, okanye uyeke sele uqalile asoze ubanjwe nganqalelo okanye uphuncukane namalunge akho.

Ndithini xandinemibuzo?

Oluphando lwenziwe ngu Zoe Nomakhushe Dlova okwicandelo lezesikolo sikaWonkewonke sezeMpilo eDyunivesi yase Ntsona Koloni. Ukuba unemibusa okanye ufuna ingcazelo ngezi zifundo-phando xhomana no:

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9553 N.U.3
Mdantsane
5219
043 706 9289 or 076 985 4932
nomakhushe.dlova@gmail.com

Ukuba unayo imibuzo ngokubhekiselele kwezi zifundo namalungelo akho njengomthathi nxaxheba kolufundo-phando okanye unqwenela ukunikeza ingxelo nangayo nayiphina ingxaki othe wayifumana ngokubhekiselele kwezizifundo nceda unxulumane no:

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Prof José Frantz
Dean of the Faculty of Community and Health Sciences
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Oluphando luxhaswe yi Dyunivesi yaseNtsona Koloni yikomiti ka Senete.

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APPENDIX D: CONSENT FORM

Title of Research Project: An investigation on food safety of the National School Nutrition Programme in Peddie, Eastern Cape, South Africa

The study has been described to me in language that I understand. My questions about the study have been answered. I understand what my participation will involve and I agree to participate of my own choice and free will. I understand that my identity will not be disclosed to anyone. I understand that I may withdraw from the study at any time without giving a reason and without fear of negative consequences or loss of benefits.

Participant's name……..

Participant's signature……..

Date……

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ISAHLUKO D1: IPHEPHA LESOXWAYISO

Igama le zifundo - uphando: Uphando ngezokhuseleko lokutya kwingingqi yaseNgqushwa, kwiMpuma Koloni apha eMzantsi Afrika.

Uphando luqhutywe ngolwimi endilithethayo nendilaziyo. Imibuzo ngophando iphenduliwe. Ndiyayazi ukuba inxaso yam koluphando imalunga natoni kwaye ndiyavuma ukuba yinxelanye nalo. Ndiyayazi okokuba oluphando soze luveze ukuba ndingubani. Ndiyazi okokuba ndingohlukana noluphando nanini na ndinga nikanga zizathu kwaye ndingoyiki kungcungcuthekiswa nakohlukana namalungelo am.

Igama ……..

Utyikityo……..

Umhla……

APPENDIX E: PROFILE OF FOOD HANDLERS

Number	Question	Coding category
1	Age	<20----------1 21-30----------2 31-40----------3 41-50----------4 ≥50----------5
2	Gender	Male----------1 Female----------2
3	Education	No schooling-------1 Primary----------2 Secondary----------3 Tertiary----------4 Other----------5
4	Marital status	Married----------1 Single----------2 Widowed----------3
5	Time worked as a food handler (year)	<1----------1 1-2----------2 3-5----------3 ≥5----------4
6	Acquisition of food safety training from current employer.	Yes----------1 No----------2
7	If yes, last training received (year)	<1----------1 1-2----------2 3-5----------3 ≥5----------4

APPENDIX E1: PREMISES AND EQUIPMENT CHECKLIST

Number	Question	Coding category
1	There is a designated cooking facility at school.	Yes--------1 No---------2
2	Availability of storage facilities.	Yes--------1 No---------2
3	Availability of a separate store room to store cleaning chemicals.	Yes--------1 No---------2
4	Availability of a fridge.	Yes--------1 No---------2
5	Lockable cupboard available.	Yes--------1 No---------2
6	Food containers to store decanted food.	Yes--------1 No---------2
7	A stove to prepare food for NSNP.	Yes--------1 No---------2
8	Washing basin in the kitchen.	Yes--------1 → Ques 9 No---------2 → Ques 10
9	Availability of warm water.	Yes--------1 No---------2
10	A container to carry water is available.	Yes--------1 No---------2
11	A bucket to wash the dishes is used instead?	Yes--------1 No---------2
12	The kitchen has clean hand drying towels.	Yes--------1 No---------2
13	Availability of a soap dispenser.	Yes--------1→ Ques 14 No---------2→ Ques 15

14	Does the soap dispenser have soap	Yes--------1 No---------2
15	Availability of soap for washing of hands?	Yes--------1 No---------2
16	A sanitizer dispenser is available in the kitchen?	Yes--------1 No---------2
17	Availability of cutting boards?	Yes--------1 No---------2
18	A broom to be used specifically in kitchen.	Yes--------1 No---------2
19	A mop to be used specifically in the kitchen.	Yes--------1 No---------2
20	The availability of a garbage bin.	Yes--------1 No---------2

APPENDIX E2: FOOD HYGIENE PRACTICES CHECKLIST

Number	Question	Coding category
Personal hygiene		
1	Employees wear clean and protective clothing.	Yes--------1 No---------2
2	Employees wear safety shoes.	Yes--------1 No---------2
3	Effective hair restraints are properly worn.	Yes--------1 No---------2
4	Fingernails are short, unpolished, and clean.	Yes--------1 No---------2
5	Hands are washed properly and frequently.	Yes--------1 No---------2
6	Employees appear in good health.	Yes--------1 No---------2
7	Kitchen is kept clean.	Yes--------1 No---------2
8	A handwashing reminder sign is posted.	Yes--------1 No---------2
Food handling		
9	Food equipment utensils, and food contact surfaces are properly washed, rinsed and sanitized before every use.	Yes--------1 No---------2
10	Procedures are in place to prevent cross-contamination.	Yes--------1 No---------2
11	Food is handled with suitable utensils.	Yes--------1 No---------2

12	Both cooked food and raw food is covered.	Yes--------1 No---------2
13	Is the fruit wiped before it is given to the students?	Yes--------1 No---------2

APPENDIX E3: GENERAL FOOD SAFETY KNOWLEDGE QUESTIONNAIRE

Number	Question	Coding category
1	Food handlers with unhygienic practice could be the source for food contamination with food poisoning pathogens.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
2	Frequent hand washing during food preparation is worth the extra time.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
3	Keeping kitchen surfaces clean reduces the risk of Illness.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
4	Wiping Cloths can spread microorganisms	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
5	Cooked foods should be kept very hot before serving.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5

6	Eating covered leftover cooked food, kept at room temperature for more than 6 hours, is at high risk to cause food poisoning.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
7	Cooked food leftover should be re-heated thoroughly.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
8	Vegetables should be placed on higher shelf in refrigerator than meat and poultry	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
9	Fruits and vegetables should be washed before eating/preparing.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
10	Keeping raw and cooked foods separate helps to prevent illness.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
11	Healthy food handlers might carry foodborne pathogens.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5

12	It is important to throw away foods that have reached their expiry date.	Strongly disagree---------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5

APPENDIX E4: ATTITUDE OF FOOD HANDLERS TOWARDS FOOD SAFETY QUESTIONNAIRE

Number	Question	Coding category
1	Safe food handling is an important part of my job responsibilities.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
2	Learning more about food safety through training courses is important to me.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
3	Foodborne outbreaks are natural life event.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
4	Before handling food, rinsing your hand with cold water is enough to get rid of the bacteria on your hands.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
5	Frequent hand washing during food preparation is necessary.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
6	Raw vegetables and meat should not be cut on the same cutting board.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3

		Agree:----------4 Strongly agree:----------5
7	Wiping off the cutting board with a clean paper towel between food items (raw meat and bread) will prevent spreading of foodborne pathogens.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
8	The freshness and appearance of food upon delivery is important.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
9	Keeping raw and cooked foods separate helps to prevent illness.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5
10	Storage practices have an impact on food safety.	Strongly disagree----------1 Disagree:----------2 Not sure:----------3 Agree:----------4 Strongly agree:----------5

APPENDIX E5: PERSONAL HYGIENE AS REPORTED BY THE PARTICIPANTS

1	How often do you wash your hands?	Once a day----------1 Few time a day----------2 When they're dirty----------3 After using the toilet----------4 When handling food----------5
2	What do you use to wash your hands?	Cold water----------1 Warm/hot water----------2 Water and soap----------3 Water, soap and hand sanitizing liquid----------4
3	How do you dry your hands after washing them?	With tissue paper----------1 With a dry cloth----------2 On whatever I am wearing--------3
4	What do you do when you have a cold/illness?	Do not work----------1 Wear a mask----------2 Continue working as normal-----3
5	What do you do when you have wound (e.g. cut)?	Wash it and continue working---1 Get it cleaned, covered and continue working----------2 Wear gloves and continue working----------3 Nothing, just continue working--4 Stop working----------5
6	Do you wear an apron while preparing food?	Yes----------1→ Ques 7 No----------2 → Ques 8
7	How often do you wash it?	Daily----------1 Weekly----------2 Monthly----------3 Only when it is dirty----------4
8	Do you properly wash, rinse and sanitize food equipment utensils, and food contact surfaces?	Yes----------1 → Ques 9 No----------2 → Ques 10

9	How often do you clean and sanitize them?	Before use----------1 After use----------2 Before and after use----------3
10	Do you use separate utensils and cutting boards when handling raw and cooked food?	Yes----------1 No----------2

END OF QUESTIONNAIRE

APPENDIX F: EASTERN CAPE PRIMARY SCHOOL MENU

EASTERN CAPE: PRIMARY SCHOOLS MENU

DAYS	MEAL PLAN	MENU (FOOD ITEM)	DRY PORTION SIZE
1 Monday	**LUNCH**		
	Protein	**Chicken Stew**	**30g**
	Starch	**Maize Pap**	**60g**
	Vegetable/fruit	**Red/Yellow Vegetable in Season**	**60g**
2 Tuesday	**LUNCH**		
	Protein	**Cooked Beans**	**40g**
	Starch	**Cooked Samp**	**60g**
	Vegetable/fruit	**Green Vegetable in Season**	**60g**
3 Wednesday	**LUNCH**		
	Protein	**Sour milk/Fresh Milk (UHT)**	**200ml**
	Starch	**Phuthu Pap**	**60g**
	Vegetable/fruit	**Whole Fruit**	**1 medium size**
4 Thursday	**LUNCH**		
	Protein	**Cooked Beans**	**40g**
	Starch	**Cooked Samp**	**60g**
	Vegetable/fruit	**Green Vegetable in Season**	**60g**
5 Friday	**LUNCH**		
	Protein	**Pilchard Stew**	**30g**
	Starch	**Sweet Potato/Rice/Brown Bread**	**60g/4 slices**
	Vegetable/fruit	**Red/Yellow Vegetable in Season**	**60g**

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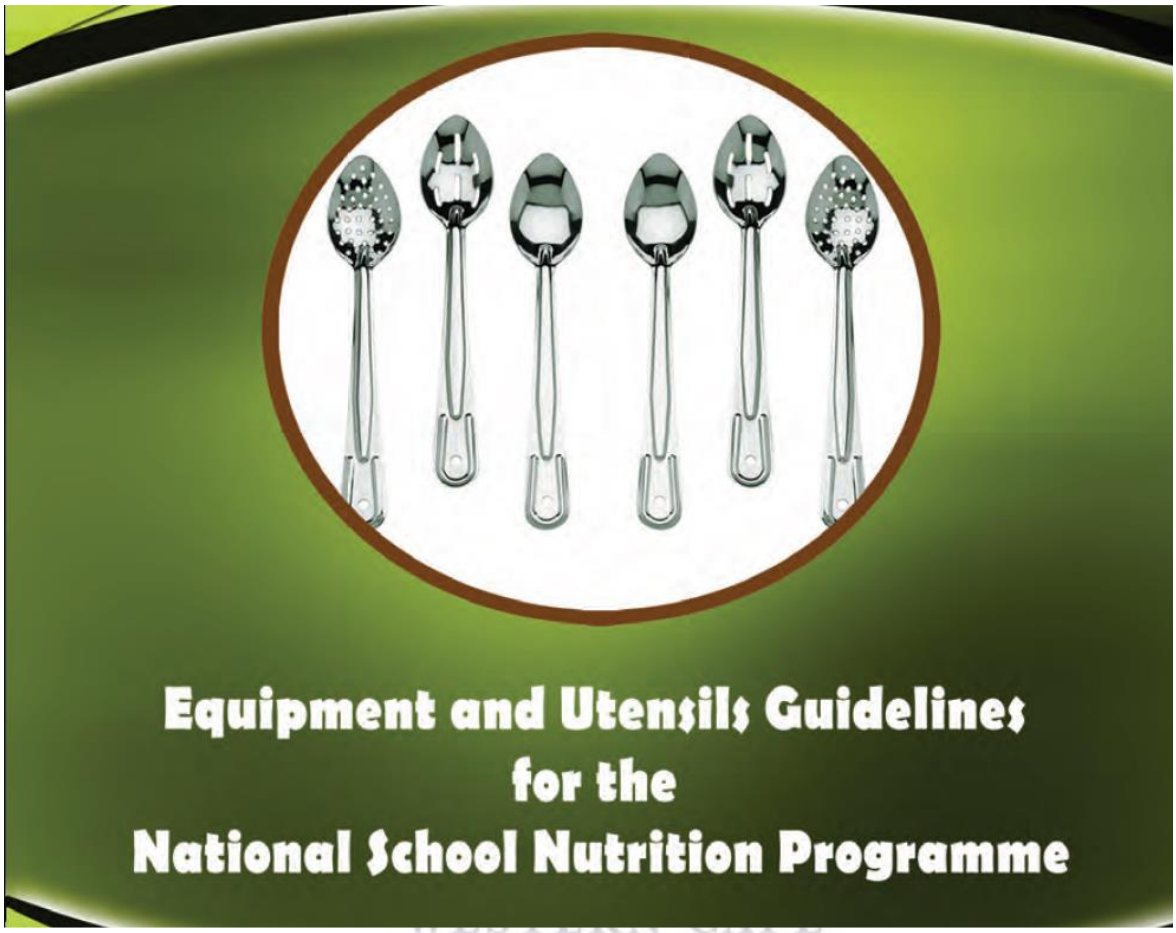
APPENDIX G: EQUIPMENT AND UTENSILS GUIDELINES FOR THE NATIONAL SCHOOL NUTRITION PROGRAMME



Item Description	Item Specification	Item Picture
Measuring cups- stainless steel or plastic	Includes 1/4-, 1/3-, 1/2-, and 1-cup nesting scoops	 
Can Opener – industrial mounted	Can Opener with clamp, spare wheel and spare blade. Opener is self adjusting for can height.	
Cutting boards- polypropylene plastic material	Available in different colors which are ideal for eliminating the cross contamination of foods- HACCP (Harzard Analysis Critical Control Principles) compliant.	

Item Description	Item Specification	Item Picture
Industrial platform scales		
Industrial food processor (vegetable cutter)		
Measuring jugs- stainless steel or plastic	Sizes: 500ml 1 Lt 2 Lt	

Item Description	Item Specification	Item Picture
Cooks' knives – one standard size for schools	Ranges from 15 cm to 36 cm in length	
Cooking Spoons- Plastic or Stainless Steel	Length of - 600mm, 1200mm and 1500mm	
Basting Spoons- Stainless Steel	Total length- 330mm & 400mm	

Item Description	Item Specification	Item Picture
LP gas cylinders and steel cage for gas cylinder storage	48kg x 2 gas cylinder	
Stainless steel cooking pots with lids	60 Lt (500 x 310mm) - SABS approved: • 18/10 Stainless Steel in 2mm thick-ness, satin finished. • Long lasting • Thermo diffusing sandwich base: Stainless steel/ Aluminum/ Stainless	

Item Description	Item Specification	Item Picture
6 Sided Grater- Stainless Steel	With six grating sides Stainless steel grating surface No-slip base	

c. Cooking Equipment & Utensils

Item Description	Item Specification	Item Picture	Usage a
3 plate gas burner	2x3 burner boiling tables		**Installat** • Supp **Specifica** • To in • Supp (SAB • All cy a loc • Com • Supp • The equi cylin • Supp

e. Eating Crockery and Cutlery

Item Description	Item Specification	Item Picture
Dinner Plate; bowls and cups-stainless steel or polypropylene plastics 	Dinner plate - 235mm x 15mm Cereal Bowl - 235mm x 35mm Cup - 220ml	
Standard table spoon, table fork and table spoon- stainless steel 		

g. Protective Clothing

Item Description	Item Specification	Item Picture
Light coloured bib apron and head gear 	Poly/Cotton blend material	
Latex gloves- powder free and silicon oven mitts-heat resistant 		
Safety shoes 	Flat, closed, non slippery sole shoes to protect one from slipping, hot water and sharp objects.	

f. Cleaning Equipment

Item Description	Item Specification	Item Picture
Cleaning buckets 	Single and Double bucket	
Mop and broom 	Plastic or Aluminum handle	
Waste bin or recycling waste bin 	Metal or plastic with lids	

h. Safety Equipment

Item Description	Item Specification	Item Picture
Fire extinguisher 	4kg SABS approved	
First aid kit 	Each kit includes a variety of bandages, compresses, tablets, eye care and burn relief products	

APPENDIX H: TYPE OF MEAL SERVED

APPENDIX H1: FOOD PREPARATION AREAS

APPENDIX H2: FOOD AND CHEMICAL STORAGE AREAS

APPENDIX H3: POOR FOOD HANDLING AND STORAGE AREAS

APPENDIX H4: OPEN BINS STORED INSIDE THE FOOD PREPARATION AREA

APPENDIX I: FOOD PREPARATION RULES