

An Investigation Into The Hygiene Practices And Food Safety Of Street Vendors Outside Pension Pay-out Points In Urban Poor Communities In The City of Cape Town

by

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DECLARATION

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Abstract

Street vended food is an affordable form of sustenance in many developing countries like South Africa. They provide urban low-income communities with an essential food supply chain. Social grants are used to purchase street foods sold by vendors who are strategically located at pension pay-out points. Food products sold by street vendors can be seen as a public health issue affecting the health and well-being of the low-income urban communities. Street Food Vendors (SFVs) may operate without due regard for the basic requirements critical to the hygienic preparation and storage of foods. A few studies on street vended foods have been performed in Gauteng and the Free State, however, there is a paucity of data within the Western Cape.

A cross-sectional study was performed to obtain demographic information on SFVs present at pension points within selected lower-income urban areas in the city of Cape Town and to concurrently assess their knowledge on food safety. Food, water and swab samples of surfaces were collected and tested for their microbiological safety expressed as the Total Microbial Activity (TMA) and Colony Forming Units (CFU). A questionnaire was also sent to the Environmental Health Practitioners (EHPs) to assess their needs and challenges.

A reported 68% of the SFVs in the study were female and 40% of the street vendors lived in informal dwellings. A reported 52% of the SFVs prepared their foods at the stall, 32% at home and the stall; but only 20% had access to ablution facilities at the stall. The street vendors who cooked foods over a wood fire comprised 64%, and 12% reported having re-sold leftovers. With regards to washing up, 60% were unsure about the frequency of changing the washing-up water and 12% did not wash their utensils. It is of concern that 32% of the SFVs did not wear any protective clothing. The Total Microbial Activity (TMA) activity for most of the food and water samples showed some very high counts (>100000), which is an indication of food spoilage and potential bacterial growth.

The samples of hot food showed no growth, but the water samples showed the presence of a variety of gram-positive and gram-negative organisms. The swab samples were only tested for *E. coli* of which, 3 vendors tested positive ($<10^3$) for *E. coli* on their hands. Thirty-one percent of the swabs from various surfaces at the food stalls indicated that the hygiene levels posed a risk.

Food safety knowledge of SFVs was found to be deficient in certain areas as 60% did not understand the importance of using safe products and 36% did not know the safe storage temperatures of cooked foods. It is compulsory to have certification to operate as a street vendor, but 80% of SFVs did not. SFVs (52%) did acknowledge that there were inspections by EHPs.

In conclusion, the samples of hot foods were safe to consume but the hygiene of the street vendors is questionable, as indicated by the quality of the water and swab samples. SFVs require further food safety and hygiene training, proper supervision as well as access to basic facilities.

Opsomming

Straatvoedsel is dikwels die mees bekostigbare vorm van voedsel in baie ontwikkelende lande soos Suid-Afrika. Dit bied stedelike lae-inkomstegemeenskappe 'n noodsaaklike voedselvoorsieningsketting. Maatskaplike toelaes is die mees betroubare vorm van inkomste wat gebruik word om straatvoedsel te koop vanaf verkopers wat strategies by pensioenuitbetalingspunte geleë is. Voedselprodukte wat deur straatverkopers verkoop word, kan gesien word as 'n openbare gesondheidskwessie wat die gesondheid en welstand van die lae-inkomste stedelike gemeenskappe beïnvloed. Straatvoedselverskaffers voldoen nie aan die basiese vereistes wat noodsaaklik is vir die higiëniese voorbereiding en berging van voedsel nie. Enkele studies oor straatvoedsel is in Gauteng en die Vrystaat uitgevoer, maar daar is 'n gebrek aan data vir die Wes-Kaap.

'n Deursnitstudie is uitgevoer om demografiese inligting te verkry oor straatvoedselverskaffers wat teenwoordig was by pensioenpunte binne die laer inkomste stedelike gebiede in die stad Kaapstad en om hulle kennis oor voedselveiligheid te evalueer. Voedsel-, watermonsters en deppers van oppervlaktes was versamel en getoets vir hul mikrobiologiese veiligheid, uitgedruk as die Totale Mikrobiëse Aktiwiteit (TMA) en Colony Forming Units (CFU). 'N Vraelys is ook aan die Environmental Health Practitioners (EHP's) gestuur om hul behoeftes en uitdagings te beoordeel.

Daar is bevind dat 68% van die straatvoedselverskaffers vroulik was en dat 40% van die straatverkopers in informele wonings gewoon het. 'n Gerapporteerde 52% van die straatvoedselverkopers het hul kos by die stalletjie voorberei, 32% by die huis en by die stalletjie; maar slegs 20% het toegang tot ablusiegeriewe by die stalletjie gehad. Die straatverkopers wat gekookte kos oor 'n houtvuur berei het, het 64% beloop en ongeveer 12% het oorskietkos verkoop. Met betrekking tot opwas was 60% onseker oor die frekwensie van die verandering van die water en 12% het nie hul gereedskap gewas nie. Dit was kommerwekkend dat 32% van die straatvoedselverskaffers het geen beskermende klere gedra het nie. Die totale mikrobiëse aktiwiteit (TMA) vir die meeste voedsel- en watermonsters het 'n paar baie hoë tellings (> 100000) getoon, wat 'n aanduiding is van voedselbederf en potensiële bakteriële groei.

Die voedselmonsters wat warm gemonster was, het geen groei getoon nie, maar die watermonsters het die teenwoordigheid van 'n verskeidenheid gram-positiewe en gram-negatief organismes. Die deppermonsters is slegs getoets vir *E. coli* waarvan 3 verskaffers

positief vir *E. coli* op hul hande getoets het. Een-en-dertig persent van die deppers van verskillende oppervlaktes by die kosstalletjies het aangedui dat die higiënevlakke 'n risiko inhou.

Kennis oor voedselveiligheid van SFV's is in sekere gebiede gebrekkig aangesien 60% nie die belangrikheid van die gebruik van veilige produkte verstaan nie en 36% nie die veilige opbergings temperatuur van gekookte voedsel ken nie. Dit is verpligtend om 'n sertifisering te hê om as straatverkoper te funksioneer, maar 80% van die SFV's het dit nie gedoen nie. SFV's (52%) het wel erken dat daar inspeksies deur Environmental Health Practitioner (EHP's) was.

Ten slotte was die monsters van warm kos veilig om te verbruik, maar die higiëne van die straatverkopers is te betwyfel, soos aangedui deur die kwaliteit van die monsters van water en watte. SFV's benodig verdere opleiding in voedselveiligheid en higiëne, behoorlike toesig sowel as toegang tot basiese fasiliteite.

Dedication

To my late grandfather who always encouraged success and made education paramount in our lives and who instilled in me an unparalleled work ethic.

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'Love all serve all', Sai Baba

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Abbreviations

AFSUN - African Food Security Urban Network

B. cereus - *Bacillus cereus*

CCA - Chromated Copper Arsenate

CFU/cfu – colony forming unit

CO₂ - Carbon dioxide

C. perfringens - *Clostridium perfringens*

C. botulinum - *Clostridium botulinum*

COVID-19 – Corona Virus Disease 2019

DOH - Department of Health

DTI - Department of Trade and Industry

E. coli - *Escherichia coli*

EHP - Environmental Health Practitioner

FAO - The Food and Agricultural Organisation of the United Nations

g – gram

GHS – General Household Survey

HACCP - Hazard Analysis Critical Control Point

HFIAPS - Household Food Insecurity Access Prevalence Scale

INFOSAN - The International Food Safety Authorities Network

JECFA - Joint Expert Committee on Food Additives

JEMRA - Joint Expert Meeting on Microbiological Risk Assessment

JMPR - Joint Meeting on Pesticide Residues

L. monocytogenes – *Listeria Monocytogenes*

ml – millilitre

NICD – National Institute for Communicable Diseases

NIDS-CRAM - National Income Dynamics Coronavirus Rapid Mobile Survey

NRCS - National Regulator for Compulsory Specifications

SANAS - South African National Accreditation System

SFVs – Street Food Vendors

spp. - species

STEC - Shiga toxin–producing *Escherichia coli*

S. aureus - *Staphylococcus aureus*

TMA – Total Microbial Activity

UIF - Unemployment Insurance Fund

V. cholerae - *Vibrio cholerae*

V. parahaemolyticus – *Vibrio parahaemolyticus*

V. vulnificus – *Vibrio vulnificus*

WEIGO - Women in Informal Employment: Globalising and Organising

WHO - World Health Organisation

Chapter 1: Introduction

Study Background

Street vending in South Africa has both survivalist and entrepreneurial roots (1). High unemployment rates due to the lack of highly skilled workers in the formal sector have created discriminating gaps in employment (2), resulting in informal trade playing an important role in the informal economy. The South African informal economy although smaller than other developing countries contributes around 7.1% to the Gross Domestic Product (GDP) and 22.3% towards total employment (2). Informal traders/vendors purchase produce such as vegetables from informal markets, wholesalers and even supermarkets (3). The informal sector also provides sustenance as part of the South African food supply chain (3) that provides an essential service to the urban low-income communities. Ready-to-eat foods and beverages sold on street pavements or public places with heavy foot traffic often prepared on site by vendors that are either stationary or peripatetic, are considered as 'street foods' (4). According to Steyn and Labadarios in 2011, 11,3% of the South African population purchase street foods. In the Western Cape province of South Africa, 6.9% of the households were found to be food insecure by the General Household Survey (GHS) in 2018 (5). Inexpensive accessible foods draw low-income households in Cape Town to purchase foods from informal vendors daily or at least once a week (3).

Pension plays a huge role in decreasing the level of poverty and helps to bridge the gap of generational poverty for many families. Pension pay-outs help provide food for the household and for some; this income is stretched to its limit (6). SASSA has designated pension points throughout the country, and the monthly cash injection into these low-income communities is a major drawcard for so-called 'pension markets' (7). These 'pension markets' attract several mobile vendors that rotate around these pension pay-out points (7). Social grants are a reliable form of income and have been shown to be the most significant contributor to the purchase of inexpensive street vended foods/products (6).

The inherent nature of street vending exposes the foods sold to possible contamination (as a result of direct exposure from pathogens in the environment, unsafe raw materials, poor storage and the holding of foods at inappropriate temperatures) and if contaminated, unsafe for human consumption (4). Street vendors in South Africa are sometimes found to operate without proper infrastructure often building their stalls daily with various leftover materials

and transporting their stalls to their place of work (1,8). Street vendors were also found to operate without appropriate food safety knowledge, food handling training and inspection (9). Food-borne disease is frequently underreported in many countries like South Africa mainly due to inconsistency and inefficiency of reporting and investigating outbreaks (10,11). An food-borne disease outbreak report from the National Institute for Communicable Diseases (NICD) in South Africa between 2003 and 2017, documented 327 food-borne disease outbreaks causing illness in 11 155 individuals, which culminated in 8 680 hospital visits, 494 hospital admissions and 49 deaths (11). Environmental Health Practitioners (EHP)s are tasked with addressing and investigating these outbreaks (12), however they often lack manpower, facilities, and are inadequately trained to efficiently perform their tasks (13).

It is important that the food safety of these 'pension markets' are investigated to prevent the burden of foodborne illness on the vulnerable elderly and young within these communities.

Problem Statement

Street foods have been shown to be an integral food source in low-income communities within Cape Town. The paucity of data on the safety of street-vended foods within these communities requires attention to ensure the health and well-being of these communities. It is imperative to investigate the food safety knowledge of street food vendors, their hygiene practises, and the constraints they encounter in implementing food safety measures. It is also important to understand the limitations faced by EHPs in performing their duties as well as the limitations set in regulations and policies that govern the operation of SFVs. Legislation changes made in light of such an assessment could help improve the policies to address the constraints of SFVs and help legitimise food safety certification for SFVs. This study hopes to address the above needs by investigating the hygiene practices and food safety of street vendors outside pension pay-out points in urban poor communities in the City of Cape Town.

Study Objectives

1. Determine the type and quality of food products sold by street vendors at pension pay-out points and assess their food safety knowledge.

2. Assess the hygienic conditions in which these vendors operate as well as determine the pollution they contribute to the environment.
3. Identify foodborne pathogens in cooked and uncooked food sold as well as through swabs of various surfaces to determine the hygienic status of the preparation area or utensils utilised by the vendors.
4. Describe environmental health practitioners' understanding of foodborne diseases in the community and the role of informal food vending in foodborne illnesses transmission.
5. Identify opportunities for strengthening implementation of the National Hygiene regulation (R638) for the inclusion of street foods and better regulations governing street vended foods

Setting

Cape Town is the second-largest city in South Africa with a population of 3.7 million people according to the 2011 census and is a hub of economic development and infrastructure contributing roughly 11 percent to the GDP (14). Even though it is one of the most popular tourist destinations in the country and attracts a substantial amount of international investors (14), it also accounts for 7,3% of food insecure households in South Africa. In the Western Cape 354 312 people receive pension and nationally pension grants account for 19.95% of the social grant total (15). There are currently a few documented studies on SFVs in low-income urban communities within the Western Cape (3,16,17). There is a dearth of data however relating to the number of SFVs that operate within Cape Town, their operational locations and their food safety practices.

Chapter 2: Literature Review

This review is a compilation of literature on the importance of food safety for street vended foods, with focus on the hygiene practices of SFVs as well as a background into the hazards that affect the safety of street foods. The highlight of the review will be the importance of the preservation and supervision of food safety in low-income urban communities.

The role of street foods in feeding the urban low-income communities

Street food vending is the trading of foods on street pavements and alleys, some vendors are mobile with carts while others are stationary (18). The practice has been around for centuries in ancient cities and still holds precedence amongst the urban low-income communities today (18). Street foods are synonymous with the words 'ready-to-eat' (RTE) because they require minimal processing or are pre-cooked (19). Street foods vary from fruits and vegetables to meat, fish, chips, including drinks like amasi (fermented milk sold in South Africa) and carbonated drinks (19). Street foods cater to the needs of the community which often includes traditional foods, as well as more westernised fast food options (19). Street foods present an enticing sight and smell, and passers-by are inclined to purchase these foods because they are affordable and convenient (20).

Street vending not only contributes to the informal economy, but it also lowers the unemployment levels, provides a sense of dignity, allows entrepreneurship to all regardless of the pay scale, and adds to the hub and lifestyle of the city (18). Street food consumption in developing countries provides food security in the face of high unemployment rates and poverty levels. It is an essential part of the informal food supply chain for the urban low-income communities (21). A case study on food supply systems in Zambia showed that essential food items such as eggs, milk and fresh vegetables for inhabitants from a lower income bracket were purchased from informal vendors, rather than the formal sector (supermarkets) (22). Even though supermarkets are present in urban cities, they do not cater to the incomes of the urban low-income communities that buy small units of food often on credit and are unable to store large food units that may require refrigeration (3). A significant portion of food retail in African cities is informal markets (21), and in South Africa, street vending provides the highest employment in the informal sector whilst contributing to the economy (23).

According to the Food and Agricultural Organisation of the United Nations (FAO), food security is, “when all people, at all times have physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life” (24). The World Health Organisation (WHO) has acknowledged food safety as a basic human right however, this often does not materialise in most developing countries, especially the African continent where food scarcity and malnutrition are an enormous stumbling block (25).

Poverty and its influence on the food map in low-income urban areas

Poverty remains one of the more formidable obstacles in achieving food security (24). ‘Hunger is also referred to as food insecurity, while its absence is considered as evidence of food security; either by the individual or the household’. (26) In 2017, GHS reported that 6.8 million South Africans and 1.7 million households in South Africa experienced hunger (27). In terms of access to food, the GHS in 2018 reported that 6.9% of the households in the Western Cape in South Africa had experienced severe inadequate access to food and 20.6% experienced inadequate access (5). The City of Cape Town showed the highest inadequacy of household access to foods (27.5%) when compared to other metropolitan areas followed by the Nelson Mandela Bay (23,4%) and Mangaung areas (23,2%) (5). Cheap, accessible street vended food is very popular in these low-income communities (28).

A cross-sectional survey on the consumption patterns of various consumers on street foods in Cape Town in 2013, revealed that consumption of street foods was highest in the black community (particularly single black males), followed by the Coloured and Indian communities (20). According to the African Food Security Urban Network (AFSUN) survey almost 20% of the households in low-income areas in Cape Town source their foods from street vendors at least five days a week (See Figure 1.1 below) (16). The urban low-income areas in Cape Town prefer to use supermarkets for bulk items but source their daily needs at street markets and vendors (16). Buying items in bulk means paying less overall per item, but many low-income communities cannot afford to pay the price regardless of the savings (16). This is where the informal traders/vendors fill a gap as they may charge more, but they allow customers to buy just what they need (29) and may even allow credit-based systems (buy now and pay later) (16).

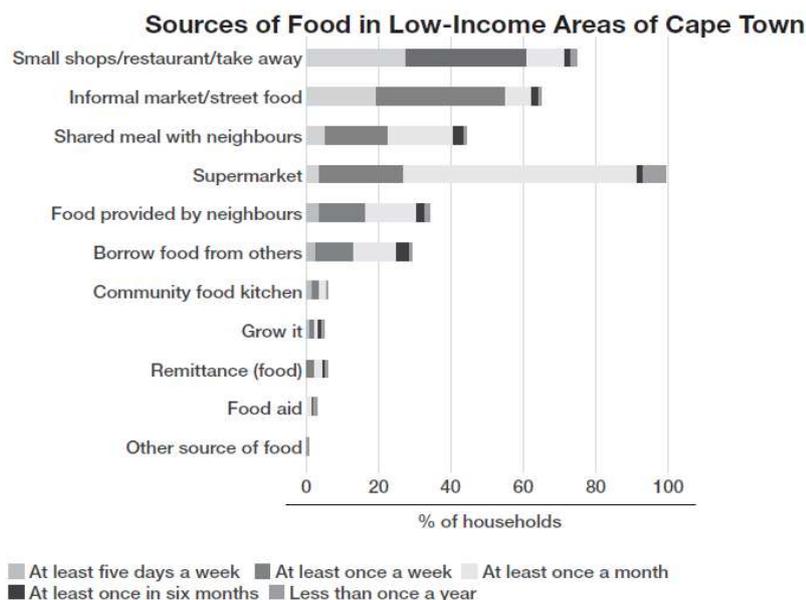


Figure 1.1: Results from a survey outlining the primary source of foods (n = 1058) in Cape Town (3,16)

Governments have social grants in place to help assist the low-income communities and the elderly, and a large portion of these grants are used to purchase food (30). According to the GHS in 2018, 44.2% (6.9% from pension and 37.3% from other grants) of the household income were obtained from grants in the Western Cape (5). Mkhize et al. (31) reported that most female vendors relied heavily on social grants to make a living and provide for their family. This statement is corroborated by the GHS in 2018 in which 37.9% of households were headed by females (5). These grants are set in place to help alleviate poverty (31).

In South Africa, many of the elderly rely on financial assistance that comes from social grants provided by the South African government (i.e. the South African Social Security Agency (SASSA)) (32). The old-age grant (pension) is approximately R1860, per month, and according to the statistical report released by SASSA between the period of 2018 to 2019, 354 312 people received the old age grant in the Western Cape (15). According to a Statistics South Africa Social profile report in 2010, grandparents who live with their families are expected to assist with household expenses; this was more prevalent in female-headed households (10%) than male-headed households (3%) (32). fruits and vegetables to meat, fish, chips, including drinks (33). These social grants are administered by the SASSA and are often the sole source of income in these households. SASSA has designated pension points within the Western Cape, which attracts street vendors who set up stalls outside pay-out points which are often referred to as 'pension markets' (7). Social grants are a reliable

form of income and the most significant contributor to the purchase of inexpensive street vended foods/products (6).

The COVID-19 global pandemic has adversely affected the informal trade industry and cut off access to street vended foods in many of these low-income urban communities (34). Thirty-one percent of informal workers were prevented from their livelihood; a large proportion of these informal workers were women (35). Women in the informal industry experienced an almost 50% decrease in typical working hours and this translated into a 70% decrease in typical earnings during the lockdown between February and April 2020 (35). Food insecurity in low-income urban areas in Cape Town intensified and led to riots and looting (36). Only vendors that had valid trade permits from their municipality that were obtained before the lockdown was allowed to trade (37), no new permits were issued to vendors in the City of Cape Town. Street vendors made the costly trip to the municipalities to obtain their permits (38). Hot foods or prepared foods were banned from being sold, however the sale of basic foods (such as fruits or vegetables) was allowed during the lockdown (37). SFVs were prevented from cooking their foods and had to resort to selling only raw meats.

The sale of hot cooked foods was not considered to be an essential service (39), which is contradictory as any food is an essential service and pre-cooked foods or ready-to-eat foods are a well-known affordable food source in many urban communities. The South African government did not consider the impact it would have on food security, where the urban low-income communities that could not buy in bulk or store large units of food items (3) would eventually desperately wait in queues for food parcels (40), negating all the effort to reduce foot traffic. The ban on selling hot foods was eventually found to be 'irrational, unconstitutional and invalid' (41) by the Judicial system of South Africa. Scrutiny of the hot foods ban revealed the unsubstantiated claims suggesting that people queuing for hot foods would cause health issues by creating a greater movement of people (42). The hot foods ban was eventually overturned during Level 3 of Lockdown on June 1st 2020 (42).

The National Income Dynamics Coronavirus Rapid Mobile Survey (NIDS-CRAM) released their reports documenting the 3 million job losses due to the lockdown (43,44). Even with the social grants like the child-care grant, pension and food aid relief provided by the government, it is not enough to cover most families food requirements, let alone the added burden of purchasing sanitisers and masks (45). Access to social grants proved difficult

during lockdown due to lack of SASSA staff and strict restrictions of movement (45,46). The government increased the child support grant by R300, the caregiver grant by R500 and all other grants by R350 for the next 6 months; also the Special COVID-19 Social Relief of Distress Grant was put in place for the unemployed (applicable to those not collecting Unemployment Insurance Fund (UIF)) providing only R350 (35). These increases are nowhere near enough to cover the shortfall from rising food prices and the reduction in income; households were still going hungry (47).

A research report by the Pietermaritzburg Economic Justice and Dignity (PMBEJD), has shown a 30% increase in food costs for low-income families during the COVID-19 pandemic in the town of Pietermaritzburg in South Africa (48). The report details the increases in products (such as rice, flour, vegetables, bread etc.) consumed by the majority of South Africans as 'household baskets', showing that the cost of these baskets has increased by 7.8% over 2 months (48). As of the 4th of May 2020, the household basket cost around R 3470,19, which is more than the national minimum wage of a worker (48). Out of the 7000 people interviewed, the NIDS-CRAM survey reported that 47% of the households ran out of money to buy food in April, 21% had someone in their household experience hunger, and 15% had a child experience hunger (47).

The increasing food prices coupled with job losses and the loss or reduction of income due to the pandemic has made life increasingly difficult for low-income communities in South Africa. The COVID-19 pandemic has called attention to the issue of hunger and food insecurity in South Africa.

The Nutritional quality of street foods

According to the FAO in 2007, 2.5 billion people consume street foods globally (49), and for most of the urban low-income communities (adults and children), this is the only form of nourishment for the day (28). Street foods are pigeon-holed as unhealthy, with high fat, high sugar contents and no nutritional value (20,50,51). Investigations carried out by the Food and Agricultural Organisation (FAO) has shown that street foods provide high energy and protein at affordable prices (49). A study of foods sold by SFVs in Cape Town in 2018 was found to be energy-dense and high in fat (17), but it focused on snacks (sweets, chips and baked goods such as 'vetkoek'(a kind of fried dumpling) and did not break down the calories for pap and meats and other types of foods that were sold. The diversity of street foods

(such as snacks, processed meats, traditional foods and meats), often makes it difficult to classify as unhealthy, unless you delve deeper into the ingredients of these foods (52), as well as into the access to nutritional street foods, the frequency of intake and most importantly, the choice between a healthy and unhealthy food/snack (53).

Most studies (17,20,50,54) concentrate on reporting the daily energy intake in terms of calories, or utilise terms such as energy-dense and high fat to describe nutritional quality; but there is a dearth of information on the salt, saturated fat, trans-fats from street foods as well as on the macro and micro-nutrients. A few studies evaluated the nutritional composition of popular street foods sold by vendors in terms of macro and micro-nutrients and these foods ranged from fried fish and rice to sweets (55–57). In terms of macro-nutrients, protein has the highest satiety level, followed by carbohydrates and lastly fat (58). The more energy-dense diet provides the least satiety (58), however, a high protein breakfast (low energy density) can reduce hunger pangs through longer-lasting satiety. However, when it comes to the health aspects of street foods, these averages or ranges can only be interpreted in relation to the rest of the diet and the frequency of intake. Nutritional deficits cannot be attributed to street vended foods alone, because they can provide a safe nutritious meal to lower-income communities (59). Choice is vital to nutrition, and some of the factors that influence choice are hunger and taste, cost, access, time and culture (53); all of which are catered for by street vended foods. In South Africa, 11.3% of the population at a national level consume street foods at least twice a week (60). The frequency of intake of unhealthy street foods (with large portion sizes, high energy-density, high fat, high salt and sugar contents), has been considered as an attributing factor to the growing obesity issues in South Africa (17) alongside fast food consumption.

In 2007, the FAO carried out a study in schools in Dar es Salaam, Tanzania, to improve the nutritional quality of streets foods available to the school children, thereby improving the micronutrients in their diets (61). There was a variety of snacks and foods available to the school children but they choose snacks that were high energy-dense (such as cassava or samosas), rather than moderately energy-dense meals like rice and beans (61). Cost of foods played a huge deciding factor as many of the school children cannot afford small meals with rice (61). Also, many school children skipped breakfast in the morning due to cost, time constraints and long travel hours to reach school (61). Skipping breakfast leads to an increase in appetite and therefore an increase in energy-intake later in the day (62). Fruits were rarely sold because there was low demand, and some fruit was seasonal, so

availability was difficult (61). These fruits were found to be more expensive because of the above issues and most street vendors stocked fried snacks instead (61). The study educated the street vendors in preparing foods hygienically and offered suggestions to include vegetables with the fried cassava to provide better food options to the school kids (61). It was concluded that either at home or at school these kids consume street foods and educating them to choose better foods with a moderate energy density and micronutrients will help improve their dietary needs (61).

Addressing the nutritional needs of the urban low-income communities is complicated, knowledge and better access to safe, and affordable fruits and vegetables is a starting point, but many facilities such as schools will require additional support from the government (61).

The hazards associated with street foods

Street foods are perceived as a public health hazard in developing countries (63–65) because some of these street foods are sold inexpensively under dilapidated shelters (66), and the street vendors may not have access to services like running water and proper waste disposal (64,66). They may also have a lack of knowledge in terms of food-borne illnesses and how to prevent them by operating hygienically and sourcing safe raw materials (65). These street foods may also be exposed to flies and other pests that carry pathogens that may perpetuate the spread of illness (19,67). The lack of appropriate infrastructure, accessibility to water and waste disposal as well as uncontrolled usage of additives and the possible presence of unsafe levels of pesticides are some of the compounding issues that create unhealthy conditions (28) and will be further discussed below. The inherent mobility, diversity and fleeting employment also make street food vending problematic to supervise and control (65). Food and water become hazardous through contamination agents that may be biological (i.e. bacterial, viral or parasitic), chemical or naturally occurring in nature (68). The sources of contamination are numerous, from infected cattle water run-off used to irrigate plants on farms, to the unregulated temperature transport/storage conditions of various raw materials (resulting in food spoilage) (68).

Raw materials

‘Food is susceptible to contamination at all stages of the food chain. Raw materials are therefore important to the safety of street-vended food because of the biological, chemical

and physical hazards that may be introduced to the vending operation and which may persist through preparation and processing'. (24,65) If the source is contaminated it stands to reason that any process downstream of the source can be infected. Raw materials should always be separated from other materials (during processing, storage and transportation) and should be carefully transported according to time-sensitive and temperature regulations to limit pathogen growth and toxin formation (65).

Raw products like meats will have inherent levels of bacteria present such as *Salmonella*, *B. cereus* and *Campylobacter* (69). According to the WHO, bacterial foodborne pathogens like *Salmonella* (found in poultry), *Campylobacter* (usually found in uncooked meats), and enterohaemorrhagic *E. coli* (found in uncooked meats and unpasteurised milk) are frequent culprits that cause foodborne illness worldwide (70). Raw materials can be contaminated, especially through livestock in which enteric bacteria such as *E. coli* O157:H7 can accumulate and the host remain asymptomatic (71,72). Enteric bacteria often cause diarrhoea (unformed stools), which is the hallmark of enteric disease (73). Some of these bacteria can be part of the normal flora of the intestine but others can be invasive and release toxins that bring about a severe inflammatory immune response that is characterised by gastroenteritis. It is because enteric bacteria are associated with the intestine that they are often referred to as faecal bacteria (74,75). Enteric bacteria can be transferred by faecal contamination during butchering and transporting meats, and to vegetables through organic fertiliser (containing animal matter and manure) and water (71).

When livestock are slaughtered the microorganisms present on the surface can contaminate the interior of the animal (72) *E. coli* O157:H7 is particularly resilient and can survive in soil, water, on the surface of foods and animal reservoirs (72). The microorganisms on the plants and feeds used to feed cattle are easily contaminated by livestock through water runoff from livestock used to irrigate farms fields (76). Untreated sewage water used to irrigate harvests are the highest risk for contamination with entero-pathogenic microorganisms (72,77). Fruits and vegetables grown in soil can be contaminated with *B. cereus*, *C. perfringens*, and *Clostridium botulinum* (*C. botulinum*) ((69). The spores from these bacteria found in soil, sand and dust can survive the cooking process and cause illness (69). The use of safe water to irrigate crops and clean crops (raw materials) during harvesting, processing and handling is imperative to ensure the prevention of food-borne illnesses (65,77).

Raw materials should always be inspected for visible deterioration and odours (65) to prevent food spoilage. Foods may undergo decay for various reasons such as physical damage to the exterior of foods (by freezing and drying of foods), invasion by insects, and slime formation/growth caused by spoilage microorganisms (76,78). Foods can be spoiled by incorrect storage temperatures and exposure to spoilage micro-organisms at any point during the farming, processing and transportation chains (79). Food spoilage often causes an alteration of smell, taste, and colouring of foods, due to breakdown by microbial enzymes (78). Nutrients, water, an energy source as well as growth factors like vitamins are essential to the growth of microorganisms (76). Typically, yeasts and moulds have the lowest growth requirements, in comparison to gram-negative bacteria (such as *E. coli*) and gram-positive bacteria (such as *B. cereus* and *C. perfringens*) (76,80). Microorganisms gain their energy by using the sugars, alcohols and amino acids of foods (76). Yeasts and moulds grow due to lower water activity and pH levels, whereas the growth of microorganisms is compromised at these levels (80).

Pseudomonas is recognised as the most common spoilage microorganism (69) and causes spoilage through the metabolism of non-protein nitrogen fractions such as urea and ammonia, and the actions of lipases and proteases that breakdown fatty acids and amino acids (76,78). This results in bad odours, a change in taste, and the colour of the meats (76,78). The outcome is the complete breakdown of texture, the development of slime and visible bacterial growth (78). The importance of choosing safe raw materials is integral to the safe consumption of foods and safe supply chains.

Waste disposal

A summary of case studies on street vending performed in 2003 in Kenya, Cote D'Ivoire, Ghana, Zimbabwe, Uganda and South Africa disclosed that only a few trading sites had access to refuse collection, but most sites did not cater for water, sanitation and electricity (81). City authorities did not cater to these sites as many of the street vendors operated without street vending permits/licenses (81). Street vendors in some parts of Africa and the Dominican Republic were found to release their bodily wastes near their stalls because there are no ablution facilities near their stalls (19,82). Dirty/grey water has been noted by other investigators being discarded onto the streets because there were no waste disposal facilities nearby (83), which perpetuates the unhygienic breeding ground for pests and bacteria (64). Improper waste disposal is a huge problem in some developing countries,

where waste from street vendors are strewn on nearby streets or next to their stalls (67,82,84,85). The waste attracts animals and insects which were found to be present near the food preparation sites documented in cross-sectional studies in Nigeria (86) and Uganda (83). Insects such as flies are vectors for microorganisms and are also capable of cross-contaminating surfaces (85,87).

Cross-contamination

It can be described as direct or indirect, with indirect contamination resulting from an unknown contaminant in the raw material, which is passed onto the food handler and spread to other surfaces (82,88). It is therefore important to separate raw materials like meats from vegetables and to keep cooked foods away from exposure to other raw materials. For example, cutting meats and vegetables with the same knife without washing in between (67) and allowing meat drippings to fall onto other raw materials and cooked foods (89).

Access to safe water sources are not readily available to some street vendors and they often carry a limited supply of water in water containers that are utilised to clean various surfaces such as the utensils and even the hands of the street vendor (65,66,90). This means that these street vendors would not be able to change out the water regularly to avoid cross-contamination during washing of utensils and the wiping down of various surfaces using multi-purpose cloths (the same cloth used to dry dishes, hands and mop up meat drippings) (4,91). Some SFVs shared utensils such as knives (8) which increased the incidence of cross-contamination and resulted in higher bacterial counts in the foods that were collected and tested by the SFV (8). Studies carried out in South Africa, showed that dishwater of SFVs was highly contaminated due to lack of replenishment of clean water (8,90). Observations of street vendors in some countries show that soap or disinfectant was rarely used to thoroughly and hygienically clean the utensils and the hands of the street vendors (19,66,82). The presence of *E. coli* in the dishwater is indicative of faecal contamination (75) from the washing of hands in the dishwater after going to the toilets (90). A study carried out on SFV's in the Central Business District and in various townships in the city of Bloemfontein, Free State Province in South Africa in 2006 reported that the knives and cutting boards used for cutting and holding various raw materials were not hygienically cleaned (66). The risk of cross-contamination from the water or utensils to the food and other surfaces are high under those circumstances (19,64,82).

Improper cooling and holding of foods at room temperature

The problem with improper cooling of foods is that they are left to cool down anywhere between 4 to 60 degrees Celsius for prolonged periods, which allows for bacterial propagation (92). This is a huge problem with street foods because most SFVs in South Africa do not have access to cooling equipment and food spoilage is a significant challenge (3,8). The storage or holding time temperature of foods influences the growth of the type of microorganism: Mesophiles such as *B. cereus*, *Salmonella*, and *C. perfringens* grow at 37°C, thermophiles grow at 40 to 70°C and psychrophiles that grow at 0°C or 10-15°C (76). Psychrophiles are particularly difficult to control because of their ability to survive and thrive in cold-storage such as *Listeria* species (spp). (76,78). The implications of the improper cooling and holding of foods is an increase in food spoilage and an increase in the risk of foodborne illness (88).

A South African study in Johannesburg in 2000, showed no significant differences in the amounts of microbes found between food samples collected during cooking and those collected during the holding of cooked foods (8). The street foods sold by vendors were cooked thoroughly and held for shorter holding times to prevent the growth of microbes at ambient temperatures (8). This study showed that the levels of the microbes found on the street vended foods were safe to consume, despite their lack of cooling equipment because of their cooking techniques and short holding times for stored cooked foods (8). However, even if foods are cooked thoroughly, microorganisms can be re-introduced into the foods even at shorter holding periods (8,92) through the use of utensils used to cut or serve both raw and cooked foods (66). If the foods are not reheated (until it is hot and steamy above 60 degrees Celsius) before consumption the opportunity for bacterial growth still exists (92). Dust contamination from leaving foods uncovered whilst the foods were being served to the customer as well as using the same serving utensil to stir the cooked foods that are left exposed to the environment allows for the re-introduction of various microorganisms (8).

Lapse of more than 12 hours between preparation and cooking foods

A lapse in time provides the perfect breeding ground for spores and other microorganisms to grow and multiply, especially if this lapse is in conjunction with improper cooling and holding of foods. The prevalence of *B. cereus*, *C. perfringens*, *Salmonella*, *Vibrio parahaemolyticus* (*V. parahaemolyticus*) and the *staphylococcal* enterotoxin have been

shown as frequent contaminants with regards to the holding of foods (93), improper cooling, and the selling of leftover foods (88). Many SFVs also prepare some foods at home and then transport them to the vending site, without proper storage or cooling equipment increasing the risk of food spoilage and microbial propagation (66). The cooking temperature is an integral factor in preventing foodborne illnesses by killing off any bacterial growth or spores (88), but spores from the bacterium *B. cereus* and *C. perfringens* can survive high temperatures.

Contamination from the food handler

The odds of the person involved in the preparation of the foods of causing the outbreak are quite high (88). A review of 816 reports of food outbreaks between 1927 to 2006 where the food handler was the likely cause of the outbreak, found that food handler may or may not be oblivious to the excretion of the pathogen depending if they were asymptomatic or sick (94). Personal hygiene (such as handwashing) is paramount to producing safe foods (82,88). Enteric pathogens are particularly resilient and due to inefficient handwashing are very easily transmitted due to the watery nature of stools experienced in enteric infections (95). These enteric organisms (such as *Salmonella*, *Shigella* and noroviruses) are also excreted over a period that may be hours or weeks (95). Even without enteric infections, studies have shown that a multitude of microorganisms can be present on the hands of food handlers/SFVs because hands touch everything from various body parts to miscellaneous objects (such as money) (96); and the presence of these microorganisms are indicators of poor hygiene (97–99). The poor hygiene of not just the hands of the food handler/SFV, but the cleanliness of the clothing, nails and overall health of the food handler/SFV plays a role in the transmission of pathogens to foods (98). The apron has also been found to be a carrier of microbes such as *Staphylococcus aureus* (*S. aureus*) and *Enterobacteriaceae*, the study however found no significant correlation between the organisms found on the hands and those found on the apron (100). If the food handler sneezes or coughs on the food, *S. aureus* usually present in the nose, throat or skin may contaminate the foods, and the surfaces (101). Any cuts or abrasions on the food handlers hands also expose foods to infection and expose the food handler to other contaminants as well (95). The handing of money during the transaction of buying and selling of foods is also an area of concern as money can harbour microbes such as pathogenic *E. coli* O157:H7 (102) and *S. aureus* (67).

The food handler may also work with raw meats (103) or unwashed vegetables (104) that have inherent levels of microorganisms. Hence they are frequently exposed to enteric pathogens and various other microorganisms present on the surface and interior of these raw materials (95). Barehand contact is hazardous under these circumstances and the wearing of protective clothing such as aprons, gloves and hairnets help reduce the transmission of microorganisms from the food handler to the food and vice versa (105). Any barrier to direct contact with food be it physical (any protective gear) and or chemical (soap or detergent) can further reduce the likelihood of the transmission of microorganisms (105).

The microbiological requirements for the safe consumption of foods and pathogenesis

According to the South African Environmental Health Practitioner guidelines from the Department of Health (DOH), 'All foodstuffs, however, should not contain microorganisms at levels, which may cause harm to humans upon consumption'. (75) Most sources of minimal infective doses of pathogens come from volunteer studies (although some organisms are deemed unethical such as *Listeria monocytogenes* (*L. monocytogenes*) and *E. coli* O157:H7, data from outbreaks and literature reviews of specific populations (106). The infectious dose is very difficult to ascertain as they differ amongst adults, children, the elderly and the immunocompromised. It is dependent on the organism, the strain, the efficiency of the stomach acid barrier as well as the fat content of foods (107). Gastric acid acts as a barrier and can kill bacteria in 15 minutes at a pH of 3, however, if the acidity is compromised lower infectious doses may result in infection (107). Fatty foods provide a degree of protection to pathogens from gastric acid (107).

The variables that the infectious dose for the host and pathogen are summarised in Table 1.1 below.

Table 1.1: Variables affecting the infectious dose for Pathogen and Host (108)

Variables affecting the infectious dose of the Pathogen	Variables affecting the infectious dose of the Host
<ul style="list-style-type: none"> • The variability of gene expression • The microorganism's ability to handle stress or damage • The integration period with food and environment • The pH susceptibility of an organism • The distinctive pathogenesis of the organism • Interactions with other organisms 	<ul style="list-style-type: none"> • Age • Health • Pregnancy • Medications (chronic or otherwise) • Metabolic disorders • Alcoholism (cirrhosis or hemochromatosis) • The amount of food consumed (in other words the number of cells consumed) • Gastric acidity variation (for example due to antacids) • Genetic disturbances (malignancy) • Nutritional status • immune competence and surgical history • Host's occupation

Pathogenesis plays an important role, Schmid-Hempel and Frank propose that pathogens that act locally by invading the host defences tend to have lower infectious doses than those that act at a distance (see Figure 1.2 below) (109). They have fewer infectious molecules that are capable of evading host defences and infect fewer cells (109). High infectious doses

act at a distance and build up a large number of infectious molecules that present a formidable attack before the infection can be cleared by the host cells (109). Table 1.2 below shows the counts/g and the number of infectious cells required to cause infection for a variety of pathogens. A pathogen with a lower infective dose will transmit easily from the food handler to the foods, however, those with higher infective doses may not have ease of transmission, but with long holding periods of foods and inefficient cooking, may build up to become highly infectious and even leave behind harmful toxins (107).

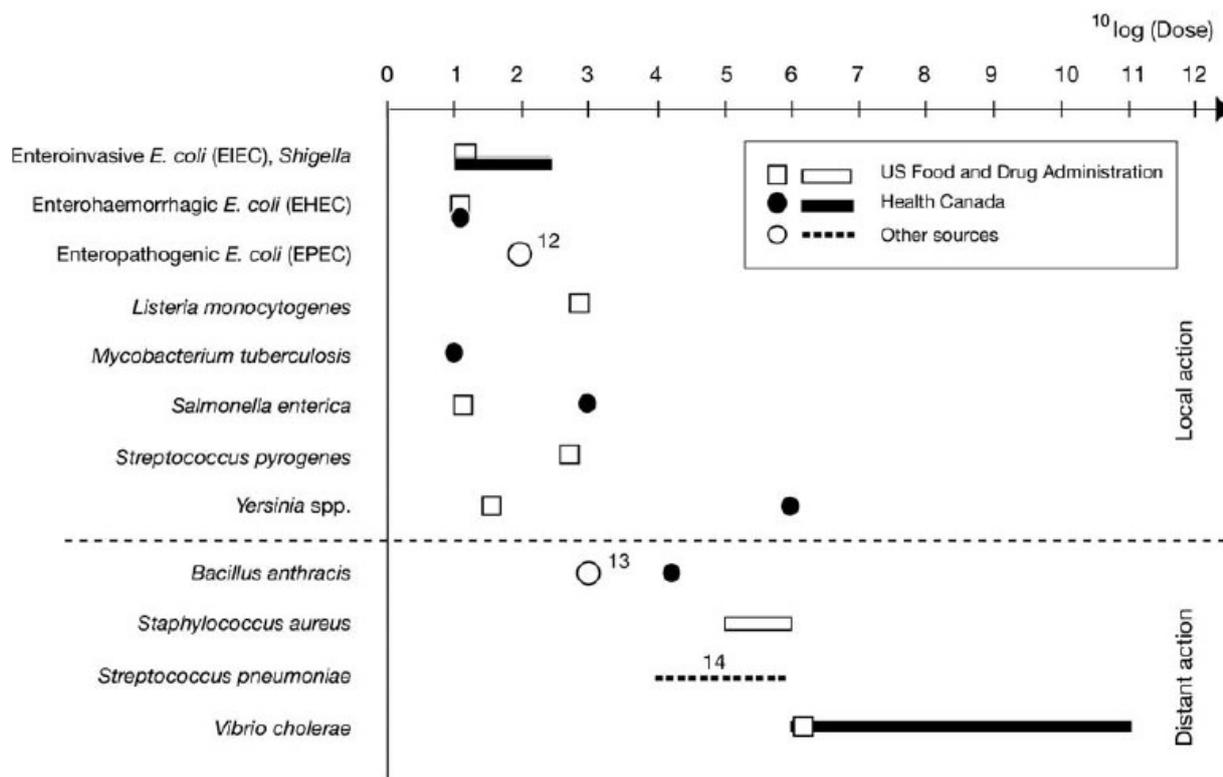


Figure 1.2 Illustration on the action of varying infectious doses (local vs. distant action) by various microorganisms ((109)p.1373)

Table 1.2: The South African Environmental Health Practitioner guidelines to microbiological levels of acceptability of food (75) versus the Food and Drug Administration (FDA) minimal number of infective cells sourced from epidemiological outbreak investigations and feeding studies on healthy voluntary participants (108)

Microorganism	Level of acceptability (<i>italic</i>)- indicates upper limit guideline for illness	FDA's estimated minimal number of infectious cells for illness¹
<i>Escherichia coli</i> <i>Escherichia coli O157:H7</i>	1 to <100/g or ml <i>Counts of 10²/g = infectious dose</i>	10-100 cells
<i>Staphylococcus aureus</i>	1 to <100/g or ml <i>Counts of 10⁷/g = enterotoxin production (200ng)</i>	<1 mg of toxin
<i>Salmonella</i>	1 to <100/g or ml <i>Counts of 10⁷/g = Salmonellosis</i>	1 cell
<i>Clostridium perfringens</i>	1 to <100/g or ml <i>Counts of 10⁵/g = Food poisoning</i>	>10 ⁶ cells
<i>Clostridium Botulinum</i>	0.1 to 1ng = death	A few ng of toxin
<i>Bacillus Cereus</i>	1 to <100/g or ml <i>Counts of >10⁵/g = infectious dose</i>	10 ⁵ to 10 ⁸ cells
<i>Listeria monocytogenes</i>	1 to <100/g or ml <i>Counts of >10²/g = minimal infectious dose</i>	<1000 cells
<i>Yersinia enterocolytica</i>	1 to <100/g or ml	10 ⁴ to 10 ⁶ cells
<i>Vibrio species (V. cholerae, V. parahaemolyticus and V. vulnificus)</i>	1 to <100/g or ml <i>Counts of >10²/g = minimal infectious dose</i>	10 ⁶ to 10 ¹⁰ cells
<i>Shigella</i>	<i>Counts of 10¹ to 10²/g = minimal infectious dose</i>	10-100 cells

1. The data obtained is an estimate of the infectious dose based on studies and outbreaks and may differ due to several variables from the pathogen to the host. It is merely a guideline and should be interpreted as such.

The South African Environmental Health Practitioner guidelines to microbiological levels of acceptability of food (75) did not factor in viruses such as Norovirus and Hepatitis A that also have very low infectious doses of 10-100 virus particles (106). Pathogens present in the nose, throat, and skin or which are of faecal origin are easily transmitted through hand contact, such as Norovirus, Hepatitis A, Salmonella, Shigella and *S. aureus* (106). Once the individual is infected, the infective period can range from a few hours to weeks during which the pathogen is shed (106). The longer the infectious period, the greater the chances of shedding the pathogen; and increased faecal contamination can occur if the individual experiences unremitting loose stools (106).

A comparison of hygiene between SFVs and Formal Food establishments in South Africa

Three studies on the food safety of street vended foods that were performed in Johannesburg, South Africa (8,90,93) have shown that even with the lack of access to basic service amenities, street vended foods had relatively low microbial counts (8,90,93). The first study was carried out in Johannesburg in 1999, in which 6 SFVs participated and a total of 51 food samples (consisting of fried steaks, beef stew and chicken stews), 18 dishwater samples and 18 surface swabs were collected and tested (90). No other studies had investigated the safety and quality of traditional street foods prior to this study in South Africa (90). The results from the study were as follows: *B. cereus* was found in 22%, *C. perfringens* in 16%, *Salmonella* spp. in 2%, and *E. coli* (non-pathogenic) in 2% of the food samples (90) out of the total of 51 food samples. The presence of *E. coli* was found in 78% of the 14 water samples and 6% of the 3 food samples (90). Majority of the isolates were found to be *Bacillus*, *Micrococcus*, and *Staphylococcus* species. Even with a plethora of bacteria detected, none of the samples (food, water or swabs) was unsafe but the hygiene practices of the vendors was concerning (90).

The presence of the *Bacillus* spp. found in the isolates was thought to have originated from spores that survived the cooking process (90). Cross-contamination was also inferred by the presence of the isolates in all samples, possibly transferred from the dishcloth used to wipe the preparation surfaces, to the dishwater and finally to the food samples (90). Although tests were also carried out for *Campylobacter* spp., *L. monocytogenes*, *S. aureus*, *Vibrio cholerae*, and *Yersinia enterocolitica*; no presence of the above bacteria was detected on the food samples (90).

The second study in Johannesburg was performed in 2000. Only two SFVs participated but 132 samples of chicken, beef, salad and gravy were tested (8). This study aimed to identify microbiological hazards in the food preparation process (8). No significant differences in microbes were shown between foods kept after cooking and foods prepared during the cooking process as well between the prepared salads and the raw materials (8). *B. cereus* was the most prevalent bacteria found in all food samples both cooked and raw, however it was also the only bacteria present in the foods during the holding period (8). The mere presences of *B. cereus* is concerning because it can produce heat stable toxins that can survive the cooking process and cause food-borne illness (8).

Raw food samples showed higher bacterial counts than the cooked samples, and the cooking process decreased the mean aerobic plate counts for the cooked foods and *Enterobacteriaceae* counts in the chicken and gravy samples (8). The second vendor had higher mean aerobic plate count and coliform count than the first vendor, that was attributed to the thawing of meats earlier in the day in the same water that was used to wash the dishes (8). The second vendor also had a higher mean and coliform count in the swab samples taken before food preparation and following food preparation due to the lack of the separation of raw meats and salad foods on the cutting board and the lack of cleaning the knife between the chopping of foods (8). Non-pathogenic *E. coli* is commonly used as an indicator of poor hygiene (faecal contamination), and a higher count was seen in the second vendor's samples. The higher count was directly attributed to poor hygiene practises by the second vendor observed by the researcher (8).

The last study was performed later in 2000 and reported in 2001, in which salad and gravy samples collected from 16 vendors in the central Johannesburg area over four months were tested (93). This study was a survey of the microbiological quality of salads and gravy samples because these foods do not require intensive preparation or cooking (93). The results of the gravies and salad samples showed the presence of some *Bacillus* species and higher bacterial counts in the salad due to its uncooked nature (93). There was no presence of pathogenic bacterial strains such as *E. coli* 0157:H7 (93).

Besides food and water samples, swabbing of preparation areas and even the street vendors hands, also serve as indicators of good hygiene and safe food handling. A study in Bloemfontein in 2006 also investigated the microbial quality of the foods and the hygienic

conditions of the SFVs (66). The results also showed acceptable levels of pathogens on street vended foods (beef, chicken and gravy), the surfaces of the tables used for food preparation and the hands of the vendors (all below the level of infectivity set by the South African Department of Health for foods <100 cfu/area²) (66). Despite pathogen levels being low, more pathogenic and non-pathogenic organisms were detected such as *E. coli*, *S. aureus*, *Salmonella* and yeasts (66) and this speaks to poor personal hygiene/poor hygienic practices during food preparation.

One cannot assume that all street vended foods pose hazards to health. A study carried out in Gauteng, South Africa found the presence of *Salmonella* (19.2%), *L. monocytogenes* (19.2%) and *Campylobacter* (32.3%) in chicken carcasses with no significant differences between store-bought and street vended chicken carcasses and frozen or fresh chicken carcasses (110). The samples taken from street vendors were only fresh chicken carcasses because they do not store frozen carcasses (110). *Salmonella* isolates found on fresh carcasses from the supermarket were significantly lower than those from the butcheries and the street vendors, and *Campylobacter* isolates were significantly higher from the supermarkets in comparison to the butcheries and the street vendors (110).

South African food establishments face challenges in implementing and maintaining hygienic practises, even with access to basic amenities (100,111). A hygiene-based study of 35 sites of a prominent South African retail group in the Western Cape found that the number of coliforms was unacceptable on the hands of 32% of the food handlers as well as on their aprons (8%) (100). *Enterobacteriaceae* were present on the hands of food handlers (44%) and their aprons (16%) and *S. aureus* were present on 88% of hands of food handlers and 48% of their aprons (100). There was no significant statistical correlation between the coliforms found on the hands and the aprons, therefore cross-contamination by hands was ruled out (100). Another study focusing on the hygienic handwashing of food handlers in 8 food outlets in the Gauteng region, found that when the average bacterial counts on hands were compared, 18% of the food handlers' hands had no detectable bacteria, but 60% of the total plate count was over the safety limit (99). Only one sample tested positive for *E. coli*, but no presence of *S. aureus* was found on the hands of the food handlers (99). One of the biggest examples of a major retail group failing to maintain hygienic standards at their food processing plants was the Tiger brands Enterprise Group in South Africa, responsible for the worst Listeriosis outbreak in history (112). By the end of 2018, 183 deaths due to the consumption of polony contaminated with *L. monocytogenes* were reported, resulting in the

shutdown of two of their food processing plants for decontamination, and the incineration of all affected products (113).

Despite working with bare minimum facilities/equipment, and under conditions described by most of the researchers as not conducive to hygienic food preparation (8,66,93) street vended foods are relatively safe to consume. However, it does warrant further investigation and possible re-training of the food vendors' hygiene methods and knowledge.

SFVs' food safety knowledge

The lack of awareness of hazards, knowledge and implementation of knowledge are the greatest factors contributing to foodborne disease (64). According to The International Food Safety Authorities Network (INFOSAN) in 2010, education and training of SFVs is the most inexpensive way to reduce the occurrence of foodborne illnesses (114).

A study in Nigeria showed that 70% of the SFVs' had no knowledge about handwashing after handling money (115). Few SFVs' (17%) acknowledged the necessity of washing hands after sneezing with a handkerchief, and 40% did not acknowledge the importance of handwashing with soap (115). Only a few vendors (10%), stopped vending after experiencing stomach cramps (115). Another study carried out in Ghana had similar findings to that in Nigeria and showed a higher number of SFVs (64%) abstaining from vending due to illness (116).

A study in Uganda tested the SFVs' knowledge of diarrhoea, 22.9% of the SFVs in the Masaka district did not have any knowledge of diarrhoea and in the district of Kampala none of the vendors linked blood in the stool or mucoid stool with diarrhoea (85). In the city of Abeokuta, Nigeria, SFVs understood that diarrhoea (92%) and stomach aches (93%) respectively were symptoms of foodborne illnesses (115). The SFVs in studies done in Ho Chi Minh City, Vietnam and Port-au-Prince, Haiti were unaware that Hepatitis A, *Salmonella* and *Staphylococcus ssp.* were foodborne microbes (117,118). SFVs should be able to understand the symptoms of foodborne illnesses and the mode of transmission. However, SFVs' are not the only food handlers who showed inadequate foodborne illness knowledge; 70.6% of the institutional food handlers in Ghana did not know that Hepatitis A was a foodborne pathogen, and 76.2% did not know that *Salmonella* was also a foodborne pathogen (119).

Another study was carried out in two markets in Nigeria (one with better sanitation facilities than the other), observing the environmental conditions in which the street vendors worked and their hygiene practises (120). It included a survey that looked at demographics and the hygiene practises of mothers with children under the age of five that frequented the markets (120). The aim was to ascertain diarrhoeal risk factors amongst children below the age of five. The level of education of the mothers' in the market that had access to better sanitation facilities, were higher than those in the market with poor sanitation; but was not found to be significant (120). It was concluded that there was no statistical difference in the diarrhoeal risks between the two markets. However, it was noted that in addition to improving the knowledge of the mothers' hygiene, street vended foods and water warranted further supervision and investigation (120).

'Some of the food safety knowledge of the vendors could not be translated to practice due to the absence of basic facilities such as water and toilets at their vending sites' (115). This statement sums up that even with adequate hygienic knowledge, street vendors must face working with bare minimum requirements (what they can provide) to achieve hygienic preparation. Government assistance in providing safe work areas and the implementation of better systems to monitor and guide street vendors should improve the safety of street vended foods.

Policies and legislation governing street food vending: a global and local perspective

Street food vending is a global activity from the hotdog vendor in New York City to kebabs in Istanbul (121), to vetkoek (a type of fried dumpling) (84) in Cape Town. INFOSAN, the FAO and the WHO have each in their way, and through joint efforts promoted food safety health hazard awareness by providing education in the form of posters, conferences and reports; and assisting countries in developing better policies to govern food safety. These organisations help standardise the Codex Alimentarius guidelines on preserving food hygiene and thus ensuring food safety and security in all aspects of food handling and processing; or as they put it from farm to plate (25,114). International Codex committees such as those on food and meat hygiene, food additives and pesticide residues, set out principles for food safety (68). The information for these principles is provided by risk assessments carried out by the three Joint FAO/WHO Expert Bodies: Joint Expert

Committee on Food Additives (JECFA); Joint Expert Meeting on Microbiological Risk Assessment (JMPRA); and the Joint Expert Meeting on Microbiological Risk Assessment (JEMRA) (68).

However, these guidelines are meant to be adopted and adapted by different countries and implemented by governments to better ensure food safety within each region. The challenges for food control authorities remain the same since its documentation in 2001 by the FAO and the WHO and are as follows: monitoring the rise of foodborne illnesses and new emerging threats, keeping up-to-date with technological advancements in food processing and production, developing food control systems based on scientific research and providing education for consumer awareness (122). The need for global trade legislation and harmonisation of standards has never been more pertinent; which is often hampered by poverty, rapid urbanisation and the evolution of food lifestyle (122).

An ideal food control system should contain the following requirements (122):

➤ Food law and regulations:

Food law should state clearly the ramifications of not abiding by the law, including the issuing of fines for those responsible, as well as the removal of the contaminated products from the market (122). It should not only be enforced after an incident but allow for preventative measures to be implemented by relevant food authorities (122). Food legislation should be based on the codex standards as an international reference, and be clear and consistent in outlining risk assessment, management and communication by the relevant authorities (122). It must include measures to trace products and issue recalls where necessary and have strict international trade standards (122).

➤ Food control management

There should be a clear hierarchy which starts at the national level, where funds are allocated for the implementation of policies and legislation at various levels (122). Leadership should be defined, and tasks distributed to different authorities for national food safety strategies as well as the establishment of food safety standards and monitoring of standards (122).

➤ Inspection services

The inspection service must interact with the food industry, trade and the public, and the efficacy of this service depends on the competency and training of these inspectors (122). They ensure compliance to regulations by inspection of premises,

sampling of foods and the rigorous testing of the facilities involved in all aspects of food processing and manufacture (122). It is also imperative that inspectors have a food science background, however in many developing countries EHPs double as food inspectors due to lack of resources (122).

➤ Laboratory Services: Food Monitoring and Epidemiological Data Laboratories

There should be a central reference laboratory that is equipped to carry out all necessary testing of samples and there should be enough laboratories widespread to handle the output of samples (122). There should be reference standards and clear criteria for analysis and reporting of results (122).

➤ Information, Education, Communication and Training

Education of consumers and all personnel involved in the food sector should be carried out during inspections through leaflets and training programs (122).

Each country and city have unique circumstances, some developing countries face more difficulties than others (18). In many developing countries (such as South America and Africa) health codes are old and outdated and are not revised to reflect the current circumstances and advancements in food safety (18,123). There is also a lack of knowledge and co-ordination between relevant authorities, on how to handle food safety issues. Most importantly, developing countries don't have the resources to keep up standards and quality for international trade, food producers and food processing plants require stricter regulations and inspections (123). It has also been noted that in many of the developing countries that it is not only the vendors who are unaware of regulations and codes, but the inspectors and the police have little knowledge of the regulations. In addition, discrepancies in the regulations, make it difficult for them to carry out their duties (18).

As described by Rahmat et al. the developed countries in the European Union (EU) have different limitations than their counterparts in the emerging economy countries and the developing countries (124). The limitations of developed countries are a lack of customer awareness, poor risk communication, and a lack of sharing of research and development knowledge between relevant authorities (124). The emerging economy countries' limitations are too few food safety laboratories, uneven distribution of resources and funds and the lack of standardisation of regulations (124). Whereas the developing countries experience drawbacks in obtaining capital for transportation and storage, and the absence of food law and guidelines (124).

In terms of South African law legislation, there is no specification of incident management in how to deal with food recalls by various business or traders (125). There is no enforcement of a recall in the Regulations Relating to Inspections and Investigations (G.N. No. R. 1128 of 24 May 1991), but Act 54 for the Foodstuffs, Cosmetics and Disinfectants Act prevents the purchasing or sale of foods or products that are hazardous (125). Food Safety Alerts can be issued by the business or if they fail to do so, then the national health authority through the information provided by the DOH can release a media statement for product recall (125). Recalls are only recorded by the DOH: Directorate of Food control if they are a class I (reasonable probability of illness) or class II (remote probability of illness) (125).

What are the differences, if any in food safety regulations between a large-scale city like New York and Cape Town? Firstly, the United States (US) Food and drug administration (FDA) has the FDA Food Code, the latest revision is dated 2017 (126). The Food code is made up of definitions, and details the management of food personnel, food operations, equipment, and facilities (126). It also sets out how to review food establishment plans, the requirements for issuing of permits, and carrying out inspections (126). It is designed to protect public health and food safety and it falls to the local, state, and the federal government to institute and comply with this model, through regulations created by the various departments, agencies, bureaus and divisions (126). Regulations and guidelines created and modelled against the Food Code have several benefits such as a uniform approach to food safety standards, standardised protocols to perform inspections, and minimal redundancies in protocols and assessments (126).

In the city of New York, the Department of Health's Bureau of Community Environmental Health and Food Protection must safeguard the food safety of the public by overseeing the operations of food establishments and street vendors (127). They also ensure compliance to Part 14 of the New York sanitary code, which details regulations for various foodservice establishments such as the one for Mobile Food Service Establishments and Pushcarts (Part 14-4) (127). The bureau is also responsible for carrying out foodborne outbreak investigations and the analysis thereof, to prevent future outbreaks (127).

In comparison, there are two relevant health Acts in South Africa, namely the Health Act 54 of 1972 Foodstuffs, Cosmetics and Disinfectants as amended last in 2007, that deals with the manufacture, sale and importation of foodstuffs (125); and the Health Act 63 of 1977 amended in 2003, which consists of several regulations governing food hygiene, transport,

the inspection of premises and the duties of inspectors (125). Regulation R638 of 2018 for general hygiene requirements, is used by local authorities, municipalities and EHPs to ensure food safety within their jurisdiction (12,125). It is important to note that though the legislation remains pertinent, some are outdated. South Africa requires a central authority such as the FDA to collaborate with the various departments and not rely solely on the local authorities and municipalities that have other mandates, in addition to the responsibility of food safety. A central authority will also help create uniformity amongst local authorities (municipalities), which currently have different adaptations of the regulations (128). Also, SFVs require their regulation, as they operate under different circumstances compared to other informal traders. SFVs in the City of Cape Town need to comply with guidelines for hawking meals (129) and need to apply for a food hawking license from the City of Cape Town, and a certificate of acceptability from the environmental health offices (130).

There is much-needed room for improvement in the South African legislation, not only in the formal sector but in the informal sector (street vending); and this requires better communication, collaboration and sharing of resources between the different departments.

The role of an EHP in foodborne outbreaks

In South Africa, all industries and businesses that are involved with food handling must adhere to legislation set out by the DOH. The DOH and the municipalities oversee policies and regulations providing the necessary guidelines that make the hygienic production and handling of foods mandatory. According to the Health Act of 2003 (Act 63 of 2003), EHPs' provide the following municipal health services: water quality monitoring, food control, waste management, health surveillance of premises, surveillance and prevention of communicable diseases, excluding immunisations, vector control, environmental pollution control, disposal of the dead; and chemical safety (131). Food control is regulated firstly by the Foodstuffs, Cosmetics and Disinfectants Act, 1972 (Act 54 of 1972), followed by the Health Act of 2003.

In terms of food control, the following is rendered by the local authorities: inspections of food premises and foodstuff, health education to food handlers, providing guidance to entrepreneurs in food safety, supervising imported foodstuffs, investigating and putting in place measures of control to reduce foodborne disease and taking action with regards to food safety complaints and reports (131). In South Africa, EHP's have dual responsibility of that of a food inspector and an environmental health officer. The clinical guidelines on

management and control of foodborne diseases in South Africa (12) highlights the importance of communicating foodborne outbreaks (or even the indication of a possible foodborne outbreak) to EHPs' by clinicians and laboratories and requires submission of a full account of the results to the nearest district or provisional office (12). It is the responsibility of an EHP to efficiently respond, ascertain by sampling and testing, and assess any potential outbreaks (12). Their goal is to prevent the spread of the outbreak/disease with the least harm to the community at risk. The steps taken by an EHP are outlined in various guidelines such as *The guidelines for an Environmental Health Officer (EHO) engaged in food poisoning investigations* (89), *the guidelines for Environmental Health Officers on the interpretation of microbiological analysis data of food* (132) and *the guidelines for the management and health surveillance of food handlers* (125). The ratio of EHPs to the population according to the WHO should be 1 EHP to 10000 population, and in South Africa, the ratio is around 1 EHP to 15000 population placing a large burden of activities on a small workforce (133).

A review of Foodborne diseases was conducted by the NICD and reported to the outbreak response unit from 2013 to 2017 (11), in which they list the inconsistencies in several areas of writing and reporting of incidents. The actual date of the outbreak, the location, the age of the patients, the total number of cases, and the proportion of the cases that developed the disease were not recorded (11). There was also a lack of environmental and clinical specimens retrieved and tested, as well as the documentation of the patients' history of food exposure, which made tracking the source of infection difficult (11). The most prevalent pathogens found in stools and food samples in the 327 cases over the five years were reported as follows: *Salmonella*, *C. perfringens*, *B. cereus*, *Shigella species*, *L. monocytogenes*, and *E. coli* (11). The report concluded with the importance of reducing errors in reporting at district and municipality levels, the long periods between sampling and testing as well as testing for appropriate and a wide array of not only bacteria but also viruses and parasites (11). Mbonane and Naicker (13), investigated the knowledge, attitude, and practises of EHPs in the Ekurhuleni Metropolitan Municipality in the Gauteng South Africa. They found that 72.1% of EHPs had not investigated a foodborne outbreak, thus reflected poorly on their knowledge scores for outbreak investigations (13). Although their attitude was noted as positive towards foodborne investigations, only 42.6% were confident in their training to handle foodborne outbreaks (13). There were notable gaps in the reporting and investigating of foodborne outbreaks in terms of the notification of outbreaks and preparation for investigating an outbreak (13) that differed from the guidelines by the DOH (89). Many

of the participants (98.4%), requested a standard operating procedure as a guideline for outbreak investigations, 69% requested additional training in environmental epidemiology and all the participants requested additional resources and support (13).

The outbreak of Listeriosis in the latter months of 2017 proved that the government and municipalities could not handle an outbreak of its magnitude effectively. Manpower was limited to EHP's, who are not only low in numbers but had access to a few laboratories that had to analyse the surplus of samples; and had the difficult task of tracking the source of the outbreak. The WHO has described the listeria outbreak as 'the worst listeria outbreak in recorded history' (112). The possible origin of contaminated foods was narrowed down to farms and food processing plants (134). The South African National Health Act 61 of 2003 section 3 (1c) hands the 'Minister of Health the responsibility to, within the limits of available resources determine the policies and measures necessary to protect, promote and maintain the health of the population' (12). The Minister of Health at the time, Dr Aaron Motsoaledi said that environmental health inspection is the duty of municipalities (112). He further stated that "It was a mistake for the Constitution to give that job to local government because municipalities can't simply afford it, because they've got basic services to provide." (112) Besides the inadequate numbers of EHPs employed countrywide, the smaller municipalities were thought incapable of inspecting larger scale corporations (112).

The EHP's tracked down infected patients and took samples of the foods in their refrigerators to gauge the source of the contaminant (134). These samples were submitted for testing at the NHLS Infection Control Services Laboratory (134). This involved a huge collaborative effort, from DOH to the laboratories to the EHPs to help reduce the number of cases by providing education and diagnosis information, as well as investigating the various strains identified and attempting to find the source of the outbreak. The source of the outbreak was finally traced to an Enterprise food processing plant in Polokwane in which the DOH confirmed the presence of the *Listeria monocytogenes* ST6 (LST6) strain, the very strain responsible for the outbreak (112). In the aftermath of 1060 confirmed cases of listeriosis and 216 deaths, the new regulations brought forward by the collaboration of the DOH and the Department of Trade and Industry (DTI) were to assign the inspections of processing plants to the National Regulator for Compulsory Specifications (NRCS) (135). The NRCS will perform regular inspections of these processing plants and report back to the DTI (135).

The extent of the outbreak raised questions concerning the DOH's and the municipalities delayed response to the outbreak and their capabilities of controlling the spread of an outbreak. These concerns were reiterated by Professor Lise Korsten, who in an interview reported her concerns on the outdated legislation and the lack of regulators and inspectors (136). She talked about the need for a central authority and standardised framework that can be executed on imports and exports to help ensure food safety locally and abroad (136). Lastly, she called for collaboration between government, industry, and academia to work together to establish a better framework and revise legislation (136).

The DOH had released media statements and provided the public with information and communication surrounding the listeriosis outbreak (134). They advised the public to follow the WHO five keys to food safety, which is centred on hygiene (such as handwashing) and the importance of safe foods (134). In the middle of the Listeriosis outbreak, the City of Cape Town was also experiencing a severe drought which prompted the municipalities and government to step in and enforce water restrictions (137). The DOH placed so much focus on educating the public on the importance of handwashing, but did not assist the street vendors with access to water (137). Instead, taps were turned off at most communal and transport areas such as taxi ranks, and train stations, where majority of street vendors operate (137). Street vendors interviewed at Wynberg taxi rank reported that customers were misinformed and thought that if they did not consume 'polony' (the food product found to be the source of the outbreak) that they would not fall prey to the disease (137). The vendors were reported as baffled as they were presented with Listeriosis pamphlets by members of the Western Cape DOH (137). The vendors had some knowledge of how to prevent the spread of the disease but without sufficient access to water, implementation of the knowledge was hampered (137).

During the COVID-19 pandemic, Women in Informal Employment: Globalising and Organising (WIEGO) developed specific COVID-19 guidelines for informal traders to allow the safe operation of street trade during the lockdown (138). The guidelines detail the highly infectious nature of the virus, how to make their disinfectant, how to practise social distancing and effective handwashing procedures (138). The government was urged to intervene and provide water, bleach, or sanitisers, and allow flexible trading on plots of land to enable social distancing (138). The listeriosis outbreak and the COVID-19 pandemic has shown that government and municipalities need to be proactive rather than reactive because

the lack of access to infrastructure in the informal trade industry is an ongoing impediment to hygienic operations.

Chapter 3: Methodology

Clarification of the Methodology

A cross-sectional survey allowed for a point in time study of the hygienic practises of the SFVs, their food safety knowledge and included microbiological testing of food samples, swab samples, and environmental water samples which were used to determine the hygienic practices of the SFVs. The surveys provided the qualitative aspect of this study in which the sourcing of raw materials, the hygienic practises, the food safety knowledge of the SFV, the documentation of the working environment and the observational practises of the SFVs such as the washing of dishes were investigated. The microbiological testing allowed for the quantitative analysis aspect to ascertain the level of acceptability as determined by the DOH and was expressed in CFU. This chapter describes the ethical considerations for the study, setting, study population, sampling locations, study size, limitations, data collection and analysis tools.

Ethical aspects of this study

The study was approved on 11th December 2015 and on the 20th July 2017 by Stellenbosch University's Committee for Human Research at the Faculty of Medicine and Health Sciences. The study registration number is S15/10/222. The fieldwork for the study took place between 11 December 2015 and 11 December 2017 in the City of Cape Town metropole.

The investigator who carried out the surveys is also the candidate for the master's study and was assisted by an isiXhosa translator, where necessary. The surveys were carried out following the International Declaration of Helsinki (1964) in which participants' information is kept confidential and the participant could withdraw from the survey at any point. The vendors were approached by the interviewer and asked for permission to participate in the study and were then handed consent forms in their preferred language outlining the study information, the reason for the study and what was required from their participation (See Addenda A). They were also asked for consent for a photograph to be taken of their surroundings. If the participants could not write their signature, they marked their signature as an 'X'. If they did not wish to sign because they felt uncomfortable, they gave verbal consent. The investigator declares that there are no conflicts of interest in the present study.

Study Population, Sample sites and strategy

The population of interest was SFVs in low-income, urban communities in the City of Cape Town. The study was carried out around the pension pay-out points within these communities, where most SFVs operate in so-called 'pension markets' (7). Although studies on hygienic practices and the microbiological testing of street vended foods have been carried out in Gauteng Province (8,93), there is a paucity of data in the Western Cape. Due to the paucity of information on the SFV population, or areas in which SFVs operated in South Africa, a non-probability sampling technique was utilized. It is an expedient and cost-effective sampling technique applicable to surveys (140), but it requires a decision to be made about the target population when there is limited information (140). A judgement call was made concerning the characteristics of the target population (i.e., the decision to use pension pay-out points to locate SFVs in the present study) by the researcher.

Pension pay-out points were used to locate SFVs, based on what is termed 'pension markets' which is pension pay-out points that attract street vendors that sell a multitude of products hence a market (7,84,141). The schedules of pension payout sites were obtained from SASSA and were used to randomly choose low-income communities within the City of Cape Town, which was then visited for street vendors. Although race was not in the selection criteria, the typically lower-income communities are currently made up of African and mixed-race constituents.

The study site met the following criteria:

- a. The pension pay-out points were situated in low-income urban communities in Cape Town.
- b. The dates and sites were selected at random from the SASSA pension payout schedule.

SFVs present at pension points within low-income areas in the City of Cape Town (such as Mitchells Plain, Langa, Gugulethu and Khayelitsha) were mapped out (Refer to the Maps 1-3 below that were created using Google Earth) according to the SASSA designated pension points as sites to be sampled. In South Africa, a state pension is paid out on various days ranging from the 1st day of the month to the 18th day of the month with different venues (such as community or school halls) allocated to the various days within these pension sites.

Sample size

It is difficult to establish an optimal size of a sample taken from such a fluid, informal process as the street vending of food because there is no statistical data to reference. The main objective in drawing this sample was to obtain the best representativity and to include as many different locations and types of vending as possible and affordable because there was no statistical data to reference. Although a larger sample size yields better quality data (140,142) it is not always feasible; particularly because of high costs. Statistical calculations may also be used to calculate the sample size required to obtain reliable data; however, this relies on previous data responses and sample sizes (140). Qualitative surveys invariably have smaller sample sizes (140), because they have more open-ended questions which require a large amount of time to answer.

The total number of participants for the study was calculated by the statistician at approximately 50 SFVs, but consideration for the availability of the vendors, and the right of refusal to participate brought the total down to 30 SFVs. It was then decided that sampling would take place in two phases (Phase 1 and 2) to maximise the availability of vendors and hopefully increase the number of vendor participation by visiting as many sites as possible. Phase 1 and 2 had 20 sites, and these sites were split amongst the two phases. Out of the 20 sites, only 18 sites had street vendors present.

Pilot site testing

A pension site was randomly selected and used to pilot the survey and ascertain if the researcher needed to make any amendments to questions. The sampling time, access to the site, noting of observations and the number of street vendors present was recorded. The pilot study was carried out at the Ikwezi pension pay-out in Gugulethu and was used to ascertain the approximate number of vendors that would be found at each pension site. A food sample and water sample were taken from the participants for testing. Initially, the investigator wore gloves, but it was perceived as suspicious by the SFVs and made them uncomfortable. It was decided that it was better to let the vendor take the sample bag and water bottle and collect the sample themselves in full view of the investigator, after which it was then handed to the investigator and placed in the sampling cooler box on ice.

The survey questions were then adapted to fit the scene where braaied meats (roasted over open coals/wood) featured prominently. On the other hand, vegetables either in salads or cooked on its own did not feature and were removed from the survey questions. None of the SFVs interviewed at the pilot site had a first aid kit and the question was also removed from the survey.

After sampling and testing numerous food samples, it was decided that swabs were a better alternative to food samples for determining surface hygiene of the SFVs. Food samples were discontinued, and the impact of this will be discussed further under study recommendations.



Figure 2.1: Map showing the pension pay-points in Mitchells Plain and Khayelitsha

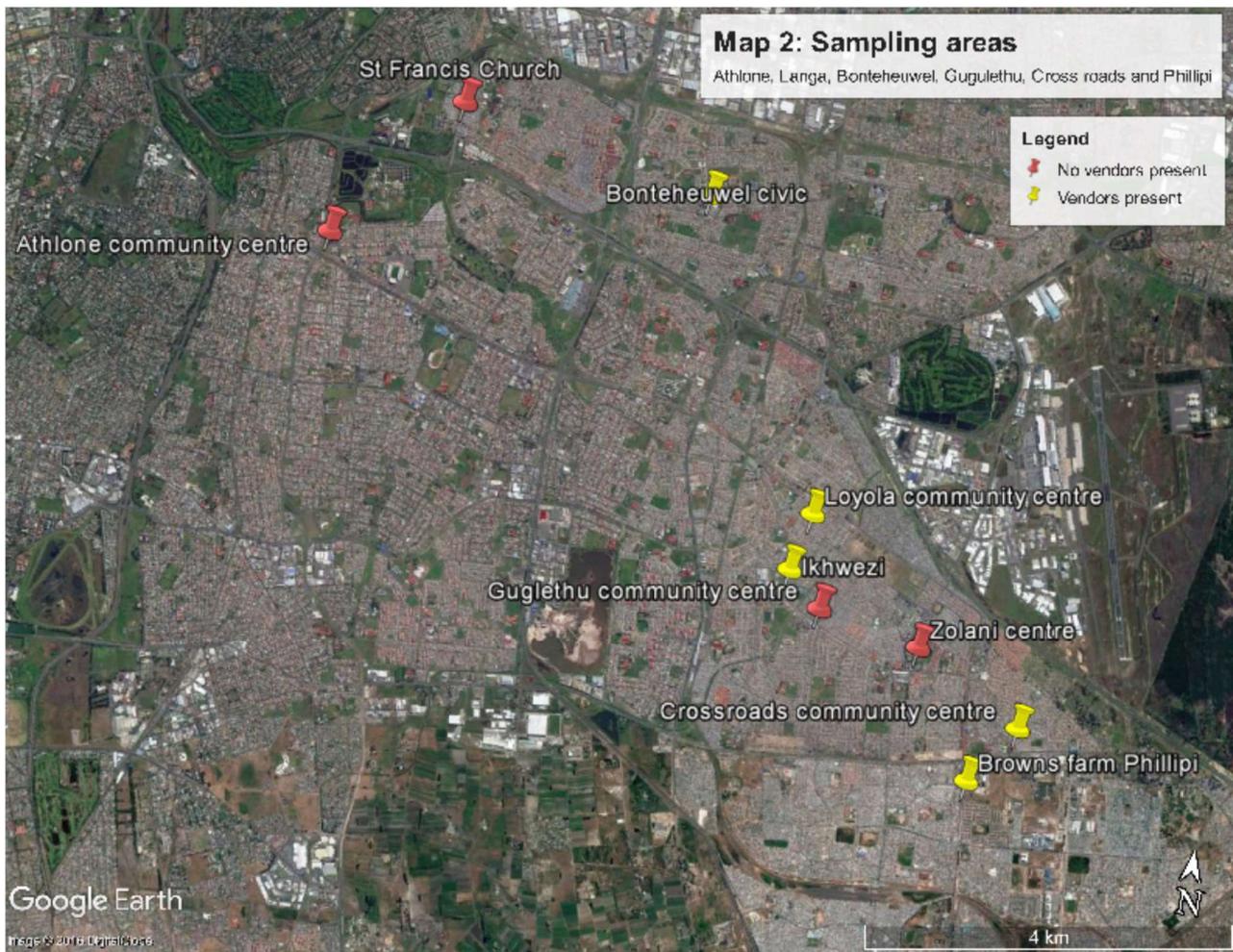


Figure 2.2: Map showing the pension pay-points in Athlone, Bonteheuwel, Gugulethu, Crossroads and Philippi



Figure 2.3: Map showing the pension pay-points in Masiphumelele and Steenberg

Rationale for the use of cross-sectional surveys and its limitations

Samples used in survey research involves the selection of individuals from a larger population of interest to make inferences about the larger population (142). The target population in the present study was identified as SFVs because emphasis was placed on the hygiene practices of the selling of cooked/uncooked foods or the quality of canned products, excluding all other informal vendors (i.e. selling fruits, vegetables, sweets and clothing). A cross-sectional survey ('or point in time survey method') was the most applicable to the investigation because it helped document demographic information, and helped gauge the knowledge of the vendor, while the recorded observations by the investigator allowed for descriptions of the vendors' food preparation and the environmental conditions in which the vendor operated (142).

The information available on the whereabouts of street vendor operations is minimal. A non-probability sampling technique was thus utilised as the decision was based on a judgment concerning the target population (140). The disadvantage of this method is selection bias (140), however, all participants who wanted to participate were allowed to and this was further classified as convenience sampling as these SFVs were present at/near the pension pay-out points. Snowball sampling was also utilised whereby a SFV would recommend other SFVs to approach for participation, which is useful when the researcher does not have a list of SFVs to interview (140).

Survey research has advantages in terms of descriptive observations based in real-time, it has a lower cost exercise and can produce a large amount of data in a short period (142). A combination of qualitative and quantitative research questions was utilised in the survey in the present study to be descriptive, attain as much information as possible and obtain facts (143). Quantitative research is designed to obtain numbers and facts, whereas qualitative research is designed to gather information about a study that includes opinions and views as well as motivations and attitudes (143). The disadvantages are the inability to calculate the response rate, the number of non-responses due to misunderstanding the question and if the survey questions are not well thought of, the data produced might not answer the aims of the investigation. Also, too much emphasis can be placed on the sample size, and the exclusion criteria which can adversely affect the data quality produced (142).

In the present study, there were a few non-responses to some questions, which was linked to not understanding the question even with a translator present or that they did not know the answer to a question and were afraid to answer incorrectly. It is a common limitation in almost all surveys, but the translator and the investigator did try to follow up for a response without making the participant feel uncomfortable or pressurised to answer.

The surveys had a combination of closed (choice of a pre-determined answer) and open questions which were recorded by the investigator onto the research tool sheets by hand in real-time. Face-to-face interviews were carried out, which was more time-consuming, but it allowed for real-time documentation of observations. Face-to-face interviews usually have higher response rates than most other research tools (such as post or email), which were not an option for this study as many of the SFVs do not have access to postal services or the internet (140).

Data collection tools

All survey information was gathered anonymously and the participant at each interview was shown the data capture sheet so that he/she could confirm the anonymity. Participants could stop the survey if they no longer felt comfortable participating in the study.

The inclusion criteria were street vendors selling cooked foods as well as packaged and canned food products; thereby excluding vendors selling clothing or detergents. Research tools in the form of surveys and data capture sheets were designed for this study, and are described below:

Research tool 1: Survey for cooked/uncooked foods focuses on vendor's food preparation, handling, and the hygienic knowledge of the vendor (See Appendix C).

- **Research tool 1.1** was an observational checklist to assess the surrounding environment in which the vendor operates (See Appendix C).

Research tool 2: Survey for canned/packaged foods focuses on the type of items being sold as well as determining the source/supplier for which no sampling was required (See Appendix C).

- **Research tool 2.1** was an observational checklist to assess the condition of the items being sold by the vendor (e.g. damaged/expired) and the surrounding environment (See Appendix C).

Research tool 3: Questionnaire for Environmental Health Practitioners (EHP) was to ascertain the procedure for documenting and tracing food-borne outbreaks and to determine the challenges they face in implementing procedures (See Appendix D).

A plain cardboard box was used to hold all documentation (surveys and consent forms). The observation checklist was used by the investigator after arrival, to document and describe in detail the layout of the surroundings, the infrastructure and equipment utilized by the vendors. Vendors were approached one at a time, once they had signed their informed consent, they participated in the survey in their preferred language which took roughly between 20-30 minutes as some of the vendors were busy attending to customers. If their preferred language was isiXhosa, the translator stepped in and assisted with the answering of the questionnaire.

The questionnaire and data capture sheets were study specific and created for this investigation. There are no gold standard to compare them against as is the case in formal validation. They can however be used as base documents for other studies with the necessary adaptations.

Data Analysis

All results obtained from the survey were entered per question and per vendor from the survey documents electronically into Microsoft Excel spreadsheets and represented in tables and diagrams to protect the anonymity of the food vendor. A points system was created by the investigator to assess the hygiene practices of the vendors by grading them according to their answers from the questionnaire concerned with basic hygiene such as handwashing. SFVs were ranked out of 100 points, a higher SFV score was associated with a low risk of foodborne illness (indicated by a dark green colour) and acceptable hygiene practices. A high risk of foodborne illness with questionable hygiene practises is indicated by a dark red colour and a low score. The grading of the colour scale was done in Excel using conditional formatting colour scales. It was compared to the results from the *E. coli* swabs to see if there was a connection between bad hygiene practises (low score) and the swab results. The points system was purely an effort to maintain consistent capturing of the qualitative data and was specially designed for this study. There is no 'gold standard' against which this system could be validated. It was not intended as an internationally acceptable research instrument. For that to happen a separate extensive study is needed.

Data were captured into a Microsoft Excel spreadsheet and transferred by a statistician at the Centre for Statistical Analysis at the University of Stellenbosch into Statistica version 9.0 Stellenbosch University (StaSoft Inc. 2009, USA) for further analyses. The candidate/investigator entered the data herself and verified all entries with the statistician. Prof Kidd, chief statistician at the Centre for Statistical Analysis at Stellenbosch University performed the analysis of data. Non-parametric Chi-square and Kruskal Wallis tests was utilised at the statistician's discretion and was interpreted by the investigator.

Sample collection and testing

As a token of appreciation for participation, a small donation (approximately R30) was given to the vendor. Paying to sample the street foods upfront after the consent, could be

misconstrued as co-coercion to participate. The Ethics Committee for Human Research of the Faculty of Medicine and Health Sciences of Stellenbosch University approved the token of appreciation which was given after participation and amounted to the value of foods purchased for testing.

A code linked the food, water, and swab samples with the survey (Research tools 1&2 above) for data analysis purposes. The code contained the participant number and site information and was printed onto stickers which were stuck onto the sample bags and bottles. Sampling began in the summer months from December to April 2016 and was restarted (second phase) in November 2016 to help increase the vendor participation numbers. There was a lag in sampling between April and November because of the winter months. The unpredictability of street vendor movement made it difficult to assess the number of vendors at one given site, therefore additional sites were added to help improve these odds. The SFVs' names were listed on a document to track those who already participated to guard against interviewing the same SFV twice.

Before leaving to the site, sealed ice packs were packed into a large cooler box which was used to store all the samples collected during the fieldwork to keep the samples below 15°C. Sterile plastic bags (in which food samples were placed) and sterile glass bottles (used to take water samples) were purchased from Swift Silliker, now called Merieux NutriSciences SA and placed in the cooler box to limit die-off of pathogens.

After the survey was administered, a food sample was taken and placed by the vendor into sterile plastic bag, sealed with a rubber band and placed in the cooler box. The food samples were labeled with stickers that linked the sample to the vendor ID. A water sample was also taken from the washing bucket or the water storage container and appropriately labeled.

Swab samples were also utilised as they can be linked to the hygiene status of specific areas of concern in the preparation of various foods by the street vendors (for example swabs of the utensils, various surfaces such as the chopping board, sink areas and tables etc.) (66). Sterile swabs were purchased from Merieux NutriSciences SA and were moistened with sterile water (contained in a sterile bottle) before applied to the surface area in question. An approximate region of 10cm by 10cm square area if possible were swabbed, carefully sweeping the swab in a constant motion until the approximate 100cm² area was covered. The swabs were carefully re-sealed after application and clearly labelled linking

the swab to the respective street vendor number. The swabs were also placed on ice packs in a sterile plastic bag assigned to each vendor. Once sampling was complete, the samples were immediately taken to the laboratory by the investigator and logged for testing.

The samples were transported by the investigator to Merieux NutriSciences SA, an accredited laboratory without delay after the last vendor was administered the survey and sampling were completed for the day. At Merieux NutriSciences SA, the samples were checked and verified by the laboratory technicians and forms were filled in for testing the various microbes.

Food and water samples were subjected to routine food and waterborne disease testing including quantitative cultures for gram-negative organisms like *E. coli*, gram-positive organisms (such as *B. cereus*, *C. perfringens*, *S. aureus* and *L. monocytogenes*) as well as the Total Microbial Activity (TMA). Swab samples (surface swabs) were only subjected to *E. coli* (a hygiene indicator) and TMA testing. Accreditation and protocols linked to testing can be found on their website and their South African National Accreditation System (SANAS) certificate (144). All samples were analysed within 24 hours of receipt by the laboratory.

A small informal pilot study was undertaken by the investigator to investigate the microbial quality of fruits and vegetables purchased at nearby grocery stores located within the sites. This was done after many persons visiting the pension payout points complained that the formal supermarket stores in their areas also stock low quality products and that using formal store outlets do not ensure better quality. This informal investigation could provide a point in time example of the quality of the produce sold at these grocery stores within these low-income urban communities. It would also point to wider issues of food quality available from formal food outlets to the inhabitants. That could serve as a caution that not all food-related quality problems should be attributed to informal trading. Five sites and five different grocery stores were randomly selected and sampled for a vegetable or fruit sample. The samples purchased from the stores were also submitted for analysis at Merieux NutriSciences SA and instead the exterior surface of the foods was swabbed and tested for TMA, *E. coli*, *Salmonella*, *L. monocytogenes*. These microbes are frequently found on surfaces of different food produce and the hands of customers or workers, which might transfer the microbes from one surface to another (8,66)

The questionnaire for the EHPs was submitted to the City of Cape Town for approval to allow consent for participation from the EHPs and the clinical nurses that work within the City of Cape Town. The City of Cape Town has its own health research request process that must be submitted via their website (145). The initial health research request was denied, because it included a questionnaire that required clinical nurses to report on the number of diarrhoea cases within the City of Cape Town. The manager for the Specialized City Health department and her team felt that the questionnaire was subjective and that the diarrhoea cases reported by nurses could not be positively linked to food poisoning. The clinical nurse questionnaire was then removed from the study. The investigator re-applied to the Committee for Human Research of the Faculty of Medicine and Health Sciences of Stellenbosch University because the ethics approval had expired and was granted ethics approval for another year. The investigator submitted a second health research request to the City of Cape Town, without the questionnaire for clinical nurses and the research request was approved. The EHP questionnaire (Research tool 3) was sent via email to some of the Environmental Health Practitioners employed by the City of Cape Town that renders service to these communities. The EHP's who participated were selected by the Senior EHP as instructed by the Manager of the Specialised City Health department and asked to participate. It was important to understand the pressures and constraints they work under in their tireless service to these communities and the steps they utilised to assess cases of food poisoning. It was also important to find out the protocol followed for foodborne outbreaks and the policies in place that allow for the execution of these protocols. Excerpts of their responses were summarised and reported.

Chapter 4: Results

In this chapter, the qualitative survey results and observations are reported first followed by the quantitative microbiological results. The SFV participation response rate was 83.3% and Table 3.1 depicts the total number of SFVs who sold uncooked/cooked foods and who participated at the various sites. There were no SFVs who sold canned/package goods such as baked beans or noodles, therefore no results were tabulated for the canned/package goods survey.

Demographic information of participants

There was a total of 25 participants from the various pension sites shown below.

Table 3.1: Number of the street vendors that participated in the study (n=25)

Pension Pay-out Sites	No. of SFVs
Crossroads	3
Khayelitsha Resource Centre (Site B)	2
Bonteheuwel	1
Khayelitsha (Site C)	3
Masiphumelele	2
Ikhewzi Gugulethu	4
Lingelethu West	4
Loyola Gugulethu	1
Browns Farm	5

The participants' preferred language of choice was isiXhosa (64%) compared with 36% who choose to converse in English (see Table 3.2). The survey was also translated into Afrikaans, however, none of the participants choose to converse in Afrikaans.

The eldest participant was 65 years of age and the youngest was 21 years old. The median age of participation was 34 years old.

Table 3.2: Characteristics of the street vendors (n=25)

Demographics		
Language	isiXhosa	English
	64%	36%
N	16	9
Gender	Male	Female
	68%	32%
N	17	8
Dwelling	Informal	Formal
	40%	60%
N	10	15
Dependants	Yes	No
	88%	12%
N	22	3
Ownership of the stall	Yes	No
	44%	56%
N	11	14
Only form of income	Yes	No
	4%	96%
N	1	24
Sufficient income to live on	Yes	No
	20%	80%
N	5	20
Supplement income with social grants	Yes	No
	36%	64%
N	9	16
Access to ablution facilities at home	Yes	No
	92%	8%
N	23	2
Access to ablution facilities at the stall	Yes	No
	80%	20%
N	20	5

There were more female participants (68%) than male participants (32%).

Domicile and Economic status of the Participants

The median number of dependants reported is four people, the highest number of dependants being 11 and the lowest being none. Only 56% were the owners of the stall, many of the SFVs work for the owner and are paid a wage per day. The SFVs (80%) reported that this income was not enough to live on, let alone care for any number of dependants. According to the results above, 96% have stated that this was not their only form of income and 36% have said that they use social grants as an additional form of income.

The median amount earned per day was R400, whereas the highest income earned was R10000 and the lowest amount was R50. The highest amount of income is an outlier as most of the SFVs earned between R150 up to R1000 per day. Many of the SFVs have been in business for up to 23 years, and some only for 3 days. The median time selling street foods was 3 years.

Educational status

Analysis of the age vs. the education level (see Figure 3.1 below) obtained by the SFVs using the Kruskal Wallis test yielded a p-value of 0.01 at a confidence level of 95%, which indicates a significant difference between the age of the participant and their level of education. Most of the SFVs between the ages of 45 to 65 years only completed or attended primary school and may not have had the necessary educational background on hygiene and food safety knowledge that may have been available to the younger SFVs who attended high school.

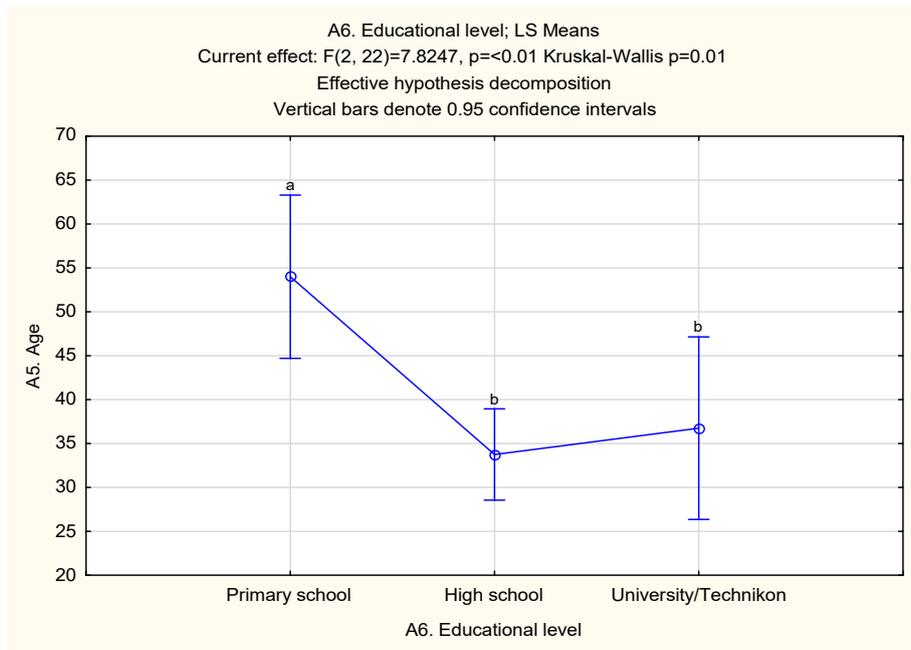


Figure 3.1: Comparison of the age vs. the education level of the participants

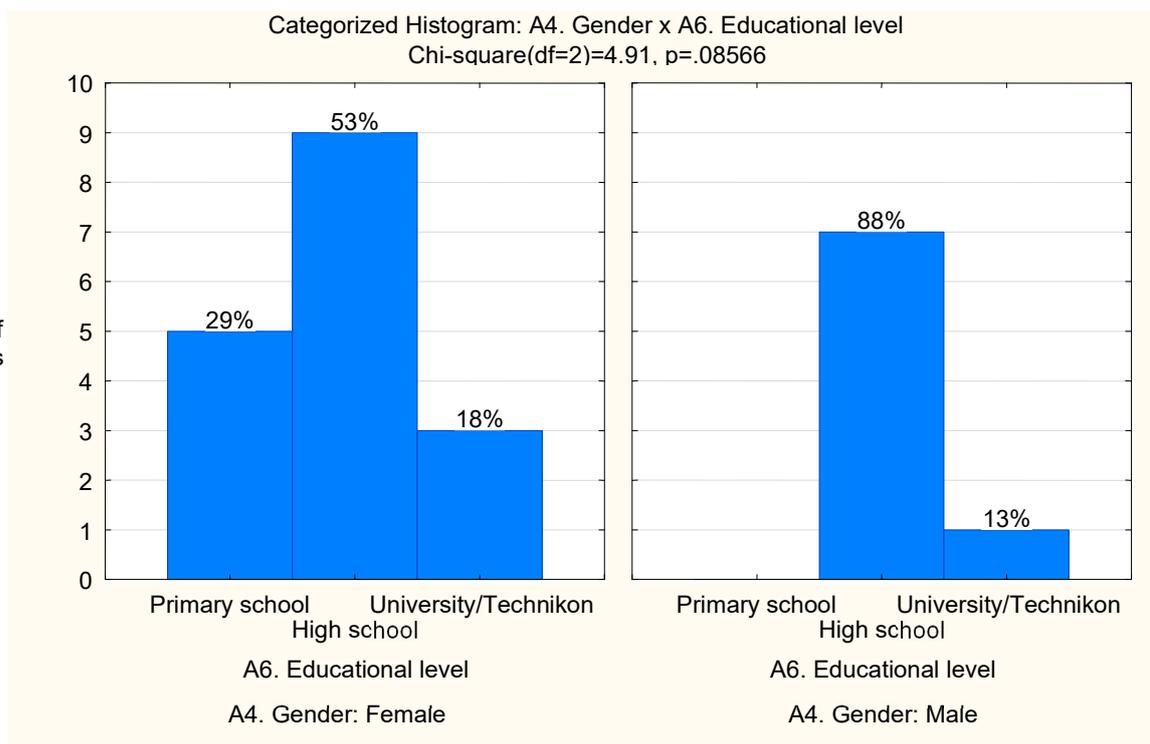


Figure 3.2 Distribution of education levels according to gender

When gender was compared to the education level, no significant difference was found using the Chi-square test (p-value = 0.8566). Only 53% of females had a high school education, while 88% of their male counterparts had some high school education.

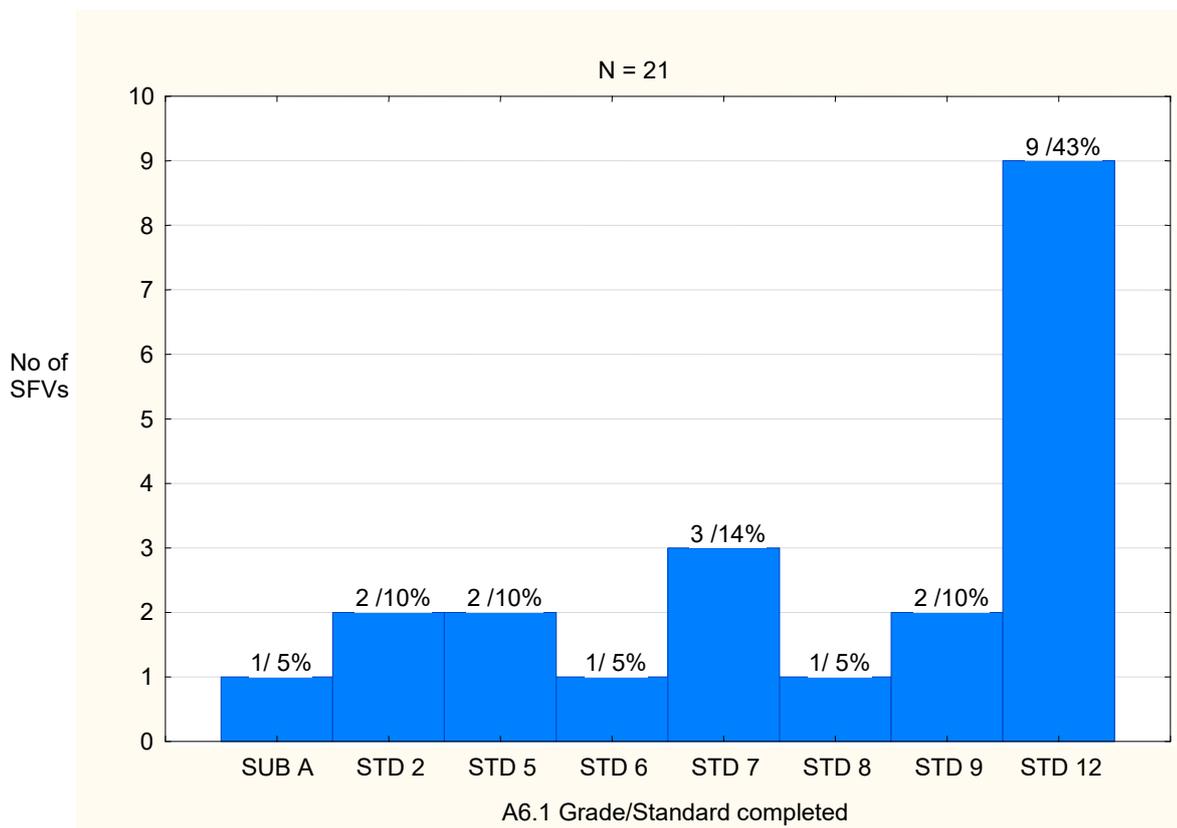


Figure 3.3: The various education grades/standards completed by the participants

Only 43% of SFVs completed grade 12 in high school, commonly referred to as a 'matric' level, whilst 10% completed primary school and 15% did not complete primary school.

Knowledge of the SFVs

All SFVs understood the basic concept of hygiene and why it is important to maintain cleanliness, and 92% understood the danger of contamination such as raw foods should be kept separate from cooked foods. All SFVs responded that they knew the five guidelines (known as keys) of food safety used by the WHO and the DOH as a form of training. The five keys are as follows: cleanliness (basic hygiene like handwashing), the separation of raw and cooked foods, cooking foods thoroughly, maintaining safe storage temperatures (e.g. refrigeration) and the importance of using safe raw materials (such as pasteurised milk) (146) However, when asked what the five keys were, they were unable to list all but understood the basic concepts.

When asked about the safe temperature of cooked foods, only 36% did not know. The responses from the 64% who said that they did know were as follows: 33.3% had no

response, 11.1% said that raw meat must be kept cool, 11.1% said a cool environment, 11.1% said medium temperature and 33.3% said high temperatures.

Table 3.3: Educational level versus response to the question 'Do you know what the safe temperature is for the storage of cooked foods?'

Educational Level	Yes	No	Row Totals
Primary School (n)	2	3	5
Row %*	40	60	
High School (n)	4	12	16
Row %	25	75	
University/Technikon (n)	3	1	4
Row %	75	25	
Totals (n)	9	16	25
Marked cells have counts >10 Chi-square (df=2) = 3.45 (p=0.17841)			

*Percentages are rounded off

More of the SFVs who had completed/attended primary and high school did not know about the safe storage temperature for cooked foods. Overall, the Chi-square $p=0.17841$ and was non-significant.

Table 3.4: Educational level versus percentage response to 'Do you know why it is important to use products that are safe like pasteurized milk?'

Educational Level	Yes	No	Row Totals
Primary School	0	5	5
Row %	0	100	
High School	7	9	16
Row %	43.75	56.25	
University/Technikon	3	1	4
Row %	75	25	
Totals	10	15	25
Marked cells have counts >10 Chi-square (df=2) = 7.22 (p=0.02703)			

None of the SFVs who completed/attended primary school knew why they should use safe food products, while 75% of the SFVs who completed/attended university understood the importance of safe food products. This result was significant $p < 0.05$, which indicates that primary school level education may not equip SFVs' with sufficient knowledge on the importance of utilising safe foods.

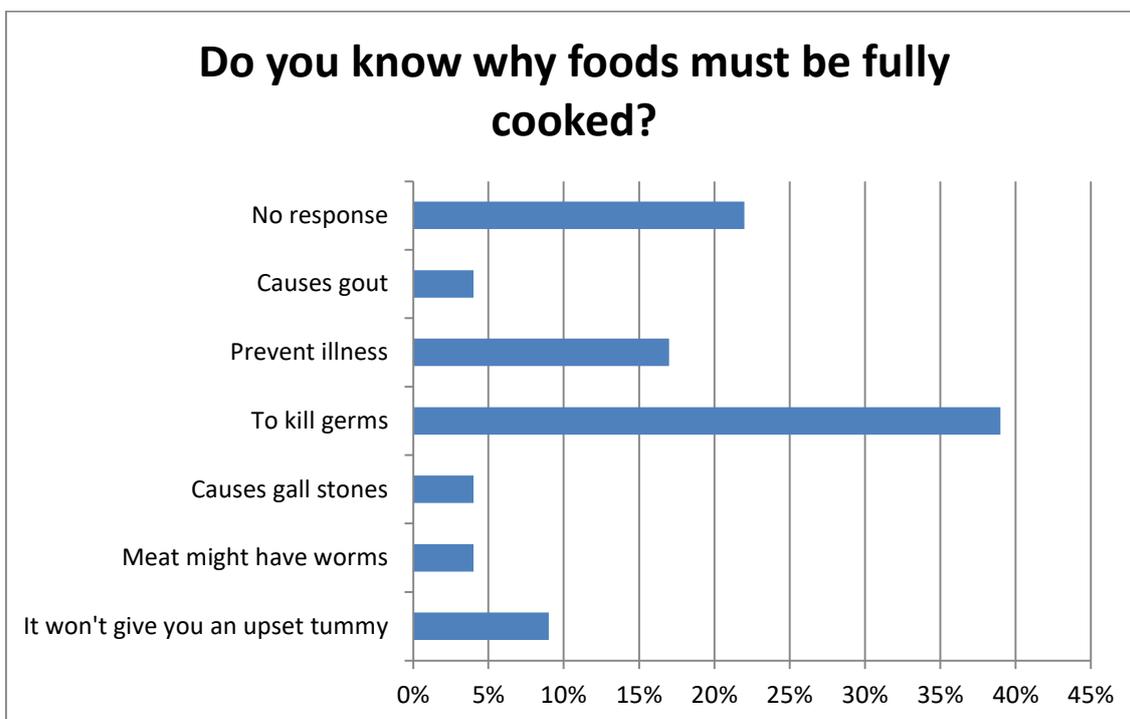


Figure 3.4: Percentages of the various responses of the SFVs in response to 'Do you know why foods must be fully cooked?' (n=25)

They understood the reason behind the cooking of meat and if they did not cook it properly it caused illness, even if the illness was not correct like gout/gall stones.

Although it is compulsory to have certification to operate as a street vendor, 80% said that they did not have one. The street vendors did acknowledge that there were inspections and 64% said they knew what an EHP was and that 52% reported that they had been inspected. The EHPs have been visiting sites as 62% of the SFVs have had food hygiene training and 72% would like more training.

Table 3.5: Educational level versus percentage in response to 'Do you know what an EHP is?'

Educational Level	Yes	No	Row Totals
Primary School	1	4	5
Row %	20	80	
High School	12	4	16
Row %	75	25	
University/Technikon	3	1	4
Row %	75	25	
Totals	16	9	25
Marked cells have counts >10 Chi-square (df=2) = 5.17 (p=0.07527)			

A quarter of the SFV's who attended high school and university did not know about the occupation of the EHP. Comparing the various education levels yielded non-significant differences (Chi-square test, $p=0.07527$).

Observations of the SFVs

SFVs are not allowed on the premises of the pension pay points, therefore they set up their operations on the side of the road, usually next to other local business or taxi ranks; and sometimes further down the road from the pay-out points.

Table 3.6: Descriptions of the various pension pay-out points (n=25)

Category of vending site	Count	%
Busy with commuters and cars passing by the pensioners	8	32
Next to the pension pay-out point opposite a crèche	1	4
Busy with commuters	1	4
In a taxi rank, busy with commuters opposite pension pay-out point	3	12
Small garage adjoining a house	1	4
Small shelter outside a house	1	4
Next to the pension pay-out point and opposite traffic department	4	16
A kilometre down the road from the pension pay-out point hidden amongst shacks and scheme housing	1	4
A kilometre down the road from the pension pay-out point with heavy traffic	5	20

These areas were heavily congested with commuters and pensioners and family members that are assisting their elderly to get their pension. Pensioners queue at the pay points from early in the morning, well before the time that the pay-points open. The street vendors usually set up shop around 9 am to 10 am, as this is the time that is the most congested. They pack up to close around 3 pm to 4 pm. Pension pay-out points are the busiest on the 1st and 2nd day of the month, and on these days the street vendors travel to the venues and try to get the best position closest to the gates.

Day to Day activities of the SFVs

According to the SFVs, 50% of them bought their meat/fish from the supermarket, 25% from the butchery, 13% from wholesalers and only 4% obtained their meat/fish from a nearby vendor. According to the survey results, 100% of the SFVs choose pension pay-out points because of its proximity to people and popularity. Many of the SFVs travel by car or van carrying all the items they require and those who live nearby push trolleys containing their belongings and walk to the pay-out points. In the present study, 44% of the SFVs walked to the pension pay-out points and 56% used a car/van. There are many taxis (commonly referred to as 'minibus taxis') and cars that shuttle people around the area for a small fee.

A reported 48% of the SFVs carried their foods in cooler boxes, 28% used plastic bags, 8% used containers, 4% used cooler boxes plus plastic bags and 12% said other. Those SFVs who had cooler boxes did not have an ice or ice packs in them to help keep the foods like meat cold. The 12% that said 'other' used large plastic containers to place their meat and again no ice was found in these containers. However, when asked how they kept foods cold; 36% said they used an ice bucket, 24% used a fridge at home and 40% said other. Fifty-two percent of the SFVs prepared their foods at the stall, even though 20% did not have access to ablution facilities at their stalls. Some SFVs prepared their foods at home (16%) and 32% prepared their foods both at home and at the vending stall

Table 3.7: Location of food preparation versus the growth of the *E. coli* swabs

Location of Preparation	<i>E. coli</i> swab		Row Totals
	Growth	No Growth	
Home	0	2	2
Row %	0	100	
Stall	2	9	11
Row %	18.18	81.82	
Both at Home and the Stall	4	1	5
Row %	80	20	
Totals	6	12	18
Marked cells have counts >10 Chi-square (df=2) = 7.48 (p=0.02376)			

Analysis of the food preparation location versus the growth of *E. coli* found on the swabs revealed a significant outcome with a p-value of 0.02376 on the Chi-square test. Foods prepared solely at home (100%) and brought to the pension sites to sell showed no growth at all, and 81.82% prepared only at the stall also had no growth. Foods that were prepared both at home and at the stall had 80% of growth of *E. coli* on the swab; it may be that either the difficulty of transporting pre-cooked foods with the additional preparation of foods at the stall in impossibly unhygienic conditions increases the chance of contamination.

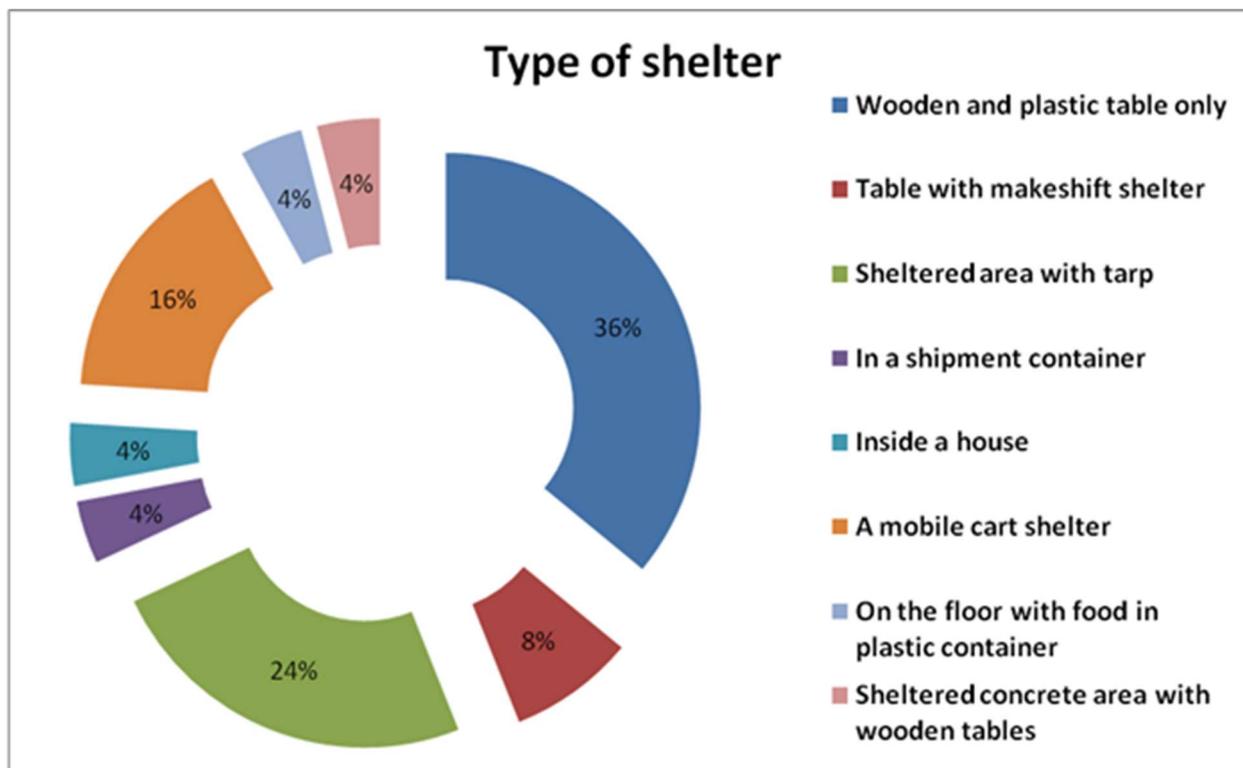


Figure 3.5: Recorded observations by the investigator details the type of shelter the SFVs operated in (n=25)

SFVs who cannot carry a tarpulin or wooden table or even a braai stand sell while sitting on the street. One particular SFV prepares and fries battered fish at home and carries the food in large plastic containers and other items like spice and salt in packets. The container holding the fried fish is left on the street. For the 24% that had a tarpaulin covering the SFV, the tarpaulin was not in good condition and was coated in soot from the braai smoke. The 16% of SFVs that had sheltered mobile carts were protected from the outside elements and used gas to cook foods. The one SFV who operated out of a shipping container had access to electricity and cooked food on a stove, however, the connection was illegal and dangerous and the shipping container had a hole in the floor.

Each customer was treated individually and the SFVs went out of the way to ensure the customers enjoyed their meal. The customers could choose to sit down and eat alongside the vendor if there was a customer table available or get the food to go as 'takeaway'. The SFVs used many forms of packaging: 68% used a plastic bag/newspaper, 24% used a Styrofoam container (this was only used at the mobile carts) and 8% used a plastic plate/paper plate to serve their customers.

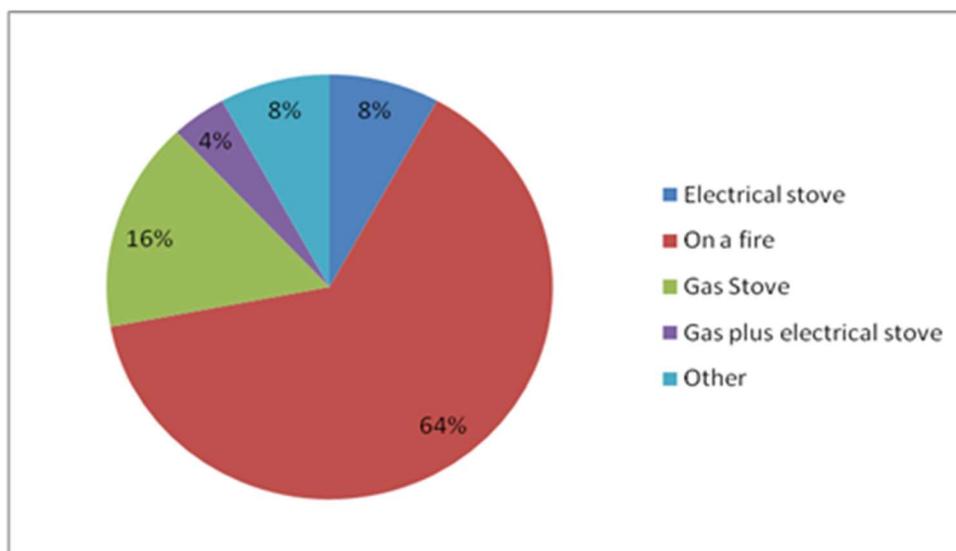


Figure 3.6: The ways in which most SFVs cooked their foods (n=25)

As shown above, in Figure 3.6, 64%, preferred to cook/'braai' their meats over a fire which is the most inexpensive option available, especially since access to electricity is not available to most SFVs. Most of the food products leftover were raw meat that is re-sold the following day to be cooked/'braaied' for customers. Only 12% of the SFVs have reported re-selling foods the following day, 76% have never sold leftovers as they are usually taken home and consumed; whereas 8% were unsure and 4% reported selling them at least once a day.

A reported 92% of SFVs used a bucket with soap and water to wash, however, 60% were unsure as to the frequency of changing the water and the washing of the utensils. Even though the SFVs washed up and changed the water twice a day (20%) or as often as possible (20%), 12% never washed their utensils ('braai' tongs and knives). None of the utensils was badly damaged, although 28% were worn out from frequent usage. Ninety-six percent of the vendors kept a neat work area and had a system whereby they carried out their preparation.

Only 60% of the SFVs showed some form of soap or detergent used to wash hands and just 8% of the SFVs tried to wash their hands after handling money. There were no visible signs of rodents, only a few stray animals, although 24% of the vendors had to fend off flies.

Table 3.8: Reports on how SFVs get rid of the waste (n=25)

How do you dispose of the waste?	Percentage (%)	Number
Refuse Bin	48	12
Storm water drain	20	5
Given away	8	2
Other	24	6

Even though 48% of the SFVs said that they disposed of their waste in refuse bins, no refuse bins were observed at the sites. There are refuse bags scattered along the roads in which some were filled with waste to be picked up by the municipality. As 20% of the SFVs have reported discarding waste down stormwater drains it is not uncommon to see stormwater drains in these areas congested with all types of waste, which can lead to unhygienic breeding grounds for pests and rodents. This also causes severe pollution of stormwater on the way to the nearest river which in turn results in serious surface water and environmental pollution. The investigator did observe a lot of garbage strewn on the roads and stray dogs and cats, but no rodents were visible. Rodents are particularly active at night, so this observation does not mean that they were absent or only a small risk.

Table 3.9: Protective clothing worn by the vendors

Protective clothing worn by the vendor	Percentage (%)	Number
Hairnet	4	1
Apron	52	13
Apron and gloves	4	1
Apron, gloves and a hairnet	8	2
None of the above	32	8
N	100	25

The female SFVs were dressed in head scarves/hairnets and the male vendors were well dressed, but not all male vendors wore a hairnet. The hands of the SFVs did not have any abrasions or cuts and their fingernails were neat and short. None of the SFVs appeared to

be ill. Eight percent of the SFVs wore all the protective gear (apron, hairnet and gloves) to prevent the spread of illness. Thirty-two percent of the SFVs did not wear any form of protective clothing, whereas 52% of the male and female SFVs had an apron on.

All SFVs interviewed reported that none of their customers have ever reported an illness that they connected to the consumption of their foods. With regards to the health and well-being of the vendor, 16% were recently ill, 4% had visited the doctor once a year, 60% only visited in an emergency and the other 20% could not recall when last, they had seen a doctor. If the SFVs were injured during food preparation, only 32% of the SFVs cleaned both the wound and the work area.

Microbiological results from food, water and swab samples

All the microbiological results are ranked according to certain levels of acceptability taken from the criteria of Merieux NutriSciences SA (147) and the DOH (75). All results are expressed in colony-forming units (cfu), food in per gram (g) and water in per 100ml.

Table 3.10: The ranges of acceptability for food (cfu/g), water (cfu/ml) and swab samples (cfu/area² including hands and various surfaces)

Counts (cfu) (include TMA and all microbes)	Swab Analysis (cfu/area ²)	Food and water Analysis (cfu/g or cfu/100ml)
<10	Excellent	Acceptable
10-70	Good	
71-99	Acceptable	
100-1000	Unacceptable. Requires attention	Requires attention
>1000	Unacceptable. Requires immediate attention	
=/>10000		
>100000		Unacceptable. Requires immediate attention

Table 3.11: The TMA of the food (cfu/g) and the water samples (cfu/ml)

Site:	Vendor No	Type of Food/water sample	TMA (cfu/g or cfu/100ml)
Crossroads	1	Sheep Trotters	310*
		Sour fermented porridge	1 000 000**
	2	Insufficient sample size for analysis	
	3	Sheep liver	180*
		Sheep fat	350 000**
Khayelitsha Resource Centre	4	Porkchop	120*
		Water	0
	5	Porkchop	40
		Water	100 000**
Bonteheuwel	6	Raw snoekfish	196 000**
		Water	100 000**
Khayelitsha Site C	7	Chicken food	0
		Water	2 150*
	8	Boerewors roll	40
	9	Porkchop	20
		Water	10 000**
Masiphumelele	10	Sausage	10
		Water	0
	11	Chips	0
		Water	720000**
Ikhewzi Gugulethu	12	Chicken feet and wings	700*
		Water	0
	13	Porkchop	20
		Water	52
	14	Battered Fish	40
	15	Sheep Liver and Fat	60

* TMA activity above (>100) is considered unacceptable

**TMA activity above (>10 000) is considered completely unacceptable

None of the food samples showed any growth of the bacteria tested (these tables can be found in Appendix E) however, the water samples from vendor 6 did indicate the presence of the gram-positive *B. cereus* and *C. perfringens*. The vendors (7, 11 and 13) also showed the presence of the gram-positive *B. cereus* in their water samples. The TMA is used as a gauge for the potential growth of bacteria and food spoilage. The TMA activity shows some very high counts well above the unacceptable (>100000), shown in Table 3.11 It is important to note that all the samples with counts >100000, had growth of bacteria shown either in the gram-positive, negative and broth DNA results (see the table of results in Appendix E). The exception was the sour fermented porridge however only a limited number of organisms were tested.

Shiga toxins (Stx) are linked to Shiga toxin– producing *E. coli* and *Shigella dysenteriae*; four of the samples tested positive for shiga toxins from vendors 3 (sheep fat), 6 (raw snoekfish), 13 (pork chop) and 15 (water). Three of the samples showed growth of gram-negative bacteria: the sheep trotters sample showed growth of *Enterobacter hormaechei*, the water sample from vendor no. 5 showed growth of *Pseudomonas oleovorans* and *Pleisiomonas shigelloides*, and the water sample from vendor 6 showed growth of *Comamonas testosteroni*, *Enterobacter hormaechei*, *Acinetobacter baumannii* complex and *Citrobacter freundii*.

Table 3.12: Swab results from the vendor’s hands

Site	Vendor No	Swab of Hands <i>E. coli</i> (cfu/area ²)
Crossroads	1	0
	3	0
Khayelitsha Resource Centre	4	50
Khayelitsha Site C	7	0
	9	0
Ikhewzi Gugulethu	13	20
	14	0
	15	40

Only 3 (vendor numbers 4, 13 and 15) of the SFVs had *E. coli* organisms present on their hands but all were low and within the range of acceptability according to Table 3.12. However, the presence of *E. coli* indicates the risk of inadequate hygiene practices.

Table 3.13: TMA of the various surfaces swabbed (n=36)

Site	Vendor No	TMA of the water container swab (cfu/area ²)
Lingelethu West	17	>10 000
	18	>10 000
	19	>10 000
Browns Farm	23	170
	24	>10 000
		TMA of the sauce container swab (cfu/area ²)
Lingelethu West	18	>10 000
Browns Farm	23	570
	24	5 800
	25	50
		TMA of the surface of chopping area swab (cfu/area ²)
Lingelethu West	16	>10 000
	17	>10 000
	19	>10 000
Loyola Gugulethu	20	>10 000
Browns Farm	21	80
	22	134 400
(chopping board)	25	>10 000
(chopping table)	25	740
		TMA of the table swab (cfu/area ²)
Lingelethu West	17	>10 000
	18	>10 000
	19	>10 000
Browns Farm	21	70
	22	870
	23	120
	24	1 400
	25	400
		TMA of the utensil swab (cfu/area ²)
Lingelethu West	16	>10 000

	17	>10 000
	18	>10 000
	19	>10 000
Loyola Gugulethu	20	>10 000
Browns Farm	21	20
	22	1 600
	23	102 400
	24	9 100
	25	100

The TMA of various surfaces is a good indicator to locate the most problematic surface areas that often go unnoticed. Only 11% of the swabs were marked as acceptable, 19% was marked unacceptable (requires attention) and 70% of the swabs were marked as unacceptable (requires immediate attention) (n=36).

Table 3.14: *E. coli* results of the various surface swabs (n=51)

Site:	Vendor No	<i>E. coli</i> swab of water container (cfu/area ²)
Crossroads	1	0
Lingeletu West	17	>10 000
	18	>10 000
	19	0
Browns Farm	23	0
	24	0
		<i>E. coli</i> swab of sauce/spice bottle (cfu/area ²)
Lingeletu West	18	>10 000
Browns Farm	23	0
	24	0
	25	0
		<i>E. coli</i> swab of surface area (e.g. chopping board in cfu/area ²)
Crossroads	1	0
Khayelitsha Site C	9	0
Lingeletu West	16	>10 000
	17	>10 000
	19	>10 000

Loyola Gugulethu	20	0
Browns Farm	21	0
	22	0
(chopping board)	25	10
(chopping table)	25	90
		<i>E. coli</i> swab of table (cfu/area²)
Crossroads	1	0
Khayelitsha Resource Centre	4	1 220
Khayelitsha Site C	7	0
	9	0
Ikhewzi Gugulethu	13	7 300
Lingeletu West	17	>10 000
	18	>10 000
	19	0
Browns Farm	21	0
	22	0
	23	0
	24	0
	25	0
		<i>E. coli</i> swab of utensil (cfu/area²)
Crossroads	3	0
Khayelitsha Resource Centre	4	0
Khayelitsha Site C	7	0
	9	0
Ikhewzi Gugulethu	13	2 040
	14	0
	15	0
Lingeletu West	16	>10 000
	17	>10 000
	18	>10 000
	19	>10 000
Loyola Gugulethu	20	>10 000
Browns Farm	21	0
	22	0
	23	0
	24	0
	25	0

In Table 3.14 above, 31% (n=51) of the swabs tested were unacceptable for *E. coli*. Each surface swabbed had at least one unacceptable swab for *E. coli*.

A points system was created to assess the hygiene practices of the vendors by grading them according to their answers to various questions concerning basic hygiene like handwashing and comparing them to the *E. coli* results (see Figure 3.7 below). A total score of 60 points and above was associated with acceptable hygiene practices and a low risk of foodborne illness (indicated by a dark green colour). High risk is indicated by a dark red colour and a score below 30 points. Vendor no.14 had the lowest score and is flagged as the highest risk based on the lack of basic hygiene practices, whereas vendor no. 11 showed the lowest risk with the highest score.

Vendor	Site	Protective clothing	Soap	Washing of hands	Covering foods	Change the water	Wash the utensils	Ranking	Ecoli swab of Hands	Ecoli presence on surfaces
1	Crossroads	Apron	No	No	No	Unsure	As often as possible	20	No Growth cfu/area	No Growth cfu/area
2	Crossroads	Apron	No	No	Yes	Once a day	As often as possible	45		
3	Crossroads	Apron	No	No	Yes	Unsure	Unsure	15	No Growth cfu/area	No Growth cfu/area
4	Khayelitsha Resource Centre	Apron	Yes	No	No	Unsure	Unsure	15	50 cfu/area	Growth cfu/area
5	Khayelitsha Resource Centre	Apron	No	No	No	Unsure	Unsure	5		
6	Bonteheuwel	None of the above	Yes	No	Yes	Twice day	Unsure	35		
7	Khayelitsha Site C	None of the above	Yes	Yes	Yes	Unsure	Unsure	35	No Growth cfu/area	No Growth cfu/area
8	Khayelitsha Site C	Apron + Gloves	No	No	No	Once a day	Once a day	40		
9	Khayelitsha Site C	Apron	No	No	Yes	Twice day	Unsure	30	No Growth cfu/area	No Growth cfu/area
10	Masiphumelele	Hairnet	Yes	No	Yes	Unsure	Unsure	25		
11	Masiphumelele	None of the above	Yes	Yes	Yes	After washing	As often as possible	65		
12	Ikhewzi Gugulethu	Apron	No	No	No	Twice day	Never	20		
13	Ikhewzi Gugulethu	Apron	No	No	No	Unsure	Unsure	5	20 cfu/area	Growth cfu/area
14	Ikhewzi Gugulethu	None of the above	No	No	No	Unsure	Never	0	No Growth cfu/area	No Growth cfu/area
15	Ikhewzi Gugulethu	None of the above	No	No	Yes	Unsure	Unsure	10	40 cfu/area	No Growth cfu/area
16	Lingeletu West	Apron + Gloves + Hairnet	No	No	Yes	Unsure	Never	30		Growth cfu/area
17	Lingeletu West	Apron	No	No	Yes	Once a day	As often as possible	45		Growth cfu/area
18	Lingeletu West	Apron + Gloves + Hairnet	No	No	Yes	Twice day	Morning and evening	60		Growth cfu/area
19	Lingeletu West	None of the above	No	No	Yes	Twice day	As often as possible	40		Growth cfu/area
20	Loyola Gugulethu	None of the above	Yes	No	Yes	After washing	Unsure	35		Growth cfu/area
21	Browns Farm	Apron	Yes	No	Yes	Unsure	Unsure	25		No Growth cfu/area
22	Browns Farm	Apron	Yes	No	Yes	Unsure	Unsure	25		No Growth cfu/area
23	Browns Farm	Apron	Yes	No	Yes	Unsure	Unsure	25		No Growth cfu/area
24	Browns Farm	Apron	Yes	No	Yes	Unsure	Unsure	25		No Growth cfu/area
25	Browns Farm	None of the above	No	No	Yes	Unsure	Unsure	10		Growth cfu/area

Points system	
Apron + Gloves + Hairnet	20
Apron + Gloves	10
Apron/Hairnet	5
Soap	10
Washing hands	15
Covering foods	10
Change the water at least once	15
Wash the utensils at least once	15
	100

Level of Risk	
High	Red
	Orange
	Yellow
Medium	Light green
Low	Dark green

Figure 3.7: Points system used to identify the level of risk according to vendor hygiene practices

Table 3.15: Results of *E. coli* on fruits and vegetables obtained from 5 supermarkets

Site	Shop	Type of food	<i>E. coli</i>	<i>L. monocytogenes</i>	<i>Salmonella</i>	TMA
Mitchells Plain	A	Potatoes	No Growth	Absent	Absent	>10 000
Crossroads	B	Spinach	No Growth	Absent	Absent	>10 000
Khayelitsha	C	Cauliflower	>10 000	Absent	Absent	>10 000
Brown's Farm	D	Peaches	No Growth	Absent	Absent	100
Gugulethu	E	Tomatoes	No Growth	Absent	Absent	>10 000

Surprisingly, all the supermarkets had an extremely high TMA activity (an indication of spoilage i.e., poor-quality produce) even with access to cooling facilities and transport vehicles equipped with cooling facilities. The cauliflower was the only food produce that showed a high (unacceptable) presence of *E. coli* detected.

Environmental Health Practitioners' (EHPs') approach to food safety inspection, foodborne illnesses and their challenges encountered with street food vending

Table 3.16: Summary of EHP responses to the questionnaire

Question	Yes	No
1. Have you ever investigated a foodborne illness?	1/9 11.1%	8/9 88.9%
	Answers	
If yes, please describe your involvement and answer question 2.	Trace suspected sample, test the suspected sample, fill in a food poisoning form and submit	
	Answers	
2. What was the leading cause of the foodborne illness you investigated, and have you ever traced foodborne	<i>S. aureus</i> , Used the Bradford Hill criteria	

illnesses using HACCP principles to find the possible source of contamination?	
3. Have you ever carried out a food safety inspection?	Yes
	No
If yes, please describe your involvement and answer question 4.	9/9, 100%
	0/9, 0%
	Answers
	Check adherence to Health Act
4. What is the frequency and outcome of food safety inspections?	Inspections performed quarterly/ outcomes-based
5. What do you think are some of the biggest challenges facing SFVs in lower-income areas?	Lack of knowledge/ ignorance of hygiene/ poor infrastructure/ lack of temperature control/ lack of pest control/poor sanitation
6. What challenges do you face in getting informal food traders to register with the City of Cape Town?	Fear of taxes/ cannot meet minimum requirements/ ignorance of laws/ failure to register for licensing/ no controlling body to address issues/ misinformation/ vendor movement/ language and religious barriers
7. In your opinion what else can the City of Cape Town put in place that could help ensure food safety amongst street vendors in lower-income areas?	Provide infrastructure and basic services/ implement a tracking system for vendors/ employ police presence at markets/ employ a designated task team for food safety/ improve waste removal system

A total of 9 responses were received from the Environmental Health Practitioners employed by the City of Cape Town's: Environmental health division in the Klipfontein (Silvertown and Fezeka offices), Eastern and Mitchells Plain districts. Only 1 out of the 9 EHPs', had

investigated a foodborne illness. This entailed ‘tracing contacts, ‘sampling the suspected food products’ and ‘completing a food poisoning investigation form that is submitted to the Health information officer and eventually to the Province’. The cause of the foodborne illness was determined to be *S. aureus* and the EHP reported to use HACCP principles to trace the source ‘as incorporated into Bradford Hill Criteria’. The Bradford Hill criteria was developed over 40 years ago, to establish a connection between cause and disease, whereby exposures can be tested as causes of disease (148). HACCP on the other hand looks at hazards that can arise in a process or system of operation that may lead to disease or illness, and is a step-wise approach that can also be used to predict the severity of the hazards identified (149).

HACCP is a systematic approach to the identification, evaluation and control of food safety hazards. It is based on the following principles: (1) Conduct a hazard analysis, (2) Determine the critical control points (CCPs), (3) Establish critical limits, (4) Establish monitoring procedures, (5) Establish corrective actions, (6) Establish verification procedures, (7) Establish record-keeping and documentation procedures (149).

All of the EHPs’ that participated in the study carried out food safety inspections that were routine and spontaneous, both at formal and informal businesses. These inspections or audits check the general hygiene practices and pest control on site. They were responsible for licensing premises with a Certificate of Acceptability (CoA). When asked how often food safety inspections are carried out the answers ranged from ‘Quarterly’ to ‘dependent on the outcome’. According to the EHPs’ they were rated as follows: High risk – not less than 3 months after the inspection, medium risk – not less than 6 months after inspection and low risk – not less than 12 months after the inspection.

The biggest challenges faced by SFVs according to the EHPs’ were unanimous and as follows:

- Lack of knowledge and ignorance of personal and environmental hygiene
- Lack of infrastructures such as toilet and taps
- Lack of adherence to requirements set out by municipal guidelines

The responses to the challenges they faced in getting SFVs’ to register were summarised as the following points:

- Ignorance of the law and misinformation

- They think we will make them pay taxes
- SFVs' cannot meet the minimum requirements for registration
- Language, religious and social barriers
- Inaccurate information supplied by the vendors upon registration

According to the City of Cape Town all hawkers/vendors selling cooked foods must obtain a 'Hawking in meals' trading license that can be purchased for a fee of R10.00, but requires the following documents to be submitted with every application where applicable:

- Land Use Clearance (Application to be made on prescribed application form).
- Copy of ID Document/Passport of Owner.
- Copy of the ID Document/Passport of Managing Director of Company or main Member of CC.
- Population and Clearance Certificate from Fire Prevention Officer.
- Application for a Certificate of Acceptability.
- Copy of approved building plan of the interior layout of the premises.

SFVs would require an ID document, an application for a certificate of acceptability, and may require an application for the erection of a temporary structure such as a tent.

Table 3.17 Guidelines for a food hawking business as specified by the City of Cape Town versus the reality of operating a hawking business in urban low-income communities

Guidelines required for hawking meals/cooked foods	SFVs observed operation
1. Suitable containers for waste and water (at least 25 litres)	Acceptable, however, the amount of 25 litres of water made it difficult for SFVs in the present study to meet this requirement. SFVs would have nowhere to store this water and carry it.
2. All working surfaces must be smooth, easily cleaned and made of an impervious material	Acceptable, and SFVs were able to meet requirements
3. Clean aprons and overalls must be worn	Acceptable, and SFVs were able to meet requirements

4. Braai tongs and food utensils must be used	Acceptable, and SFVs were able to meet requirements
5. Cooked and raw meat must be covered	Acceptable, but not all SFVs in the present study carried out this requirement
6. The name and address of the hawker must be displayed	Unacceptable, SFVs in the present study did not carry out this requirement out of fear
7. A basin, soap and clean disposable towels for handwashing	Unacceptable, only SFVs working out of a garage, home or formal mobile vending cart would have access to a basin. Disposable towels are expensive and SFVs would not buy it. SFVs did use buckets for handwashing, but not all SFVs used soap.
8. A refuse container for storage of refuse	Unacceptable, SFVs in the present study did not have access to refuse bins and these should be provided by the municipality.
9. A cooler box with ice for raw meats and the temperature should be kept at 10 degrees Celsius	Acceptable, but not all SFVs in the present study carried out this requirement. SFVs would need to monitor the cooler box with a thermometer. None of the SFVs had something to monitor temperature.
10. A suitable place for storage and washing of equipment	Acceptable, but not all SFVs in the present study carried out this requirement due to lack of tables/space
11. A floor or ground cover to prevent the soiling of the ground surface	Unacceptable, SFVs in the present study did not carry out this requirement as many of them worked off the paved or tarred streets
12. Only gas or electric equipment for cooking	Unacceptable, not all SFVs in the present study could meet this requirement as gas is expensive and wood fire is a cheaper option.

13. Squeeze bottle containers for sauces	Acceptable, and SFVs were able to meet requirements
14. An umbrella for shelter or shade to cover the cooking area	Acceptable, and most SFVs were able to meet the requirements of an umbrella or tent cover for shelter

When asked about what the City of Cape Town could implement to help ensure food safety, there was consensus in the responses and was surmised as follows:

- Provide infrastructures such as taps and toilets
- Provide efficient waste removal systems
- Create market areas where all food vendors trade to better monitor and control trading
- Establish a safety task team to monitor vending sites
- Support health promotions or health open days

Chapter 5: Discussion

Street vending is a common sight and occupation in South Africa, where unemployment and urbanisation levels are high and work and social growth opportunities are hard to come by (90). Street vendors are free to work their hours and can be mobile or stationary. The South African municipal guidelines do not address the issues faced by SFVs in terms of infrastructure and certification. SFVs cannot uphold these regulations due to monetary and other reasons. There are also no policies or regulations to positively uplift and influence street vending.

Demographics of the SFVs: Age, educational level, gender, income, the longevity of street food vending and knowledge of SFVs

Whilst there are many street vendors selling clothing, vegetables, sweets and snacks, in the present study SFVs were difficult to locate but pension pay-out points in low-income urban communities was a hub for different types of street vendors. There is a paucity of data (in terms of microbiological testing of street vended foods and demographic information) when it comes to SFVs in the Western Cape, partially due to the sporadic nature of street vending and their mobility. Despite the small sample, the results from the present study align with other studies and will be discussed further below.

In the present study, the median age of SFVs was 34 years old (range 21 - 65 years), similar to a study in Gauteng that looked at the socio-economic profile of SFVs where 38.5% of participants were between the ages of 31-40 years old (84). Another study on SFVs in Cape Town showed that majority of the participants (64.3%) were within the ages of 25-44 years old (17). Age is not a barrier to street vending activities and many vendors operate well into retirement age (>60 years old). The age range of participants in the present study was similar to that of the Informal Economy Monitoring Study (IEMS) study of SFVs in Durban, South Africa that showed an age range of 19-74 years old (31). This means that anyone who is willing and able to, can join this occupation with ease, adding to the popularity of street food vending.

Female SFVs tend to dominate the informal street food industry, outnumbering their male counterparts as was seen in the present study in which 68% of the SFVs were female and only 32% were male. A study focusing on food nutrition, knowledge and hygiene aspects of

street vended foods in Cape Town in 2018 showed that 52.9% of the SFVs were female (17) and numerous other studies, particularly in Africa, showed similar results (85,119,150). Studies in Brazil (151) and Vietnam (118) also show a higher number of female vendors, but conflicting results have been found in India (152), The West Indies (153), and Kenya (154) where males dominate street food vending. It seems that street food vending empowers females who are not well-educated or otherwise disadvantaged to help support their family by cooking. It is for this reason that women who are skilled at cooking tend to lead the informal food business. Findings from an informal food economy study in 2016 in Cape Town showed that female vendors were preferred by customers to male vendors even in the braaiing of meat, which is typically male-orientated (3).

SFVs are sometimes paid as a worker by the owner of the stall/mobile cart to vend; 56% of the SFVs in the present study were not the owners and were employed to run the stall. Hill et al. (17) showed that 84.3% of the street vendors in Cape Town in 2018 had ownership of their stalls. SFVs in the present study said that street food vending was not their only form of income, which was supported by the IEMS study that showed that vendors supplemented their income with pension and other grants to keep cash flow for their informal business and help provide for their family (31). Martin's study on the socio-economic and hygiene features of street vending in Gauteng in 2006 (84) reported that all the SFVs in his study obtained their main income from street food vending. If the SFV is an owner, they would benefit directly from the income acquired if they also managed the stall.

The SFVs' in the present study had been in the informal business for several years (the median number was 3 years); the time frame ranged from 3 days to 23 years. This also suggests that street food vending can be a long-term occupation or a short-term occupation. The median amount of income in the present study was R400 a day and R2000 per 5-day work week. Hill et al. 2018 (17) reported that 67.9% of the income of SFVs in Cape Town, earned less than R1000 per week, 21.6% earned between R1000 to R5000 and 11% earned between R5000 to R10000 per week. The fluctuations in income earned can be attributed to the type of foods sold, meats are expensive compared to sweets and a packet of chips. In the present study, foods were considered to be different types of meat/fish sold raw/cooked, whereas the other study in Cape Town in 2018 included sweets, chips and baked goods as food items (17). Fluctuations in income can also be area-specific, it is for this reason that SFVs prefer to be mobile.

SFVs earn money to support their families, and in the present study 88% of the SFVs had dependants in their care. The median number of dependants was 4 (dependents ranged from 0 to 11). When asked if the income they earned from street food vending was enough to live on, 80% reported it was not enough. In the present study, 36% of SFVs have relied on social grants. According to the General Household survey in 2016, 4.8% of the household income in the Western Cape is contributed through pensions (155). The IEMS inferred that more female SFVs depended on social grants for their livelihood than male SFVs (31). This is attributed to the burdens of household and reproductive responsibilities of female SFVs, as they require the flexibility of street trade and a low-risk work environment.

The main drivers for street vending in developing countries are low employment opportunities and the fact that the occupation needed little to no schooling. SFVs are often associated with lower levels of education; several studies support this statement (31,85,156), which further explains why street food vending is an attractive opportunity for resource-poor persons. It does not require a high level of training or completion of high school. In the present study, 43% of the SFVs had completed high school (3). A study on the contributions of street vending to the informal economy in Cape Town (part of the AFSUN survey) showed that only 20% of the vendors had completed high school. The SFVs in the present study who were older than 45 years had attended or completed primary school level; whereas those below 40 years old had attended or completed high school. In the present study, no significant difference (see Figure 3.2) was found between gender and the level of education, whilst the IEMS survey in Durban (31) reported that male SFVs are more likely to have higher levels of education than their female counterparts.

All SFVs in the present study said they knew the 5 keys to food safety as set out by the WHO (146). This is promising as EHPs' use this as a teaching tool and the EHPs' response in the questionnaire stated that they use the 'WHO 5 keys to food safety as their guide' in addition to the guidelines in R638. In the present study, 100% of the SFVs knew the importance of keeping clean, 92% knew why raw foods should be kept separate from cooked foods, 92% knew the importance of thoroughly cooking food, 64% knew the safe storage of cooked foods, and 40% said they knew the importance of using safe food products like pasteurised milk. Even though SFVs knew the importance of cleaning and cooking foods thoroughly, the safe storage of foods was not well known. Only 11.1%, of the SFVs in the present study, knew that cooked foods must be kept at cool temperatures or in a cool environment; the other responses ranged from 'high' to 'medium' temperatures. Further

questioning and observation by the investigator showed that the SFVs did not keep the cooked meats in a cooler box but kept them at the side of the braai area. The cooler box was reserved for uncooked meats, but most were kept without any ice to help lower the temperature. However, R638 regulations allow for uncooled cooked foods to be sold within an hour of preparation, and SFVs in the present study were observed to reheat the meats before serving them to the customer if they were pre-cooked. Most of the meats were cooked to order, so cooked meats were not left out for long periods.

SFVs in the present study understood the basic concepts of handwashing and cooking food thoroughly but others did not understand how to store foods safely and the importance of sourcing safe raw materials. The incorrect storage of foods and the purchase of unsafe raw materials increase the risk of contamination and the propagation of microbes that lead to foodborne illnesses.

SFVs: Source of foods, transport, preparation, cooking and access to ablution and other facilities

SFVs in the present study made use of supermarkets (50%), butcheries (25%) and wholesalers (13%) mostly for their supplies of cuts of meat or fish, only 8% was self-obtained/farmed and 4% bought from a nearby vendor. According to the findings of the AFSUN survey completed in 2008, households in the low-income communities in Cape Town obtained their foods for the week mostly from informal food markets (19.2%) and supermarkets (3.7%) (16). While most of their customers cannot afford to buy in bulk, SFVs in the present study would make use of the wholesalers' discount to purchase foods like meats. Most of the pension sites in the present study were situated close to a supermarket that was within walking distance, particularly the pension sites at Khayelitsha Site C, Site B, Gugulethu and on Eisleben Road in Browns Farm, Philippi. The SFVs could purchase the meat/fish required on their way to the sites and if they ran out, could easily obtain more stock. In the present study, most of the foods were sourced from wholesalers and supermarkets, which are presumably food secure and have high food quality standards (16). The investigator noted that the customers preferred buying from local vendors. Local vendors are preferred over supermarkets because supermarkets require the buying of foods in bulk to qualify for specials and they don't cater to the specific needs of these communities (16). Informal vendors usually allow credit for people in the community and they don't have to travel far distances to buy basic foods (16).

One of the barriers facing vendors in the AFSUN survey was food spoilage, due to inadequate storage and lack of refrigeration facilities (3). In the present study, the transport and storage conditions of the SFVs were not ideal, even though 48% used cooler boxes, there were no ice or ice packs utilised to maintain cool temperatures. SFVs that used plastic containers (8%) left them on the floor and were exposed to the heat and dust from the environment. Some of the SFVs carried them in plastic bags (28%) and 4% used a combination of plastic bags and cooler boxes. The SFVs that used other forms of storage such as large plastic containers with handles, had no form of coolant/ice to keep food at cool temperatures. Only 36% of the SFVs reported using ice, 24% had refrigeration at home and 40% reported to have used other means but failed to elaborate further.

Studies have shown the ease in which street foods can be contaminated (85,157,158). Contaminated raw materials, improper holding times of cooked foods, inadequate cooling and re-heating of foods, and a 12-hour lapse between preparation and cooking were identified as some of the factors in the causation of food-borne illness/disease outbreaks between 1977 to 1982 in the United States (82,88). SFVs have the option of either preparing/cooking foods at home or preparing/cooking foods at their stall/vending site, both options present significant challenges in the transport, storage of foods and holding times of foods (cooked/uncooked). In the present study, 52% of the SFVs prepared/cooked their foods at the stall, 16% cooked their foods at home, and 32% cooked/prepared their foods both at home and at the stall. A street food study in Bloemfontein showed that 67% of SFVs prepared their foods both at home and at the stall (twice more than the present study), 11% at home and 22% at the stall (66). The foods that are cooked/prepared at home and the stall are exposed to the highest risk of contamination through the time-lapse between preparation and cooking, transportation of the prepared foods and the temperature in which these foods are stored and transported (82). The foods in the present study were prepared for cooking the night before, approximately 12 hours before they will be cooked at the stall. If they have been exposed through the usage of contaminated raw materials, contaminated surfaces (cross-contamination), improper heat holding of foods or the through the lack of hygiene of the SFV, the contaminants such as microbes have a chance to multiply and build up high levels of infectivity. Foods prepared/cooked at home and the stall, also need to be transported to the stall at refrigerated temperatures and need to be cooked and reheated before being sold. Only SFVs that cooked over a fire or a gas stove were able to reheat foods before serving to customers.

The result of the analysis of the food preparation location (home, stall, both at home and the stall) versus the growth of *E. coli* found on the swabs was significant (see table 3.7). The foods that were prepared both at home and at the stall had 80% of growth of *E. coli* on the swab; those that had been prepared at the stall had 18.18% growth of *E. coli* and no growth of *E. coli* was found in the foods prepared and cooked at home.

In terms of access to ablution facilities at the stall, 20% of the SFVs in the present study said that they did not have access at their stalls/vending sites. Depending on the type of dwelling that the SFVs lived in, access to water and ablution facilities for example can be restricted to a nearby communal tap/portable toilet respectively. In the present study, 40% of the SFVs lived in informal dwellings such as shacks and 92% of SFVs had access to ablution facilities (portable toilets) near home but 8% did not. The importance of having access to ablution facilities and clean running water is essential to maintaining hygiene and the lack of access of thereof is what links street foods as a public health hazard.

When factoring in the lack of proper storage facilities at home and at the stall, the added burden of transporting these items to the vending sites and the lack of ablution facilities at the site or even at home; it is reasonable to assume that these conditions have high-risk potential as shown by the *E. coli* swab results of this study. The presence of *E. coli* organisms is an indicator of lack of hygiene, as it colonises the intestine of humans and animals and is transmitted via the faecal-oral route (159,160). The presence of *E. coli* on surfaces such as hands, cutlery, cutting boards and tables is enough to deduce a lack of hygiene particularly handwashing by the SFV or by a contaminant introduced during cutting of vegetables and meat by sharing unwashed utensils and cutting boards. Microbes such as *E. coli*, *Salmonella* and *Listeria*, have been shown to adhere to surfaces for prolonged periods and can therefore be spread from one surface to another known as cross-contamination (161).

The descriptions of the types of shelters at the stalls utilised by SFVs in the present study are analogous to the observations of other researchers (8,66,88). In the present study, 36% used a wooden and or plastic table, 24% had a sheltered area with a tarpaulin covering, 16% had a mobile cart shelter and 8% had a table with a makeshift shelter. Other notable work areas for SFVs' in the present study included work in a shipment container (4%), vending in a garage (4%), working in a sheltered concrete area with wooden tables (4%)

and working off the floor (4%). The type of shelter used by SFVs influences the amount of exposure to the outside elements. Most of the tables were in good condition, but the tarpaulin coverings were worn out and coated with soot from the fire.

The SFVs that had no protection from the sun was completely exposed to dust and other insects, although 72% of the SFVs did attempt to cover the foods with cloths and lids. The SFVs in the present study (24%), had to fend off flies although the attempts were futile because if they did not land on the meat, they were on the utensils etc. The risk of exposure to spoilage of foods by direct sunlight is greatly increased without any cover or with a tarpaulin that has a limited range of cover. Insects (such as ants) can also influence spoilage by damaging the outside integrity of foods (76) and flies are carriers of bacteria that can result in contamination of foods and various preparation surfaces (87).

The concerns associated with the cooking and selling of street vended foods

Contaminants can persist from the environment in which the vendor is located, is dependent on the personal hygiene of the SFV, from unwashed or unsafe raw materials or the improper storage or heating of foods (64). In the present study, the method of cooking foods varied with each SFV, but 64% cooked their meats over a fire, 16% used a gas stove, 8% used electricity, 4% used a combination of gas and electricity, and 8% said other such as a paraffin stove. SFVs that cooked their meats over the fire had a much higher cooking temperature (the investigator noted that the heat from the fire was unbearable to stand next to) and the different cuts of meats were cooked as needed. Customers looked over the different cuts of meat (pork and beef), large pieces of fat, liver, sausage, and chicken feet. The cooked meats were held for a short time and were even re-heated over the flame before they were handed to the customer. The low microbial growth in the food samples in the present study can be attributed to the high temperatures from cooking the raw cuts of meat on an open fire. This is corroborated by a study in Johannesburg that proved that high temperatures are critical in preventing cytotoxic effects from the bacterium *B. cereus* (8). Although the temperatures of the foods were not taken, the investigator reported that the heat from the fire could be felt when standing too close to the flames during the interviewing of the SFVs.

The *stx1* gene was detected in samples from vendors (3, 6, 13 and 15) in broth DNA, which means the presence of the genes that code to produce Shiga toxins were found. The

potential for infection and risk of human health from the Shiga toxins is high because they are extremely invasive and can survive in soil, manure, abiotic surfaces and foods (161). Shiga toxin-producing *Escherichia coli* (STEC) is one of the most prominent causes of foodborne disease with symptoms varying from mild intestinal discomfort and gastroenteritis to more serious conditions like hemolytic uremic syndrome (HUS), end-stage renal disease (ESRD), and even death (162). STEC has many different serotypes with the most prevalent disease-causing serotype being O157:H7 and it can produce two types of powerful cytotoxins (stx1 and stx2) (159,161). Food that had been cooked was kept on the 'braai' stand to the side but was re-heated over the fire before they were handed to the customer. Reheating is shown to be important in preventing cytotoxicity from the *Bacillus* and STEC species (8). The foods in the present study were always served piping hot in plastic bags or paper by 68% of the SFVs, but 24% of the SFVs in the mobile carts served foods in Styrofoam containers and 8% served their foods in plastic plates. The newspaper and plastic bags were most likely sourced from the local supermarkets. Unfortunately, the plastic bags were not tested for microbes in the present study, it would have helped determine the cleanliness of these bags.

All the food samples from the SFVs had no growth of any gram-positive bacteria tested, but one food sample (sheep trotters) showed growth of a gram-negative organism (*Enterobacter hormaechei*). The presence of the *Enterobacteriaceae* indicates post-processing contamination (from cooking the food at home and carrying it to the stall) or the inadequate cooking of foods (not thoroughly cooking foods) (163).

The water samples from vendor numbers 6, 7, 11 and 13 had the presence of either *B. cereus* or *C. perfringens* or both in their dishwater. Foodborne pathogens like *B. cereus*, *C. perfringens*, *E. coli*, and *L. monocytogenes* are common contaminants of raw meat and poultry (8) and these foodborne pathogens have been previously detected in street vended foods in South Africa (8,90). The levels in the present study were found to be acceptable $<10^3$ and concur with a study of SFVs in Gauteng where *B. cereus* counts were less than 150 cfu/g (84). *B. cereus* is linked to the reselling of left-over foods (90), the low levels in the present study support 76% of the SFVs response that they had never sold leftovers or kept foods for long periods. SFVs in the present study had reported to rarely have leftovers and if foods were left over, they were taken home to eat. This means that if there were contaminants in these leftover foods, the SFV and their family would be exposed to these

contaminants and would be at risk. In most cases of food outbreaks, the lack of hygiene or compromised health of the food handler is often the cause of the outbreak (82).

TMA (also referred to as total plate count/aerobic plate count (APC)) refers to the general microbial load and is used to evaluate the safety of foods, as well as its deterioration or shelf life (164). It includes all the micro-organisms in a product (for e.g. all aerobic bacteria, yeast, moulds and fungi both non-pathogenic and pathogenic) (165). The presence of *Pseudomonas* spp. in the water sample is an indicator of spoilage (69), in this case, the pork meat sold by the vendor 5 might be undergoing the spoilage process (characterised by off-odours and slime formation at very high levels of *Pseudomonas* spp.) (69). The pork meat sold at that time was inspected and did not show any discolouration or give off any odours. Food spoilage was highlighted in the AFSUN survey on the informal economy in Cape Town as a challenge facing more than half of the vendors in the study (3). The TMA levels in the present study supports the fact that spoilage may be one of the biggest hurdles for SFVs to overcome. Food spoilage increases exposure and enhances the competition from other pathogens that can grow and cause harm (122). Cold-storage and cold-chain transportation is an impossible requirement for most street vendors, instead, the focus must shift to emphasizing high cooking temperatures, short-holding times of food products for SFVs and the reheating of foods be it over a fire as it provides realistic solutions to the prevention of bacterial growth.

The importance of maintaining hygiene levels by cleaning and washing, proper waste disposal and the wearing of protective clothing for street vended foods

Water samples from SFVs numbers 5 and 6 in the present study, also showed the presence of many gram-negative organisms such as *Pseudomonas oleovorans*, *Pleisiomonas shigelloide*, *Comamonastestosteroni*, *Enterobacter hormaechei*, *Acinetobacter baumannii* complex and *Citrobacter freundii*. The presence of the above bacteria (some typically found on fresh meat and poultry) (69) does bring into question the hygiene of the vendors. Contamination of the water could have been the result of the exposure of raw meats to cooked foods (using the same chopping board/surfaces for the holding of foods), or by the washing of raw meats in the same water used to clean utensils and cloths used to wipe clean various surfaces. This was also supported by the TMA in the present study, which showed some extremely high levels ($>10^5$) for potential growth of bacteria. Cross-contamination is a huge problem not only in street vended foods (64) but in processing food

plants as well (166). It increases the chances of exposure to contaminants on numerous surfaces, the increased TMA increases the potential growth of these pathogens and the transmission of infection.

Handwashing helps reduce the spread of pathogens (167), and it is strongly recommended and re-iterated by the WHO in public health awareness initiatives on food safety (168). Esrey et al. show that adequate water supply and sanitation reduces illness; therefore, the lack of basic infrastructure available to most SFVs increases the burden of illness (169). The washing of hands, utensils, the frequency with which water is changed after washing, the temperature of the water and the addition of detergent plays an important role in maintaining hygiene and preventing the spread of contamination. Most studies in South Africa and other African countries have shown that the hygiene of street vendors is questionable (8,67,85,163). This was also the case for the SFVs in the present study. According to the WHO, the lack of sanitation, access to safe water, hygiene and waste disposal are the environmental factors promoting communicable diseases. Communicable diseases, as the name suggests relies on the transmission of the pathogen/contaminant and the lack of these factors drastically improves its effectiveness (122,168).

Many of the vendors in the present study reported to have access to ablution facilities that were nearby to the stall (80%); however, there were no signs of such facilities in the vicinity. Majority of the SFVs reported to wash their utensils with soap and water (92%), 4% used a bucket with warm water and 4% used a bucket with cold water. A few of the SFVs could not show the investigator proof of soap used for washing even though they reported using it. This is important to note since it indicates that the answers provided by the SFVs were to some extent suffering from obsequiousness bias (that is providing answers that the respondent thinks the researcher would like to hear or that would make the SFV appear in a favourable light).

The SFVs in the present study have reported having washed the utensils once a day (4%), 20% reported as often as possible, 4% reported in the morning and the evening and 12% reported to have not washed their utensils. Even if the vendors washed their hands and worked cleanly, the potential for cross-contamination from the unwashed utensils is high. As to how often they changed out the dirty water: 12% reported once a day, 20% changed the water twice a day, and only 8% changed out the water after washing. A study in Johannesburg, South Africa showed that dishwater samples collected from the first street

vendor in the mornings were found to be lower in microbial counts than those collected in the afternoon ($p < 0.05$) but results for the second vendor's dishwater samples were non-significant ($p > 0.05$) (8). It warrants concern that 60% of the SFVs in the present study were unsure as to how often they washed their utensils and to how often they replaced the dirty water. This water used to clean utensils can become a potential carrier of pathogens. In the present study some of the SFVs' dishwater, used to wash utensils in these buckets was observed to be extremely murky, greywater. The continued use of dirty/grey water predisposes food to contaminants through the washing of utensils and cloths etc. The consumers are exposed to the contaminants through the consumption of these foods; increasing the potential for infectious propagation (170). In the present study, SFVs discarded their waste into refuse bins/bags (48%) that were provided by the municipality, 20% discarded their waste down a storm drain, 8% gave the waste away and 24% said they used 'other ways' to discard their waste. Similar results were reported by the AFSUN survey in Cape Town, where waste disposal consisted of bins provided by the municipality, however, the frequency of disposal was not high, and waste often accumulated, leading to putrid smells (3).

A study in Burkina Faso marked the different types of dishwater used at street vending sites as soapy water (E1), and those used for rinsing (E2 and E3) (67). The results indicated that E1 has the most impure water, followed by E2 marked as 'impure' and E3 marked as 'acceptable' (67). The study reported that 38.57% of the vendors used all the above three types of water, and 61.43% used very impure and impure water (67). The dishwater was classified into the categories by the total coliform load, in which E1 had an average coliform count of 1.9×10^5 with the presence of *Salmonella* and *Shigella* bacterial growth, E2 had an average of 1.7×10^4 and E3 had an average of 2.7×10^3 (67). The dishwater from E1 with the high bacterial findings and was also found to be the murkiest water and was not replenished with clean water (67). Several studies support the same findings in which unchanged/non-renewed water used for washing leads to increased contamination of water, which is associated with the presence of bacterial contamination and often high levels of contamination (90,171,172). Observations of SFVs in other African studies (67,85,163) are consistent with findings in the present study; they describe the washing of utensils in one or more buckets filled with water, sometimes without soap. The wastewater was thrown out into the road or alongside the stalls and garbage was thrown out in a nearby field or on the roadside, and could lead to rodents and pests' infestations and flies (88). A study in Alice, in the Eastern Cape, compared foods from cafeterias with access to water and ablution

facilities (considered to be hygienic) and those without (considered to be unhygienic); the unhygienic cafeterias had the highest number of bacterial counts and this was attributed to the lack of hygiene and the unclean water re-used for a myriad of cleaning tasks without being replaced (163).

The meta-analysis study undertaken by Aiello in 2002, focused on the link between hygiene and infection and concluded that 'personal and environmental hygiene reduces the spread of infection' (173). Handling of the foods also presents a risk of contamination, particularly if foods are not handled with protective clothing such as gloves. The hands of food handlers are often the next source of contamination after raw materials and farming practices. They play a role as a vector in the transmission of communicable diseases through lack of hygiene or cross-contamination (111). The transmission of infection can be controlled through improved hygienic practices and the use of protective gear.

South African regulation 638 states that gloves must always be worn by food handlers (174). Only 8% of the SFVs in the present study wore gloves, a hairnet and an apron, 4% wore only a hairnet, 4% wore an apron and gloves, and 52% wore an apron only. A reported 32% of the SFVs in the present study did not wear any protective gear, which is worrying as this is an essential pre-requisite in the hygienic preparation of food and in preventing the spread of microbes; and is mandated by the DOH in various regulations (such as the R638). Similar observations of SFVs operating without wearing gloves have been reported in studies in Kenya (172) and Nigeria (175). The lack of protective clothing increases the transmission of pathogens/other contaminants. If the SFV does not wash their hands, if there are abrasions or cuts on their hands, or if they encounter chemicals or other contaminants in the environment, this increases the possibility of transmission from one infected person to another through the handling of foods (66). The wearing of gloves does not mean that handwashing is not required. If the food handler or SFV does not wash their hands and places the gloves back on, the gloves are now contaminated both on the outer and inner layer. The warm environment inside the glove may provide a breeding ground for pathogens like bacteria, reducing the effectiveness of wearing gloves (100). The wearing of protective gear is only effective if the food handler has good personal hygiene and cleans the work area hygienically.

Ninety-two percent of the SFVs in the present study reported washing their hands after handling money. However, the investigator noted that even if gloves were worn, SFVs'

handled the food and the money with the same gloves; which means that if the currency (notes or coins) was contaminated it would be transferred to the food. A study in Burkina Faso showed coliform counts from three different pieces of money (5.4×10^2 and 4.6×10^1 cfu/mo, and 1.8×10^2 cfu/mo) with the presence of *S. aureus* also found (67). The strain of pathogenic *E. coli* O157:H7 can last for up to 11 days on the surfaces of various currencies (102). In the present study, swab samples were taken from some vendors hands (with their permission) that did not wear gloves (n=8). The results showed that 37.5% (vendor numbers: 4, 13 and 15) of the hand swabs tested positive for *E. coli*, even though they were within the 'acceptable' limits of detection according to the Merieux NutriSciences SA (<70 cfu/area²) the vendors were not practising good hygiene. Only vendor number 4 reported to have used soap, but the investigator did not observe handwashing during interaction with the vendor. Vendor numbers 13 and 15 neglected to wash hands or utensils, were unsure as to whether water was changed out and did not use soap. The investigator ranked all SFVs that participated in the study according to observed hygienic practises and responses to the frequency of operating under these hygienic practices. These vendors (numbers 4, 13 and 15) were ranked poorly in the hygienic rankings scoring less than 20 points (see figure 3.7). Handwashing, is one of the first basic rules to preventing the transmission of communicable diseases and these SFVs neglected to practise it (168). The Guidelines for Environmental Health Officers on the Interpretation of Microbiological Analysis Data of Food for South Africa (75) does not explicitly state the limit for *E. coli* and other bacterial growth on hands, perhaps because the mere presence indicates a lapse in hygiene. Other studies in Africa have shown unacceptable counts of bacteria in particular *S. aureus* on SFVs hands (67, 176), however, the swab samples in the present study were only tested for *E. Coli*.

All the SFVs inspected in the present study were dressed neatly, had clean short nails with no visible cuts or abrasions and 68% of the vendors who were female, had their hair covered in scarfs. The above findings show that the SFVs in the present study practised good personal grooming and body cleanliness. None of the SFVs appeared to be sick and only 16% said that they had recovered from an illness. In the present study, 32% of the SFVs reported that if they cut themselves, they would clean the wound and work area immediately, 56% said that they would stop working and clean it. This finding is in contrast to a study in Bloemfontein showed that even if the SFVs were sick they carried on vending because it was their livelihood (66). No first aid kits were present or used by all the SFVs, which meant the cut or abrasion may be cleaned with cloth or water from the buckets used to wash the

utensil etc and expose the SFV to the contaminants in the water buckets. A reported 4% of SFVs' would continue working while sick or injured and 8% of the SFVs' said they would not do anything to clean up the work area; which is very concerning as they put the customer at risk for infection. The DOH maintains that the preparation and serving area should always be kept clean to prevent any cross-contamination or direct contamination from various body secretions (sweat, saliva or blood) (174). Cleanliness of food contact surfaces is the first step to the prevention of cross-contamination (100).

The swab results in the present study (unlike most food samples that showed no growth) uncovered areas of concern involving the preparation of foods. Only 11% of the TMA swabs were marked as acceptable, 19% of the TMA swabs were marked unacceptable requires attention and 70% of the TMA swabs were marked as unacceptable requires immediate attention (n=36). Of those surfaces swabbed, 31% had unacceptable levels of *E. coli* ($>10^3$ cfu/area²). *E. coli* is an enteric bacterium and is associated with faecal contamination(74). Vendors (vendor numbers: 4 and 13) could have transferred the *E. coli* detected on their hands at acceptable levels to the utensils and the table surfaces (direct contamination). The investigator did note that ablution facilities were far away and the presence of *E. coli* on the hand and surface swabs indicate poor handwashing after going to the bathroom. This is classified by the WHO as a short faecal-oral cycle, as the contaminants will have direct contact (direct contamination) with the foods through the SFV hands and are concerning as handwashing is the first step in the 5 keys to food safety. Swabs of table surfaces taken in the morning and the afternoon from a SFV study in Johannesburg showed no significant difference in coliform counts, although the swabs result from the first vendor was lower than the second vendors (8). Vendor number two in this study showed the presence of *B. cereus* in 36% of the surface swab results (8), but overall the results of the swabs samples were found to be acceptable (8). A study in Bloemfontein isolated 16% of *E. coli*, 16% of *Salmonella*, and 43% of *S. aureus* from the centre of table surfaces of SFVs (66). The levels of coliform units were also found to be within the acceptable range however, they have recommended that SFVs need better facilities like running water and toilets near their stalls (66). The spread of contamination goes unnoticed because we cannot visualise these pathogens, but basic cleanliness and hygienic practices can prevent the spread of foodborne pathogens and infection.

The swab results in the present study confirmed the possibility of spread of pathogens through cross-contamination, and in some cases direct contamination. Even though the food

samples were negative which was attributed to the high cooking temperatures, the swabs show that there is a lapse in sanitary conditions from the personal hygiene of the food handler, to the preparation of foods and the washing of utensils and various surfaces (such as the sauce bottle, water container, utensils, sink, chopping boards and the table). Cross-contamination increases the risk of infection through the ease of dissemination; it also increases the difficulty in identifying the source of infection. Cross-contamination and direct contamination proves that the five keys to food safety as recommended by the WHO have not been followed diligently (70).

A small project was undertaken by the investigator in the present study, in which a few fruits and vegetables from prominent supermarkets within these communities were tested at random for the presence of *E. coli*, *L. monocytogenes* and *Salmonella*. This sampling was not meant for statistical analysis but provides a point in time assessment of the quality of the produce in supermarkets available to the vendors as well as these low-income urban communities. Only one sample (the cauliflower) in Khayelitsha showed unacceptable levels of *E. coli* ($>10\ 000\ \text{cfu/area}^2$), but leafy vegetables tend to have higher microbial loads (161,177). Contaminated irrigation water used in farming has been frequently implicated in foodborne outbreak cases and may account for the high levels of *E. coli* present on the produce (161).

The TMA for the samples were also unacceptably high and produce with high TMA results increase the chances of spoilage. This is contrary to what is expected because supermarkets are thought to have the freshest produce (low spoilage and low microbial load) due to cold chain management and advanced farming methods. Battersby reported that there is a misconception amongst SFVs that supermarkets provide the freshest, safest produce compared to the local street vendors (16). However, if the SFVs are purchasing their raw materials from supermarkets in these communities, there is the possibility that these raw materials are compromised. Further processing of these raw materials thought to be safe, could result in the spread and multiplication of these contaminants in street vended foods.

The challenges facing EHPs and SFVs

In South Africa, EHPs are responsible for inspecting, monitoring and issuing Food Safety certificates to businesses and SFVs, and they are also responsible for preventing and

managing foodborne outbreaks. According to the City of Cape Town, an EHP must inspect premises, collect samples for analysis, investigate notifications of outbreaks/complaints, and where necessary remove and destroy contaminated products as well as pursue legal action (178). EHPs within their districts are also required to perform inspection duties which include food sampling and testing on informal vendors, and to access certification (178).

The vast majority of SFVs (80%) reported operating without a certificate from the City of Cape Town because it was difficult for them to leave their stall and apply for one. The responses from the EHPs' questionnaire to the challenges in getting vendors to register range from 'Traders are misinformed about registration' to 'They think we will make them pay tax' and most importantly 'Traders do not want to go through the red tape'. There is a lot of mistrust and miscommunication surrounding the terms of registration and the requirements for informal traders.

According to the guidelines for a food hawking business as specified by the City of Cape Town, several requirements need to be met. SFVs need to carry at least 25 litre containers for clean water and waste, an impossible task for SFVs who cannot afford transportation to and from their stalls. They are also required to use a basin for washing up, which not all SFVs had access to and instead used their ingenuity to wash up in large plastic dishes. The requirement for disposable towels for cleaning is expensive and unnecessary as SFVs use dishcloths to wash up and these can be easily cleaned, dried, and reused. SFVs could afford soap and basic detergents, and 60% of the SFVs in the present study used soap. One of the requirements for registration is a gas braai, this rules out 64% of the SFVs' in the present study that burn wood for a fire. Burning wood is considered a 'health nuisance' by EHPs', but some SFVs' cannot afford to purchase a gas braai. The burning of wood can be hazardous, particularly wood that has been treated with chemicals such as arsenic (179) that is banned in some countries. A study in Cape Town in 2013, showed that chromated copper arsenate (CCA) treated wood is still utilised by residents and informal caterers and that their levels of exposure to the toxins found in urine samples exceeded the environmental exposure limit in 12% and 30% of participants for chromium and arsenic respectively (180). Requirements for street food vending need to be realistic and affordable to be successfully implemented by street vendors. Instead of setting vendors up to fail certification, the municipalities need to revise the regulation/policies and provide designated braai areas for the food vendors to braai.

Many of the SFVs knew what an EHP (64%) was and 52% said that inspections had been done and samples had been taken from them for testing. According to the EHPs' responses to the questionnaire, inspections are carried out quarterly and the home of the food vendor is also inspected during the registration process. The SFVs had acknowledged that 64% had some form of training from the DOH and it was promising that 72% said that they would benefit from further training. The responses from the EHPs' questionnaire in the present study, cited 'lack of adherence to regulations from SFVs. However, some of those regulations need to be adapted to reduce the challenges faced by SFVs such as their access to facilities.

The Western Cape authorities have an Informal Trading Policy and Management Framework to guide and control street vendors since 2003, which aimed to ensure access to new job opportunities and to help merge the informal trading sector with the various economic, spatial and social developments of the City (181). This was followed up with the Informal Trade By-Law in 2009, revised in 2013 (182). The City of Cape Town's improved 2013 Informal Trading By-law was also met with disapproval by many informal vendors and researchers as they felt the by-law was too controlling and stringent; instead, they felt it hampered informal economic growth (3). The City of Cape Town stands by the Informal Trading by-law and continues to monitor its compliance (3).

The integration of the framework and by-laws has not been easy, an example is the upgrade of the Town centre in Mitchells Plain in which the city is trying to accommodate informal traders by ensuring vendors are allocated bays (183). These bays do not have storage facilities or basins but are located near ablution facilities. The City of Cape Town is also freeing up walkways that previously was congested, blocking formal businesses and thereby creating animosity between formal and informal businesses (183). Resolving issues unfortunately takes time and vendors felt the process in which permits were issued was not carried out fairly and that they were uninformed of the process (183). The traders felt that the relocation from the busy walkways was not in their best interests and would impact their earning ability and objected to paying an R80 trader fee (183). Many of the SFVs operate on sidewalks or on the side of roads that may be considered a hazard for traffic. They are also prohibited from cooking fires with gas or firewood if there is potential for the destruction of public property (182).

Despite the challenges faced, there is more that can be done to assist street trade through policy revision concerning street food vendors, assistance with registration for compliance and well as training and education.

Study limitations

Although a larger sample size yields better quality data (140,142) it is not always feasible, and a few street food studies in South Africa have had low numbers of SFV participants (8,90,93). Statistical calculations may also be used to calculate the sample size required to obtain reliable data; however, this relies on previous data responses and sample sizes that have not been populated for SFVs in the Cape Town (140). The recommended number of participants calculated by the statistician amounted to 50, but this total was brought down to 30 participants after considering the refusal to participate and the paucity of data on the availability of SFVs. To reach the goal of 30 participants, the sampling took place in two phases and all pension sites within the low-income communities were visited.

Despite these limitations, the results from the present study align with other studies reported in South Africa (8,66,90,93), which show that even in adverse working conditions safe street vended foods can be produced. A consequence of data aligning is known as 'obsequiousness' bias, where participants often answer/act to support the stance of the researcher's area of interest (184). An example that the investigator noted was that SFV's placed extra effort on cleaning when in the presence of the investigator, particularly if they noticed a sample being taken such as a swab. To avoid this the investigator did not wear a lab coat or gloves and asked the participants to hand over the samples such as food as they would normally placing them into the plastic sample bags.

Food and water testing of samples are very expensive and time-consuming. Merieux NutriSciences SA lab was used to perform the analysis and report the results according to the SANAS criteria (144). It was difficult to narrow down microbes for food and water testing, but some established studies in South Africa (8,90,93), helped identify key issues in street food vending such as holding times of foods (such as *B. cereus*), the lack of cooling equipment, and the presence on raw meats (*C. perfringens*) and RTE foods (*L. monocytogenes*) that lead to the identification of the microbes most prevalent in those situations. The greater the variety of bacteria tested (gram-positive and gram-negative), the wider the scope of the investigation. Considering that hygiene was the prime focus of this

investigation, *E.coli* was the ideal indicator organism for testing. The analysis of the *E.coli* strains was not aimed at identifying pathogenicity, as the presence of *E.coli* was enough to prove poor hygiene practices. Unfortunately, the *E.coli* strain responsible for severe enteric infections and diseases (O157:H7) was very costly and was not tested.

The negative results from microbes thought to be prominent in street vended foods and drinks in the present study, lead to a shift in focus from testing samples of foods and water used in the street vending process, to the presence of microbes on the surfaces of the various preparation areas and utensils. There are many forms of swabs used for microbe analysis, the most common types are those with wooden or plastic shafts with cotton, rayon, or a combination of fibres spun into a bud (185). The swabs can be treated with a neutralizing agent to prevent the presence of detergents interfering with the yield of bacteria (185). The swabs purchased from Merieux NutriSciences SA was treated with a neutralizing agent that lasts for up to 7 days in the refrigerator. However, there was a contention as to whether these swabs needed to be pre-wetted before sampling the area in question.

According to Bryan et al, if the sample surface is wet, there is no need to pre-wet the swab (88). Unfortunately, there is no standard protocol that is universally recognized for the type of swab, the dry vs. wetting of a swab, the diluent used for pre-wetting and the swabbing technique (185). This makes comparing microbial data particularly problematic and creates a plethora of variables that will influence the number of bacteria accumulated. However, even the most sensitive swab utilised without following proper swabbing techniques will influence the number of bacteria lifted from the surface (185). Cotton tips swabs have been shown to harbour more bacteria on the tip (which is great for bacterial removal from the surface), but fewer bacteria are released into the solution for cultivation and detection (185). Even the size of the surface area swabbed, and the degree and angle of pressure applied to the swab can affect the number of bacteria detected (185).

Further studies are required to validate a swabbing protocol that can be used globally for microbial detection.

Conclusion

The levels of microbes in the food and water samples were acceptable despite the dilapidated conditions of the shelters and the lack of basic access to running water and ablution facilities near their stalls. However, the swab samples showed cross-contamination and unacceptably poor hygiene results from some SFVs.

SFVs are an important part of these communities and the informal economy and much support are required to uplift and educate them. These SFVs need assistance from the municipalities to help build better shelters and provide them with a safe place to work. The infrastructure such as taps and toilets near vending sites would help tremendously in limiting the spread of contamination and improve the hygienic preparation of foods. The SFVs showed that they had basic hygienic knowledge (washing of hands etc.), which needed improvement in terms of understanding how cross-contamination can occur, and especially in the importance of storing and transporting foods under the correct temperature conditions. Even the EHPs' agree that 'health promotions or open days' need to be created, as the level of knowledge at Primary school level does not equip SFVs' with sufficient food safety knowledge.

Recommendations for further studies and safer, more hygienic infrastructure and future policy changes with regards to street food vending

In light of the findings of this study, a policy review is needed to consider updating the DOH's Regulation 638 concerning the general hygiene requirements for food premises and the transport of food. Regulation R638 needs a section based solely on the informal food sector and cannot apply a 'one rule fits all' situation. It needs to address the reality of operating as a SFV in these communities by amending the guidelines for a food hawking business.

The rules for obtaining certification should include a mandatory training session on hygiene and the importance of food safety before certification is issued. Follow up certification should include/require re-training to ensure that all staff has understood the importance of food safety.

The City of Cape Town needs an easier, more accessible method to allow street vendors to apply for certification. Many of these vendors cannot leave their stall to obtain certification, instead, a mobile unit could be sent out to these communities to help with the application process. They also need a database that can allow them to pinpoint SFVs by plotting GPS coordinates of popular vending areas making tracking of street vendors easier. This data can be linked to the SAP Informal trading permitting system that is already in place.

Given the findings of the study and the discussion above the municipality should create shelters for these vendors that will allow them to produce safer foods without exposure to the elements and build taps for access to running water and ablution facilities. A simple concrete slab as a table with tin roofing could be used as basic infrastructure. If this is not possible, the municipalities can help supply these vendors with umbrellas or a tarpaulin upon a successful registration. The eThekweni municipality has successfully built up the Warwick junction area in which the majority of the street vendors live and work and provided a safe area equipped with access to sanitation and structures to vend (128). They also require safe and efficient waste removal systems, not just a supply of plastic trash bags and bins.

Finally, further studies on SFVs are required to get a better understanding of the level of support required in training and educating vendors. Also gauging their attitude towards food safety and their compliance with current legislative laws on food safety would be extremely informative. EHPs also require further education and training in addressing and investigating outbreaks uniformly, and access to better resources and collaboration efforts with other municipalities. EHPs need a more hands-on approach towards SFVs with training and demonstrating basic hygiene. Promotional health days would be beneficial, not only assess the hygienic practises of SFVs but also find ways to help them improve their hygienic processes. A safety task team should be implemented to carry out these health promotion activities and monitor the SFV sites regularly. The presence of EHP's should be welcomed by SFVs and not feared such that they are willing to participate and learn, this can only be achieved by showing up regularly in these communities to gain their trust and not just to monitor compliance in a rigid format occasionally.

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Appendices

Appendix A: Participation information and leaflet and consent form for SFVs

TITLE OF THE RESEARCH PROJECT:

An investigation into the hygiene practices and food safety of street vendors outside pension pay-out points in urban poor communities in the City of Cape Town.

REFERENCE NUMBER:

PRINCIPAL INVESTIGATOR: Shamiska Rohith

ADDRESS: No. 72 Santenay Complex, 175 Amber Road, Burgandy Estate, Tableview, 7441

CONTACT NUMBER: 0728737101

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please do let me know if you have any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the Health Research Ethics Committee at Stellenbosch University (located in the Tygerberg campus, Faculty of Medicine and Health Sciences) and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

I am a student at the University of Stellenbosch and this study is part of my project to complete my master's degree in communicable diseases. This study is an investigation

into the hygiene practices and knowledge of street vendors and the occurrence of food pathogens associated with food-borne illnesses on the food products sold. The study will be conducted in five districts in the low-income urban communities in the City of Cape Town at the South African Social Security Agency (SASSA) designated pension points, where street vendors are commonly present. A total of approximately 50 participants (street vendors) will be recruited from all five districts. Identification of the vendors will be done using photographs with your permission taken at the start of the interview, should you wish to be informed of the results of the study.

I would like to understand the conditions under which street vendors such as yourself work, observe the difficulties you face if any, in terms of access to basic necessities such as clean running water to reduce the risk and spread of food-borne illnesses. The end goal is to establish a framework around the health and hygiene regulation to assist the City of Cape Town in conjunction with SFVs to promote the food safety.

Why have you been invited to participate?

The study is focused on food products sold by street vendors such as yourself.

What will your responsibilities be?

I will require at most 20 minutes of your time to answer the questions from my survey on food safety, which is completely anonymous and will not affect your business or livelihood in anyway. I will also sample one or more food products from you as part of participation and take a photo with your permission of course. Please try to answer the questions as honestly and accurately as possible.

Will you benefit from taking part in this research?

There are no personal benefits from this study. However, in the future the results from the study might persuade the municipality to help street vendors with better working conditions. I will come back and inform you of the results of the study.

Are there in risks involved in your taking part in this research?

There are no risks whatsoever involved from participation in this research. All participants are anonymous and are free to decline from participation at any point.

If you do not agree to take part?

You have the right to refuse participation and we thank you for your time and consideration.

Will you be paid to take part in the present study and are there any costs involved?

No, you will not be paid to take part in the study, but as a token of our appreciation for your time and allowing us to sample your food a small fee will be given to cover the cost of the sampling. There will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

- You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I agree to take part in a research study entitled (*insert title of study*).

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in the present study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) on (*date*)2017.

.....

Signature of participant

Signature of witness

Declaration by investigator

I (*name*) declare that:

- I explained the information in this document to
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (*If an interpreter is used then the interpreter must sign the declaration below.*)

Signed at (*place*) on (*date*) 2017.

.....

Signature of investigator

Signature of witness

Declaration by interpreter

I (*name*) declare that:

- I assisted the investigator (*name*) to explain the information in this document to (*name of participant*) using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (*place*) on (*date*)

.....
Signature of interpreter

.....
Signature of witness

Appendix B: Participation information and leaflet and consent form for Environmental Health Practitioners (EHPs)

TITLE OF THE RESEARCH PROJECT:

An investigation into the hygiene practices and food safety of street vendors outside pension pay-out points in urban poor communities in the City of Cape Town.

REFERENCE NUMBER:

PRINCIPAL INVESTIGATOR: Shamiska Rohith

ADDRESS: No. 72 Santenay Complex, 175 Amber Road, Burgandy Estate, Tableview, 7441

CONTACT NUMBER: 0728737101

You are being invited to take part in a research project. Please take some time to read the information presented here, which will explain the details of this project. Please do let me know if you have any questions about any part of this project that you do not fully understand. It is very important that you are fully satisfied that you clearly understand what this research entails and how you could be involved. Also, your participation is entirely voluntary, and you are free to decline to participate. If you say no, this will not affect you negatively in any way whatsoever. You are also free to withdraw from the study at any point, even if you do agree to take part.

This study has been approved by the Health Research Ethics Committee at Stellenbosch University (located in the Tygerberg campus, Faculty of Medicine and Health Sciences) and will be conducted according to the ethical guidelines and principles of the international Declaration of Helsinki, South African Guidelines for Good Clinical Practice and the Medical Research Council (MRC) Ethical Guidelines for Research.

What is this research study all about?

I am a student at the University of Stellenbosch and this study is part of my project to complete my master's degree in communicable diseases. This study is an investigation into

the hygiene practices and knowledge of street vendors and the occurrence of food pathogens associated with food-borne illnesses on the food products sold. The study will be conducted in five districts in the low-income urban communities in the City of Cape Town at the South African Social Security Agency (SASSA) designated pension points, where street vendors are present. A total of approximately 50 participants (street vendors) will be recruited from all five districts.

I would like to understand the policies and regulations governing food safety in the City of Cape Town from an Environmental health practitioners (EHPs') perspective. I also would to know about the solutions/initiatives EHPs' such as yourself have undertaken to curb the spread of foodborne illnesses as well as the challenges you face with unregistered street vendors in the City of Cape town. The end goal is to establish a framework around the health and hygiene regulation to assist the City of Cape Town in conjunction with SFVs to promote the food safety.

Why have you been invited to participate?

I require an EHPs' understanding of food safety within the City of Cape Town at pension pay-out points in particular.

What will your responsibilities be?

I will require at most 20 minutes of your time to answer the questions from my survey on food safety, which is completely anonymous and will not affect your business or livelihood in anyway.

Will you benefit from taking part in this research?

There are no personal benefits from this study. However, in the future the results from the study might persuade the municipality to help street vendors with better working conditions. I will come back and inform you of the results of the study.

Are there in risks involved in your taking part in this research?

There are no risks whatsoever involved from participation in this research. All participants are anonymous and are free to decline from participation at any point.

If you do not agree to take part?

You have the right to refuse participation and we thank you for your time and consideration.

Will you be paid to take part in the present study and are there any costs involved?

No, you will not be paid to take part in the study. There will be no costs involved for you, if you do take part.

Is there anything else that you should know or do?

You will receive a copy of this information and consent form for your own records.

Declaration by participant

By signing below, I agree to take part in a research study entitled (*insert title of study*).

I declare that:

- I have read or had read to me this information and consent form and it is written in a language with which I am fluent and comfortable.
- I have had a chance to ask questions and all my questions have been adequately answered.
- I understand that taking part in the present study is voluntary and I have not been pressurised to take part.
- I may choose to leave the study at any time and will not be penalised or prejudiced in any way.
- I may be asked to leave the study before it has finished, if the study doctor or researcher feels it is in my best interests, or if I do not follow the study plan, as agreed to.

Signed at (*place*) on (*date*) 2017.

.....
Signature of participant Signature of witness

Declaration by investigator

I (*name*) declare that:

- I explained the information in this document to
- I encouraged him/her to ask questions and took adequate time to answer them.
- I am satisfied that he/she adequately understands all aspects of the research, as discussed above
- I did/did not use an interpreter. (*If an interpreter is used then the interpreter must sign the declaration below.*)

Signed at (*place*) on (*date*) 2017.

.....

.....

Signature of investigator Signature of witness

Declaration by interpreter

I (*name*) declare that:

- I assisted the investigator (*name*) to explain the information in this document to (*name of participant*) using the language medium of Afrikaans/Xhosa.
- We encouraged him/her to ask questions and took adequate time to answer them.
- I conveyed a factually correct version of what was related to me.
- I am satisfied that the participant fully understands the content of this informed consent document and has had all his/her question satisfactorily answered.

Signed at (*place*) on (*date*)2017.

.....

.....

Signature of interpreter Signature of witness

Appendix C: Research Tools

Research tool 1: Questionnaire for SFVs' selling cooked/uncooked foods

NOTES: This survey will be administered by the principal investigator for the purpose of establishing the hygiene and food handling of vendors.

Hello, my name is Shamiska Rohith and I am a student at Stellenbosch University. I require about 20 minutes of your time to participate in my survey for my masters research in communicable diseases. My study focuses on food safety of street vended foods at pension pay-out points in the communities as well as the handling and preparation of foods.

You will remain completely anonymous, would you be interested in participating? Circle answer: Yes / No (If yes, hand them an informed consent form to read in their preferred language to read and sign.)

Do you consent to have your food preparation area sampled for microbial testing? Circle answer: Yes / No

Section A: Demographics and socio-economic status			
A1. Site:			
A2. Date of the Interview:			
A3. What is your preferred language for interview?	1. English	2. Afrikaans	3. Xhosa
A4. What is your gender?	1. Male	2. Female	
A5. What is your age?			
A6. What Educational level did you complete?	1. Primary school If Primary school, 1.1 What level?	2. High School If High school, 2.1 What level?	3. Post Secondary School e.g. University/TECHNIKON
A7. Are you the owner of this stall?	1. Yes	2. No	
A8. Is this your only form of income?	1. Yes	2. No If No, 2.1 What is your main occupation?	
A9. What is the approximate income from your food selling?			
A10. Is this income enough to live on?	1. Yes	2. No	
A11. Do you or anyone you live with receive any social grants like pension?	1. Yes	2. No	
A12. In what type of dwelling do you live?	1. Informal	2. Formal If formal 2.1 Is this your own home? (Yes/No) If No, explain:	
A13. Do you have any dependants?	1. Yes	2. No	

	If yes, 1.1 How many dependants do you have?	
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Section B: Hygiene status (Food preparation and handling of cooked/uncooked foods)					
B1. How long have you been selling foods at this pension pay-out location?					
B2. Why did you choose this particular location to sell your product?					
B3. How do you get to your stall at the pension pay-out point?					
B4. What kinds of foods do you sell?					
B5. What is your most popular item?					
B6. Where is the food prepared?	1. At the stall	2. At home	3. Both at home and at the stall	4. Other	
B7. Do you have access to ablution facilities at home?	1. Toilet	2. Communal taps	3. Both	4. None	
B8. Do you have access to ablution facilities near your stall?	1. Toilet	2. Communal taps	3. Both	4. None	
B9. Do you sell raw meat or fish?	1. Yes, if so state what product	2. No			
B10. Where do you get the fish/meat/other products from?	1. Butchery/Abattoir	2. Nearby vendor	3. Supermarket	4. Wholesalers: Cash and carry	5. Self-obtained i.e. from fishing/from your own cattle
B11. How do you carry the food products/items to work?	1. Cooler box	2. In a plastic bags	3. In containers	4. Other	
B12. How do you cook your foods?	1. On a fire	2. Gas stove	3. Electrical stove	4. Other	
B13. How do you keep the foods cold?	1. Fridge	2. Ice bucket	3. Portable fan	4. Other	
B14. What kind of temperature do you think is required for the storage of foods?	1. Room temperature	2. Weather dependent	3. Kept at high temperatures on a stove	4. Other	
B15. How do you wash these utensils?	1. Bucket with cold water	2. Bucket with warm water	3. Bucket with water and soap/detergent	4. No water wipe dry	5. None of the above
B16. How do you wash your hands?	1. Bucket with cold water	2. Bucket with warm water	3. Bucket with water and soap/detergent	4. No water wipe dry	5. None of the above
B17. How often do you change the water?	1. After washing	2. Once a day	3. Twice a day	4. Unsure	5. Never

B18. How often do you wash the utensils?	1. Morning and evening	2. Once a day	3. After food preparation	4. As often as possible	5. Never
B19. What do you do with excess food or raw materials?	1. Give it away	2. Throw it away	3. Keep it for another day	4. Take it home to eat	5. No excess food left over
B20. If foods are left over, how often do you re-sell leftover foods?	1. Once a day	2. Morning and evening	3. As often as possible	5. Unsure	
B21. How much of the foods are thrown away?	1. Foods that were not sold	2. All perishable items	3. Some foods not all	4. Everything	5. None
B22. What do you do with the excess fat from the meat?	1. Used in the cooking process	2. Sold to other vendors/customers	3. Thrown in a bin	4. Thrown on the floor or down a drain	5. No excess fat
B23. How do you dispose of all waste (e.g. oil, dirty water etc.)?	1. In a refuse bin	2. On the floor	3. Down a storm water drain	4. Given away	5. Other
B24. Do you know whether anyone got sick from your food? If so, describe what they reported to you.	1. Yes		2. No		
B25. What happens if you cut yourself?	1. Stop working and clean the wound	2. Continue working	3. Clean the wound and the work area immediately	4. None of the above	
B26. How often do you visit the clinic or doctor?	1. Once a week	2. Once a month	3. Once a year	4. Only in emergency situations	
B27. Have you been ill recently?	1. Yes, if so describe illness (e.g. diarrhoea or the flu)		2. No		

Section C: Vendor Knowledge on food safety

C1. Do you know the 5 keys to food safety?	1. Yes	2. No (If No, explain it to them)
C2. Do you know the importance of hygiene/cleanliness?	1. Yes	2. No (If No, explain to them)
C3. Do you know why you must separate raw foods like meat from the cooked foods?	1. Yes (Write down their answer)	2. No (If No, explain to them)
C4. Do you know why foods like meat must be fully cooked?	1. Yes (Write down their answer)	2. No (If No, explain to them)

C5. Do you know what the safe temperature is for the storage of cooked foods?	1. Yes (Write down their answer)	2. No (If No, explain to them)
C6. Do you know why it is important to use products that are safe like pasteurised milk?	1. Yes (Write down their answer)	2. No (If No, explain to them)
C7. Do you have a certificate from the Department of Health to operate as a food vendor?	1. Yes	2. No
C8. Do you know what an Environmental Health Practitioner (EHP) is?	1. Yes	2. No (If No, explain what it is)
C9. Has anyone come to inspect your stall or take food samples?	1. Yes	2. No
C10. Have you ever had anyone come to do hygiene promotions/programmes?	1. Yes	2. No
C11. Would you like to have more education on Food hygiene and safety?	1. Yes	2. No
C12. What do you think the municipality can do to better to support your business?		

Research Tool 1.1

Observation check list for uncooked/cooked foods:					
Describe the layout of the pension point (where the vendors are located, the variety of other goods sold etc.)?					
Describe the vendor's shelter?	1. Wooden/plastic table only	2. Table with makeshift shelter	3. Inside the back of a van	4. Other, If other state:	
Where is the vendor located at the pension point?	1. On the side of the road	2. Next to a taxi rank	3. Next to local businesses	4. Other	
Describe the condition of the surrounding area of the pension pay-out point?					
Record the temperature reading for the area					
Describe the vendor's appearance?					
Does the vendor appear ill?	1. Yes	2. No			
Describe the condition of the vendor's hands?	1. Cuts/wounds	2. Sores	3. Length of nails	4. All of the above	5. None of the above
What kind of protective clothing is worn by the vendor?	1. Apron	2. Hairnet	3. Gloves	4. All of the above	5. None of the above
What kind of utensils/equipment if any does the vendor use?	1. Cutlery	2. Chopping board	3. Containers	4. Cloths	5. Pots/pans
	What kind of material are the cutlery made from?	What kind of material is the chopping boards made from?	What kind of material are the containers made from?	What type of cloths are there?	5.1. With lids 5.2 Without lids

	1.1 Metal 1.2 Plastic	2.1 Glass 2.2 Plastic 2.3 Wooden	3.1 Metal bowls 3.2 Plastic bowls 3.3 Plastic buckets	4.1 Drying cloths 4.2. Wiping cloths 4.3. Tablecloth for covering	
Describe the condition of the utensils	1. Good condition	2. Worn out but still usable	3. Should not be used needs replacing		
Do the utensils etc. look like they have been cleaned?	1. Yes	2. No	3. Hard to say		
Is the work area cluttered or messy?	1. Yes	2. No			
How is the food presented to the customer?	1. In a plastic container	2. In a Styrofoam container	3. In a plastic bag/brown paper bag		
Does the vendor have soap or detergent?	1. Yes	2. No			
Does the vendor wash his hands after handling money?	1. Yes	2. No			
Are there pests/insects clearly visible?	1. Yes	2. No			
Is there anything used to cover foods from insects or direct sunlight?	1. Yes, if so describe	2. No			

Research tool 2: Questionnaire for SFVs' selling canned/packageged foods

NOTES: This survey will be administered by the principal investigator for the purpose of establishing the quality and food types sold by vendors.

Hello, my name is Shamiska Rohith and I am a student at Stellenbosch University. I require about 20 minutes of your time to participate in my survey for my masters research in communicable diseases. My study focuses on food safety of street vended foods at pension pay-out points in the communities as well as the quality and conditions of the foods sold.

You will remain completely anonymous, would you be interested in participating? Circle answer: Yes / No (If yes, hand them an informed consent form to read in their preferred language to read and sign.)

Section A: Demographics and socio-economic status			
A1. Site:			
A2. Date of the Interview:			
A3. What is your preferred language for interview?	1. English	2. Afrikaans	3. Xhosa
A4. What is your gender?	1. Male	2. Female	
A5. What is your age?			
A6. What Educational level did you complete?	1. Primary school If Primary school, 1.1 What level?	2. High School If High school, 2.1 What level?	3. POST SECONDARY SCHOOL e.g. University/TECHNIKON
A7. Are you the owner of this stall?	1. Yes	2. No	
A8. Is this your only form of income?	1. Yes	2. No If No, 2.1 What is your main occupation?	
A9. What is the approximate income from your food selling?			
A10. Is this income enough to live on?	1. Yes	2. No	
A11. Do you or anyone you live with receive any social grants like pension?	1. Yes	2. No	
A12. In what type of dwelling do you live?	1. Informal	2. Formal If formal 2.1 Is this your own home? (Yes/No) If No, explain:	
A13. Do you have any dependants?	1. Yes If yes, 1.1 How many dependants do you have?	2. No	

Section B: Assessing quality of Canned/Packaged food products and knowledge of the vendor				
B1. How long have you been selling foods at this pension pay-out location?				
B2. Why did you choose this particular location to sell your product?				
B3. How do you get to your stall at the pension pay-out point?				
B4. What kinds of food products do you sell?				
B5. What is your most popular item?				
B6. Where do you get the food products from?				
B7. Are there any pests or rodents at the site where you buy from / where the supplier stores them?				
B8. Do you get a discount on the items? If so, explain why?				
B9. Do you understand the language on the product such as the storage conditions?				
B10. How do you store the food products?				
B11. How do you carry the food products/items to work?	1. Cooler box	2. In a plastic bags	3. In containers	4. Other
B12. How do you keep the perishable foods cold?	1. Fridge	2. Ice bucket	3. Portable fan	4. Other
B13. What kind of temperature do you think is required for the storage of perishable foods?	1. Room temperature	2. Weather dependent	3. Kept at high temperatures on a stove	4. Other
B14. Do you have access to ablution facilities near your stall?	1. Toilet	2. Communal taps	3. Both	4. None
B15. How do you dispose of all waste?	1. In a refuse bin	2. On the floor	3. Other, explain:	
B16. Do you know whether anyone got sick from your food products? If so, describe what they reported to you.	1. Yes		2. No	

B17. What happens if you cut yourself?	1. Stop working and clean it	2. Continue working	3. Clean the wound and the work area immediately	4. None of the above
B18. How often do you visit the clinic or doctor?	1. Once a week	2. Once a month	3. Once a year	4. Only in emergency situations
B19. Have you been ill recently?	1. Yes, if so describe illness (e.g. diarrhoea or the flu)		2. No	

Research Tool 2.1

Observation check list for canned/packaged food products:					
Describe the layout of the pension point (where the vendors are located, the variety of other goods sold etc.)?					
Describe the vendor's shelter?	1. Wooden/plastic table only	2. Table with makeshift shelter	3. Inside the back of a van	4. Other if other state:	
Where is the vendor located at the pension point?	1. On the side of the road	2. Next to a taxi rank	3. Next to local businesses	4. Other	
Describe the condition of the area?					
Record the temperature reading for the area					
Describe the vendor's appearance?					
Does the vendor appear ill?	1. Yes	2. No			
Describe the condition of the vendor's hands?	1. Cuts/wounds	2. Sores	3. Length of nails	4. All of the above	5. None of the above
Is the work area cluttered or messy?	1. Yes	2. No			
Are there pests/insects clearly visible?	1. Yes	2. No			

Is there anything used to cover foods from insects or direct sunlight?	1. Yes, if so describe	2. No
Are the canned food products damaged?	1. Yes	2. No
Are the cans rusty/ the packaging tampered with?	1. Yes	2. No
Are the packaged food products expired?	1. Yes	2. No
Are the products sold made in South Africa or imported?		
Is the language clear and understandable?		

Appendix D

Research tool 3: Questionnaire for Environmental Health Practitioners

<p>1. Have you ever investigated a foodborne illness? If yes, please describe your involvement and answer question 2.</p>
<p>2. What was the leading cause of the foodborne illness you investigated, and have you ever traced foodborne illnesses using HACCP principles to find the possible source of contamination?</p>
<p>3. Have you ever carried out a food safety inspection? If yes, please describe your involvement and answer question 4.</p>
<p>4. What is the frequency and outcome of food safety inspections?</p>
<p>5. What do you think are some of the biggest challenges facing SFVs in lower income areas?</p>
<p>6. What challenges do you face in getting informal food traders to register with the City of Cape Town?</p>
<p>7. In your opinion what else can the City of Cape Town put in place that could help ensure food safety amongst street vendors in lower income areas?</p>

Appendix E: Low levels of growth shown in the microbial data obtained from hot foods and water samples

Table 3.18: Showing the growth results of the Gram-positive bacteria from the various food and water samples

Vendor No	Type of Food/water sample	B.Cereus	C. Perfringens	L. Monocytogenes	Staph Aureus
1	Sheep Trotters	No Growth	No Growth	No Growth	No Growth
	Sour fermented porridge	No Growth	No Growth	No Growth	No Growth
3	Sheep liver	No Growth	No Growth	No Growth	No Growth
	Sheep fat	No Growth	No Growth	No Growth	No Growth
4	Pork chop	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth
5	Pork chop	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth
6	Raw snoekfish	No Growth	No Growth	No Growth	No Growth
	Water	Growth	Growth	No Growth	No Growth
7	Chicken food	No Growth	No Growth	No Growth	No Growth
	Water	Growth	No Growth	No Growth	No Growth
8	Boerewors roll	No Growth	No Growth	No Growth	No Growth
9	Pork chops	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth
10	Sausage	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth
11	Chips	No Growth	No Growth	No Growth	No Growth
	Water	Growth	No Growth	No Growth	No Growth
12	Chicken feet and wings	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth
13	Pork Chop	No Growth	No Growth	No Growth	No Growth
	Water	Growth	No Growth	No Growth	No Growth
14	Battered Fish	No Growth	No Growth	No Growth	No Growth
15	Sheep Liver and Fat	No Growth	No Growth	No Growth	No Growth
	Water	No Growth	No Growth	No Growth	No Growth

Table 3.19: Showing the results of the Gram-negative bacteria

Vendor No	Type of Sample	Broth DNA	Isolated Gram negative organisms
1	Sheep Trotters	Negative	Growth
	Sour fermented porridge	Negative	No Growth
2	Chicken feet	Negative	No Growth
	Water	Negative	No Growth
3	Sheep liver	Negative	No Growth
	Sheep fat	stx1 (Broth DNA) +	No Growth
4	Pork chop	Negative	No Growth
	Water	Negative	No Growth
5	Pork chop	Negative	No Growth
	Water	Negative	Growth
6	Raw snoekfish	stx1 (Broth DNA) +	No Growth
	Water	Negative	Growth
7	Chicken food	Negative	No Growth
	Water	Negative	No Growth
8	Boerewors roll	Negative	No Growth
9	Pork chops	Negative	No Growth
	Water	Negative	No Growth
10	Sausage	Negative	No Growth
	Water	Negative	No Growth
11	Chips	Negative	No Growth
	Water	Negative	No Growth
12	Chicken feet and wings	Negative	No Growth
	Water	Negative	No Growth
13	Pork Chop	stx1 (Broth DNA) +	No Growth
	Water	Negative	No Growth
14	Battered Fish	Negative	No Growth
15	Sheep Liver and Fat	Negative	No Growth
	Water	stx1 (Broth DNA) +	No Growth

Appendix F: Photographs from the study sites



Photograph 1: SFVs' braaiing and selling different cuts of meat



Photograph 2: The cooler box containing ice utilised to house the samples of water and foods sold by the SFVs obtained by the investigator



Photograph 3: Shows the SFVs situated adjacent to the pension site entrance next to the queues of pensioners around the vicinity of the pension site.



Photograph 4: The inside preparation area of one of the mobile street food vendor carts



Photograph 5: SFVs situated on New Eisleben road in Philippi Browns Farm situated about 3km from the pension site