MICROBIAL- AND FOOD-SAFETY-RELATED HAZARDS ASSOCIATED WITH CHILDCARE FACILITIES IN THE FREE STATE

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DECLARATION OF INDEPENDENT WORK

I, the undersigned, do hereby declare that this research project submitted to the **Central University of Technology, Free State**, for the degree **MAGISTER TECHNOLOGIAE ENVIRONMENTAL HEALTH** is my own original and independent research work that is true and authentic. This research work has not been submitted before to any institution by myself or any other person in fulfilment of the requirements for attainment of any degree or qualification.

N.A.A. BOADUO

03 January 2016

DATE

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SUMMARY

Childcare facilities provide essential services that cater for the mental, physical and developmental needs of children. Considering that childcare establishments provide care services for individuals who are most vulnerable to infections, it is essential that they occupy a safe environment and cared for in such a way that will not compromise their health and wellbeing. The purpose of this study was to uncover aspects that could potentially compromise the health and safety of children in childcare facilities. This was carried out by, (i) evaluating regulatory compliance of childcare facilities by assessing infrastructural compliance and registration terms; (ii) evaluating and assessing hygiene levels, associated knowledge and practices within the childcare facilities by means of checklists and questionnaires; and (iii) quantifying and identify airborne microbes and microbes on the hands and aprons of childcare personnel.

The findings in relation to regulatory compliance revealed lack of childcare by-laws knowledge and training among childcare personnel and deviation from registration terms. The infrastructural compliance assessments revealed unfavourable conditions such as structural defects, inadequate diaper changing areas and equipment as well as inadequate sanitary facilities. Such findings indicate a dire need for assistance regarding infrastructural upgrades and maintenance, the formulation of less complex childcare facility by-laws, strict implementation of registration terms and training of childcare owners and

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personnel on childcare facility by-laws. Assessing the hygiene practices and associated knowledge of childcare personnel revealed inadequate practices associated with daily care duties, diapering, disposing diapers, hand washing and separating children according to age groups.

Air samples were obtained for microbiological quantification and identification from the classrooms of three facilities by means of a Single stage surface air sampler (SAS Super 90). Samples from the hands and aprons were obtained from childcare personnel in the three facilities. Bacterial classification and identification of the colonies was done by means of a Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS). Bacterial strains from the air samples were not identified, colony growths that occurred on the plates however indicted occurred indicating the presence of bacteria, yeast and moulds. Numerous bacterial species were detected on the hands and aprons samples. A majority of the microbes are associated with inadequate sanitary practices. The microbes identified on the hands of the childcare personnel include *Bacillus cereus*, *Clostridium perfrigens*, *Streptococcus pneumonia*, *Escherichia coli*, *Enterobacter cloacae*, *Pseudomonas luteola*, *Acinetobacter baumannii*, *Pseudomonas stutzeri* and *Ochrobactrum anthropic*. The apron samples revealed various species such as *Staphylococcus aureus*, *Bacillus cereus*, *Bacillus megaterium*, *Klebsiella oxytoca*, *Acinetobacter haemolyticus*, *Acinetobacter junii, Enterobacter cloacae*, *Haemophilus influenzae* and *Pseudomonas stutzeri*. The microbes obtained from the samples are

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opportunistic and can cause respiratory and gastrointestinal illness. The overall findings of this study have identified aspects that may harm the health and safety of children in childcare facilities. It would therefore be essential to formulate and implement precautionary measures that would control and possibly eliminate the hazards similar to those identified in this study.

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CHAPTER ONE

LITERATURE REVIEW

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MICROBIAL AND FOOD SAFETY RELATED HAZARDS ASSOCIATED WITH CHILDCARE FACILITIES IN THE FREE STATE

LITERATURE REVIEW

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1.1. INTRODUCTION

Childcare establishments in South Africa are predominantly established by community based organizations, non-governmental organizations in community centres, churches and residential settlements (Department of Social Development, 2014). The business of childcare generates employment and income for many women in South Africa (Giese *et al*., 2011). Childcare facilities established in disadvantaged communities of developing countries like South Africa are under-funded and therefore dependent on the fees paid by parents (Barker and Misselhorn, 2014; Simkiss *et al.,* 2010). The monthly fee expected from parents is sometimes not guaranteed due to lack of payment or unwillingness to pay (Bhabhathane project, 2013). A majority of the fees from parents is spent on food for children, leaving less money for personnel salaries, necessities, equipment, infrastructural upgrades and maintenance or to cover basic costs (Harrison, 2012). Due to the above mentioned challenges, childcare settings in disadvantaged communities are prone to challenges such as under staffing, poor building conditions and inadequate sanitary facilities amongst others (Simkiss *et al.,* 2010).

Childcare establishments play a major role in early childhood development by providing temporary care and other essential services that enhance various aspects of child development (Dowsett *et al*., 2008; Grey, 2006; Penn, 2004). These establishments care for individuals who have vulnerable immune systems; the quality of the environment can either protect or harm a child's development

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and wellbeing (Department of Social Development and The Economic Policy Research Institute, 2014, van der Kleij, 2008). Children have a right to an environmentally safe, healthy learning and care environment that is clean and in good condition (Healthy Schools Network and Advocates for Children of New York, 1999). Since childcare establishments provide care for vulnerable individuals it is essential that they operate in accordance to mandates and norms that safeguard the health and wellbeing of children (Li, 2012). Regulatory mandates for childcare establishments are clearly stipulated in the Children's Act 38 of 2005 and municipal by-laws for childcare facilities (Berry *et al*., 2011, Manyike, 2012). Regulatory mandates and guidelines for childcare establishments regulate infrastructure, equipment and activities within establishments. Aspects that are regulated are those pertaining to space, infrastructural necessities, ventilation, illumination, sanitation, walls, floors, food preparation, refuse disposal, management of illnesses and staffing (Table 1.1).

The Department of Social Development and Municipal health services are the primary sectors that play a role in ensuring that childcare establishments are operated according to required norms and standards for childcare facilities. Section 80 of the Child Care Act 38 of 2005 stipulates the compulsory registration of childcare establishments with relevant provincial and local departments where the establishments are located. Registration is only granted when facilities demonstrate compliance to the norms and standards stipulated in municipal public health by-laws for day care centres, Department of Social Development

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Guidelines for Day Care Centers and section 79 of the Child Care Act 38 of 2005 (Table 1.1).

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Table 1.1: A summary of norms and standards for childcare facilities

Facility features	Requirements	References
Structure and premises	Clean and well maintained premises Exterior walls and roof should be safe and waterproof structure that is able to provide protection from strong winds, rain and other weather conditions Openable doors and windows that are able to provide cross ventilation and natural lighting Rodent proof structure Solid, impervious and damp-proof floors Indoor space of an area of 1 m² per child Outdoor space of 2m² per child and free from excavations and projections Separate indoor play area for children under the age of three and children above the age of three Separate office area Equipped with fire fighting equipment Sickbay in a separate space with a mattress, blanket and first aid kit	Ethekwini Municipality, 2015; Overberg District Municipality, 2014; Emalahleni Municipality, 2012; Manyike, 2012; Ekurhuleni Metropolitan Municipality, 2009; Mangaung Metropolitan Municipality, 2008; Department of Social Development, 2001; Child Care Act 38 of 2005; Govan Mbeki Municipality, 2000.
Kitchen/Food preparation area	Concrete or tiled crack free impervious floor Not less than 12 m^2 hand wash facilities with running hot and cold water Separate partitioned area or separate room Tiled or smooth-plastered wall surfaces painted in light-coloured washable paint Table/work surface made of impervious material Cooling facilities for the storage of perishable food Waste bins with tightly fitting lids Adequate washing up facilities and clean, drinkable water Adequate storage space Adequate lighting and ventilation Equipped with a refrigerator Adequate supply of water and cleaning agents for the; cleaning of equipment Separate storage areas for food and cleaning agents Cleaning agents must be kept in their original containers and out of the reach of children A separate cooling facility for the storage of milk and milk bottles	
Sanitary facilities	Separate toilet and hand washing facilities for staff Minimum of 25 litres of potable water should be supplied on a daily basis in facilities without running water Toilets must be clean and safe One potty for every eight children Designated area for washing and disinfecting potties Adequate hand wash facilities for children, one hand wash basin for every 20 children one toilet and one hand washing facility must be provided for every 20 children (ages 3 to 6 years) one bath or washing sink for every 20 children in nappy changing are	
Storage area	Adequate accesses controlled separate storage area for food, crockery, cutlery, kitchen utensils, personal belongings for each child and personnel	
Refuse accommodation	Waterproof refuse bins that are easy-to-clean with close-fitting lids Out of children's reach Separate disposal bin for soiled disposable diapers.	

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Individuals who wish to establish a childcare facility have to apply for registration at their local or district Department of Social Development office (Department of Social Development, 2011). A Social Worker from local or district office will discuss the application and registration requirements and information with the applicant before issuing a registration form (Department of Social Development, 2011).

The registration process of childcare establishments requires the following supporting information and documents; (i) a business plan, (ii) the constitution of the centre, (iii) approved building plans, (iv) emergency plans, (v) clearance certificates confirming that the applicant and staff members do not appear on the national register for sex offenders, (vi) a health certificate, and (vii) Staff qualifications (Barker and Misselhorn, 2014; Berry *et al*., 2011). Compliance inspections and assessments for registration are also carried out by various local authorities such as municipal health services (Environmental Health Department), fire department, town planning and building inspectorate (Barker and Misselhorn, 2014; Atmore *et al.*, 2012[(b)]; Department of Social Development, 2006). The applicant is expected to fulfil requirements of building regulations, building plan, zoning schemes, fire safety and environmental health and safety (City of Cape Town, 2013).

Once the relevant local authorities have completed all the required inspections the respective assessors issue a report on the findings and recommendations to Environmental Health and the applicant. This will be followed by an assessment by an Environmental Health Practitioner who will consolidate all the reports and submit to the DSD together with a health certificate which is only issued if the establishment complies with the environmental health requirements for childcare facilities (City of

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Cape Town, 2013; National Norms and Standards Relating to Environmental Health in terms of National Health Act, 2003; Department of Social Development, 2006). A health compliance certificate is vital for registration by the Department of Social Development (Department of Social Development, 2014). Infrastructural non-compliances often hamper facilities from obtaining health compliance certificates (Viviers *et al*., 2013). Once the applicant has obtained such a certificate, a copy should be visibly displayed at the facility as an indication of registration (National Norms and Standards Relating to Environmental Health in terms of National Health Act, 2003).

The health compliance certificate displays the terms of registration, certificate number, date of registration, name of the municipality, full particulars of the owner, the name of the facility, physical address of the facility, the maximum number of children permitted, minimum and maximum age groups permitted, classification of the place of care, operational hours, types of food served, restrictions and conditions, expiration date and the signature of an Environmental Health Practitioner (Ethekwini Municipality 2015; Overberg District Municipality, 2014; Emalahleni Municipality, 2012; Ekurhuleni Metropolitan Municipality, 2009; Department of Social Development, 2006; Govan Mbeki Municipality, 2000; Child Care Act, 1983).

Facilities that fully comply to the registration and regulatory requirements are granted full registration which should be renewed every two years or upon new ownership of the establishment. Facilities that only comply to the minimum requirements are granted conditional/provisional registration (Berry *et al*., 2011). Section 98 of the Children's Act permits conditional or partial registration to facilities that do not fully

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comply with the registration requirements stipulated in the by-laws and guidelines for childcare facilities (Department of Social Development, 2013). This type of registration is granted for a grace period of two years so that facilities can rectify and improve non-compliances in order to achieve full registration (Department of Social Development, 2013). Following registration, continuous inspections and assessments have to be conducted by officials from the Department of Social development and Environmental Health Practitioners monthly or quarterly to ensure that registered facilities still comply with by-laws and registration conditions (National Norms and Standards Relating to Environmental Health in terms of National Health Act, 2003; Department of Social Development, 2006). In most cases due to financial challenges, childcare facilities often don't comply with by-laws and registration conditions and this poses a threat to the health and wellbeing of children.

1.2. INFECTIONS AND ILLNESSES ASSOCIATED WITH CHILDCARE FACILITIES

Children cared for in childcare facilities are at greater risk of contracting respiratory, parasitic, skin and gastrointestinal infections compared to children who do not attend childcare (Table 1.2) (Zomer *et al*., 2013; Simkiss *et al.,* 2010; Nesti and Goldbaum 2007; Olaitan and Adeleke, 2007). The prevalence and transmission of infections in childcare settings are facilitated by factors such as building conditions, overcrowding, playroom/class size, close frequent personal contact between children and caregivers, hygiene practices utilized by caregivers and children, number of employees, management of sick children and immunological characteristics (Li, 2012; Simkiss *et al*., 2010; Nesti and Goldbaum 2007).

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Children who attend childcare often fall sick with illnesses which are more likely to be caused by opportunistic microbes which are either food borne, waterborne or airborne (Aydogdu *et al.,* 2009; Lee *et al*., 2007). Infectious organisms are transmitted primarily from person-to-person, via fecal-oral route, direct skin contact, contact with body excretions and body fluids, transmission by aerosols (Nesti and Goldbaum, 2007).

Table 1.2: Common infectious diseases occurring in childcare facilities (Nesti and Goldbaum, 2007; Colorado Department of Public Health and Environment, 2003).

Type of spread	**Infectious Disease/ Microbial Agent**
Airborne	Chickenpox, Common Cold, Fungal spores, Influenza, Measles, Meningitis, Mumps, Rubella, *Streptococcus pyogenes*
Fecal-oral route	*Escherichia coli*, *Shigella*, *Giardia*, Rotavirus, *Campylobacter*, *Salmonella*, *Cryptosporidium* and Hepatitis A
Skin Contact	Chickenpox, Head Lice, Impetigo, Pink Eye, Scabies, Herpes Simplex

Since children have unhygienic habits which include mouthing equipment and toys, touching almost everything and anything, failing to wash hands after using the toilet; their habits can also aid and facilitate contamination, transmission of infectious and opportunistic agents (Tansey, 2010; Lee and Greig, 2008, Lee *et al*., 2007). Childcare facilities are additionally vulnerable to foodborne illness outbreaks and cross contamination which can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, diaper changing, serving and cleaning up after infants and young children (Todd *et al*., 2007). Foodborne illness cases are also associated with inadequate cooking, temperature

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abuse, improper storage, cross contamination between raw and cooked foods through food contact surfaces (Cosby *et al*., 2008).

Previous studies have demonstrated that many food service and serving surfaces including tables, kitchen counters, toys, eating utensils, blankets, washing sinks, and dinner plates in childcare facilities are often contaminated with bacterial levels that exceeded public health standards (Li, 2012; Krilov *et al*., 1996; Mildred *et al*., 1994). Various microbial studies conducted in childcare facilities in the United States have reported the presence of faecal coliforms on various surfaces and objects in childcare facilities (Li, 2012; Cosby *et al*., 2008; Staskel *et al*., 2007; Laborde *et al*., 1993; Van *et al*., 1991; Weniger *et al*., 1983). Surfaces and objects in childcare facilities are often involved in the transmission of enteric diseases among children in childcare (Li, 2012; Cosby *et al*., 2008; Staskel *et al*., 2007; Brady, 2005). Disinfection of inanimate objects coupled with good hand washing is important in controlling the spread of enteric diseases in childcare facilities (Li, 2012; Cosby *et al*., 2008; Staskel *et al*., 2007; Brady, 2005).

Statistics South Africa (2014) reported a total number of 35 094 deaths of children below the age of five in 2013 whereby intestinal infectious diseases was the leading cause followed by respiratory and cardiovascular conditions. The National Institute of Communicable Diseases bulletin reported a Hepatitis A outbreak in Tshwane in 2009 where 70% of the cases were linked to three schools and two childcare facilities. However, there are currently no statistics reflecting the impact or the prevalence of foodborne illness outbreaks at South African childcare facilities. The Centres for Disease Control and Prevention (CDC) data and statistics information on foodborne

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illness outbreaks reported 51 foodborne outbreaks in childcare facilities in the United States between 1998 and 2008 where 1947 individuals fell ill (The Centres for Disease Control and Prevention, 2012; Li, 2012). In 2007, the first case of *Shigella* was reported in Citrus County in Florida United States of America. Out of all the cases reported during 46 confirmed cases occurred in childcare facilities (Fraser, 2007).

The presence of diapered children in childcare is a risk factor for enteric pathogens in a childcare setting (Li, 2012). Having diapered children crawl on carpets including changing diapers on inappropriate surfaces such as blankets and mattresses contributes to the prevalence and transmission of enteric pathogens in childcare facilities (Li, 2012). These surfaces become contaminated with faeces and rarely disinfected following contamination (Li, 2012). Carpets also harbour various contaminants such as dust, allergens, bioaerosols, fungi, moulds and toxic chemicals which can be redistributed in the environment or spread through contact (Krieger and Higgins, 2002). Children in childcare often play, sleep, sit and eat on carpets and are likely to pick up and eat almost anything including food that has fallen on the floor. Children have immune systems that are more sensitive to foreign substances such as those found harboured by carpets (Horton, 2008). Studies have reported the presence of potentially pathogenic microbes such as *Aeromonas*, *Escherichia coli*, *Enterobacter*, *Klebsiella pneumonia,* *Salmonella* and *Staphylococcus aureus* in carpets (Ali *et al*., 2014; Rahouma *et al*., 2010; Anderson *et al*., 1982).

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Carpets can hold eight times its weight in toxin filled dirt and one's naked eye cannot even see the trapped dirt that the carpet is hiding (Michael, 2013). Issues related to the cleanliness and safety of carpets go as far back as 1850, when Florence Nightingale wrote, "For a sick room a carpet is perhaps the worst expedient could by any possibility have been invented, a dirty carpet literally infects the room" (Nightingale, 1969). A few published studies have compared the presence of micro-organisms in rooms with carpet and in those without carpet with regards to indoor air quality and reported that carpets contribute to the presence and quantity of microorganisms in the air (Bates, 2011; Foarde and Berry, 2004; Luedtke, 2003). However, little research has been conducted on the presence of airborne contaminants especially volatile organic compounds and micro-organisms on carpets (Leonas, 2003). The transmission including occurrence of infections and illnesses in childcare facilities generally depends on the environment, carriers of the agent, the characteristics of the agent itself as well as hygiene practices utilized (Nesti and Goldbaum, 2007).

Childcare facility staff and family members are also at increased risk of acquiring childcare related infectious illnesses, therefore children are not the only individuals involved in acquiring and transmitting infectious diseases associated with childcare facilities (Zomer, 2013; Nesti and Goldbaum, 2007). Good hygiene habits in childcare facilities are essential for reducing the risk of contamination, illnesses, cross infection between children and adults (Tansey, 2010). This makes monitoring and assessment of cleanliness, sanitation and hygiene practices within these facilities a crucial aspect (Todd *et al*., 2007). Understanding the potential health risks associated with childcare attendance requires a better understanding of microbial

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diversity within childcare settings (Lee *et al*., 2007). This can possibly be achieved by looking into aspects such as those of the built environment, environmental hygiene and associated hazards.

1.3. INFRASTRUCTURAL ASPECTS AND ASSOCIATED HAZARDS

Children in childcare spend most of their time in playrooms and classrooms. Poorly structured and under-resourced childcare establishments hinder the quality of childcare and health and safety of children (Atmore *et al*., 2012[(a)]). Children are vulnerable to environmental hazards caused by infrastructural defects or poorly built structures (Bolte *et al*., 2009, European Environment Agency and the World Health Organization, 2002; Healthy Schools Network and Advocates for Children of New York, 1999). Frequent exposure to hazards associated with the built environment causes dormant conditions and diseases such as cancer, respiratory diseases and neurological diseases (Joshi, 2008; Cummins and Jackson, 2001; Healthy Schools Network and Advocates for Children of New York, 1999). The absence of safe drinking water, food preparation areas, waste storage areas, sanitary facilities and adequate diaper changing area plays a role in the transmission of infections in a childcare setting (Bonnefoy, 2007; Krieger and Higgins, 2002).

Regulating infrastructural aspects of a childcare facility and ensuring compliance thereof assures safety (Department of Social Development, 2006). Infrastructural compliance has however been among the main reason behind the non-compliance or partial compliance of childcare facilities in South Africa particularly those that are located in disadvantaged communities (Department of Social Development, 2014). Childcare establishments in South Africa are commonly faced with financial

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constraints which makes meeting the necessary infrastructural requirements a major challenge (Ilifa labantwana, 2013). Results from the national audit conducted in childcare facilities in 2000 revealed that 8% of childcare facilities in South Africa function without basic infrastructural requirements such as running water, electricity or adequate sanitation (Atmore *et al*., 2012 [(a)]). The audit uncovered that 42% of conditionally registered childcare facilities in South Africa require urgent infrastructural maintenance. Other aspects that have been linked to non-compliance of childcare establishments are lack of knowledge and understanding of childcare regulations (University of Pretoria Centre for Child Law, 2013).

Other possible sources that result in the occurrence of infections associated with the built environment include indoor air contaminants. Indoor air consists of a complex mixture of various microorganisms such as fungi, bacteria, viruses, secondary microbial products such as endotoxins, mycotoxins; microbial and non-microbial volatile organic compounds (Aydogdu *et al.,* 2009; Douwes *et al.,* 2002; Gorny *et al*., 1999) and all of these are referred to as bioaerosols. Bioaerosols are dispersed into the air via respiratory droplets, breathing, sneezing, talking, coughing, or released from carpet flooring, clothing, the skin and hair of animals and human beings (Ammor *et al.,* 2004; Beggs 2002; Cundith *et al*., 2002; Gorman *et al*., 2002; Chambers 2001). Exposure to bioaerosols may result in adverse health effects such as allergies, contagious infectious diseases, toxic effects, cancer, asthma and inflammatory lung diseases (Shin *et al*., 2015; Douwes *et al.,* 2002).

Bioaerosols utilize carriers such as dust particles, water and saliva as transportation media to aid their distribution in nature (Gorny *et al*., 1999). These carriers facilitate

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bioaerosol inhalation and the settling of bioaerosol on surfaces and food. Heating, ventilation and air-conditioning systems can also provide a favourable environment that facilitates the survival of microbial airborne contaminants (Cundith *et al*., 2002; Pastuszka *et al.,* 2000). Indoor air microbial studies conducted in childcare facilities revealed the presence of bacterial and fungal species such as *Staphylococcus, Streptococcus*, *Bacillus*, *Pseudomonas*, *Micrococcus*, *Corynebacterium*, *Aspergillus Cladosporium* and *Penicillium* (Shin *et al*., 2015; Mandal and Brandl, 2011; Aydogdu *et al.,* 2009).

Indoor environments with poor sanitary and unhygienic conditions can act as a source for bioaerosols or any other form of microbial contamination. Such areas require monitoring and control of air quality in places where food is served or prepared (Lues *et al*., 2006), and where children are looked after such as in childcare and nurseries. It has been reported that fungal and bacterial growth in indoor environments can release infectious airborne spores (Aydogdu and Asan, 2008; Stetzenbach *et al*., 2004) which eventually end up in food resulting in food contamination and possible ingestion into the human body.

There has been an increased interest and awareness regarding bioaerosol exposure and their ability to cause infections in occupational and residential indoor environments (Lee and Jo, 2006; Lues *et al*., 2006; Douwes *et al.,* 2002). Childcare facilities appear to provide daily opportunities for exposure and transmission of bacteria and viruses. However little is known concerning the diversity of microorganisms in childcare facilities (Lee *et al.,* 2007). The occurrence of infections in childcare facilities is not only facilitated by the built environment or bioaerosols.

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Hygiene and food safety practices utilized in childcare settings also facilitate the prevalence and transmission of infections.

1.4. HYGIENE PRACTICES OF CHILD CAREGIVERS

Children fully depend on parents and caregivers to fulfil their mental, emotional and physical needs and this makes parents and caregivers to be considered as gatekeepers of children's health (World Health Organization, 2004). Care activities include routine activities such as feeding, bathing, cooking, toilet training, diapering or playing (Jamieson, 2013; World Health Organization, 2004). Care giving practices, behaviours and activities are essential aspects that determine and influence child growth, development and survival (Peter and Kumar, 2014; Nti and Lartey, 2008; World Health Organization, 2004).

Health and safety in childcare facilities is guaranteed when childcare staff has adequate and sufficient knowledge on general hygiene and sanitary practices together with the knowledge on childcare regulatory framework and guidelines (Alkon *et al*., 2009; Taylor, *et al*., 2008; Enke *et al*., 2007; Sangster *et al*., 2004). Enteric outbreaks in childcare facilities have often been associated with inadequate hygiene practices that were carried out when executing care duties such as diaper changing, toilet training, cleaning, feeding and food preparation (Galanis *et al*., 2003; O'Donnell *et al*., 2002; Williams *et al*., 1997; Belongia *et al*., 1993).

Children in daycare facilities frequently come into contact with surfaces, objects and hands of caregivers and that of other children (Buzby, 2001). Hands and fomites (inanimate objects such as clothing, utensils, toys, etc.) play a

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role in the transmission of infections and illnesses (Lopez *et al*., 2013; Boone and Gerba, 2007). Microbes and particles that settle on clothing can spread through contact with hands and surfaces and eventually to food as illustrated in Figure 1.1 (McDonagh, 2013; Nicas and Sun, 2006).

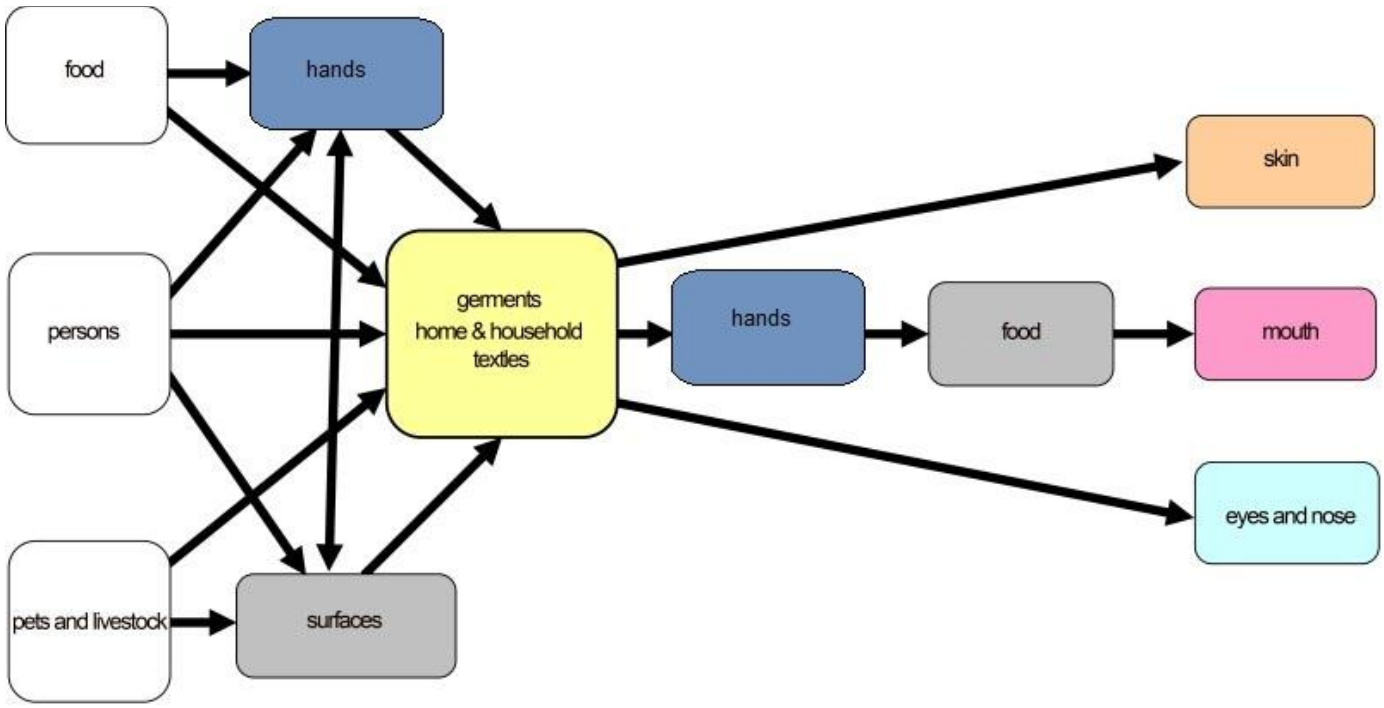

Figure 1.1: Diagram showing the transmission routes for microorganisms via hands and clothing (Hohenstein Institute, 2014).

Examples of infections that are commonly spread by fomites and hands include infections such as influenza, herpes simplex, conjunctivitis, *Escherichia coli* and *Staphylococcus aureus*, *Giardia* including rotavirus (Nwankiti, *et al*., 2012). Hands and clothing become contaminated with infectious agents either via directed or indirect contact with surfaces, people, raw foods, animals, body fluids and excreta (saliva, sweat, nasal secretions, blood, urine, vomit or feces), body parts, or by settling of airborne particles and bioaerosols (Lopez, *et al*., 2013; Boone and Gerba,

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2007). The hands of caregivers are considered as a major contributor to fecal contamination in childcare facilities (Cosby *et al*., 2008). Children in nappies at childcare facilities increase the risk of enteric agents spreading to others via caregivers' hands and clothing (Lee and Greig, 2008). Children have limited control over hygiene and food safety risks because caregivers are responsible for cooking their meals and performing hygiene related care activities (Buzby, 2001; Taylor *et al*., 2008). Equipping child caregivers with adequate resourceful training on aspects and practices that positively enhance child development affect how caregivers behave with children (Li, 2012; World Health Organization, 2004, Enke *et al*., 2007).

1.5. RATIONALE

Childcare facilities are associated with certain epidemiological characteristics that contribute to the risk of infections (Nesti and Goldbaum, 2007). Several studies have recognized childcare attendance as a risk factor for acquiring respiratory and gastrointestinal infections (Nesti and Goldbaum, 2007, Zutavern *et al*., 2007; Barros, 1999; Lu *et al*., 2004; Louhiala *et al*., 1997). Poor hygiene practices, lack of cleanliness and non-compliance to regulatory requirements facilitate the transmission of infections in childcare facilities (Nesti and Goldbaum, 2007, Colorado Department of Public Health and Environment, 2003). Regulatory compliance in childcare is an essential towards safeguarding the health and wellbeing of children who attend care facilities (Li, 2012). Infectious acquired in childcare facilities do not only affect children and childcare personnel, transmission also extends to members of their households (Thacker *et al*., 1992; Holt *et al*., 2004). Intestinal infectious diseases and respiratory conditions are the top two underlying causes of death in children below five years of age in South Africa (Statistics South Africa, 2014).

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Minimizing the prevalence of infections associated with childcare attendance may reduce the burden of diseases responsible for child mortality in South Africa. Minimizing the risk of infection in a childcare setting can be facilitated by exploring, understanding and addressing circumstances and challenges associated with childcare settings, mainly those of regulatory compliance, the built environment, hygiene practices, food safety practices and environmental hygiene.

Aim and Objectives

The main aim of this study was to assess the factors that contribute to the prevalence of microbial hazards associated with childcare facility setups in the Free State Province, South Africa.

The objectives of this study were to:

- evaluate the regulatory compliance of childcare facilities by assessing infrastructural compliance and registration terms;
- evaluate and asses the hygiene levels, associated knowledge and practices within the childcare facilities by means of checklists and questionnaires; and
- quantify and identify airborne microbes and microbes on the hands and aprons of childcare personnel.

The results obtained from this study will be used to identify problem areas within child day care facilities. Depending on the results and outcomes of the study, workshops and awareness campaigns will be conducted to equip scholars, day care employees and parents with the necessary knowledge regarding good adequate hygiene and food safety practices.

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1.6. REFERENCES

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CHAPTER TWO

AN ASSESSMENT OF INFRASTRUCTURAL REQUIREMENTS COMPLIANCE AND ASPECTS THAT INFLUENCE THE PROCESS OF CHILDCARE FACILITY REGULATORY REGISTRATION

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AN ASSESSMENT OF INFRASTRUCTURAL REQUIREMENT COMPLIANCE AND ASPECTS THAT INFLUENCE THE PROCESS OF CHILDCARE FACILITY REGULATORY REGISTRATION.

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ABSTRACT

An environment occupied by children has a strong influence on their health and well-being. Childcare facilities that are poorly built and poorly maintained pose a health risk to children. This study assessed the structural conditions including the aspects and challenges that influence regulatory compliance of childcare establishments in the Free State (n=62). The criterion used to assess compliance was aligned with municipal by-laws and guidelines that regulate childcare facilities within South Africa. The survey revealed infrastructural defects such as holes in walls and ceilings, cracked walls and peeling paint in a majority of the facilities (81%). Thirty two percent of the facilities had hand wash basins were not functioning as required by law. Majority (85%) did not have appropriate diaper changing stations and equipment. All the facilities that participated were in possession of health certificates. Sixty five percent of the facilities were conditionally registered of which 25% had exceeded the two year probation period for conditional registration. Thirty eight percent deviated from the registration terms and conditions stipulated on their health compliance certificates whereby the facilities accommodated more children as opposed to the numbers that were stated on the health compliance certificates. Inherent requirements such as training on childcare guidelines and regulation had not been received by a majority of the respondents (89%). Financial constraints and poor knowledge of childcare regulations appeared to have been the reasons behind partial compliance and failure to implement necessary upgrades for full compliance.

Keywords: By laws; Childcare facility; compliance; Hazards; Environmental health practitioner; Infrastructure; Municipality, registration, Health compliance certificate

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2.1. INTRODUCTION

Childcare establishments that render childcare services for more than six children up to the age of six have to be registered with the Department of Social Services as Section 30 of the Child Care Act prohibits admission of children in unregistered places of care (The Child Care Act 74 of 1983). The registration of childcare facilities primarily requires compliance to standards concerning the environment of the facility, resources, building structure, equipment, sanitation and staffing (Biersteker and Streak; 2008, Blau, 2006). Compliance regulations for childcare facilities ensure the health and safety of children in childcare facilities (Matthews *et al*., 2015; Blau, 2006).

Since children spend seven to ten hours a day in care and learning environments, the quality and design of a child's built environment can influence the occurrence and prevention of illnesses and injuries (Landrigan and Etzel, 2013; Cummins and Jackson, 2001). Poorly structured and under-resourced childcare establishments hinder the quality of childcare and health and safety of the children (Atmore *et al*., 2012). Children are more vulnerable to environmental hazards due to their underdeveloped immune system (Bolte *et al*., 2009, European Environment Agency and the World Health Organization, 2002; Healthy Schools Network and Advocates for Children of New York, 1999). Children who are frequently exposed to environmental hazards may have tendencies of developing cancer, respiratory diseases, neurological diseases that manifest later in life (Joshi, 2008; Cummins and Jackson, 2001; Healthy Schools Network and Advocates for Children of New York, 1999).

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Infrastructural defects such as cracks, holes, peeling paint, leaking pipes as well as infrastructural features such as poor ventilation and moisture provide a favourable environment for microbes and pests to breed and thrive (Landrigan and Etzel, 2013; Makene, 2007; Wargo, 2003). The above mentioned defects lead to exposure to hazards such as pests, allergens, bioaerosols and volatile organic compounds that lead to respiratory infections, vector-borne diseases and allergies (Landrigan and Etzel, 2013). Additionally, the absence of adequate infrastructural features such as safe drinking water, food storage areas, waste storage areas, toilets and hand wash facilities plays a role in the transmission of infections (Bonnefoy, 2007; Krieger and Higgins, 2002).

Early childhood development centres in South Africa are commonly faced with financial constraints which makes meeting the necessary infrastructural requirements a major challenge (Ilifa labantwana, 2013). A study conducted by Atmore *et al*., (2012) cited poor financial management as a possible root cause for the financial challenges experienced by registered childcare establishments in South Africa. In 2000, the National Department of Basic Education conducted national audit in childcare facilities across South Africa; the finding revealed that 8% of the faculties that were audited function without running water, electricity or adequate sanitation (Atmore *et al*., 2012). The audit findings also uncovered that 42% of registered childcare facilities across South Africa require urgent infrastructural maintenance.

A compliance driven registration process of childcare facilities is essential since it entails the involvement of inspectorate and regulatory authorities who ensure compliance and apply measures to safeguard the health and wellbeing of the

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children and childcare personnel (Li, 2012). Infrastructural compliance and awareness would be beneficial towards minimizing and preventing environmental hazards within childcare facilities. An assessment of the core challenges that hinder the compliance of childcare establishments may provide a better understanding and guidance on practical strategic initiatives that may curb the dilemma behind achieving full compliance. This study was therefore aimed at assessing the infrastructural regulatory compliance and registration terms of childcare facilities in the Free State.

2.2. MATERIALS AND METHODS

2.2.1. Sampling sites

A survey assessing infrastructural compliance, registration terms and regulatory knowledge was conducted in childcare facilities located in three municipalities in the Free State namely Mangaung Metropolitan Municipality, Matjhabeng Local Municipality and Moqhaka Local Municipality (Figure 2.1, Table 2.1). Ethical clearance was not requested. However permission to conduct the study was requested in writing and submitted to municipal Environmental Health managers and local heads of the Department of Social Development (Appendix A).

The Department of Social Development in the Lejweleputswa District did not respond. Telephonical responses were received from the Mangaung Metropolitan Municipal Health Services, Lejweleputswa District Municipal Health Services, Fezile Dabi Municipal Health Services and Fezile Dabi Department of Social Development.

Approval to conduct the study was granted verbally during meetings that were held with the respective stakeholders where the study was further elaborated and

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discussed. Facilities were randomly selected from a list of registered childcare facilities captured by the respective municipalities. A total of 70 facilities were selected for the study. Upon the visits eight facilities declined to participate, five of the eight mentioned that they cannot participate in any type of interview without the presence of the manager or owner of the facility. Only 62 facilities participated in the study (Table 2.2).

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Figure 2.1: Map of District and metropolitan municipalities (Wikipedia, 2012)

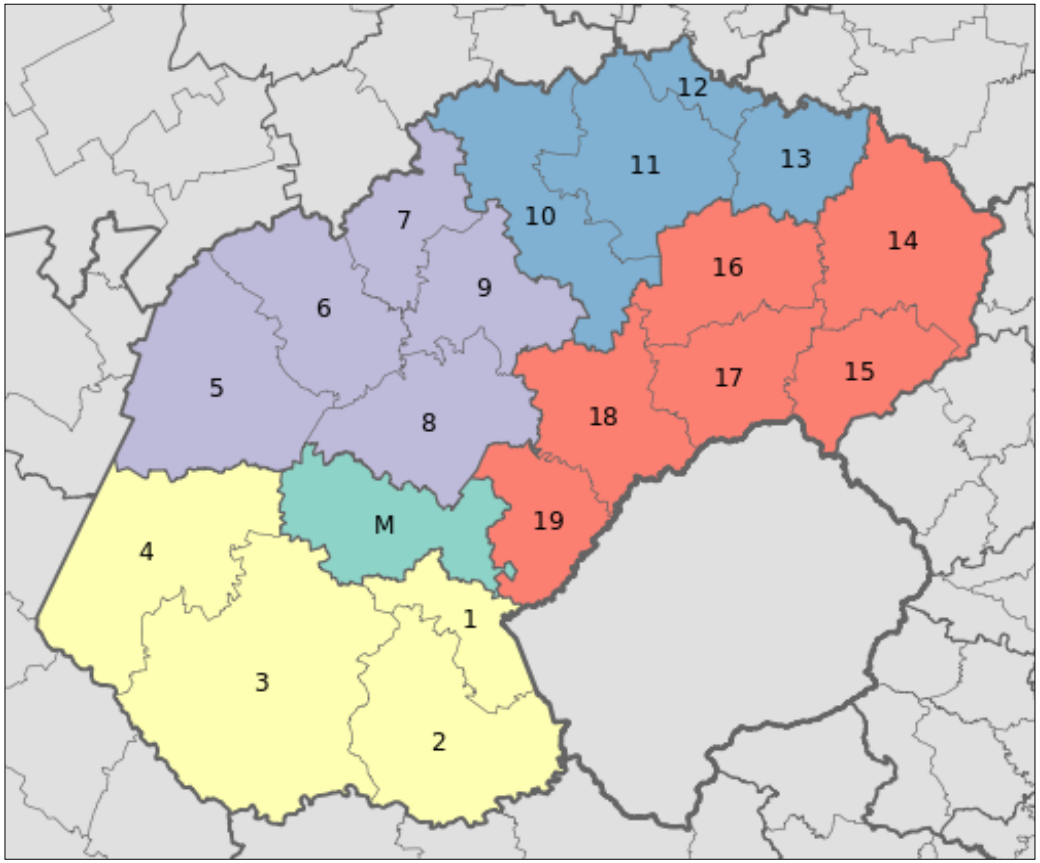

Table2.1: District and metropolitan municipalities (Wikipedia, 2012)

District Municipality	Map Key	Local Municipality
Mangaung Metropolitan Municipality	M	Mangaung Metropolitan Municipality
Xhariep District Municipality	1	Naledi Local Municipality
	2	Mohokare Local Municipality
	3	Kopanong Local Municipality
	4	Letsemeng Local Municipality
Lejweleputswa District Municipality	5	Tokologo Local Municipality
	6	Tswelopele Local Municipality
	7	Nala Local Municipality
	8	Masilonyana Local Municipality
	9	Matjhabeng Local Municipality
FezileDabi District Municipality	10	Moqhaka Local Municipality
	11	Ngwathe Local Municipality
	12	Metsimaholo Local Municipality
	13	Mafube Local Municipality
Thabo Mofutsanyana District Municipality	14	Phumelela Local Municipality
	15	Maluti-a-Phofung Local Municipality
	16	Nketoana Local Municipality
	17	Dihlabeng Local Municipality
	18	Setsoto Local Municipality
	19	Mantsopa Local Municipality

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Table 2.2: The total number of childcare facilities visited and number of personnel interviewed per municipality.

Local Municipality	Town	Number of Facilities Sampled		Number of Childcare Personnel Interviewed	
Mangaung Metropolitan Municipality	Bloemfontein		12		30
	Botshabelo		3		9
	Thaba Nchu		9		21
		Sub Total:	**24**	**Sub Total:**	**60**
Matjhabeng Local Municipality	Odendaalsrus		8		24
	Welkom		10		20
	Windburg		5		12
		Sub Total:	**23**	**Sub Total:**	**56**
Moqhaka Local Municipality	Kroonstad		8		24
	Steynsrus		3		6
	Viljoenskroon		4		8
		Sub Total:	**15**	**Sub Total:**	**38**
		Grand Total:	**62**	**Grand Total:**	**154**

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The research team collecting data introduced themselves upon arrival at every facility. The purpose of the visit, the study and associated activities such as administering questionnaires, noting observations and taking photographs were explained to the owners of the facilities. Data was only collected after verbal permission had been granted by the facility owners or person in charge. The facilities were assessed by means of a checklist that was drafted according to the childcare structural requirements stated in the Guideline for day care centres and various municipal health by-laws regarding childcare facilities. The checklist was used to assess and to note findings of the structure in general, walls, floor, ceilings, toilet facilities, hand wash facilities, kitchen and other areas within the establishment and condition thereof.

Observations that were made during the assessment were noted in a notebook together with the follow up questions that were asked based on the findings and the answers provided by the child caregivers. Additional findings that were in line with the objectives of the study were noted in writing. Questionnaires were also used to document the registration status of the facilities, the frequency of inspection visits by Department of Social Development officials and Environmental Health Practitioner. Evidence of registration and health compliance certificates was requested. The registration terms stated on the health compliance certificates were compared to the circumstances that were present during the visit. The managers and employees (n=124) were questioned about their familiarity on regulatory compliance framework for childcare establishments, how they came about knowing about the regulations. The respondents were requested to briefly summarise the contents of the regulations and guidelines according to their

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understanding. Questions were translated in Sesotho to accommodate employees who did not understand English. Discussions regarding collaborative initiatives in the registration and assessment processes were held with officials from Environmental Health and Department of Social Development.

2.3. RESULTS AND DISCUSSION

All the facilities (62) (Table 2.1 and 2.2) were in possession of health compliance certificates. Mangaung Metropolitan Municipality was the only municipality that issued additional certificates that grade an establishments' compliance level according to the environmental health aspects that are categorized in the municipality's by-laws for childcare facilities, the grading certificates are valid for two years. Conditional registration was granted to a majority of the facilities (65%) of which 25% of the 65% had overdue conditional registration probation terms which had not been renewed (Figure 2.2). Conditional registration has been noted to be a stagnant and repetitive cycle in most provinces in South Africa (Barker and Misselhorn, 2014). Conditionally registered childcare facilities in disadvantaged communities often battle to achieve full registration resulting in the repeated renewal of the conditional registration (Barker and Misselhorn, 2014).

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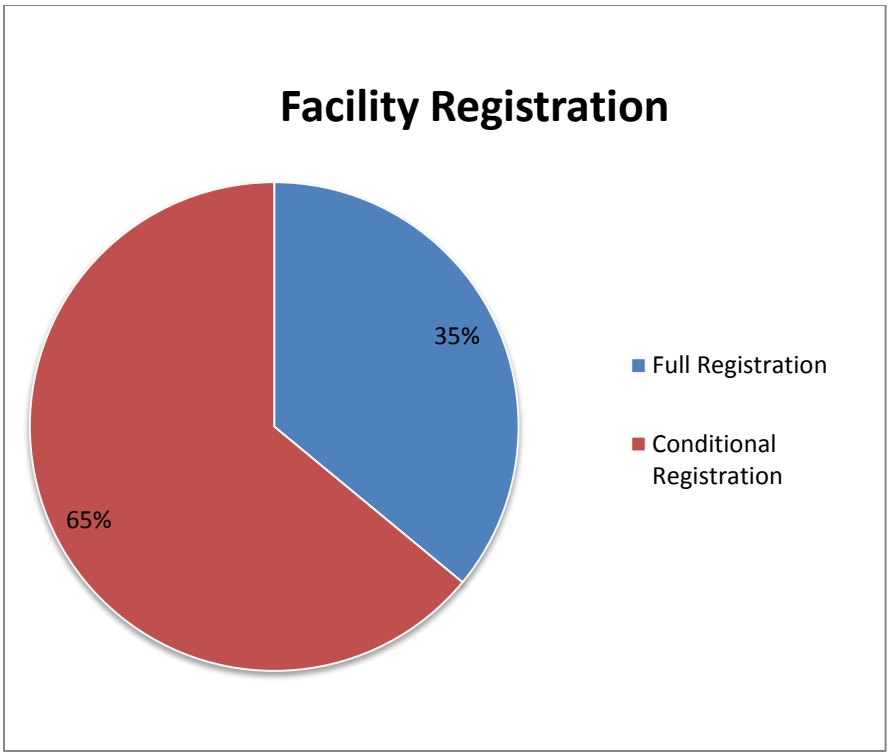

Figure 2.2: Percentages of fully registered and conditionally registered childcare facilities.

The facilities that were in possession of out-dated conditional registration certificates in this study have been operating for more than five years; for that reason it can be concluded that conditional registration was repetitively granted therefore supporting Barker and Misselhorn's statement on conditional registration. The nationwide Department of Social Development audit (2014) indicates that inadequate infrastructure is the most common reason behind conditional registration of childcare facilities. This was also the case for conditionally registered facilities that participated in this study.

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Conditional registration is based on the discretion and leniency of the regulatory and inspectorate officials and varies between provinces (Barker and Misselhorn, 2014). It has been reported that the Free State Province renews conditional registration indefinably and overlooks the initial purpose behind conditional registration (Barker and Misselhorn, 2014). Jacobs and Cordova (2005) mention that compliance and inspectorate officials in developing countries exercise too much discretion and leniency as opposed to issuing penalties and shutting down establishments that do not comply with relevant regulations. Extending discretionary powers without limits hinders compliance and the quality of standards (Jacobs and Cordova, 2005). Overlooking conditional registration and granting indefinite extension may consequently compromise the quality of childcare as well as the health and safety of the children and childcare personnel.

Discrepancies were found when comparing the terms of registration on the health compliance certificates to the circumstances that were found during the visits. Section 30(6) of the Child Care Act (74 of 1983) recognizes the deviation or non-compliance with registration terms and conditions as an offence. The study found that twenty two facilities had more children than the maximum allowable limit stated on the health compliance certificates. The facilities indicated that the reason behind the deviation from the conditions stated on the health certificate was that based on their understanding, it is unlawful to deny a child his or her right to childcare by turning them away from the facility. A few facilities (40%) added to say that they gain financially when admitting more children. It was also found that some facilities (8%) cared for infants while the

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health compliance certificates stated that the facilities may only care for children from the ages three and above. After acquiring information regarding the type of registration conditions and terms granted to the different facilities, an assessment on the infrastructural conditions and compliance was conducted. The childcare facilities that were visited were constructed using different building materials. A minority of the facilities (44%) were constructed from concrete bricks/block and 56% were of zinc sheeting supported by gum poles (Figure 2.3 A-C).

Figure 2.3: A-B indicating the type of childcare facility structures. A and B- Concrete structures; B- Zinc sheeting structure.

The classrooms were evaluated by means of a checklist (Appendix B) assessing the conditions of the walls, floors, ceilings. Structural defects were identified in fifty facilities. Common defects identified were cracked walls (Figure 2.4 A and B), holes and openings in roofing and ceilings (Figure 2.5 D; Figure 2.6 A-E); peeling paint (Figure 2.5 A) and damp ceilings (Figure 2.6 D). All the childcare facilities constructed of zinc sheeting had holes in the sheeting; 49% had lined their “walls” with newspapers,

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cardboard boxes (37%) or woven polypropylene bags (14%) as shown in Figure 2.5 C. Eight shack facilities used cardboard as roof liners (Figure 2.6 B and C). These were identified as potential health hazards as they can carry dust which harbours microbial contaminants.

Figure 2.4: A and B Structural defects identified in childcare facilities. A and B- Cracked walls.

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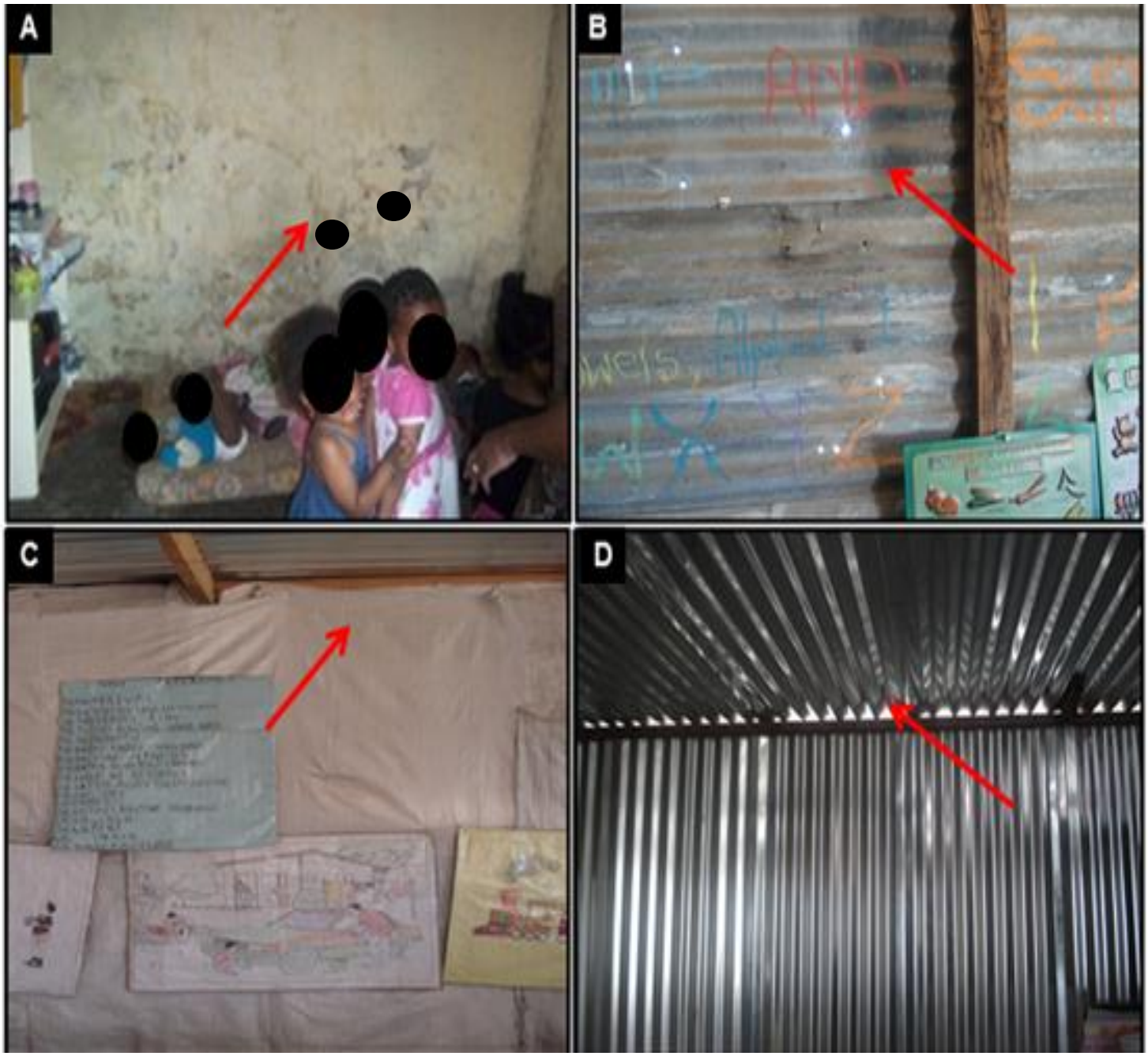

Figure 2.5: A-D Structural defects identified in childcare facilities. A- Peeling paint from wall; B- Holes in zinc sheeting wall; C- woven polypropylene bag used to line zinc sheeting wall; D- Holes in zinc sheeting wall.

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Figure 2.6: A-D Structural defects identified in childcare facilities. A- Peeling paint from wall; B- Holes in zinc sheeting wall; C- woven polypropylene bag used to line zinc sheeting wall; D- Holes in zinc sheeting wall.

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Structural defects such as holes and cracks provide an entrance and breeding place for pests as well as an entrance of environmental contaminants such as dust (Krieger and Higgins, 2002). Pests can carry pathogens which can be transmitted to humans either through contaminated food, contaminated surfaces or by their presence in the environment (Battersby, 2009). Environmental contaminants can also settle on food contact surfaces resulting in possible food contamination. Peeling wall paint is the most common source of lead in an indoor environment (World Health Organization, 2010). Lead exposure in early ages has detrimental health effects such anaemia, impaired growth, hypertension, renal impairment and immunotoxicity (Naicker *et al*., 2013; World Health Organization, 2010). The nature of a child's immune system in their early stages of growth and development makes them more susceptible to relatively low lead levels which may not have immunotoxic effects in healthy adults (World Health Organization, 2010). The routes of lead exposure from the source to children occur through the skin, inhalation and ingestion (World Health Organization, 2010). The amount of lead present in the air was not measured in the current study as this was an unexpected finding; this was an identified limitation. Future studies will measure lead amounts to assess its concentration in day-care centres as it is an identified health hazard.

Cardboard is not impermeable; facilities using such material as a ceiling could experience accumulation of water on the cardboard during raining or wet seasons. Accumulation of water, excessive moisture and dampness in an indoor environment or indoor surfaces such as walls and ceilings facilitates growth of mould, fungi and

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bacteria; which release spores, fragments and volatile organic compounds into the air (World Health Organization, 2010). Moulds reportedly produce toxins (mycotoxins), allergens and irritants (McClay and Marple, 2006). Susceptible individuals such as children are more vulnerable to infections caused by moulds; the presence of moulds in an indoor environment can also worsen existing health conditions such as asthma, upper and respiratory infections (Taskinen *et al*., 1999). Results from an indoor air study conducted by Brasel *et al*. (2005), revealed that buildings affected by molds and dampness had higher levels of mycotoxins. Mycotoxins can have negative effects on human health (Occupational safety and health administration, 2011). These effects can also be adverse on children due to their underdeveloped immune systems.

Assessments conducted in the food preparation areas of the sixty two childcare facilities revealed that not all kitchens (66%) comply with the requirements stipulated in guidelines and by-laws. Infrastructural defects such as openings in walls and floors were noticed; some facilities (17%) lined their zinc sheeting kitchen walls with newspapers in an attempt to cover holes however the newspapers were greasy and dirty. Carpet flooring was found in five kitchens, this included one facility that provides care for children who are infected and affected by HIV and AIDS (Figure 2.7 A). The use of carpets and paper surfaces was of concern as these are absorbent, non-durable and not easy to clean. Food and liquid spillages that occur during food preparation ultimately accumulate on floors and walls. Consequently, accumulation of debris, dirt and grease on floors and wall surface provides food for pests and encourages the

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presence of pests in the premises which are conducive to food contamination (Food and Environmental Hygiene Department, 2013).

Figure 2.7: A-B Food preparation areas. A- Carpet floors in kitchen; B- Compliant kitchen with impermeable floors and waterproof walls.

One facility did not have a designated food preparation area and used the staff office as a food preparation area. All the kitchens that were assessed had hand wash basins and those that did not have customary hand wash basins (56%) made use of domestic plastic basins. None of the facilities had separate basins designated for hand washing in the kitchen. A few facilities (27%) had hot and cold running water in their kitchens; ten facilities only had cold water running from their kitchen sink taps; thirty five facilities did not have running water, cold water was fetched from the outside tap and stored in water storage containers.

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Childcare facility guidelines and by-laws specify the infrastructural attributes of food preparation premises in childcare facilities with the aim of promoting food safety and hygiene. In relation with the findings, childcare guidelines and by-laws specify that floor and wall surfaces of food preparation areas have to be impervious, durable and easy to clean and free of structural defects similar to the one captured in Figure 2.7 B. A separate designated area for food preparation, double stainless steel compartment sink, separate hand wash basin, hot and cold running water should be present (Food and Environmental Hygiene Department, 2013; Fezile Dabi District Municipality Municipal Health Services By-Laws for Child - Care Services, 2008; Mangaung Local Municipality By-Laws Regarding Child Care Facilities 2008, The South African Department of Social Development Guidelines for Day Care, 2001).

Sanitary and ablution facilities are a regulatory requirement for all child care facilities (Department of Social Development, 2001). The availability of adequate sanitary facilities and water supply promotes effective hygiene practices, hygiene education and implementation (Zomerplaag and Mooijman, 2005). Ninety two percent of the facilities were equipped with flushing toilets (Figure 2.8 A and B). Eight percent used pit latrine toilets which were in satisfactory conditions (Figure 2.8 C).

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Figure 2.8: A-C Toilets. A- Waterborne toilet; B- Waterborne toilet; C- Pit latrine toilet.

Six percent did not provide separate toilets for staff members and toilet trained children as prescribed in by-laws and guidelines for childcare establishments. Facilities that use potties, plastic buckets and paint buckets as potties for toilet training placed them out in the open in reach of children or in partially concealed areas (Figures 2.9, 2.10 and 2.11). Placing potties or plastic buckets for toileting openly can result in them being knocked over and having faecal spills in areas where children play. A few facilities (11%) placed seat barriers over potties as seen in Figure 2.11 A-D. The carpet seat barrier cover in one of the facilities raised concern (Figure 2.11 C), because carpet material is permeable; permeable toilet seat covers trap faecal bacteria and transmit bacteria from the seat to the child (Reiman,1995). None of the childcare centres had a designated area for washing potties as guided by the municipal by-laws.

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Figure 2.9: A-C Potties. A- Potties in a partially concealed area with a plastic bowel as a hand wash basin; B- Partially concealed potty area; C- Partially concealed potty area with domestic buckets as potties; D- Container potties.

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Figure 2.10: A-C Potties. A- Potties out in the open; B- Household domestic bucket potties in an open area; C- Potties.

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Figure 2.11: A-C Potties. A- Paint container potties; B- Support seat for potties; C- Potty seat concealed with carpet; D- Wooden Support seats for potties.

Childcare facilities should be equipped with clean separate toilet facilities for children and adults; commodes or potties; suitable area for cleaning potties; hand wash facility with hot and cold water, soap, paper towel or facecloth for each child (Department of Social Development, 2006; Swanepoel, 2003). The facility assessments revealed that

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nearly half of the facilities (47%) had wall mounted hand wash basins (Figure 2.12 A-C) of which 31% non-functional due to plumbing faults and broken taps (Figure 2.12 A).

Figure 2.12: A-C Hand-wash basins. A- Wall mounted hand-wash basin; B- Wall mounted hand-wash basin with dismantled taps; C- Wall mounted hand-wash basin with hand-wash soap.

Facilities which did not have customised hand wash basins (53%) used plastic basins instead as illustrated in Figure 2.13 A-D. Two facilities used a unique technique to wash

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hands where five litre plastic water bottles were used; a straw is inserted below the centre of the bottle by making a small hole; the bottle is placed in an upright position, filled with water and closed with a lid; when one wants to wash hands the lid is loosened and water is dispensed through the straw. A plastic basin used to collected dirty water is placed below the container (Figure 2.14 A and B). One facility using this method added Dettol disinfectant liquid to the water.

Figure 2.13: A-D Hand-wash stations.

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Figure 2.14: A-B Hand-wash stations with straws.

Hand washing with soap is a preventative method of reducing illnesses and preventing child diarrhoea by 30-47% (Curtis *et al*., 2009). A question was raised regarding the availability of hand wash soap; a number of facilities (44%) facilities mentioned that hand wash soap was not placed in sight to prevent waste by children. Respondents further indicated that soap was only provided under supervision after the children have used the toilet, before and after eating. Observations made at the facilities where children visited the toilet during the survey showed that the children only washed their

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hands with water in a few facilities (8%) in spite of the fact the respondents claimed to be providing soap under supervision.

The occurrence of gastrointestinal diseases in a childcare set up is frequently linked to inadequate provision and poor maintenance of toilet and hand washing facilities (Fujiwara-Pichler *et al*., 2006). Studies have shown that access to a functional, well-resourced and well maintained sanitary facility aid in preventing and minimizing incidents of diarrhoeal related diseases (Kotch *et al*., 2007; Reeves *et al*., 2012). The experiences that children have with sanitary facilities within their schools can affect their attitude and behaviour towards hand hygiene (Reeves *et al*., 2012). A few facilities (15%) had separate diaper changing rooms which were equipped with hand washing facilities and supplies as prescribed by by-laws and guidelines for childcare facilities (Figure 2.15 A-B). Other facilities (85%) changed diapers in the class rooms and playrooms which had no hand washing station nearby; the areas were also used as dining areas for the children.

Majority of the facilities (89%) changed nappies on pervious material such as linen sheets, blankets and old sponge mattresses (Figure 2.16 A-B). One facility's changing surface was ideal (impermeable and easy to clean) however it was worn out (Figure 2.16 C). The minority (11%) were equipped with adequate changing mats however it was noticed that only one or two changing mats were used and the rest were packed away. The caregivers further indicated that the other changing mats are packed away for future use.

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Figure 2.15: A-B Diaper changing stations. A- Diaper changing toddler wash basin; B- Diaper changing wash basin and changing surface; C- Impervious diaper changing mat.

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Figure 2.16: A-D Diaper changing surfaces. A- Duvet changing surface; B- Blanket changing surface; C- Torn changing surface; D: impervious wooden changing surface.

Pervious surfaces trap debris and harbour microorganisms (Infectious diseases in childcare settings, 2013). Changing surfaces should be impervious, non-absorbent and easy to clean (Figure 2.15 B-C) in order to minimize the risk and transmission of faecal borne diseases (Manning and Vivian-Book, 1995; National Resource Centre for Health and Safety in Child Care and Early Education, 2014).

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Assessing the infrastructural conditions of the various facilities revealed the magnitude of hazards that can be associated in childcare. Having witnessed the unfavourable conditions (building defects, inadequate sanitary facilities) that existed in a few facilities that have been granted conditional registration repetitively raised an alarming concern regarding the health and safety of children considering the type of conditions and numerous hazards that they can be exposed to.

The compliance of childcare facilities is predominantly based on the requirements stipulated in the regulatory scope and guidelines for childcare facilitates. It is therefore essential for individuals within the business of childcare to have sufficient knowledge regarding childcare facility legislative compliance. The owners/managers and childcare employees (n=124) were asked a question regarding their familiarity with by-laws and guidelines for childcare facilities; 52% answered that they were unfamiliar with such laws, 48% indicated that they were familiar with childcare facility laws. The owners and managers were the majority respondents who were familiar with such regulations. A majority of the respondents (62%) indicated that they gained compliance information from their local DSD offices while the other respondents gained information from Environmental Health Practitioners (20%), early childhood development forums and organizations (15%), fellow community members who own childcare facilities (3%).

Those unfamiliar with the by-laws briefly mentioned basic compliance requirements regarding the facility infrastructure, the availability of sanitary facilities, kitchen requirements, play area requirements, record keeping, sickbay requirements and the

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management of injuries and illnesses. The study revealed that a majority of the respondents (89%) have not received any form of training on childcare compliance regulations, those who received training (11%) indicated that training was provided by an Early Childhood Development Organization (Figure 2.17).

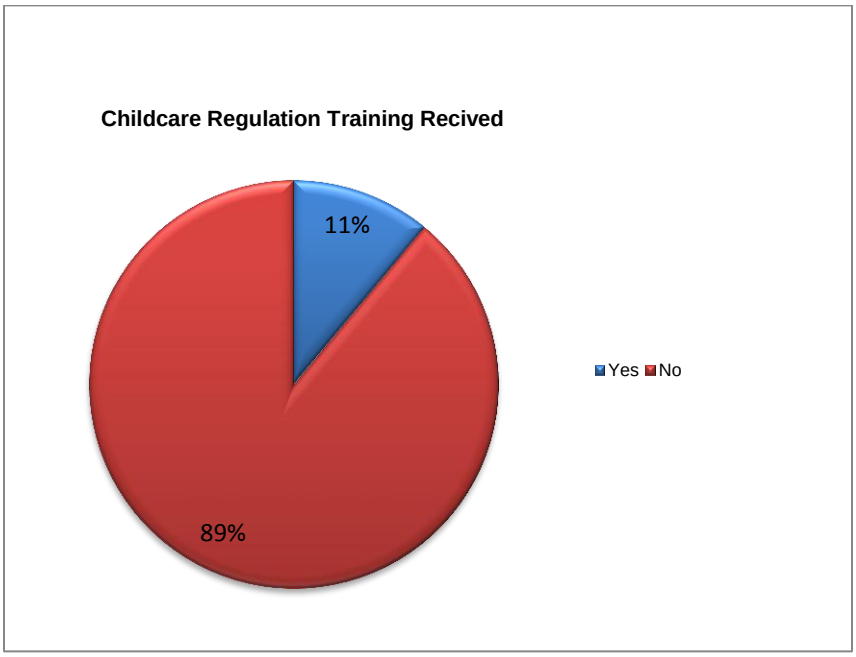

Figure 2.17: Percentages of responses regarding childcare regulation training.

Officials from the Department of Special Development and Environmental Health were asked about their collaborative relationship with one another and departments associated with the registration process of childcare facilities. Moqhaka Local Municipality was the only municipality which indicated that quarterly meetings were conducted where all the relevant authorities are invited and expected to attend, attendance registers and minutes were provided as evidence. A letter was submitted to the Free State Department of Social Development requesting permission to interview officials at Matjhabeng Department of Social Development following an advisory

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instruction from the Matjhabeng Department of Social Development manager. However no correspondence has been received to date.

Continuous inspections by Environmental Health Practitioners and officials from the Department of Social development are vital initiatives that ensure safety and compliance with by-laws and registration conditions (National norms and standards relating to environmental health in terms of national health act, 2003; Department of Social Development, 2006). Regular inspections and assessments by such officials also assist childcare facilities with compliance related recommendations and corrective measures. When asked about the frequency of inspections by regulatory and inspectorate authorities, 44% of the facilities indicated that Environmental Health Practitioners rarely visit facilities to conduct routine inspections, all facilities (n= 62) indicated that officials from The Department of Social Development visit facilities as required (monthly or quarterly).

The results from the survey indicate that interventions are required to address registration renewal backlogs, collaboration among departments and frequency of inspections by essential departments. Childcare officials require necessary knowledge on childcare establishment compliance regulations in order to understand the importance and basis of compliance, registration terms and conditions. Interventions aimed at improving the childcare establishments, addressing challenges and developing implementable and lenient childcare policies and regulations has been undertaken by various government departments by means of conducting nationwide audits, compiling

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target based annual performance and action plans (Moodley, 2012). Atmore and co-workers (2012) believe that childcare establishment compliance can be achieved provided that government formulates a long term realistic compliance and competency plan for childcare services.

The accreditation and the registration process of childcare facilities in South Africa is alleged to be burdensome, out dated and unachievable as applicants have to consult with various authorities and comply with complex requirements set by the various authorities (South African Law Commission, 2002). Due to the complex nature of childcare by-laws, childcare facilities struggle to comply, especially those located in disadvantaged communities (Spies, 2011). The building requirements for childcare establishments in South Africa have been regarded to be unachievable for facilities in impoverished communities (South African Law Commission, 2002). The requirements that were found to have been a challenge to achieve in the facilities that participated in the study included requirements relating to sanitary facilities, diaper changing areas, food preparation area and interior structural features. The owners of the facilities expressed that the required norms and standards are difficult to achieve due to financial constraints.

The respondents further elaborated that their top budgetary priorities include purchasing food for the children and paying personnel salaries. The owners of a few establishments (26%) expressed their financial frustrations and revealed that their subsidy grant applications were not yet approved by Department of Social Development, such

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facilities therefore depend entirely on the school fees (± R 100 - R150) that some parents struggle to pay. Structural developments and renovations that were in progress were seen in five facilities where the owners indicated that the financing of the building materials, equipment and labour came from their own pockets. Out of the facilities that had fully compliment buildings three indicated that the facilities were built by local and international charity organizations, two facility owners indicated that they funded their own infrastructural improvements.

An on-going nationwide audit on existing childcare establishment was initiated in 2000 (Samaad and Links, 2014). The aim of the audit was to establish a credible regulatory foundation and to identify existing challenges and gaps (Samaad and Links, 2014). The audits found that there is lack of coherence between legislation, policies and plans as well as the segregated and silo based monitoring and evaluation systems by different departments (Municipal Health Services, Department of Health, Social Development and Education) and programmes (Biersteker and Streak; 2008). The lack of collaboration between departments is created by Inter-Departmental conflict, the lack of detailed allocation of responsibilities and accountability mechanisms (Moodley, 2012).

The Department of Social Development's annual performance plan for 2014/2015 in line with the nationwide Early Childhood Development (ECD) audit findings aim to improve the quality of Early Childhood Development services by 2019. One of the activities on the action plan involves revising regulations and mandates governing childcare establishments. Another activity aims to address the deficiencies in the sphere of Early Childhood Development Centres to ensure that all the children in South Africa receive

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"the best start in life" (Department of Social Development, 2014). The National Early Childhood Development Policy drafted by Department of Social Development (2015) displays strategic initiatives which will ensure comprehensive and aligned Environmental Health norms and standards that regulate early childcare development programmes (Department of Social Development, 2015). A collective reviewing of the regulatory framework for childcare establishments by relevant departments and authorities at provincial and municipal level is evidently needed. This will promote uniformity, implementation strategies, service delivery, sharing of different expertise and prevent duplication and overlapping of services (Moodley, 2012).

The South African Parliamentary Monitoring Group's National Council of Provinces Social Services Committee recently (2014) indicated that registration of childcare establishment in South Africa will be reviewed by possibly adopting the Three-tiered licensing system. Tiered rate reimbursement system where facility licensing will be recognized with Bronze, Silver or Gold accreditation colour ranking (South African Parliamentary National Council of Provinces Social Services Committee, 2014; Children, Youth and Families Department, 2012). The Three-tiered licensing system is aimed at encouraging, recognizing, and rewarding child care providers for their excellence in providing quality child care services (Children, Youth and Families Department**,** 2012). Gold is accredited to facilities where the childcare establishment provides an excellent quality service and complies to all the fundamental requirements such as staff qualifications, environmental health and safety, hygiene, infrastructure, staff-to-child ratios, child based learning activities, staff in-service training, health

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promotion practices, centre policies and infrastructure. Silver accreditation is issued to facilities with satisfactory compliance while bronze is issued to facilities comply with minimum requirements (Children, Youth and Families Department**,** 2012). Facilities that maintain gold and silver accreditation are rewarded with higher subsidies and reimbursements (Children, Youth and Families Department**,** 2012).

Guidelines to upgrade informal early childhood development centres in South Africa (Barker and Misselhorn, 2014) also propose a new registration process that involves rapid assessment and categorisation of childcare establishments. The proposed registration model aims to assist conditionally registered childcare facilities in informal settlements towards achieving full registration (Barker and Misselhorn, 2014). Childcare care facilities will be mapped, assessed and categorised based on their potential, needs and the prevalence of health and safety hazards within the facility (Barker and Misselhorn, 2014). Facilities will be categorised into High functioning centres (facilities that are unlikely to pose a health and safety risk and require less support), basic functioning centres (facilities with minor health and safety hazards and minor needs) and low functioning centres (facilities with major health and safety hazards, require major, urgent and extensive support with funds and infrastructural upgrades) (Barker and Misselhorn, 2014). The categorization of childcare facilities according to their needs and potential could assist inspectorate officials with identifying facilities that require extensive remedial action and more frequent visits, additional attention assistance and guidance.

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The interventions cited above have capabilities of steering the compliance and registration process of childcare establishments into a less complex and more achievable direction. The Three-tiered licensing system where childcare establishments are rewarded based on their compliance may encourage facility owners and managers with partially compliant facilities such as those identified in this study to invest in improvements knowing that rewards will be reaped in the end. The financial challenges experienced by childcare establishments such as those identified in this study may however restrict the facilities towards embarking on infrastructural improvements provided that they receive financial assistance from government. Addressing gaps and deficiencies that exist in the regulatory scope of childcare establishments could assist in tackling the challenges such as those highlighted in the findings of this study, and the "bottleneck" that exists with regards to compliance and registration. Interventions for childcare establishments by Municipal health services are rarely cited and available in literature. This is of concern considering that environmental health requirements for childcare facilities are the dominant compliance criteria that determines a childcare establishment's approval for registration.

2.5. CONCLUSION

This study provided a glimpse of the type of unfavourable building conditions that children and childcare personnel are exposed to on a daily basis. The study also revealed that lack of knowledge and financial constraints could possibility be the factors that influence compliance. The infrastructural hazards that were identified in this study may potentially compromise the health, safety and sanitary practices of children and

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personnel. Funding initiatives and strategies for infrastructural upgrades and maintenance would assist childcare establishments in achieving overall compliance for full registration which will be beneficial to the wellbeing of children and childcare personnel. Providing awareness on requirements regarding the basic layout and design of childcare establishments and necessities can assist childcare personnel, facility managers and owners to understand what is required. In addition, financial assistance for compliance related challenges would assist childcare establishments to achieve full compliance and full registration. Regulatory training and awareness for childcare employees and owners would also be beneficial towards achieving compliance. Knowledge can ensure the provision of a safe environment for children and enhance the understanding of childcare regulations. In order to phase out the indefinite extension of conditional registration, compliance inspectorates should be provided with decision making guidance that will assist when exercising discretion. Environmental Health Practitioners play an immense role in the compliance and registration of childcare establishments. Scarce visits by such officials may result in childcare establishments being non-compliant. It would therefore be essential to encourage frequent visits by such officials.

Further studies will be needed to determine the extent of environmental hazards and health effects associated with structural defects in poorly structured childcare establishments; and wherever a relationship between hazard exposure and clinical history exists.

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CHAPTER THREE

ASSESSMENT OF HYGIENE, KNOWLEDGE AND ASSOCIATED PRACTICES OF CAREGIVERS IN CHILDCARE FACILITIES IN THE FREE STATE

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ASSESSMENT OF HYGIENE KNOWLEDGE AND ASSOCIATED PRACTICES OF CAREGIVERS IN CHILDCARE FACILITIES IN THE FREE STATE

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3.1. ABSTRACT

Childcare facilities provide an environment where children interact closely in large numbers for most part of the day; this can favour the prevalence and transmission of microbial agents. Childcare related illnesses in facilities located in disadvantaged communities may be higher as a result of inadequate sanitary facilities, building conditions, poor sanitary practices, overcrowding and lack of knowledge regarding hygiene and food handling aspects. A survey was conducted at different childcare facilities in Mangaung Metropolitan, Moqhaka and Matjhabeng municipalities to assess knowledge and practices of care givers with regards to food handling, personal hygiene practices as well as food safety and related hazards. The study revealed that caregivers in thirty two of the sixty two facilities performed combined duties per individual such as food handling, feedings and changing of diapers. When these duties are performed with negligence, it could result in contamination of food by microbial pathogens resulting in disease and possible outbreaks. Improper diaper disposal practices resulting from the use of inadequate disposal bins were observed in a majority of the facilities (61%). Additionally, results showed that majority of the caregivers (73%) of have not received formal training on food safety and hygiene practices. Improper hand washing practices were observed during the visit, which was a concern because proper hand washing limits the spread of disease and infections. Training including monitoring and evaluation are recommended for these day-care centres.

Keywords: Caregivers; Childcare; Day care facility; Food safety; Hygiene, Practices

3.2. INTRODUCTION

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Children have undeveloped hygiene habits and limited knowledge, for this reason their wellbeing is highly dependent on the practices of child caregivers (Infection control guidelines for child care centres, 2008). Caregiving practices executed by caregivers are among various aspects that influence a child's growth and development (Peter and Kumar, 2014; World Health Organization, 2004). Caregiving in childcare facilities consists of numerous duties such as changing diapers, potty training, cleaning, cooking, serving food and feeding. When these duties are performed with negligence and poor hygiene practices; the prevalence of food related hazards and other microbiological hazards within the facilities may increase (Chen, 2013; Nesti and Goldbaum, 2007). The practice of combining duties is of great concern especially in facilities where childcare employees work with diapered toddlers on a daily basis, as they may transmit faecal associated infections especially when staff members are responsible for a large number of children (Lee *et al*., 2007; Bright and Calabro, 1999).

Understaffing at day-care centers has resulted in employees performing multiple duties including food handling. Understanding the interactions of food handlers, their food safety knowledge and associated practices can minimize infections and outbreaks (World Health Organization, 2000). Several studies (Bas *et al*., 2004; Mederios *et al*., 2001) identified improper food handling practices, poor personal hygiene, inadequate cooking or reheating, temperature control and cross contamination from other foods or food contact surfaces as factors commonly associated with food borne outbreaks. All these factors may be a consequence of lack of required training, lack of knowledge or

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negative perception towards performing duties with the required caution (Li, 2012; Alkon *et al*., 2009).

Formal education or training is not a compulsory compliance prerequisite for childcare facility owners and childcare personnel in South Africa; facilities obtain permits to operate as soon as they have fulfilled the minimum compliance requirements pertaining to the inspections conducted by relevant municipal official (Grey, 2006). Additionally, childcare personnel do not require any training to pass the inspection conducted by municipal officials (Grey, 2006). In developed countries, childcare employees are compelled to have formal education or training qualification obtained from a recognised institution of higher learning.

Numerous studies have reported that the physical environment and practices carried out in a childcare facility can contribute to the occurrence of health related hazards (Li, 2012; Cosby *et al*., 2008; Petersen and Bressler, 1986). As a precautionary measure, local municipalities formulate by-laws regarding child day care facilities aimed at promoting hygiene and safety within childcare. Childcare regulation non-compliance, inadequate sanitary practices, lack of training and understaffing may result in challenges that might affect child health. Assessing knowledge and practices of childcare personnel on hygiene will provide an insight on the type of practices utilized, factors and challenges that hamper hygiene in childcare facilities.

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3.3. MATERIALS AND METHODS

The survey assessed hygiene practices and associated knowledge of childcare personnel in registered childcare facilities. This will assist in gaining insight regarding practices utilized and understanding the challenges and factors that influence hygiene in childcare establishments. Ethical clearance was not requested. However permission to conduct the study was requested in writing and submitted to municipal Environmental Health managers and local heads of the Department of Social Development (Appendix A). Approval to conduct the study was granted verbally by the facility owners during meetings where the study was further elaborated. The researchers collecting data introduced themselves upon arrival at every facility.

The purpose of the visit, the study and associated activities such as administering questionnaires, noting observations and taking photographs were explained to the owners of the facilities. Data was only collected after permission had been granted by the facility owners or person in charge. Questionnaires (Appendix C) were administered at sixty two childcare facilities after permission was granted from owners interviewees. A total number of one hundred and fifty four childcare employees were interviewed. The interviewer translated questions in Sesotho in order to accommodate employees who did not understand English. The number of respondents selected to participate in the study was based on the total number of people who worked at each facility and the type of duties allocated to staff members. The respondents primarily consisted of the owner or manager of the facility, a class room teacher or caregiver and the cook.

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Questionnaires were used to interview and evaluate the knowledge and practices of childcare personnel in terms of personal hygiene, general hygiene, food safety, food handling, food poisoning, cleanliness, housekeeping, cleaning and disinfection of food and non-food contact surfaces as well as infant and toddler related practices. The questions asked were close-ended questions that required “yes” or “no”. Observations that were made during the assessment were noted in a notebook as well as the answers of the follow up questions based on the observations in order to probe findings and for to gain more clarity and understanding. Additional findings that were in line with the objectives of the study were noted in writing.

3.4. RESULTS AND DISCUSSION

Caregivers require the necessary knowledge and skills to be able to render quality childcare services which aid a child’s developmental needs and wellbeing (Department of Social Development and UNICEF, 2006). The absence of relevant qualifications and training among childcare personnel has an impact the level of care and contributes to poor quality childcare (Biersteker *et al*., 2010; Department of Social Development and UNICEF, 2006). The consolidated responses indicate that majority (67%) of childcare employees in did not finish matric (Grade 12) and dropped out of school due to reasons that were not disclosed. Twenty three percent completed matric and only 10% studied beyond matric and obtained qualifications from institutions of higher learning.

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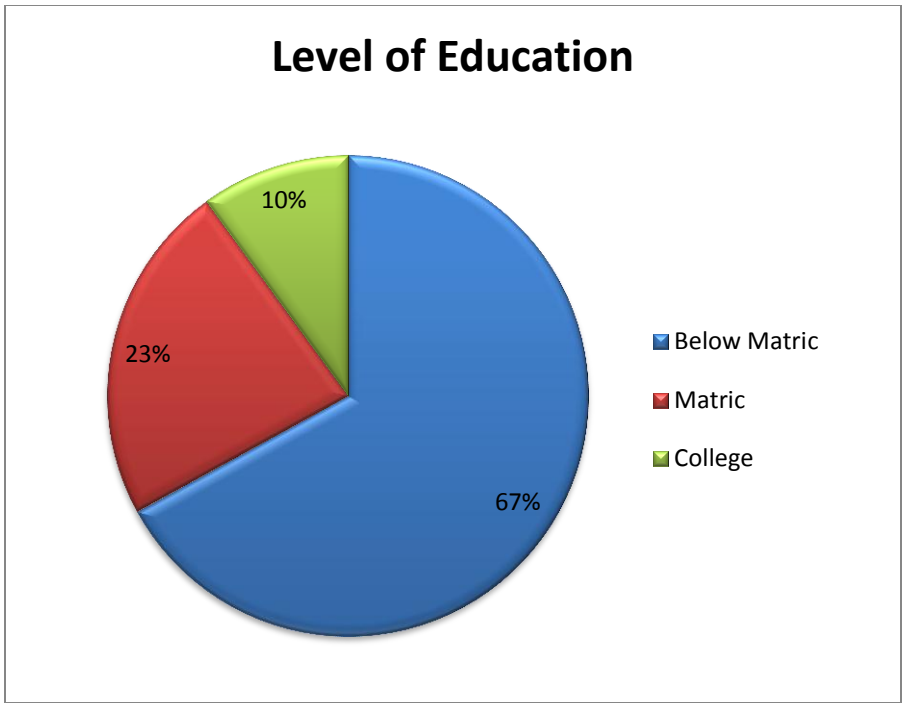

Figure 3.1: Respondent's level of education

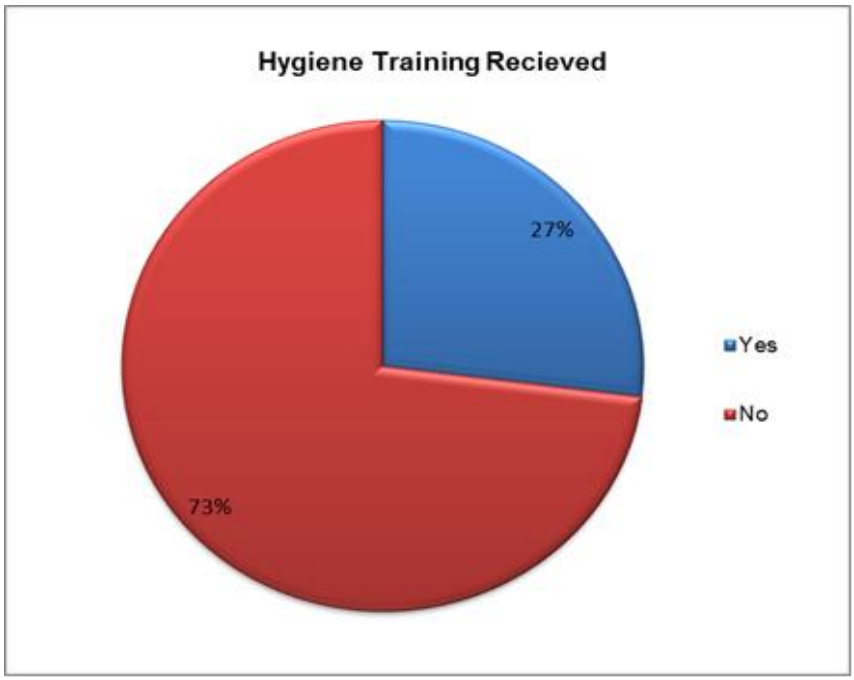

Figure 3.2: Percentage of respondents who received hygiene training.

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When questions regarding food safety training where asked a minority (27%) of the respondents indicated that they have received formal training on food safety and good hygiene practices (Figure 3.2), while 73% indicated that they have not received training.

Numerous studies have demonstrated that sufficient hygiene training of childcare staff can reduce the risk of communicable illness in children and promote hygiene within the facility and among children (Chen, 2013; Kelley, 1998). The respondents of the childcare facilities in Moqhaka revealed that a non-profit organization, Ntataise assists them with their training needs. This organization offers South African Qualifications Authority accredited early childhood development training programmes, courses, as well as workshops and learning materials. Such programmes assist childcare employees in disadvantaged communities to gain knowledge and skills to establish and operate quality childcare services (Ntataise, 2008). Early childhood development courses offered by higher institutions of learning and non-profit organizations have modules that cover aspects of hygiene, health and safety, childcare related illnesses and environmental sanitation (South African Qualifications Authority, 2012). The programs are known to assist childcare employees acquire relevant skills and knowledge which will help them improve the quality of childcare facilities.

Municipal by-laws encourage separation of children under the age of three from children of over the age of three (City of Tshwane Health by-laws for child care services, 2010). Separation of diapered children and toilet trained children in a childcare facility has been considered as a preventative measure that can potentially minimize the risk and transmission of infections in childcare settings (Huskins, 2000; Holmes *et al*., 1996).

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The study revealed that some facilities (45%) separated children according to their age groups and susceptibility, i.e. diapered children and toilet trained children. Facilities that did not separate children according to age groups indicated that separation is a challenge due to space and lack of staff due to budget constraints to employ more staff. Allocating a certain number of children to be cared for by one staff member is a practice that is recommended for childcare facilities (All family resources, 2011), a practice known as the staff to child ratio.

Apart from having one staff member responsible for a certain number of children, the practice of the staff to child ratio also encourages separation of children according to their age groups and susceptibility. Staff to child ratio influences the risk and prevalence of childcare related infections (Huskins, 2000). The advantages of childcare personnel caring for fewer children have been highlighted, an employee can attend to a child's hygiene related individual needs compared to those who have a poor adult to child ratios (Grey, 2006). The child day care by-laws of the three municipalities that participated in the study neglect to stipulate the child to staff ratio recommendations. Staff to child ratio might not have been a priority for childcare facilities in the three study areas as a result. On the other hand, municipalities such as Senqu, Ethekwini and Cape Town metropolitan municipality by-laws regarding child day care facilities clearly stipulate child to staff ratio. The ratios vary for the different municipalities where Ethekwini Municipality childcare facilities by-laws (2015) prescribe one assistant and one childcare worker per group for example, one caregiver and one assistant for: 8 children aged between 0-2 years, 15 children aged between 2-3 years and 20 children

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aged between 3-6 years. Recommendations for the child to staff ratio in Cape Town metropolitan municipality are listed in table 3.1.

Table 3.1: Recommended Staff-to-children ratio in day care centres (Berry *et al*., 2011)

Age group	**Ratio**	
	Maximum number of children : Number of child care worker	
0-18 months	6	1
18 months - 3 years	12	1
3-4 years	20	1
4-5 years	30	1

If a staff member is responsible for a large group of children, the risk of infections may increase because a caregiver will unlikely be able to attend to the individual hygienic needs of each child (Kelley, 1998). Being responsible for a large group of children can also overburden the caregiver and hinder the caregiver's ability to perform adequate hygiene practices when performing hygiene related chores.

Childcare givers perform a number of duties that entail cleaning, feeding, cooking, washing dishes, laundry, diaper changing and potty training. The performance of duties by childcare personnel was assessed and we found that the execution of duties varied among the facilities. Forty eight percent (48%) facilities indicated that duties are either divided or rotated among staff members in a manner that a childcare personnel who is responsible for either cooking, feeding or serving children is not the same individual who is responsible for changing diapers, potty training or handling any other soiled objects. However, during one of the visits an employee that was supposedly on kitchen duty was

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noticed changing a soiled diaper in the very same apron that was worn in the kitchen during food preparation. This practice was worrying because an apron worn by the caretaker may be contaminated with faeces from changing the diaper. Food handlers are likely to touch aprons or wipe their hands with aprons while preparing food; by doing this the food handler could transfer bacteria or other microorganisms from the apron to the food (Gordon-Davis, 2011).

Facilities that never rotated or segregated duties (52%) indicated that the reason for not doing so was because of the immense amount of workload, lack of staff, lack of funds to pay additional personnel. Employees from some facilities (8%) that did not rotate duties believed that rotation and segregation of duties will result uneven distribution of workload which will result in one's duties being more demanding than others. Additionally, respondents believed that employees may take advantage of this situation by leaving work early if the tasks to be performed are completed before end of business. Such behavior seemed to be a common trend in childcare facilities that participated in this study.

Duties such as changing nappies and preparing or serving food provide a potential route for cross contamination when carried out by one employee (Work safe Western Australia Commission, 2002). A caregiver will eventually perform an excessive number of duties and chores as result of lack of staff or overcrowding (Calamusa *et al*., 2009). Studies conducted by Nesti and Goldbaum (2007) and Lemp *et al*. (1984) confirm that diarrheal incidences in childcare facilities are linked to the same employee performing diaper changing and food handling duties. To have a caregiver perform duties of food

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handling and diapering provides an opportunity for cross contamination between hands and food resulting in the transmission of pathogens (Chen, 2013; Lee and Grieg, 2008). A case control study conducted by Mohle-Boetani *et al*. (1995) on Shigellosis outbreaks in six childcare facilities in Lexington-Fayette County, Kentucky found that the incidences occurred in facilities where childcare givers combined food handling and diaper changing duties.

Since childcare involves hands on care and food handling, adequate personal hygiene should be practiced in order to minimize contamination and transmission that might occur when performing care associated duties. Childcare personnel were questioned on aspects of hand washing. All the respondents (100%) were aware of the importance of hand washing and sanitizing after handling soiled diapers, nappies and potties. However, we observed that hands were not sanitized after changing diapers in four facilities that happened to be changing diapers at the time of the survey. Only two diaper changing areas were equipped with adequate hand wash basins as required in the municipal by-laws. Inadequate hand hygiene after diaper changing may be as a result of lack of hand wash facilities near changing areas. An inadequate practice was captured in Figure 3.3(A) at a diaper changing station where a caregiver washed hands in a basin with standing water. Figure 3.3(B) further illustrates a similar hand wash practice that was observed in some facilities (21%) where children washed their hands in bowl of standing water that was reused by another child for the same purpose; water was only discarded after all the children have washed their hands. Such practices are alarming taking into consideration the likelihood of hands becoming contaminated if

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washed in a basin of standing water that has been contaminated through previous use (Centers for Disease Control and Prevention, 2013). Adequate hand hygiene has been shown to effectively reduce gastrointestinal infections (Rosen *et al*., 2007; Black *et al*., 1981). Improving hand hygiene among childcare employees and children is the easiest form of prevention and control of communicable illnesses and enteric pathogens (Usfar *et al*., 2010).

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Figure 3.3: A – B indicating hand wash practices. A**-** Childcare giver washing hands in a basin of standing water. B- Child washing hands in a basin of standing water.

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Another inadequate personal hygiene was captured in Figure 3.4(B and C) where a caregiver used one face cloth to wipe the faces of five children. Sharing face cloths can transmit *Staphylococcus aureus* infections, Bacterial conjunctivitis and Trachoma (Bannister *et al*., 2009; Seewoodhary and Stevens, 1999. Lewallen *et al*., 2008).

Figure 3.4: A- Face clothes for individual children hung out to dry. Figure B and C Childcare personnel wiping children's faces with the same facecloth.

The presence of diapered children falls among the risk factors that also contribute to the transmission of enteric pathogens in childcare settings (Li, 2012). Enteric pathogens associated with diaper changing are primarily transmitted through changing surfaces as well and through the clothes and hands of caregivers (Chen, 2013; Li, 2012; Nesti and Goldbaum, 2007). For the purpose of this study, the manner in which child care facilities change diapers was questioned focusing on essential hygienic practices such as disinfection of surfaces, the use of personal protective clothing and hand washing. The significance of assessing hygienic practices involved in diaper changing was based on the fact that diaper changing in day care is considered the highest risk procedure for

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transmission of enteric pathogens between children and day care workers due fecal contamination that is likely to occur during changing (Miller, *et al*., 2012; Nesti and Goldbaum, 2007).

Diaper changing surfaces have to be cleaned and sanitized between each diaper change to minimise contamination (Swanepoel, 2003). Appropriate hygienic diaper changing methods/practices are essential in all child care facilities, predominantly in facilities that do not allocate separate duties and have the same caregiver to change nappies and handle food. The survey revealed alarming diaper changing practices that could potentially increase the risk of enteric pathogens in the facilities. When assessing the diaper changing surfaces eighty two percent (82%) facilities changed diapers on blankets and sponge mattresses. Forty eight of the fifty one facilities that use sponge mattresses revealed that mattresses are never washed; if the mattresses have an offensive odour they are normally hung outside in the sun. In some cases it was observed that the same sponge mattress used for changing was also used for sleeping. The 82 % that utilized blankets as a diaper changing surface indicated that blankets are washed with fabric washing powder that does not contain any form of disinfectant. Thirty three percent (33%) indicated that the blankets are only washed when there is visible soiling, the remainder (67%) washed the blankets on a weekly basis.

Diaper changing surfaces should be waterproof and suitable for sanitization (Chen, 2013; National Norms and Standards Relating to Environmental Health, 2003). When

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asked on the use personal protective equipment during diaper changing as a measure to minimize contact with faeces and body fluids, 49% of the respondents revealed that they do not use personal protective equipment. Where personal protective equipment was utilized (51%) it was revealed that equipment was only used in cases where the infant to be changed is HIV positive or has diarrhoea (21%). The facilities that utilized personal protective clothing (51%) use reusable cleaning household rubber gloves which are rinsed in normal household detergent with no disinfectant properties. One facility indicated that disposable facemasks are utilized, shared with other staff members and reused instead of being disposed; one pair of non-disposable domestic household gloves are used by the entire staff, rinsed in bleach after use and left to dry. It is advisable to dispose disposable personal protective equipment after use and not to use reusable protective equipment again until it is thoroughly and disinfected clean in order to avoid cross contamination (Virginia school health guidelines, 2012).

In addition to the hygiene associated aspects that were assessed in this study, waste management practices were also evaluated. It was found that all childcare facilities that participated in the study generate a variety of waste namely general waste (papers, plastics, etc.); food waste (left over food, vegetable peels) and infectious waste (soiled diapers, faeces, disposable gloves). Waste generated in child care facilities has to be disposed in a sanitary manner as prescribed in metro/municipal by-laws and guidelines for childcare centres. The storage and disposal of soiled articles within the selected facilities was assessed. It was found that soiled diapers were not correctly disposed in line with the waste disposal procedure specified in the by-laws and guidelines for child

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care facilities. Soiled articles are to be disposed in plastic lined bins or containers with tight fitting lids; bins should be closed at all times and kept out of reach of children (Mangaung Local Municipal By-laws, 2008).

Only eight percent (8%) of facilities complied with municipal by-laws, they were equipped with a foot pedal operated lidded waste bins lined with refuse bags for the disposal of soiled diapers. Thirty one percent of the facilities used ordinary waste baskets lined with a refuse bag without lids. The rest of the facilities (61%) disposed soiled diapers in free standing refuse bags (Figure 3.5). The facilities that did not have separate changing areas and used classrooms as changing areas placed their diaper waste in the classroom, not properly sealed and within reach of children.

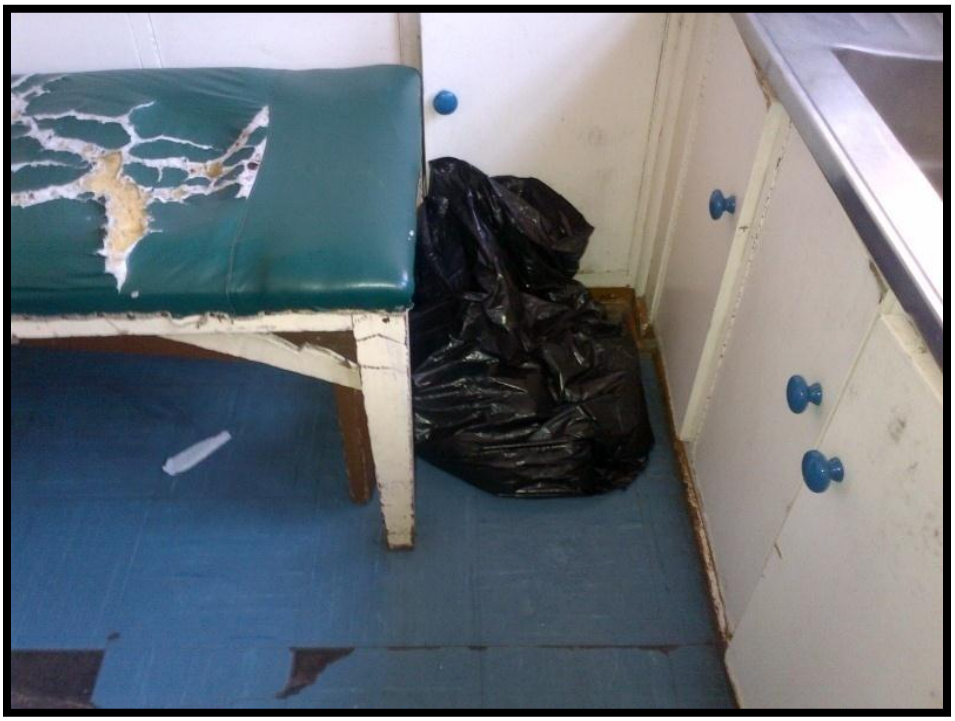

Figure 3.5: Diapers disposed in black plastic bag left on the floor.

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An unsanitary disposal practice was witnessed in one facility where a soiled diaper was disposed in close proximity of children as well as toys and equipment that the children could easily come in contact with (Figure 3.6 A and B).

Figure 3.6: A-B indicating diaper disposal practice. A- Soiled diapers disposed on the floor near children and toys; B- Close-up of the soiled diaper disposed near children and toys.

The children in Figure 3.6 A are likely to touch the dirty soiled diapers discarded on the floor. Placing soiled diapers in such a manner within reach of children is a health hazard because children have habits that facilitate the spreading of diseases such as, mouthing objects, touching objects and then putting their fingers in their mouths and that of other children (Centers for Disease Control and Prevention, 2011; Nesti, 2007). A study conducted by Barlett *et al*. (1992) examining the association of hygiene behavior indicators with persistent diarrhoea of young children revealed that one of the six behavioural indicators was associated with soiled diapers precisely the presence of a soiled diaper on the floor. Disposal of diapers in an unsanitary manner increases the

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potential for contamination and places children at risk of contracting faecal-oral route related infections which can be transmitted to other children (Miller *et al*., 2012).

In addition to the risk factors highlighted above, food safety is another curial aspect that contributes to the prevalence of illnesses in childcare settings. Food safety is compromised by the practices utilized by food handlers (Chen, 2013). None separation of food handling and diaper changing duties in a number of facilities identified (52%) is among one of numerous practices that can compromise food safety in childcare facilities. Furthermore, contact surface also play a role in food hygiene since food contact surfaces are prone to bacterial contamination and serve as a source for cross contamination between raw and cooked foods (De Cesare *et al*., 2003; Cosby *et al*., 2008).

The responses regarding the disinfection of food contact surfaces revealed that all childcare personnel cleaned food contact surface, however 73% indicated that they do not disinfect kitchen food contact surfaces at all; they reportedly used standard liquid cleaning detergents that do not have disinfecting properties. The 27% who do disinfect indicated that they do so only when such surfaces appear to have stubborn stains. According to the California Childcare Health Program (2002), cleaning with a standard liquid detergent gets rid of visible dirt while cleaning with a detergent followed by disinfecting the surface gets rid of visible dirt as well as microorganisms. Studies indicate that disinfecting food contact surfaces reduces the risk of cross-contamination

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and decrease the prevalence of food pathogens on surfaces (Li, 2012; Cosby *et al*., 2008; Staskel *et al*., 2007; Henroid *et al*., 2004; Sneed *et al*., 2004). When asked if food handling is avoided when contagious symptoms such as diarrhoea prevail, 46 % answered that they do avoid handling food when ill and 54% said they still handle food even if they display sickness symptoms.

Plastic feeding tubes were utilised for children with special needs at one childcare facility. These children have mental and physical disabilities and some are unable to chew or swallow solid food. They obtain essential nutrition in a liquid or soup which is made with vegetables and meat. During the visit, it was observed that the liquids meant for consumption were not refrigerated but stored at room temperature in an enclosed container together with the feeding tubes. The practise was worrying because when food stands at room temperature for longer than two to three hours; there is opportunity for growth and activity for foodborne bacteria which can cause illness (Garden-Robinson, 2004). When questioned about the cleaning procedure for the feeding tubes, the childcare giver mentioned that feeding tubes are only rinsed with water after meals and parents are responsible for the replacement of old feeding tubes.

During the assessment of the practices in the various facilities, another practice that was evaluated was associated with carpet flooring. The survey revealed the presence of carpets and rugs in the majority of the facilities' (n=61) classrooms and play rooms. Respondents were asked if children (i) play on carpets or mats, (ii) eat while sitting on carpets mats, (iii) sleep on carpets or mats. Respondents were also asked how they clean carpets and mats and the frequency of cleaning. All the facilities with carpets

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indicated that children play on them. Fifty one facilities indicated that children eat while seated on carpets as illustrated in Figure 3.7A. Eighteen facilities indicated that children sleep directly on carpets (Figure 3.8B). All the facilities (n=61) indicated that carpets and mats are swept daily. A majority indicated that carpets are not vacuumed (n=55), facilities that vacuumed carpets (n=6) indicated that vacuuming is done once a week. When asked about shampooing or washing of the carpets the responses ranged from once a year (n=1), twice a year (n=6), quarterly (n=50) to once a month (n=4).

Figure 3.7: A-B indicating children eating while sitting on a carpet and sleeping on carpet flooring. B- Children eating while seated on a carpet; B- Children sleeping on a carpet.

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Dirty carpets are reservoirs for dust, allergens, bioaerosols, fungi, moulds and toxic chemicals (Krieger and Higgins, 2002). Carpets can be contaminated by shoes or by diapered children who sit on the carpets (Chen, 2013). When spillages and deposits of debris, food, faecal matter or aerosolized bacteria occur on carpets the particles can attach and colonise on carpet fabrics which can result in the possible spread of pathogens (Chen, 2013; Ferrara *et al*., 2011). Since children crawl and play on the floor they come into contact with contaminants which can be harmful with inhaled or ingested (Levine, 2007). Studies have reported the presence of potentially pathogenic microbes such as *Aeromonas*, *Escherichia coli*, *Enterobacter*, *Klebsiella pneumonia, Salmonella* and *Staphylococcus aureus* in carpets (Ali *et al*., 2014; *Rahouma*, *et al*., 2010; Anderson *et al*., 1982). Efficient and frequent cleaning of carpets removes and reduces the accumulation and attachments of contaminants and debris (Berry, 2015; Chen, 2013).

3.5. CONCLUSION

Due to the diversity of hazards associated with hygiene and food safety practices in childcare facilities, aspects of cleanliness, execution and separation of duties as well as activities requiring sanitary practices should therefore be improved in order to minimize the risk of infections in childcare settings. The findings regarding waste disposal, care duties, child separation, hygiene practices, diapering practices and food safety highlight an urgent need for awareness and education for childcare personnel on adequate hygiene and care related practices. Training and awareness can minimize infections and food safety related hazards in these facilities. Childcare personnel will be

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capacitated with the necessary knowledge and understand the significance of hygiene related requirements stipulated in the bylaws, this will be beneficial towards improving the circumstances in their respective facilities. Awareness should also include information regarding the health implications associated with dirty carpets; refuse disposal, safe appropriate diaper changing techniques, safe placement of potties, requirements of appropriate potties and appropriate toilet seat cover material. Since the quality of caregiving affects the health and wellbeing of children, providing information and training can assist childcare personnel in instilling change and deviating from inadequate practices such as those that were observed and captured by this study.

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CHAPTER FOUR

MICROORGANISMS AND BIOAEROSOLS ISOLATED AT SELECTED CHILDCARE FACILITIES

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MICROORGANISMS AND BIOAEROSOLS ISOLATED AT CHILDCARE FACILITIES

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4.1. ABSTRACT

Microorganisms associated with childcare establishments are mostly opportunistic pathogens. The transmission of pathogens in childcare facilities is highly influenced by the hygiene practices carried out by childcare providers. In the current study microbial samples were obtained from the hands and aprons of childcare providers employed at different childcare facilities located in Mangaung Metropolitan Municipality. Air samples were obtained from one room in each facility using a Single stage surface air sampler (SAS Super 90). Samples were cultivated on selective media, analysed and quantified. Bacterial classification and identification of the colonies was done by means of a Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS). Based on the results from the hands and apron samples *Bacillus* spp were predominant (23.5%); followed by *Pseudomonas* spp (20.6%), *Enterobacter* spp (17.6%), *Acinetobacter* spp (8.8%), *Escherichia* (5.9%) and *Staphylococcus* spp (5.9%). The minority were species of *Clostridium*, *Klebsiella*, *Streptococcus*, *Haemophilus*, *Ochrobactrum* and *Lactobacillus*. Majority of microbes identified are associated with poor hygiene practices after diaper changing, using the toilet and contact with nasal secretions. Microbial hazards can put children at risk of acquiring illnesses. The microbes identified highlighted the need for infection prevention and control interventions in childcare establishments. Possible infections in childcare can be prevented if adequate hygiene practices are carried out with the aid of hygiene training, policies and guidelines.

Keywords: Hygiene, Infection, Food Safety, Diaper changing, Hand washing, *Enterobacteriaceae*, *E. coli*

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4.2. INTRODUCTION

Childcare settings have the potential to create an environment that is highly conducive to transmission and exposure to pathogens and opportunistic microbes. This is favoured by the nature of the setting where children are cared for in large numbers for a long period in close contact with one another and childcare employees (Moritz, 2010; Lee *et al*, 2007; Riggins, 2006; Holmes *el at*., 1996). Numerous studies on the diversity of microbes in childcare settings found childcare settings to be ideal settings for transmission of respiratory agents (*Haemophilus influenzae*, *Mycobacterium tuberculosis, Streptococcus pyogenes, Streptococcus pneumoniae),* Enteric bacteria (*Campylobacter*, *Clostridium difficile*, *Escherichia coli*, *Salmonella*, *Shigella*), and microbes transmitted through direct skin contact (*Staphylococcus aureus, Streptococcus pyogenes, Pseudomonas aeruginosa*) (Moritz, 2010; Olaitan and Adeleke, 2006).

Attending childcare increases the risk of acquiring gastrointestinal and respiratory infections that can be prevented and controlled through adequate hand hygiene practices (Li *et al*., 2013; Chen, 2013; Zomer, *et al*., 2013). Other risk factors that contribute to the transmission of infections include inadequate facilities for diapered children, poor water quality, poor surface disinfection practices, inadequate food safety and food hygiene practices, behavioural habits of children (mouthing objects and fingers), poor ventilation, overcrowding and dependency on caregivers to fulfil the sanitary needs of children (Li *et al*., 2013; Sanders *et al*., 2009). The risk of infections in

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childcare facilities may vary based on the size of the group, the type of facility and hygiene practices within the facility (Holmes *el at*., 1996).

Since children lack control and awareness over essential sanitary practices utilized when preparing meals or changing diapers, their hygienic needs are generally fulfilled by adults (Fan, 2013, Marzano and Balzaretti, 2013). Hygiene practices of childcare employees play a vital role in the transmission and prevention of infections; the sanitary practices used by childcare employees when handling children or executing daily duties such as food handling, potty training and diaper changing will either have an adverse or beneficial impact on the health and wellbeing of children (Nesti and Goldbaum, 2007). Limited studies have focused on bacterial carriage and colonization in childcare employees (Moritz, 2010).

Children attending day care are indoors for most of the day, indoor air quality is therefore another factor that plays a role in childcare acquired infections (Fernandez, *et al*., 2012). The quality of indoor air is vital for the health of children who spend more time indoors (Fernandez, *et al*., 2012; Luksamijarulkul *et al*., 2012). Indoor air quality studies conducted in childcare facilities also revealed the presence of aerosolized bacteria such as *Actinobacteria, Proteobacteria*, *Micrococcus, Bacteroidetes*, *Bacillus*, *Aspergillus*, *Alternaria*, *Cladosporium* and *Penicillium* (Shin *et al*., 2015; Chen, *et* al., 2012; Lee *et al*, 2007; Aydogdu *et al*., 2005; Jo and Seo, 2005; Andersson *et al*., 1999; Daisey *et al*., 1999; Kampfer, *et al*., 1999). Understanding the microbial diversity in childcare settings will therefore facilitate the understanding of the potential health risk associated with day care attendance (Lee *et al*., 2007). This case study was aimed at

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quantifying and identifying the microbial diversity present on the hands of caregivers, aprons of caregivers and air quality in an indoor environment of the childcare settings.

4.3. MATERIALS AND METHODS

4.3.1. Sampling protocol

The pilot study was conducted at three childcare facilities located in Mangaung Metropolitan Municipality. Ethical clearance was not requested. However permission to conduct the study was requested in writing and submitted to municipal Environmental Health managers and local heads of the Department of Social Development (Appendix A). Mangaung Metropolitan Municipality was selected for this pilot study based on the municipality's versatile childcare establishment grading system. The municipality categorises childcare establishments under different levels. Every level has its own type of registration status and minimum requirements. The grading ranges from level 1 to level 4 where the grading is as follows:

- Level 1 (Starting grade - provisory registration);
- Level 2 (Developing grade – interim registration);
- Level 3 (Standard grade – full registration);
- Level 4 (Top grade- full registration).

The facilities that were selected for this pilot study are those that fall under Level 3. Additional elements that influenced the selection include hygiene practices, hygiene education or training and duty combination.

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The childcare providers who participated in this study work in childcare facilities where daily tasks are not designated per caregiver; caregivers are allocated all the tasks associated with their specific “classrooms”. Therefore one caregiver caring for a certain group of children will be responsible for changing diapers, potty training, assisting with toileting, cleaning, feeding and handling food. Microbial samples were obtained from the hands and aprons of the caregivers, during the day in-between their daily chores. Air samples were taken in one learning room in each facility. In total, 90 surface samples and 10 air samples were collected. For the purpose of this study, childcare facilities and child caregivers were alphabetically and numerically labelled to maintain confidentiality.

4.3.2. Microbiological sampling and analysis

4.3.2.1 *Surface samples*

Surface samples of the hands and aprons were collected by using Rodac plates. The agar media used for the plates was prepared according to the manufacturers’ instructions. The Rodac plates containing different media were used to sample total viable counts, total coliforms, yeast and moulds. A total of five childcare staff members participated in the study (Facility A: n=2; Facility B: n=1, Facility C: n=1). The right and left hands of the staff members were sampled by simultaneously placing the index finger, middle finger, ring finger and small finger on the contact plate containing different types of media. A total of 60 hand samples were collected. Contact plates were also used to collect microbial samples on aprons. Samples were obtained from the upper sections and mid-sections of the apron. A total of 30 apron samples were obtained. All the samples were clearly labelled and transported on ice to the laboratory for analysis.

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Upon arrival, plates were grouped accordingly and incubated at appropriate temperatures in an inverted position. Plate Count Agar (PCA) (Merck, SA) was incubated at 36°C for 48 hours, Violet Red Bile (VRB) (Merck, SA) plates were incubated at 37ºC for 24 hours and Potato Dextrose Agar (PDA) (Merck, SA) 37°C for 24 to 72 (Lues and van Tonder, 2007). After the incubation duration, the colonies on the plates were counted and recorded manually prior utilising Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS) machine for colony identification.

4.3.2.2. Air Sampling

Air sampling took place in the three facilities where one classroom was randomly selected in each facility. Air samples took place while the children and caregivers were present in the classrooms. The purpose was to assess microbes that children and caregiver might be exposed to. A single stage surface air sampler (SAS Super 90) was used to collect air samples. Samples were collected 1.5 meters above the floor. The air sampler was pre-calibrated at 180 l. min^{-1} prior sampling. All the removable parts of the air sampler were autoclaved prior sampling and sterilized with 70% ethanol between sampling runs (Shale *et al*., 2006).

A total of 10 samples were obtained. Plate Count Agar (PCA) and Potato Dextrose Agar (PDA) plates were used for quantification of total viable aerobic counts and total fungi (Shale *et al*., 2006). The samples were clearly labelled and transported on ice to the laboratory for analysis. Upon arrival, plates were grouped accordingly and incubated

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under respective temperatures in an inverted position. Plates containing Plate Count Agar (PCA) (Merck, SA) were incubated at 36°C for 48 hours and Potato Dextrose Agar (PDA) (Merck, SA) 37°C for 24 to 72 (Lues and van Tonder, 2007). After the incubation duration, the colonies on the plates were counted manually prior utilising Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS) machine for colony identification

4.3.2.3. Microbial colony identification

Colonies were identified by using a Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS). A single colony from each plate was picked up and transferred by means of a sterile pipette tip and smeared as a thin film directly on a MALDI steel target. The MALDI steel target containing the colonies was overlaid with 1µl of MALDI matrix solution (20 mg/ml 3, 5-dimethoxy-4-hydroxycinnamic acid in acetonitrile, purified water, trifluoroacetic acid) and air-dried for 10 minutes before it was placed in the MALDI-TOF MS for analysis (Bruker Daltonik, Bremen, Germany). Calibration of the spectrometer was done using *Escherichia coli* ribosomal proteins. Sample measurements were conducted using a Microflex Mass Spectrometer (Bruker Daltonik, Bremen, Germany) with Flex Control software (version 3.0). Spectra were recorded in the positive linear mode (laser frequency, 20Hz; ion source 1voltage, 9.1Kv; mass range, 2000 to 20000 Da. For each spectrum 240 shots in 40-shot steps from different positions of the target spot (automatic mode) were collected and analysed. The results were reported in a colour coded ranking table. A score of ≥2 indicated highly

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probable species identification; a score between 1.7-1.9 indicated genus identification and a score of <1.7 indicated an unreliable identification.

4.4. RESULTS AND DISCUSSION

The microbiological quantification of the samples obtained from the facilities are tabulated in Table 4.1 (hands and aprons) and 4.2 (air samples). Total viable counts isolated from hand and aprons, 90% of the surfaces sampled had innumerable counts; coliforms were not detected on 27% of the VRB plates; yeast and mould counts were present on all the PDA plates of which 30% had innumerable counts (Table 4.1). Air samples at different day care centre showed that 60% of samples had innumerable total viable counts; yeast and mould counts ranged from 1-32 cfu.m^{-3} (Table 4.2). The British Columbia Centre for Disease Control Guide for Environmental Officers was used to evaluate the results. The guide provides a vast range of guidelines and specifications as compared the South African regulation R. 962 (Regulations governing general hygiene requirements for food premises and the transport of food).

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Table 4.1: Microbial counts from contact surfaces of childcare facilities in Mangaung Metropolitan Municipality

Facility	Participant	Surface	Bacterial Counts		
			Total Viable counts (cfu)	Total Coliforms (cfu)	Yeasts and Moulds (cfu)
A	1	Left hand 1A	TNTC	1	24
		Left hand 2A	TNTC	1	32
		Right hand 1A	TNTC	0	11
		Right hand 2A	TNTC	0	17
	2	Left hand 1B	TNTC	10	60
		Left hand 2B	TNTC	12	55
		Right hand 1B	TNTC	6	TNTC
		Right hand 2B	TNTC	5	TNTC
	1	Apron 1A	TNTC	2	84
		Apron 1B	TNTC	2	90
	2	Apron 2A	TNTC	1	73
		Apron 2B	TNTC	1	65
B	1	Left hand 1A	TNTC	0	TNTC
		Left hand 2A	TNTC	6	TNTC
		Right hand 1A	TNTC	TNTC	TNTC
		Right hand 2A	TNTC	TNTC	TNTC
	1	Apron 1A	TNTC	2	18
		Apron 1B	TNTC	0	51
C	1	Left hand 1A	TNTC	TNTC	46
		Left hand 2A	TNTC	TNTC	35
		Right hand 1A	TNTC	TNTC	46
		Right hand 2A	TNTC	4	TNTC
	2	Left hand 1B	TNTC	33	74
		Left hand 2B	TNTC	9	59
		Right hand 1B	TNTC	54	TNTC
		Right hand 2B	TNTC	27	TNTC
	1	Apron 1A	TNTC	0	19
		Apron 1B	31	0	TNTC
	2	Apron 2A	50	0	14
		Apron 2B	11	0	62

Table 4.2: Microbial counts from air samples of childcare facilities in Mangaung Metropolitan Municipality.

Facility	Sample Room	Total Viable counts (cfu)	Yeast and Moulds (cfu)
A	Room 1A	TNTC	1
	Room 1B	2	3
B	Room 1A	12	10
C	Room 1A	TNTC	10
	Room 1B	TNTC	23

* Too Numerous To Count (TNTC)

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Based on the British Columbia Centre for Disease Control (BCCDC)(2010) Guide for Environmental Officers, 95% of the total viable counts obtained from the hands were unsatisfactory, 25% of coliforms counts detected on hand samples were unsatisfactory counts whereas yeast and mould counts were satisfactory on 55% of the hand samples. Majority (80%) of the total viable counts obtained from the apron samples did not comply to the specifications of the BCCDC guide, all the coliform counts (100%), yeast and moulds (95%) were satisfactory. Even though the overall majority samples (83%) of the coliforms detected on both hand and aprons were satisfactory the fact that coliforms were detected on 73% of the samples show possible coliform contamination and poor hygiene practices. The innumerable and unsatisfactory counts on the samples show that the childcare givers failed to practice adequate hygiene and hand wash practices.

Numerous bacterial species were detected on the hands and aprons samples. Twenty two (22) different species were positively identified (Tables 4.3 and 4.4). The Microflex LT mass spectrometer (Bruker Daltonics, Germany) did not detect any bacterial strains of the colonies from all the air samples, 40% of the hand and 20% of the apron samples. Detection failure might have been due to the, faint protein band or because the peak profiles of the air samples did not match any of the reference profiles stored in the database (Hrabák *et al*., 2013; Dridi and Drancourt, 2011; Ferreira, *et al*., 2010).

The analysed colonies from the hands and aprons revealed various species that included *Bacillus* as predominant species (23.5%); followed by *Pseudomonas* spp. (20.6%), *Enterobacter* spp. (17.6%), *Acinetobacter* spp. (8.8%), *Escherichia* (5.9%) and *Staphylococcus* spp. (5.9%). Species such as *Clostridium*, *Klebsiella*, *Streptococcus*,

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Haemophilus, *Ochrobactrum* and *Lactobacillus* were also identified in the minority from the isolated samples (Table 4.3 and Table 4.4).

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Table 4.3: Gram-positive bacterial characterisation of samples

	Facility	Origin	Species identification (Gram (+) bacteria) using MALDI-TOF MS	MALDI Biotyper Score	Possible Source	Possible Health Effects	Reference
HAND SAMPLES	A	Right Hand: Participant 1	*Lactobacillus equi* DSM 15833T	1.7	Gastrointestinal tracts	Diarrhoea	Morotomi *et al*., 2002
			Bacillus cereus 994000168	1.7	Soil, dust, air, fomites, water	Food poisoning, gastroenteritis, ocular infections, bacteremia	Sankararaman and Velayuthan, 2013
			Staphylococcus capitis ssp capitis DSM 20326	1.7	Skin, mucos, human gut	Catheter-related bacteremia, endocarditis, urinary tract infection.	Takano *et al*., 2011 Li *et al*., 2014 Cui *et al*., 2013
			Clostridium perfringens DSM 11779	1.8	Soil, intestines, faeces	Gas gangrene , Soft tissue infections, food poisoning, enteritis, necroticans, septicemia	Li *et al*., 2007
			Streptococcus pneumoniae besSt29	1.8	Upper respiratory tract	Pneumonia, ear infections, sinus infections, meningitis, bacteremia	Walsh and Camilli, 2011
		Right Hand : Participant 2	*Bacillus megaterium* DSM 32	1.7	Soil, plant, water	Non-pathogenic	Eppinger *et al*., 2011
	C	Left Hand: Participant 1	*Bacillus subtilis ssp subtilis* DSM 10	2.0	Soil	Nosocomial septicemia	Oggioni *et al*., 1998
		Right hand: Participant 2	*Bacillus cereus* DSM 31	1.7	Soil, dust, air, fomites, d water	Gastroenteritis, ocular infections, bacteremia, food poisoning	Sankararaman and Velayuthan, 2013
			Bacillus pseudomycoides DSM 12442	1.7	Soil	Non-pathogenic	Nakamura, 1998
		Left Hand: Participant 2	*Bacillus mojavensis* DSM 9205	1.7	Soil	Non-pathogenic	Bacon and Hinton 2011
APRON	A	Apron: Participant 1	*Bacillus megaterium* DSM 32	2.2	Soil, plant, water	Non-pathogenic	Eppinger *et al*., 2011
		Apron: Participant 2	*Staphylococcus aureus* ATCC 33862	1.9	Skin, nasal cavity	Skin and soft-tissue infections, endovascular infections, pneumonia, septic arthritis, endocarditis, osteomyelitis	David and Daum, 2010
	B	Apron: Participant 1	*Bacillus cereus* 994000168	1.7	Soil, dust, air, fomites, water	Food poisoning, gastroenteritis, ocular infections, bacteremia	Sankararaman and Velayuthan, 2013

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Table 4.4: Gram-negative bacterial characterisation of samples

	Facility	Origin	Species identification (Gram (-) bacteria) using MALDI-TOF MS	MALDI Biotyper Score	Possible Source	Possible Health Effect	Reference
HAND SAMPLES	A	Right hand: Participant 1	*Enterobacter* spp DSM 15156	2.0	Gastrointestinal tract	Nosocomial infections in the lungs, urinary tract and intrabdominal cavity	Villegas and Quinn, 2001
			Escherichia coli ATCC 25922	1.7	Intestinal tract	Diarrhoea, haemolytic uraemic syndrome, haemorrhagic colitis	Ateba *et al*., 2008
		Left Hand: Participant 1	*Pseudomonas stutzeri* BK_02099_09	2.2	Soil, water	Nosocomial infections	Bisharat *et al*., 2012
		Right hand: Participant 2	Pseudomonas stutzeri BK_02099_09	2.2	Soil, water	Nosocomial infections	Bisharat *et al*., 2012
			Enterobacter cloacae MB_8779_05	2.0	Gastrointestinal tract	Nosocomial bacteremia, lower respiratory tract infection, skin and soft tissue infections, urinary tract infections, endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, and ophthalmic infections	Musil *et al*., 2010 Paauw *et al*., 2008
			Ochrobactrum anthropi DSM 20150	1.8	Soil, plants, water sources, saline solutions, antiseptic solutions, dialysis liquids	Bacteremia in patients with debilitating illnesses	Kettaneh *et al*., 2003
		Left hand: Participant 2	*Pseudomonas stutzeri* B367	2.1	Soil, water	Nosocomial infections	Bisharat *et al*., 2012
			Acinetobacter baumannii LMG 994	1.8	Soil, water, plants, foods	Causes nosocomial pneumonia, skin and wound infections, bacteremia, and meningitis	Antunes *et al*., 2011
	B	Right hand: Participant 1	*Enterobacter cloacae* MB11506_1	1.8	Gastrointestinal tract	Nosocomial bacteremia, lower respiratory tract infection, skin and soft tissue infections, urinary tract infections, endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, and ophthalmic infections	Musil *et al*., 2010 Paauw *et al*., 2008
			Escherichia coli MB11464_1	1.7	Gastrointestinal tract, urinary tract	Diarrhoea	Bach *et al*., 2002 Collignon, 2009
			Pseudomonas luteola VA_00501_09	1.8	Soil, water	Bacteremia, pneumonia, biliary tract infections, surgical wound infections, abscesses, peritonitis, subdural empyema and infections associated with the presence of prosthetic devices.	Ramana *et al*., 2010

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Table 4.4 (cont.): Gram-negative bacterial characterisation of samples

HAND SAMPLES	C	Right hand: Participant 1	*Pseudomonas oleovorans* DSM 1045	1.7	Water-oil emulsions	Oil dermatitis.	Lee and Chandler, 1941
		Left Hand: Participant 1	*Enterobacter cloacae* DSM 30060	1.7	Gastrointestinal tract	Nosocomial bacteremia, lower respiratory tract infection, skin and soft tissue infections, urinary tract infections, endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, and ophthalmic infections	Musil *et al*., 2010
APRON SAMPLES	A	Apron: Participant 1	*Enterobacter cloacae* 20105_2	2.1	Gastrointestinal tract	Nosocomial bacteremia, lower respiratory tract infection, skin and soft tissue infections, urinary tract infections, endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, and ophthalmic infections	Musil *et al*., 2010
			Pseudomonas stutzeri BK_02099_09	1.9	Soil, water	Nosocomial infections	Bisharat *et al*., 2012
			Pseudomonas stutzeri DSM 13592T	1.7	Soil, water	Nosocomial infections	Bisharat *et al*., 2012
		Apron: Participant 2	*Haemophilus influenzae* ATCC 35056	1.7	Upper respiratory tract	Bacteremia, pneumonia, epiglottitis, acute bacterial meningitis, ear infections, eye infections, sinus infections	Dabernat *et al*., 2003 da Silva and Marin, 2001
			Enterobacter cloacae 20105_2	1.8	Gastrointestinal tract	Nosocomial bacteremia, lower respiratory tract infection, skin and soft tissue infections, urinary tract infections, endocarditis, intra-abdominal infections, septic arthritis, osteomyelitis, and ophthalmic infections	Musil *et al*., 2010 Paauw *et al*., 2008
			Klebsiella oxytoca ATCC 700324	1.8	Gastrointestinal tract, stools, sewage, soil	Community-acquired meningitis and brain abscesses, Nosocomial infections, colitis and sepsis.	Lowe *et al*., 2012
	B	Apron: Participant 1	Acinetobacter haemolyticus LMG 1033	1.9	Environment	Nosocomial infections	Quinteira *et al*., 2007
			Acinetobacter junii DSM 14968	1.7	Soil water	Nosocmial septicemia	Tayabali *et al*., 2012

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Microbial contamination of hands and clothing occur through regular contact with surfaces, people, raw foods, animals, body fluids and excreta (saliva, nasal secretions, blood, urine, vomit or faeces), body parts, or by settling of airborne particles and bioaerosols (Lopez, *et al*., 2013; Boone and Gerba, 2007; Hota, 2004). Members of *Enterobacteriaceae* were detected on the hands of four employees and aprons two employees indicate poor or ineffective hygiene practices probably after using the toilet, potty training or changing diapers (Marzano and Balzaretti, 2013; Lues and Van Tonder, 2007). The human gastrointestinal tract consists of a variety of normal flora anaerobic bacteria such as *Enterococci*, *Escherichia coli*, *Klebsiella*, *Enterobacter* and *Proteus* which may be harmless (Dodrill, *et al*., 2011).

Enteric bacteria discovered on the samples are often associated with opportunistic nosocomial infections. Among the enteric bacteria detected on the samples, *E. coli* has pathogenic potential depending on the strains (Owusu, 2012, Dodrill, *et al*., 2011). Certain strains of *E. coli* (H7, 0121:H19 and 0104:H21) produce potent toxins that cause food poisoning (Owusu, 2012, Dodrill, *et al*., 2011). The *E. coli* detected on the right hand of one of the participants (Table 4.4) indicates possible occurrence and transmission of potentially toxin producing *E. coli* through the hands of childcare personnel.

Diaper changing and assisted toilet training are considered as the most common source of enteric pathogens by virtue of close and frequent contact with faecal material (Li *et al*., 2013; Arvelo *et al*., 2009). *Clostridium perfringens*, another indicator of faecal contamination was present on right hand of childcare provider

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number one in facility A (Table 4.3). The presence of this organism was of concern because *C*. *perfringens* can be transmitted to food via contaminated hands (Trickett, 2001; Merry, 1997). Ingestion of this enterotoxin producing microbe can result in *Clostridium perfringens* food poisoning (Ata *et al*., 2013, Charlebois *et al*., 2014).

Bacillus cereus and *Streptococcus pneumonia* were among other microbes detected on the hands of some care providers (75%). The presence of *Bacillus cereus* on hands (Table 4.3) raises a food safety concern. *B. cereus* produces heat-liable and heat-stable enterotoxins that cause food poisoning (Parija, 2012; Schneider *et al*., 2004). Consumption of food that has been contaminated by this bacterium will result in symptoms such as acute abdominal pain, nausea and diarrhoea (Parija, 2012). Apart from food poisoning *Bacillus cereus* also causes systemic and local infections in immunocompromised and immunocompetent individuals such as pneumonia, bacteraemia, meningitis etc. (Sankararaman and Velayuthan, 2013; Bottone, 2010; Klietmann and Ruoff, 2002). *Streptococcus pneumonia* colonizes in the nasopharynx and upper respiratory airway and transmitted through direct contact with respiratory secretions of the host (Walsh and Camilli, 2011), the presence of this microbe on hands indicates that personal hygiene was probably not practiced by the caregiver after coming into contact with her own nasal secretions or that of a child.

Microbes found on the aprons the rest of the participants included *Staphylococcus aureus*, *Bacillus cereus*, *Bacillus megaterium*, *Klebsiella oxytoca*, *Acinetobacter haemolyticus* and *Acinetobacter junii, Enterobacter cloacae*, *Haemophilus influenzae* and *Pseudomonas stutzeri* (Table 4.3 and 4.4). The aprons used by the providers

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are worn throughout the day and while performing daily duties such as preparing food, feeding, changing diapers and so forth. Figure 4.1 shows a childcare provider from one of the facilities with an apron in children's learning room and a child making direct contact with the apron. The image demonstrates one of the contamination risks associated with wearing an apron outside food preparation areas. Personal protective clothing is initially worn for the purpose of preventing and minimizing contamination and then again such clothing can serve as sources of contamination if misused.

Figure 4.1: Childcare provider wearing an apron in the children's learning area.

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Fabrics harbour and transmit of microbes through direct contact with the fomite or indirectly through cross contamination (Lopez *et al*., 2013; Bajpai, *et al*., 2011). The presence of enteric bacteria on some of the aprons (n= 2) confirm contamination from either diaper changing or contamination by hands that were not washed after using the toilet.

Staphylococcus aureus can be transmitted through direct skin contact with contaminated clothing (Miller and Diep, 2008). *S. aureus* infections manifest as respiratory infections, food poisoning, skin and soft tissue infections. *S. aureus* has the ability to survive on clothing for a long period after initial contact (Chaibenjawong and Foster, 2011). *Haemophilus influenzae* is rarely transmitted by fomites, however the presence of the bacteria on the care provider's apron is an indication that the apron came in contact with mucosal secretions of the upper respiratory tract by direct contact with the nose or through hands that were in contact with mucosal secretions (Gupte, 2002).

Bacterial strains from the air samples were not identified, on the other hand colony growth on the Rodac plates occurred indicating the presence of bacteria, yeast and moulds. Aerosolized bacteria have been known to cause mucous membrane irritation, bronchitis and obstructive, pulmonary disease, allergic rhinitis and asthma, allergic alveolitis and tuberculosis (McDonagh, 2013; Douwes *et al*., 2002). Bioaerosols that settle on the skin and clothing can be redistributed into the environment or transmitted through contact with persons, surfaces and food (McDonagh, 2013; Nicas and Sun, 2006). In relation to this study, contaminated aprons may potentially contribute to the transmission of microbes.

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Direct “hands-on” care provided to day-care children by caregivers is amongst numerous factors that can contribute to the transmission of infections in childcare settings (Lu, 1998). Childcare providers are therefore in frequent physical contact with children as well as performing out duties associated with food handling, feeding, cleaning, diaper changing, toilet training and so forth. Since childcare facilities in this study do not distinctly allocate diaper changing and toilet training duties from food handling duties to caregivers, contamination of the hands and clothes will occur. The practice of combined duties is highly discouraged because it increases the risk of transmission of enteric pathogens (Arvelo *et al*., 2009). Studies have reported higher incidences of diarrhoea in facilities where care providers were responsible for both diaper changing and food handling compared to facilities that allocate separate duties per individual (Chen, 2013; Mohle-Boetani *et al*., 1995; Lemp *et al*., 1984). Because this pilot study focused mainly on identifying and quantifying microbes in childcare facilities, data regarding incidences of diarrhoea was not gathered.

In addition to poor hygiene practices and combining duties, the hygiene practices of the participants were likely to have been influenced by lack of hygiene training. The practices and knowledge utilized by the caregivers are probably self-taught or adopted; similar to that of an individual in a home environment. Hygiene practices that are adopted from a home environment are often influenced by psychological factors (optimistic bias, illusion of control and habit), demographic factors (age, gender and race) and socio-economic factors (level of education, knowledge and income) (Al-Sakkaf, 2013, Brennan, 2010; Sherriff *et al*., 2002). Li and colleagues (2013) conducted a comparative and observational study on microbiological indicator

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levels and hygienic conditions in childcare facilities in North and South Carolina, United States of America. Based on the results of their study, facilities that did not have written policies on personal hygiene, food handling, surface cleaning and disinfection had higher total viable counts and coliform counts on hand samples and surface samples.

Hygiene policies have been a successful tool in promoting and encouraging hand hygiene practices among health care employees (Agency for Healthcare Research and Quality, 2013; Pittet, 2001). Additionally, Li *et al*. (2013) highlighted that policies are more likely to be implementable if they contain clear guidelines and detailed instructions on when and how to execute the required practices. To ensure that such policies and guidelines are carried out and practices efficiently; constant training has to be provided (Ferson, 1997). Policy and guideline orientated interventions can possibly assist in promoting adequate and satisfactory hygiene practices that can prevent the occurrence of potentially harmful microbes such as those identified in this survey. Hygiene procedures and guidelines for childcare facilities have been formulated in various places such as in the United States, Australia, United Kingdom and Ireland. The manuals are either formulated by childcare facilities themselves or by the authorities that regulate the facilities. The manuals contain basic instructive step-by-step hygiene procedures on (i) when and how to wash hands, (ii) how and when to clean and sanitize surfaces, food preparation surfaces, toys, diaper changing areas, mops, brooms, toilets, potties, feeding bottles, etc., (iii) instructions on how to mix disinfectants to clean surfaces, equipment and infectious spillages, (iv)

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food safety aspects such as temperature control, hand washing, adequate food storage, separating cooked food from raw food, etc.

4.5. CONCLUSION

Results of this study revealed poor hand hygiene among the childcare providers as well as potential microbial hazards associated with combining duties especially when diaper changing or assisted toilet training are involved, furthermore utilizing the same apron while performing all required duties. A considerable amount of microbes identified on the hands and aprons of the childcare providers are often associated with food poisoning. Bacteria such as *E. coli*, *Clostridium perfringens* and *Bacillus cereus* the on hands of care providers are potential causes for foodborne outbreaks. Microbial hazards in childcare facilities do not only impact a child's health, childcare acquired infections also affect household members of the children attending day care (Lu, 1998). Infection prevention and control, strategic interventions in a form policies and training are therefore needed in childcare establishments. Hand hygiene has been a long-standing recommended method for effectively reducing enteric and respiratory infections if implemented and practiced accordingly (Lambrechts *et al*., 2014; Aiello *et al*., 2008; Nesti and Goldbaum, 2007). Training on hand hygiene, food safety, proper use and cleanliness of personal protective clothing as well as microbes associated with poor hand hygiene, food safety and multipurpose use of personal protective clothing should be provided. The compilation of hygiene guidelines and procedures should be adopted and implemented in childcare facilities in South Africa. It would be highly beneficial to include culture based routine sampling for hygiene indicators in Environmental Health inspections in childcare

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establishments. This will assist in determining and monitoring microbial hazards and whether effective hygiene practices are carries out.

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CHAPTER FIVE

GENERAL DISCUSSION, CONCLUSIONS AND RECOMMENDATIONS

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5.1. INTRODUCTION

Childcare establishments provide essential services that play an immense role in the emotional, physical and mental development and wellbeing of children (Grey, 2006). Even though childcare establishments provide a beneficial service, they also pose a threat to the health and wellbeing of children due certain factors and attributes. Children have underdeveloped immune systems and vulnerable to infections, it is essential that they occupy a safe and healthy environment and cared for in a manner that will not compromise their health and wellbeing. The risk for infections in childcare facilities is facilitated by conditions and certain characteristics that are accustomed to a childcare environment. Risk factors associated with the prevalence and transmission of infections in childcare settings include being cared for in a group, close frequent contact between children and childcare staff, diapering and poor hygiene (Li, 2012; Sanders *et al*., 2009).

Infections that are acquired by children who attend day care can also be transmitted outside day care to members of their households and other individuals who interact with the children outside day care (Holt *et al*., 2004). In order to understand the factors that are associated to the occurrence of hazards in childcare facilities, the main aim of this study was to assess the factors that contribute to the prevalence of microbial hazards associated with childcare facility setups in Free State Province, South Africa. The objectives of this study were to:

- to evaluate the regulatory compliance of childcare facilities by assessing infrastructural compliance and registration terms;

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- to evaluate and asses the hygiene levels, associated knowledge and practices within the childcare facilities by means of checklists and questionnaires; and
- to quantify and identify airborne microbes and microbes on the hands and aprons of childcare personnel.

Achieving the objectives entailed site visits, administering questionnaires to facility owners and caregivers, collecting microbiological samples and conducting meetings with municipal Environmental Health Practitioners, officials from the Department of Social Development and other relevant officials.

5.2. GENERAL DISCUSSION

Chapter 2 assessed the structural conditions and equipment of childcare facilities including the challenges associated with the registration requirements and compliance of childcare establishments in the Free State. The criterion used to assess compliance was aligned with municipal by-laws and guidelines that regulate childcare facilities within South Africa. The results obtained revealed that the facilities were either fully registered or conditionally/partially registered as prescribed in by-laws for childcare facilities and Section 95 of the Children's Act 38 of 2005.

Chapter 2 also revealed the kind of unfavourable building conditions that can potentially compromise the health and safety of children and childcare staff. These unfavourable conditions included structural defects, the use of newspapers and cardboard boxes to line ceilings and walls, inadequate diaper changing areas and

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equipment as well as inadequate sanitary facilities. Structural defects provide harbouring places for microbes and an entry point for pests. The inadequacies of the sanitary facilities included broken taps, plumbing faults, the sheltering and placement of potties. Inadequate sanitary facilities can possibly hamper adequate sanitary practices and implementation thereof (Zomerplaag and Mooijman, 2005).

Facilities with structural defects, inadequate sanitary facilities or inadequate diaper changing areas were those that were granted conditional/partial registration. The owners of those facilities expressed that financial constraints hider facility improvement for full compliance and full registration. A number of facilities deviated from their registration terms and conditions where they accommodated more children as opposed to the allowable numbers that were stated on the health compliance certificates. Certain facilities reported that Environmental Health Practitioners rarely visit their facilities for compliance inspections. This chapter also revealed the childcare service providers and caregivers' lack training on norms and standards that regulate childcare establishments.

Childcare service providers are legally required to register their establishments as stipulated in Section 95 of the Children's Act 38 of 2005. Childcare establishments have to comply with norms and standards for childcare establishments in order to qualify for registration. Norms and standards for childcare centres stipulate mandatory infrastructural standards for the premises and equipment for the purpose of safeguarding the health and wellbeing of children. Requirements for childcare

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settings state the provision of a safe environment, with adequate space and ventilation; safe drinking water; adequate water supply; hygienic and adequate toilet and sanitary facilities; adequate means of refuse disposal and a hygienic food preparation area (Berry *et al*., 2011). Financial constraints and lack of training on childcare regulations might have been the reason behind partial compliance and failure to implement necessary upgrades for full compliance.

Chapter 3 evaluated and assessed the hygiene standards, associated knowledge and practices within the childcare facilities by means of checklists and questionnaires. Child caregivers are the custodians of health and hygiene in childcare. Their hygiene practices influence the prevalence and transmission of infections in childcare settings. The assessment revealed that some childcare facilities (52%) had one personnel combining duties of diapering and food handling. Combining such duties facilitate the transmission of enteric pathogens in childcare settings. Chapter 3 also revealed lack of hygiene training among childcare personnel, improper hand washing practices, incorrect use of diaper changing personal protective equipment, handling of food while sick, improper disposal of soiled diapers, the use of inadequate diaper changing surfaces (blankets, sponge mattresses), non-separation of children; poor cleaning and disinfection of food contact surfaces, diaper changing surfaces and carpets.

The practices that were found were those that facilitate the occurrence and transmission of infections. This chapter identified a need to train childcare personnel on adequate hygiene practices and implementation thereof. In addition to hygiene

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training, training on regulatory requirements for childcare settings is also essential because they regulate activities within childcare settings by stipulating requirements that aid the minimisation of infections. Children do not have well developed hygiene habits and practices they are dependent on those of childcare givers. Poor domestic hygiene and inadequate sanitary practices are among the causative risk factors for diarrhoea in children (Usfar *et al*., 2010). Adequate personal hygiene, environmental hygiene and food safety practices can minimize the occurrence and transmission of infections in childcare facilitate.

The close and frequent contact between childcare personnel and children provides an opportunity for the transmission of infections. Hands and clothing of childcare personnel carry microbes that can be transmitted through contact or while performing duties such as food handling. Chapter 4 documents a microbial pilot study that was was conducted in four childcare facilities with the aim of quantifying and identifying microbes of the samples obtained from the hand and aprons of childcare personnel. The species identification of the samples was done by means of a Matrix-assisted laser desorption/ionization-time of flight mass spectrometry (MALDI-TOF MS). The results obtained and associated health implications.

The microbes identified on the hands of the childcare personnel include *Bacillus cereus*, *Clostridium perfrigens*, *Streptococcus pneumonia*, *Escherichia coli*, *Enterobacter cloacae*, *Pseudomonas luteola*, *Acinetobacter baumannii*, *Pseudomonas stutzeri* and *Ochrobactrum anthropic*. The apron samples revealed various species such as *Staphylococcus aureus*, *Bacillus cereus*, *Bacillus*

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megaterium, *Klebsiella oxytoca*, *Acinetobacter haemolyticus*, *Acinetobacter junii, Enterobacter cloacae*, *Haemophilus influenzae* and *Pseudomonas stutzeri*. The microbes obtained from the samples are opportunistic and can cause respiratory and gastrointestinal illness. Children do not have robust immune systems; this makes them prone to developing illnesses as a result of opportunistic microbes similar to those identified in this pilot study. The enteric microbes that were identified indicated that poor sanitary practices were carried out. Since the childcare facilities in this study do not distinctly allocate diaper changing and toilet training duties from food handling duties to caregivers, contamination of the hands and clothes will occur. Studies have reported higher incidences of diarrhoea in facilities where care providers were responsible for both diaper changing and food handling compared to facilities that allocate separate duties per individual (Chen, 2013; Mohle-Boetani *et al*., 1995; Lemp *et al*., 1984).

The results revealed an overview of microbes that are associated with poor hygiene practices among caregivers. Such findings highlight a need for infection control and hygiene policies and procedures, training and implementation. A single stage surface air sampler (SAS Super 90) was used to collect air samples in four childcare facilities for the identification and quantification of bioaerosols. The MALDI-TOF MS failed to identify colonies from the air samples possibly due to faint protein band or because the peak profiles of the air samples did not match any of the reference profiles stored in the database (Hrabák *et al*., 2013; Dridi and Drancourt, 2011; Ferreira, *et al*., 2010). Total viable counts, yeast and mould colony growths occurred on the Rodac plates. The colony growths indicate the presence of microbes in the classrooms that were sampled. Bioaerosols have been known to cause mucous membrane irritation,

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bronchitis and obstructive, pulmonary disease, allergic rhinitis and asthma, allergic alveolitis and tuberculosis (McDonagh, 2013; Douwes *et al*., 2002). The presence of bioaerosols in a childcare environment can therefore cause adverse health effects among children.

5.3. CONCLUSIONS AND RECOMMENDATIONS

Various aspects in a childcare environment are capable of posing a health hazard to children in childcare. The scope of health and safety in childcare encompasses issues of infrastructure, facility resources, environmental hygiene, hygiene practices and care practices utilized by child caregivers. Ensuring that children are cared for in facilities that do not compromise their health and well-being entails facility compliance to childcare regulations and utilizing adequate hygiene practices.

The results obtained in this study illustrated the scale of hazards that are associated with childcare and the possible consequences. The major challenges identified are those associated with infrastructure, hygiene practices of caregivers, environmental hygiene, deviation from registration terms, lack of training regarding childcare regulations, hygiene and food safety practices. The results presented in this study also highlighted the importance of childcare regulatory compliance and adequate hygiene and food safety training in a childcare environment.

Reviewing and simplifying the current regulatory scope for childcare facilities, providing financial aid and strategies for infrastructural upgrades and maintenance

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would also assist childcare establishments in achieving for full registration. Such initiatives could improve the state of childcare facilities and tackle the unfavourable conditions and challenges that were identified in this study. In addition to reviewing childcare regulations and providing financial aid; formulating instructive cleaning and food hygiene procedures would immensely assist childcare facilities in South Africa to apply adequate and effective hygiene and food safety practices.

Hygiene procedures and manuals for childcare facilities have been formulated in various places such as in the United States, Australia, United Kingdom and Ireland. The manuals are either formulated by childcare facilities themselves or by the authorities that regulate the facilities. The manuals contain basic instructive step-by-step hygiene procedures on (i) when and how to wash hands, (ii) how and when to clean and sanitize surfaces, food preparation surfaces, toys, diaper changing areas, mops, brooms, toilets, potties, feeding bottles, etc., (iii) instructions on how to mix disinfectants to clean surfaces, equipment and infectious spillages, (iv) food safety aspects such as temperature control, hand washing, adequate food storage, separating cooked food from raw food, etc. The formulation of such procedures can be carried out by local municipal Environment Health office in collaboration with the Department of Social Development, child caregivers and childcare facility owners. Inputs, remarks, suggestions and relevant data towards formulating the procedures can be done by conducting focus groups with child caregivers; facility owners, childcare forms and organizations assist community based childcare facilities.

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Training on childcare regulations, care practices, adequate hygiene and food safety training are essential for childcare personnel and parents. Knowledge will assist caregivers in ensuring, implementing and practising adequate standards that will ensure a safe childcare environment. Capacitating parents with such knowledge will aid awareness and provide guidance when choosing care facilities for their children. It would also be ideal for Environmental Health Practitioners to include routine microbial sampling on surfaces and hands as part of compliance indicators. The microbes identified from the routine samples can shed perspective the type of control measures to be implemented and strengthened based on the type of microbes identified.

5.4. FUTURE RESEARCH/PROJECTS

From the results of this study, the following were identified as possible future research opportunities:

- Determination of the extent of environmental hazards and health effects associated with structural defects in poorly structured childcare establishments; and whether a relationship between hazard exposure and clinical history exists.

- Routine microbial sampling in childcare facilities as a tool to aid interventions aimed at minimizing infections associated with childcare settings.

- Compilation of childcare hygiene and infection control procedures and manuals followed by an assessment on the implantation and influences made on the hygiene practice and behaviours of childcare personnel.

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- The selection criteria that parents apply when selecting childcare facilities for their children. Are parents aware of the childcare regulations and hazards associated with childcare facilities?

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APPENDICES

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APPENDIX A: LETTERS OF REQUEST TO CONDUCT RESEARCH STUDY

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Soaring to 202

Faculty of Health and Environmental Sciences
Environmental Health Department
Unit of Applied Food Science and Biotechnology

28 February 2012

Fezile Dabi Municipality
Kroonstad
9499

Attention: To whom it may concern

Re: Request to conduct a research study in collaboration with Fezile Dabi Municipality

I am currently studying for an M. Tech degree in Environmental Health at the Central University of Technology, Free State. I am expected to conduct a research study as a requirement for the degree. The title of my research study is "*Microbial and food safety related hazards associated with level one day care facilities in the Free State*". My study leaders for this project are Dr K. Shale and Dr N.J. Malebo.

This study will look into the hygiene and food safety issues associated with day care facilities by conducting a survey of airborne contaminants and extrinsic factors in food preparation areas of day care facilities as well as in classrooms with carpets, focusing on bioaerosols and other airborne contaminants, the impact of air contaminants on food within day care facilities.

Studies have shown that whenever outbreaks occur within a community, the attack rates tend to become much higher among employees and attendants of day care facilities and children cared for at day care facilities are at greater risk of contracting infections than those who do not attend day care. Day care facilities are vulnerable to foodborne illness outbreaks and cross contamination can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, nappy changing, serving and cleaning up after infants and young children.

A few studies have compared the presence of micro-organisms in rooms with carpets and in those without carpets in regards to indoor air quality and reported that carpets contribute to the presence and quantity of microorganisms in the air. Carpets provide a home to microorganisms than any other kind of flooring because the fibres that carpets are made up of trap allergens like mold and bacteria; and volatile organic compounds.

This study will be conducted by means of checklists, questionnaires. Collection of samples with appropriate instruments will be done in the kitchen(s) on food contact surfaces, non food contact surfaces, carpets and from classrooms. Samples will be taken to the laboratory for microbial and chemical analysis.

With this background in mind, may I therefore request a list of level one child day care facilities as registered by the Fezile Dabi Municipality. I would also appreciate meeting with relevant officials to discuss the study in detail, as well as the time frame to conduct the study.

This study will shed more light on hygiene and microbiological safety statuses within day care facilities.
Your assistance will be greatly appreciated.

Yours truly,

N. A. A. Boaduo

Unit of Applied Food Science and -Biotechnology • Private Bag X20539 • Bloemfontein • SOUTH AFRICA • 9300 •
Tel: +27 51 507 3884 • **Fax:** +27 51 507 3435 • **E-mail:** kshale@cut.ac.za • **Website:** www.cut.ac.za

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Faculty of Health and Environmental Sciences
Environmental Health Department
Unit of Applied Food Science and Biotechnology

28 February 2012

Private Bag X20616
BLOEMFOTEIN
9300

Attention: To whom it may concern

Re: Request to conduct a research study in collaboration with Department of Social Development, Free State

I am currently studying for an M. Tech degree in Environmental Health at the Central University of Technology, Free State. I am expected to conduct a research study as a requirement for the degree. The title of my research study is "*Microbial and food safety related hazards associated with level one day care facilities in the Free State*". My study leaders for this project are Dr K. Shale and Dr N.J. Malebo.

This study will look into the hygiene and food safety issues associated with day care facilities by conducting a survey of airborne contaminants and extrinsic factors in food preparation areas of day care facilities as well as in classrooms with carpets, focusing on bioaerosols and other airborne contaminants, the impact of air contaminants on food within day care facilities.

Studies have shown that whenever outbreaks occur within a community, the attack rates tend to become much higher among employees and attendants of day care facilities and children cared for at day care facilities are at greater risk of contracting infections than those who do not attend day care. Day care facilities are vulnerable to foodborne illness outbreaks and cross contamination can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, nappy changing, serving and cleaning up after infants and young children.

A few studies have compared the presence of micro-organisms in rooms with carpets and in those without carpets in regards to indoor air quality and reported that carpets contribute to the presence and quantity of microorganisms in the air. Carpets provide a home to microorganisms than any other kind of flooring because the fibres that carpets are made up of trap allergens like mold and bacteria; and volatile organic compounds.

This study will be conducted by means of checklists, questionnaires. Collection of samples with appropriate instruments will be done in the kitchen(s) on food contact surfaces, non food contact surfaces, carpets and from classrooms. Samples will be taken to the laboratory for microbial and chemical analysis.

With this background in mind, may I therefore request a list of level one child day care facilities as registered by the Fezile Dabi Municipality. I would also appreciate meeting with relevant officials to discuss the study in detail, as well as the time frame to conduct the study.

This study will shed more light on hygiene and microbiological safety statuses within day care facilities.

Your assistance will be greatly appreciated.

Yours truly,

N. A. A. Boaduo

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Faculty of Health and Environmental Sciences
Environmental Health Department
Unit of Applied Food Science and Biotechnology

22 August 2012

Attention: To whom it may concern

Re: Request to conduct a research study in collaboration with Ntataise

I am currently studying for an M. Tech degree in Environmental Health at the Central University of Technology, Free State. I am expected to conduct a research study as a requirement for the degree. The title of my research study is "*Microbial and food safety related hazards associated with childcare facilities*". My study leaders for this project are Dr K. Shale and Dr N.J. Malebo.

This study will look into the hygiene and food safety issues associated with day care facilities by conducting a questionnaire survey to assess the knowledge, attitude, behavior and practices of childcare givers, checklist survey to evaluate facility's compliance to municipal childcare by laws, challenges associated with failure to comply with by laws, analysing the practicality of childcare facility by laws as well as factors that inhibit execution of appropriate hygiene and food related practices in childcare facilities.

Studies have shown that whenever outbreaks occur within a community, the attack rates tend to become much higher among employees and attendants of day care facilities and children cared for at day care facilities are at greater risk of contracting infections than those who do not attend day care. Day care facilities are vulnerable to foodborne illness outbreaks and cross contamination can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, nappy changing, serving and cleaning up after infants and young children.

Literature emphasises the significance of training and education among childcare personnel. However in South Africa, a childcare employee is not required any formal education or training. Whilst in developed countries, childcare givers are strictly required to have formal education or training qualification obtained from an institution of higher learning.

This study will shed more light on hygiene and microbiological safety statuses within day care facilities and factors that influence such aspects.

I would appreciate meeting with relevant officials from your organisation to discuss the study in detail. Additional information with regards to this study is available on request.

Your assistance will be greatly appreciated.

Yours truly,

N.A.A. Boaduo

Unit of Applied Food Science and -Biotechnology • Private Bag X20539 • Bloemfontein • SOUTH AFRICA • 9300 •
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Faculty of Health and Environmental Sciences
Environmental Health Department
Unit of Applied Food Science and Biotechnology

28 August 2012

Lejweleputswa District Municipality
P O Box, 2163
Welkom
9460

Attention: To whom it may concern

Re: Request to conduct a research study in collaboration with Matjhabeng Local Municipality

I am currently studying for an M. Tech degree in Environmental Health at the Central University of Technology, Free State. I am expected to conduct a research study as a requirement for the degree. The title of my research study is "*Microbial and food safety related hazards associated with childcare facilities*". My study leaders for this project are Dr K. Shale and Dr N.J. Malebo.

This study will look into the hygiene and food safety issues associated with day care facilities by conducting a questionnaire survey to assess the knowledge, attitude, behaviour and practices of childcare givers; checklist survey to evaluate facility's compliance to municipal childcare by laws, challenges associated with failure to comply with by laws, analysing the practicality of childcare facility by laws as well as factors that inhibit execution of appropriate hygiene and food related practices in childcare facilities.

Studies have shown that whenever outbreaks occur within a community, the attack rates tend to become much higher among employees and attendants of day care facilities and children cared for at day care facilities are at greater risk of contracting infections than those who do not attend day care. Day care facilities are vulnerable to foodborne illness outbreaks and cross contamination can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, nappy changing, serving and cleaning up after infants and young children.

This study will shed more light on hygiene and food safety status within day care facilities and factors that influence such aspects.

I would appreciate meeting with relevant officials from your organisation to discuss the study in detail. Additional information with regards to this study is available on request.

Your assistance will be greatly appreciated.

Yours truly,

N.A.A. Boaduo

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Faculty of Health and Environmental Sciences
Environmental Health Department
Unit of Applied Food Science and Biotechnology
14 July 2011

Mangaung Metropolitan Municipality
Medical Officer of Health
108 Nelson Mandela Drive
Bloemfontein
9300

Attention: Mr. Billy Barnes

Re: Request to conduct a research study in collaboration with Mangaung Metropolitan Municipality

I am currently studying for an M. Tech degree in Environmental Health at the Central University of Technology, Free State. I am expected to conduct a research study as a requirement for the degree. The title of my research study is "*Microbial and food safety related hazards associated with level one day care facilities in the Mangaung Metropolitan Municipality, South Africa*". My study leaders for this project are Dr K. Shale and Dr N.J. Malebo.

This study will look into the hygiene and food safety issues associated with day care facilities by conducting a survey of airborne contaminants and extrinsic factors in food preparation areas of day care facilities as well as in classrooms with carpets, focusing on bioaerosols and other airborne contaminants, the impact of air contaminants on food within day care facilities.

Studies have shown that whenever outbreaks occur within a community, the attack rates tend to become much higher among employees and attendants of day care facilities and children cared for at day care facilities are at greater risk of contracting infections than those who do not attend day care. Day care facilities are vulnerable to foodborne illness outbreaks and cross contamination can easily occur when poor hygiene practices are practiced by caregivers who are involved in food preparation, nappy changing, serving and cleaning up after infants and young children.

A few studies have compared the presence of micro-organisms in rooms with carpets and in those without carpets in regards to indoor air quality and reported that carpets contribute to the presence and quantity of microorganisms in the air. Carpets provide a home to microorganisms than any other kind of flooring because the fibres that carpets are made up of trap allergens like mold and bacteria; and volatile organic compounds.

This study will be conducted by means of checklists, questionnaires. Collection of samples with appropriate instruments will be done in the kitchen(s) on food contact surfaces, non food contact surfaces, carpets and from classrooms. Samples will be taken to the laboratory for microbial and chemical analysis.

With this background in mind, may I therefore request a list of level one child day care facilities as registered by the Mangaung Metropolitan Municipality. I would also appreciate meeting with relevant officials to discuss the study in detail, as well as the time frame to conduct the study.

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APPENDIX B: CHECKLISTS AND QUESTIONERS USED FOR DATA COLLECTION DESCRIBED IN CHAPTER 2

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AN ASSESSMENT OF THE INFRASTRUCTURAL CONDITIONS, REGISTRATION STATUS OF AND THE REGULATORY KNOWLEDGE OF CHILDCARE PERSONNEL IN CHILDCARE FACILITIES

A questionnaire survey will be conducted by means personal interviews with childcare facility personnel at the childcare facilities that were selected to participate in the study. This survey will assess the hygiene status, food handling practices, hygiene practices, infant and toddler practices within the facility; as well as other aspects influencing such practices. A checklist will also be contacted to assess the conditions of the facilities.

CHECKLIST/ QUESTIONNAIRE

1. Name of day care facility?

   _____

2. Address and Location?

   _____

   _____

   _____

3. Person in charge?

   _____

4. Registration type?

Full registration	
Conditional registration	

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Other	

5. Valid health certificate?

Yes	
No	

6. Are the terms stated on the certificate still carried out?

Yes	
No	

Findings and comments:

7. How often do officials from the Department of Social development visit the facility?

Monthly	
Every three months (Quarterly)	
Every six months	
Once a year	
Other (Specify)	

8. How often do Environmental Health Practitioners visit the facility?

Monthly	
Every three months (Quarterly)	
Every six months	
Once a year	
Other (Specify)	

9. Are you aware of regulations and guidelines for childcare facilities

Yes	

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No	

10. How did you know about by-laws?

By who?	
How?	

11. Are you familiar with the contents of the regulations?

Yes	
No	

12. If you answered “yes” to the question above give a brief summary of the contents within the regulations and guidelines.

13. Have you received training regarding childcare guidelines and regulations

Yes	
No	

14. Additional findings and comments

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Infrastructure

Facility requirements	Available			Condition/State	Findings and observations
	Yes	No	NA		
Structure					
Walls, floors, ceilings, windows					
Toilets Facilities					
Hand wash facilities					
Kitchen					
Other					

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APPENDIX C: CHECKLISTS AND QUESTIONERS USED FOR DATA COLLECTION DESCRIBED IN CHAPTER 3

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AN ASSESSMENT OF THE KNOWLEDGE AND PRACTICE OF CHILDCARE EMPLOYEES IN THE FREE STATE

A questionnaire survey will be conducted by means personal interviews with childcare facility personnel at the childcare facilities that were selected to participate in the study. This survey will assess the hygiene status, food handling practices, hygiene practices, infant and toddler practices within the facility; as well as other aspects influencing such practices. A checklist will also be contacted to assess the conditions of the facilities.

CHECKLIST/ QUESTIONNAIRE

1. Name of day care facility?

_____

2. Age of facility?

_____

3. Address and Location?

_____

_____

_____

4. Person in charge?

_____

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5. Type of day care facility?

Level one	Level two	Level three	Level four

6. Profit or non-profit?

Profit	Non profit

7. Number of staff

_____

8. Number of children and age

Age Group	Number of children
0-2 years	
2-6 years	

Demographic Characteristics

1. Duties and responsibilities?

Owner	
Manager	
Teacher	
Cooking staff	
Serve children	
Feed children	
Cleaner	
Change nappies	
Potty train	

2. Gender?

Male	
Female	

3. Race?

Black	
White	
Coloured	
Indian	
Asian	

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4. Home language

English	
Afrikaans	
Vernacular	

5. Age?

18-25	
26-30	
31-35	
36-40	
40+	

6. What is the highest level of education you have completes?

No schooling completed	
Lower than grade 10/ Std 8	
Lower than matric/ Std 10	
Matric/ Std 10	
Higher education	

7. Working experience?

< 1 year	
1-5 years	
6-10 years	
11-20 years	
>20 years	

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Cleaning and disinfection of surfaces and equipments

Yes	No

1. Do you have a cleaning schedule/register?

2. How often do you clean and/or disinfect the following equipment and surfaces, method and type of product used?

2.1 Kitchen

a) How often do you clean kitchen surfaces?

Before preparing meals	
After preparing meals	
After using surface for different types of food	
Three times a day	
Twice a day	
Once a day	
Only when surfaces appear dirty	
Never	

b) Products and agents used?

Water only	
Water and detergent	
Water, detergent and disinfectant	

c) Method (s) used?

Scrub with detergent	
Scrub with disinfectant	
Scrub with detergent then disinfectant	
Wipe with wet dish cloth	
Wipe with detergent	
Wipe with disinfectant	
Wipe with detergent then disinfect	

a) How often are cooking surfaces such as stoves, ovens, toasters, microwaves, etc.?

After preparing meals	
Three times a day	
Twice a day	
Once a day	
Only when surfaces appear dirty	

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Never	

b) Products and agents used?

Water only	
Water and detergent	
Water, detergent and disinfectant	

c) Method(s) used?

Scrub with detergent	
Scrub with disinfectant	
Scrub with detergent then disinfectant	
Wipe with wet dish cloth	
Wipe with detergent	
Wipe with disinfectant	
Wipe with detergent then disinfect	

2.2 Diaper changing area

a) How often do you clean changing mats and surfaces?

Before and after changing toddler	
Only before changing toddler	
Only after changing toddler	
Only when surface and mat appears dirty	
Twice a day	
Once a day	
Never	

a) Products and agents used?

Water only	
Water and detergent	
Water, detergent and disinfectant	

b) Method(s) used?

Scrub with detergent	
Scrub with disinfectant	
Scrub with detergent then disinfectant	
Wipe with wet dish cloth	
Wipe with detergent	
Wipe with disinfectant	
Wipe with detergent then disinfect	

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2.3 Non disposable hand towels

a) How often do you change hand towels?

Monthly	
Every three months	
Every six months	
Once a year	
When its torn and worn out	
Never	

3. How often do you wash hand towels?

Daily	
Twice a week	
Once a week	
Once a month	
Less than once a month	
When they appear dirty only	
Hardly ever	

4. Method(s) used to wash hand towels?

Just rinse	
Wash in water only	
Wash in detergent	
Soak in detergent	
Soak in disinfectant	

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Food safety practices/general/personal hygiene

1. Kitchen N/A	YES		NO
Do you regularly clean all cooking surfaces, such as stoves, ovens, toasters, grills, and microwave ovens?			
Do you always clean and then sanitize food preparation surfaces after preparation is complete?			
Do you regularly clean areas where shelf-stable foods are stored?			
Do you change all cloth towels and dishcloths daily?			
Do you regularly wash the inside surfaces of your refrigerator?			
Do you routinely defrost and clean the inside of your freezer?			

2. Food Handling N/A	YES		NO
Do you always wash your hands thoroughly using soap and water:			
• before, during, and after food preparation?			
• before and after wiping tables?			
• before setting tables?			
• before and after assisting children at meal times?			
• after visiting the toilet?			
• after sneezing, coughing and blowing nose?			
• after toughing face or hair?			
• during handing raw and cooked food?			
Do you avoid preparing or handling food when you are sick?			
Do you wash your hands after you change diapers?			

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Do you wash your hands after you take children to the toilet?			
Do you always use a separate cutting board to prepare meat, fish, and poultry?			
Do you let milk or cooked food cool down first before placing it in the refrigerator?			
Do you use the same cutting board can be used for raw and cooked food			
Do you store raw food separately from cooked food?			

3. Appearance of food handlers	**YES**	**NO**	**N/A**
Hair covered during food preparation?			
Nails clean, kept short, no nail polish?			
Cuts on hands, skin lesions, wounds?			
****Cuts, wounds and lesions covered?			
Is jewellery worn during food preparation?			
Are aprons worn during food preparation?			

4. Infant and toddler practices	**YES**	**NO**	**N/A**
Do you always sterilize infant bottles before use?			
Do you sterilize all equipment that is needed for preparing infant formula?			
Do you always check the expiration dates on cans of infant formula?			
Do you always cover and refrigerate formula after it has been			

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prepared?			
Do you always use a formula that has been made from a powdered formula within 24 hours?			
Do you always discard partially consumed milk in bottles?			
Do you ask mothers to supply breast milk?			
Do you store breast milk in the refrigerator?			

5. Diaper changing	**YES**	**NO**	**N/A**
Person protective equipment worn during changing?			
Hand wash basin provided within the area?			
How do you dispose of soiled diapers?			

6. Children's Eating Practices	**YES**	**NO**	**N/A**
Do children wash their hands before meals and snacks?			
Do you always discard uneaten portions of food?			
Do children share food, cups, plates, or utensils?			
Do children use serving trays?			
Do children share eating utensils?			
Where do children sit when they eat?			

7. What do you think causes food poisoning?	**YES**	**NO**	**N/A**
Bacteria?			
Contaminated food?			
Hands not washed?			

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Cross contamination between raw and cooked foods?			
Dirty equipment and utensils?			
Food items not cooked properly?			
Improper storage of perishable foods?			
Poor hygiene practices?			
Food stored for too long?			
Contact with pests such as flies, cockroaches, rodents?			
Leftovers not reheated properly?			
Contaminated water?			
Don't know?			

Pest control

1. How often do you encounter one or more of the following?

	Daily	Weekly	Monthly	Seasonally	Annually	Never
Rats and Mice						
Flies						
Cockroaches						
Other **Specify** **----------**						

2. What pest control method do you utilize in this facility and how often?

_____
_____
_____
_____

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Carpets

1. Carpets or mats?

_____

2. How long have you had the carpet/mat?

More than a week	More than a month	More than six months	More than a year	More than a year +

Yes	No

3. Do children eat carpets/mats?.....
4. Do children play on the carpets/mats?.....
5. Do children sleep on carpets/mats?.....

6. Method of cleaning carpets?

Sweep	Vacuum	Shampoo

7. How often to you sweep carpets/mats?

Daily	Twice to three times a week	Once every two weeks	Once a month	Less than once a month

8. How often do you vacuum carpets/mats?

Daily	Twice to three times a week	Once every two weeks	Once a month	Less than once a month

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How often do you shampoo carpets/mats?

Once every two weeks	Once a month	Less than once a month

Training

1. Have you had any formal training on personal or general hygiene?

If yes, give details

_____

_____

_____

_____

	Yes	No
2. Do you feel that the formal training that you received is adequate?		

3. Do staff members receive first aid training?.....		

4. If yes, how long was the training?

5. Form of training?

Workshop	Seminar	Health institution	Other

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