# FACTORS OF FOODBORNE DIARRHEA IN CHILDREN UNDER 5 YEARS OF AGE IN MARRACUENE AND KAMAXAQUENI DISTRICTS, MAPUTO-MOZAMBIQUE

**Student name:** Nórgia Elsa Machava

**Student number:** 19406429

Submitted in fulfilment of the requirements for the degree Doctor of Philosophy in Nursing Science

In the

Department of Nursing Sciences

School of Health Care Sciences

Faculty of Health Sciences

University of Pretoria

**Supervisor:** Prof. FM. Mulaudzi

**Co-supervisor:** Prof. E. Salvador

**Date:** August, 2023

## DECLARATION

I, **Nórgia Elsa Machava,** declares that this thesis, ***"Factors of foodborne diarrhea in children under five years of age in Marracuene and Kamaxaqueni districts, Maputo Mozambique***", is my original work. It was not submitted to any other institution prior to any degree or examination. All sources used and quoted are acknowledged by means of complete references in the text and bibliography.

Signature: Nórgia Elsa Machava

Date: 25.08.2023

## DEDICATION

I dedicate this study to my mother and beloved husband, without constant support; this thesis should not have been possible. At the same time, my thanks go to my children, who always inspired me.

## ACKNOWLEDGEMENT

My gratitude and appreciation go to God for his protection and direction throughout my studies. I would like to extend my profound thanks to the people and institutions who contributed to the success of this achievement.

- My husband, Aurelio Elias Salomão, for his unconditional love, encouragement, and support.
- My sons, Aren, Elon and Elad, for their support and understanding.
- Special thanks to my supervisor Prof. F. Mulaudzi, for her guidance, support, and encouragement. My co-supervisor, Prof. E. Salvador, for all the teachings, assistance, support, love, and encouragement, and for always making me feel good through positive input in my life and career.
- My colleagues, for their contributions to our online classroom.
- Marracuene and Kamaxaqueni District Health Services for their acceptance of the study and the support provided during the research period.
- Eduardo Mondlane University for the scholarship.
- The Bill and Melinda Gates Foundation for the financial support.
- The Instituto Superior de Ciências de Saúde (ISCISA) allowed me to attend this study.
- The mothers and caregivers of the children who participated in the research, health workers, and community leaders who supported data collection.
- Mrs Lúcia Jamo for language editing.
- Mr Mambo for data Analysis.
- To all who directly or indirectly contributed to the study.

Thank you all, many thanks for your suggestion.

## ABSTRACT

**Introduction:** Several foodborne diarrhea factors coexist. Prevention, diagnosis, and treatment of diarrhea are considered easy. This study investigated the factors associated with foodborne diarrhea and developed a local strategy for preventive measures against foodborne diarrhea in children under five years.

**Methods:** The multiphase method was used. This study was divided into three phases. A quantitative method was utilized in Phase 1 to assess practices implemented by health professionals in the diagnosis and treatment of foodborne diarrhea, and a retrospective study was conducted using data from four referral health facilities from 2015 to 2019. All data regarding age, sex, signs and symptoms, diagnosis, and treatment were collected. In Phase Two, the study explored and described the household factors of foodborne diarrhea. Three hundred children, accompanied by mothers or caregivers, participated in the study, and the data were descriptively and mathematically analyzed using Epi Info modelling. In Phase Three, a local strategy to prevent foodborne diarrhea was developed using a Nominal Group Technique (NGT) telephonically invited stakeholders. Sixteen stakeholders from rural areas and 15 stakeholders from urban areas participated in this study.

**Findings:** 9,041 cases were found in the retrospective study, of which 4,052 (44 8%) were female, and urban areas accounted for 7,668 (74.8%). Considering the age, children younger than six months, 1,013 (11.2%); from 6 to 11 months, 1,370 (15.2%); from 12 to 23 months, 2,535 (28%); from 24 to 35 months, 1,674 (18.5%), from 36 to 47 months 1,239 (13.7%) and from 48 to 59 months 1,210 (13.4%). Approximately 3,644 (40.3%) had a fever, 3,467 (38%) vomited, 1,999 (22%) blood in stool, and other symptoms; only 5 (1%) of the children's stools were submitted for laboratory analysis. The clinical diagnoses were diarrhea 3,905 (43%), diarrhea and vomiting 2,037(22%), and others. The primary treatments were oral rehydration salts, 7,118 (79%) and 21% antibiotics. In Phase Two, caregivers

mainly were female in both rural and urban areas 93.3% and 84%, respectively); they were aged between 18 and 38 years; children with diarrhea according to age; under six months of age, 23.3% in rural areas and 16.6% in urban; between 12 and 23 in urban areas, 36.6% and 30% in rural had diarrhea, urban relatives had similar symptoms before the child became ill were 12.6% rural and 13.3% urban). Before medical assistance, the children were treated with traditional medication in 51.3% rural, 16% rural, urban areas; water before drinking was not treated in 48% of rural and 45.3% of urban. Infants in urban areas, 24.6%) and 12.6 % in rural areas use feeding bottles. In Phase 3, 31 stakeholders participated in the NGT discussion, 16 in rural areas and 15 in urban areas. Among the 17 preventive measures for foodborne diarrhea, ten were elected, which compose the local strategy. It was observed that stakeholders bet on hand washing as the principal measure to prevent foodborne diarrhea and the need to always observe hygiene practices during the handling and care of children.

**Conclusion and Recommendations:** Children with diarrhea were treated with antibiotics, without screening for etiological agents. The main factors associated with foodborne diarrhea were the use of traditional medications in rural areas, whereas bottle feeding and inappropriate water consumption were noted. In designing a strategy for preventive measures, it is important to involve stakeholders and consider their beliefs to be effective. Ten preventive measures for foodborne diarrhea were identified as priorities and were composed of the local strategy: hand washing and good hygienic practices by mothers or caregivers were bet up as fundamental to prevent diseases, including foodborne diarrheal diseases. It is recommended that agents be screened before the administration of antibiotics to develop a mitigation plan for the main factors found in the present study. Stakeholders should implement the strategy of preventive measures developed in the present study, and a future study should be conducted to assess the impact of the strategy within the community.

**Keywords:** Children, diarrhea, factors, foodborne.

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# LIST OF ABBREVIATIONS

| Abbreviation /acronym | Meaning |
|---|---|
| CDC | Centre for Disease Control and Prevention |
| DALYs | Disability-adjusted life years |
| DDC | Diarrheal Diseases Collaborators |
| FAO | Food and Agriculture Organization |
| FDA | Food and Drug Administration |
| HIV | Human Immunodeficiency Viruses |
| IADS | Acquired Immune Deficiency Syndrome |
| INE | Instituto Nacional de Estatística |
| MDKM | Municipality District of KaMaxaqueni |
| MISAU | Ministry of Health Mozambique |
| NGT | Nominal Group Technique |
| ORL | Oral rehydration salts |
| SPSS | Statistical Package for the Social Sciences |
| ToC | Theory of Change |
| TRIPLE A CYCLE | Triple Action Cycle |
| UN-Habitat | United Nations Human Settlements Programme |
| UNICEF | United Nations Children's Fund |
| USAID | United States Agency for International Development |
| WHO | Word Health Organization |

# CHAPTER ONE

# INTRODUCTION, BACKGROUND AND OUTLINE OF METHODS

## 1.1 INTRODUCTION

This chapter introduces the concept of foodborne diarrhea, the background, problem statement, research questions, aims, and research objectives of the study. It clarifies the main concepts, significance of the research, brief overview of the research methodology, outline of the thesis, summary, and a list of references.

Foodborne diseases occur when food is contaminated with pathogens such as bacteria, viruses, parasites, and poisonous (chemicals or biotoxins) consumed (WHO, 2012; Torgerson, 2014). However, foodborne diseases are closely related to water contaminated with dangerous substances, which means that foodborne and waterborne diseases are related because water is the main ingredient in all stages of the food chain (WHO, 2015). Both foodborne and waterborne diseases are characterized by gastrointestinal signs and symptoms such as diarrhea and vomiting, which are the most common causes of morbidity and mortality in children, particularly in developing countries (Osei-Tutu & Anto, 2016).

In Mozambique, the main risk factors for foodborne diarrhea include practices related to personal hygiene, inappropriate food preparation, contaminated utensils (FDA, 2018), lack of clean water, deprived sanitation conditions, and inadequate infrastructure (UN-Habitat, 2014; WHO/UNICEF, 2017).

Diarrheal diseases are considered to be a public health concern around the world (Milles, 2014); annually, the World Health Organization (WHO) report about 4.6 million cases of diarrhea around the world (Pires *et al*., 2015); according to the DDC Diarrheal Diseases Collaborators (2017) 1.3 million deaths per year are due

to diarrheal diseases, the situation is severe in Africa and Asia, where more than 25% of children under five years die because of diarrhea (Naghavi *et al.*, 2017). In Mozambique, diarrheal diseases account for 20% of hospital admissions, ranking in the fourth position for mortality in rural areas (INE, 2018), and are also considered the sixth cause of death in children under five throughout the country (WHO, 2015).

Diarrheal diseases in children are common in places contaminated with fecal material. The causative pathogens are called enteric pathogens, as they can be found in the enteric tracts of humans and animals. Carriers eliminate pathogens, such as bacteria, viruses, and protozoa, in the environment through feces (Knee *et al.*, 2018). Pathways of pathogens are fecal-oral (de Graaf *et al.*, 2017) when individuals consume contaminated food and water or interact with the contaminated environment (Berendes *et al.*, 2017). The pathways and risk factors of diarrheal diseases are complex. Generally, in health facilities, diarrheal infections are treated without the diagnosis of the agent. This means that health professionals rely on symptoms rather than confirmation of the diagnosis by laboratory testing (Arendt *et al.*, 2013). The present study investigated the factors of foodborne diarrhea and developed a household and community strategy for preventive measures against diarrhea in children younger than five years of age in the Marracuene and Kamaxaqueni Districts of Maputo, Mozambique.

## 1.2 PROBLEM STATEMENT

Exposure to contaminated food can lead to illnesses. Globally, contaminated food has caused approximately 600 million cases of diseases, 420 000 deaths, and 33 million disability-adjusted life years (DALYs) (WHO, 2015). Among all age groups, the diarrheal load due to contaminated food is the highest in African countries (Kirk *at al*., 2015). According to ONU News (2019), in Mozambique, more than 500 000 cases of illnesses caused by the consumption of unsafe food have been reported;

the illnesses pointed out are dysentery (100 000) and 7 000 cases of cholera, corresponding to 5.5% of notified cases in the whole country.

Contaminated food carries diarrheal pathogens such as bacteria, viruses, and protozoa. Hald *at al*. (2016) reported about 11 microbial agents related to foodborne diarrhea. Recurrent exposure to microbial agents in food results in a high incidence of diarrhea and asymptomatic gut infections in children (Shariati et al., 2019). Diarrhea is the main cause of foodborne diseases. In 2010, contaminated food was responsible for 4.6 million cases of diarrheal infections resulting in 1.6 million deaths (Pires *et al*., 2015). The consequences of foodborne diarrhea include debilitating symptoms, enteropathies, intestinal diseases, malnutrition, and growth stunting (Cumming *et al*., 2020; Black and Walker, 2020).

The critical moment of foodborne diarrhea in Mozambique is during the flood season due to poor water sanitation and hygiene; the outbreak of cholera characterizes this season. At this critical moment, health authorities are concerned about diarrheal diseases and intensify health promotion activities related to hygiene and water sanitation to address foodborne diarrheal diseases (Alex, 2018).

Foodborne diseases are a public health and economic concern worldwide, mainly in children under five years (Havelaar *et al.*, 2015; Osei-Tutu and Anto, 2016). According to WHO (2015), children under five years account for 9% of the world population and are committed to 40% of the load of foodborne diseases, resulting in 30% of deaths. Approximately 75% of deaths in developing countries (Havelaar *et al*., 2015; Liu *et al*., 2016); in Africa, approximately 700 000 people of all ages die annually due to diarrheal diseases related to contaminated food (WHO, 2015). Foodborne diseases are typically associated with poor and young people (Oloruntoba *et al*., 2014; Scharf *et al*., 2014) due to unsafe food and water. They are also associated with food insecurity, nutrition, and wastage. Undernourished young people living in unsafe environments, such as those contaminated with fecal

material, are at a high risk of acquiring foodborne diarrhea, which affects health and wellbeing (WHO, 2015).

From 1997 to 2017, approximately 7 million cases of diarrhea were reported in Mozambique (USAID, 2017). The National Inspection of Economic Activities closed 20 food institutions in 2017 because of poor hygiene conditions (Folha de Maputo, 2017). Mozambique is a low-income country with more than 28 million inhabitants and a population density of 36.1 inhabitants/km$^2$ (INE, 2019). Approximately 64.8% of the total population lives in rural areas and 16.4% of the total population comprises children under five (INE, 2016). The country is characterized by deprived sanitary conditions and poor infrastructure associated with natural annual seasonal droughts and floods (Nhampossa *et al.*, 2013; WHO and UNICEF, 2017). Within this population, there is limited knowledge and perception of food safety. Studies conducted in South Africa (Cape Peninsula University of Technology) and Riyadh (Saudi Arabia) indicated a low-level risk perception of foodborne diarrhea among females and improper food safety practices in terms of its prevention (du Toit & Venter, 2005; Alsayeqh, 2015).

In Mozambique, foodborne diarrheal diseases are important during the rainy season due to cholera outbreaks. The country does not permanently prioritize surveillance and mitigation strategies. It is well known that the prevention and control of foodborne diarrhea are complex because of co-factors intervening in transmission. Each factor contributes differentially to the transmission of diseases, depending on the route, source, and geographic region (Hald *et al.,* 2016). The present study investigated the factors of foodborne diarrhea and developed a household- and community-level strategy of preventive measures for diarrhea in children younger than five years of age in the Kamaxaqueni and Marracuene Districts of Maputo, Mozambique.

## 1.3 RESEARCH QUESTION(S), AIM AND OBJECTIVES

*Table 1.. Research Question(S), Aim and Objectives*

| | |
|---|---|
| **Research aim:** To investigate the factors of foodborne diarrhea and develop a strategy at household and community levels for preventive measures of foodborne diarrhea in children younger than five years of age in Kamaxaqueni and Marracuene Districts of Maputo, Mozambique. | |
| **Phase 1 (Quantitative): Professionals of health diagnose foodborne diarrhea in children younger than five years of age.** | |
| **Research question** | How do health professionals diagnose foodborne diarrhea in children younger than five? |
| **Research objective** | To assess the practices of diagnosing foodborne diarrhea in children under the age of 5 implemented at referral health facilities in Maputo. |
| **Phase 2 (Quantitative): Household factors for the origin of foodborne diarrhea in children younger than five years of age.** | |
| **Research question** | What are the household factors for the origin of foodborne diarrhea in children younger than five years? |
| **Research objective** | To explore and describe the household factors for the origin of foodborne diarrhea in children younger than five years. |
| **Phase 3 (Qualitative NGT): Development of strategy** | |
| **Research question** | What strategy should be developed at household and community levels for preventive measures of foodborne diarrhea in children younger than five years of age in the Kamaxaqueni and Marracuene Districts of Maputo, Mozambique? |
| **Research objective** | To develop household and community level strategies for preventive measures of foodborne diarrhea that can be implemented by children food preparers/handlers. |

## 1.4 OPERATIONAL DEFINITIONS

**Child** is any person under the age of 18 (UNICEF, 1998).

**Children under five years of age** are younger than five years (UNICEF, 1998).

**Diarrhea** is characterized by the loss of liquid stools more than three times daily (Morais *et al*., 2013; WHO, 2015).

**Diagnosis** involves determining the nature of the disease by observing its symptoms and signs (Oxford, 1993).

**Foodborne disease** are caused by the consumption of contaminated foods or drinks (Dewey-Mattia *at al.,* 2018). Contaminated foods and drinks enter the gastrointestinal system and cause foodborne diseases. The main symptom is diarrhea; in this case, diarrhea is considered a foodborne disease.

**Food Safety** is a practice related to preparing, making, and storing food in the best form to decrease the risk of personal health and the risk of people becoming sick from foodborne diseases (Australian Institute of Food Safety, 2020). To achieve food safety, handlers and consumers should consider five important factors (WHO 2019).

1. Keep clean;
2. Separate raw and cooked;
3. Cook thoroughly;
4. Keep food at safe temperatures;
5. Use safe water and raw materials.

**Factor** are among several issues that affect or influence a situation (Oxford, 1993).

**Strategy** is a plan to achieve something or reach a goal (Oxford, 1993).

## 1.5 SIGNIFICANCE

In general, the present study showed evidence of the health effects of diarrheal infections in children under the age of the household and the community. This study contributes to the knowledge of the causes, sources, and contributing factors of foodborne diarrhea. Health professionals (nurses, doctors, and health technicians), researchers, and policymakers can use these results to prepare guidelines to avoid exposure to foodborne diarrheal diseases. This evidence can be used by health providers and food safety decision-makers to implement preventive and control strategies for critical factors in foodborne diarrhea.

**• To research**

This study could assist researchers in developing guidelines for foodborne diarrhea in Mozambique, and contribute to the knowledge and understanding of the healthcare needs of children with diarrhea. These findings could provide options for future research on the implementation of holistic health care interventions for the diagnosis of diarrhea.

**• To nursing Practice**

These findings could promote general health and nursing care. Healthcare providers and nurses who implement the guidelines in practice will prevent, diagnose, and treat children with diarrhea not only attend to meet their biomedical needs.

**•To policy Development**

The findings of this study could assist government and non-governmental organizations in developing policies, strategies, and guidelines on healthcare interventions for managing children with diarrhea.

## 1.6 OUTLINE OF METHODS

### 1.6.1 Context

The study was conducted in two Districts of Maputo: one in an urban area, the Municipality District of KaMaxaqueni (MDKM), and the other in a rural area, the Marracuene District. Figures 1, 2, 3, 4, 5, and 6 illustrate in detail from the African point of view Mozambique, the provinces, and districts where the study occurred.

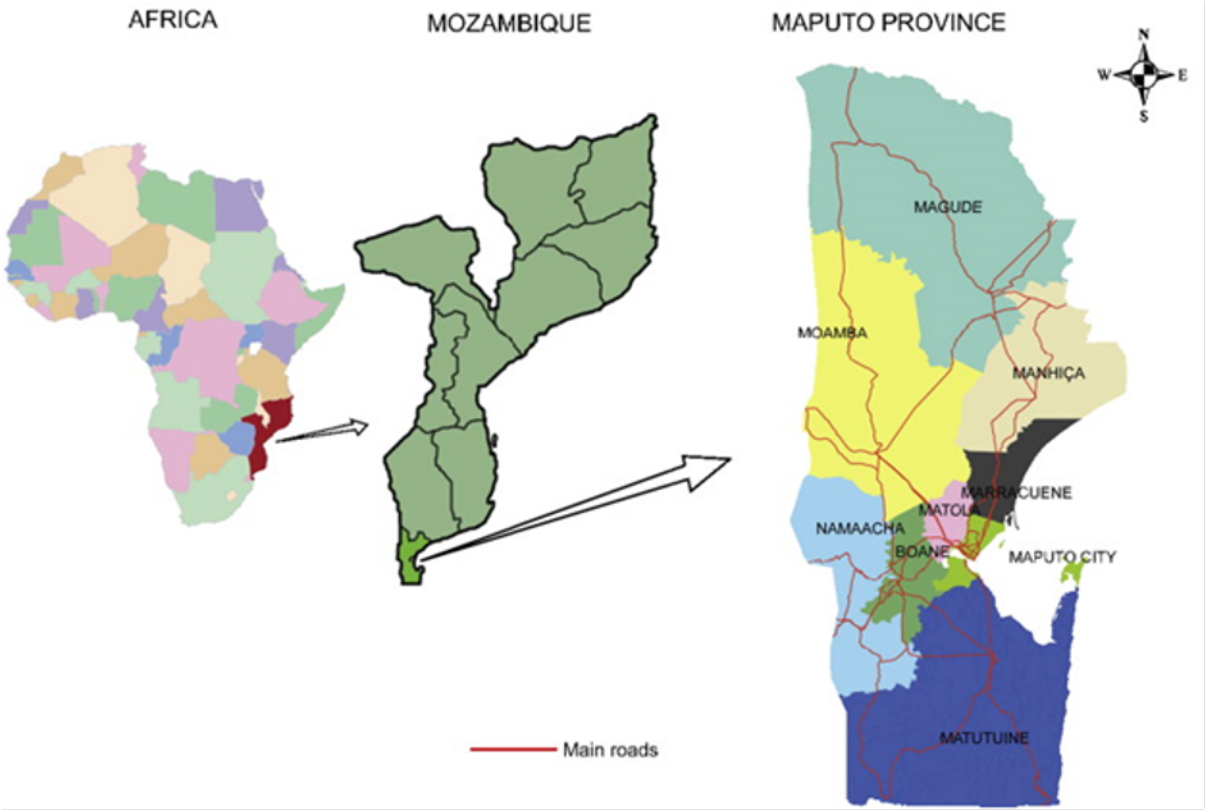


*Figure 1. Africa, Mozambique and Maputo Maps*

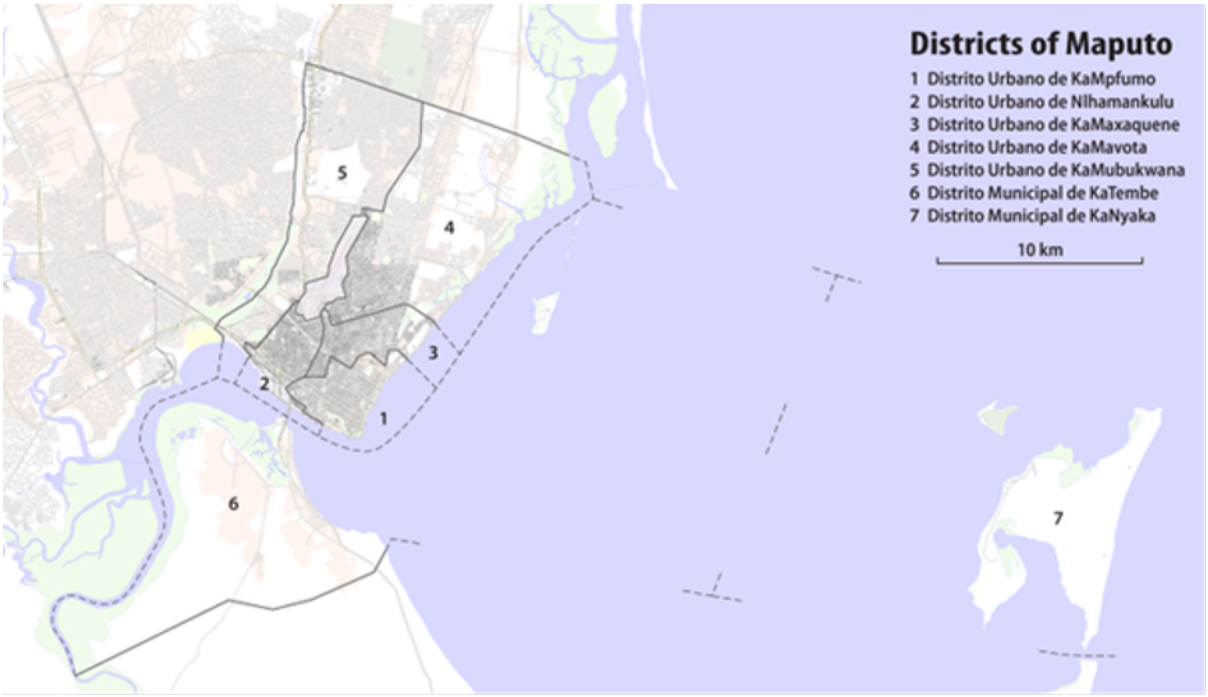


*Figure 2. Kamaxaqueni District Map*

https://pt.wikipedia.org/wiki/Maputo

Figure 3. Urban settings in Kamaxaqueni area, Maputo

http://www.pierofumo.com/portfolioitem/polana-canico/

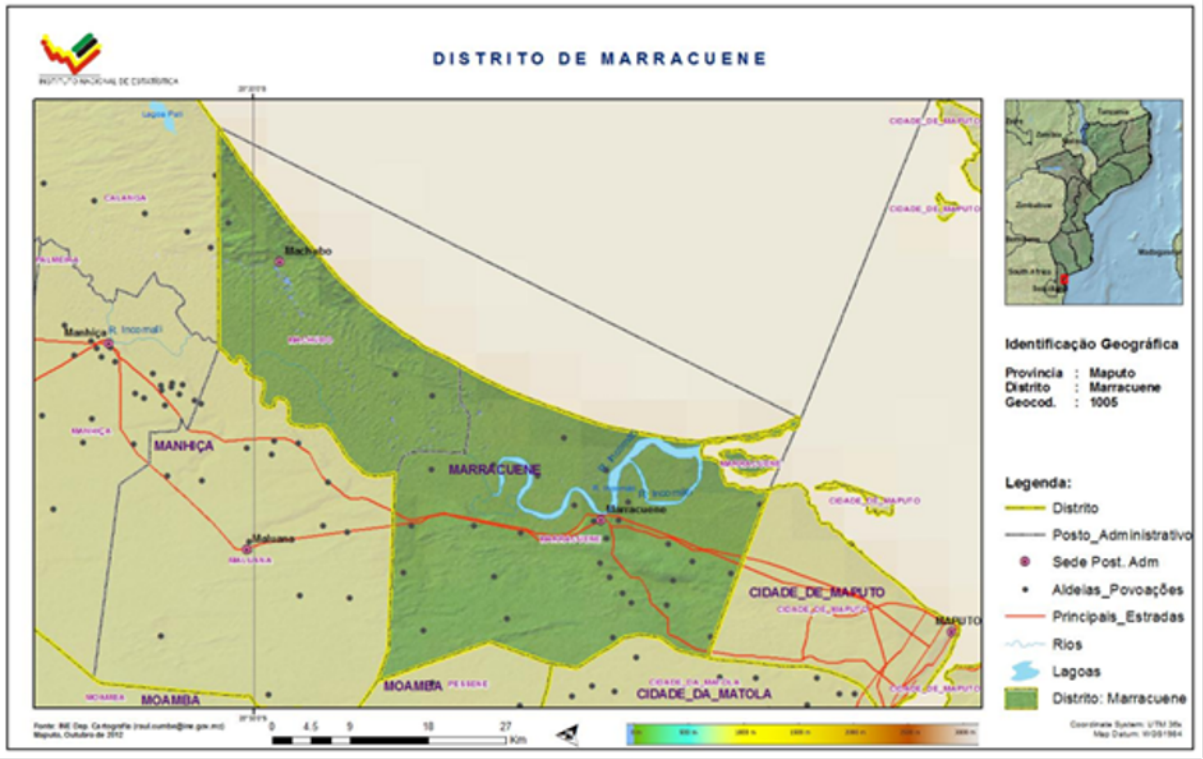


*Figure 4 Marracuene District*

*Figure 5. Rural setting in Marracuene, Maputo*

Kamaxaqueni and Marracuene Districts were chosen because they are the main study areas of the FOCAL project and sponsors of the researcher. Districts were selected because of accessibility and financial issues. Kamaxaqueni is a District of Maputo City (25°58 s, 32°35'E). According to the Census 2017, approximately 41 746 households corresponding to a population of 203 660 inhabitants. Children below five years of age are estimated to be 10.3% of the total population (INE, 2017). The City has an elevation above the mean sea level of 47 m, an average temperature of 22.7oC (range 18.5 – 26.2$^{o}$C), and an average monthly rainfall of 65 mm (range 15 – 160 mm), with the wettest month being January. 84.3% Of the households lived in improved houses; the remaining houses were made of poor materials. 52.7% of households had channelled water, 43.5% from public fountains, and 3.8% used water from other sources, such as open wells, covered wells, and rainwater. Sixteen% of the households used unimproved latrines and 0.5% of the households did not have latrines.

The Primeiro de Maio Health Center is located in Kamaxaqueni District. The cases in this study were captured in a healthcare facility. This health center provides the following services: delivery, vaccination, maternal and child health consultations, external consultations, and stomatology consultations. The health center provides services to the population of the neighborhoods and the entire Kamaxaqueni Municipality district due to the transformation of the Polana Caniço Health Center into a Management Hospital for COVID-19.

Marracuene (25 °44'S, 32o41'E) is a District of Maputo Province located in the northern part of the province, with an area of 697 km$^2$. The population was estimated to be 230,530, corresponding to 59,366 households. The population density in 2017 was estimated at 218.8 inhabitants/km$^2$, and the population of children younger than five years of age was approximately 12.7% of the District's total population (INE 2019). The area has an elevation above the mean sea level of 14 m, an average temperature of 23.5$^{o}$C (range 19.6 – 26.5$^{o}$C), and an average monthly rainfall of 67 mm (range 18 – 138 mm), with the wettest month being January. Regarding house building materials, 48.2% of the households lived in

improved houses, and the remainder were poor. Approximately 60% of households consume water from unsafe sources such as wells, rivers, and rain water. 47.6% of households used unimproved latrines and 13.3% did not use latrines.

Cases from rural areas were captured at the Marracuene Healthcare Center, a rural hospital with primary healthcare services located in the Marracuene District in the Eastern part of Maputo City. Around 12 000 people with several illnesses were treated at this hospital. Malaria is a major disease that has previously been identified. However, many other services and programs are also offered, including diarrheal diseases, HIV/AIDS, sexually transmitted infections, natal care, family plans, and non-communicable diseases (diabetes and high blood pressure).

### 1.6.2 Methodology

The research design includes an overall proposal to answer the research question (Polit and Beck, 2017). In this study, we used a multiphase method (quantitative and qualitative).

Mixed Methodology is a research procedure in which the researcher performs two or more quantitative or qualitative (Morse and Niehaus 2016). Quantitative and qualitative procedures allow researchers to combine intent and/or research questions with methods (Morgan, 2014). Mixed methods can be classified into several categories: This study uses an explanatory sequential mixed-method design. First, qualitative data were collected to provide relevant information to understand the research problem. Qualitative methods were used, based on the findings of the quantitative method (Creswell, 2012). For phases one and two of this study, quantitative data were collected to assess, explore, and understand the factors of foodborne diarrheal infections in children under five. In Phase One, the assessment was conducted based on retrospective data, whereas in Phase Two, exploration and understanding were conducted based on an action survey in which a structured questionnaire was implemented. Phase 3 used the findings from

phases one and two to develop the household and community strategy, where the Nominal Group Technique was used. The details of the study methodology for each phase are found in Chapters Three, Four, and Five of this thesis. Table 2 summarizes the three phases of the study and Table 3 presents the data collection organization for each phase.

*Table 2. Summary of the research design and methods*

| ***Phase*** | ***Phase I*** | ***Phase II*** | ***Phase III*** |
|---|---|---|---|
| ***Research question*** | *How do health professionals diagnose foodborne diarrhea in children younger than five years?* | *What are the household factors for the origin of foodborne diarrhea in children younger than five years?* | *What strategy should be developed at household and community levels for preventive measures of foodborne diarrhoea in children younger than five years of age in Kamaxaqueni and Marracuene of Maputo, Mozambique?* |
| ***Objective*** | *To assess the practices of diagnosis of foodborne diarrhea in children under five implemented at referral health facilities in Maputo* | *To explore and describe the household factors for the origin of foodborne diarrhea in children younger than five years.* | *To develop household and community-level strategies of food safety preventive measures for foodborne diarrhea that can be implemented by children's food preparers/handlers.* |
| ***Method*** | *Retrospective study* | *Quantitative method* | *Nominal Group Technique (NGT)* |
| ***Population*** | *Children under five years of age with cases of diarrhea infection reported at the health facilities' record books* | *Mothers/caretakers accompanying a child under five* | *Main stakeholders (health professionals, mothers/ caretakers and community leaders)* |
| ***Sampling*** | *All records with cases of diarrhea infections found in the study period* | *300 children and caregivers participated in the study* | *40 individuals* |
| ***Data collection*** | *Record bocks* | *Face-to-face interviews* | *Nominal Group Technique (NGT)* |
| ***Data analyse*** | *Descriptive statistics* | *A descriptive analysis* | *Open coding of data analysis of consensus rate* |

### 1.6.2.1 Data Collection and Organization

*Table 3. Data collection and organization*

| Objective | Variable | | Method | Observation | | Instrument of collected data |
|---|---|---|---|---|---|---|
| | Independent | Dependent | | How | Why | |
| 1 | Age, gender, local of residence; | Type of diarrhea, symptoms (e.g., diarrhea, vomiting), duration of diarrhea, type of treatment, diagnosis. | Quantitative | Retrospective data of a period of 5 years based on a record book. | To identify the foodborne diarrhoea problem. | Data collection form<br><br>Annexure A1 |
| 2 | Age of child, caregiver- Socio-economic demographic factors including occupation - Location (rural/urban; countryside/village/town/city) | Incidence and prevalence of diarrhea among children - Incidence and prevalence of diarrhea among caretakers - Proportion of children with diarrhea - Presence/absence or state of potential factors as indicated by the data collected in the questionnaire or during the household visit: - Vaccination and medical treatment, Co-infections - Symptoms related to the diarrheal disease event - Contact with other potential cases - Food consumption - Food purchases - Food preparation practices - Contact with animals - Drinking water sources - Contact with water - Sanitary and living conditions | Quantitative | Source attribution questionnaire | To explore the problem and understand the role of foodborne diarrhea | Semi-structured questionnaire<br><br>Annexure A2 |
| 3 | Local of residence, occupation, age | Preventive measure of diarrhea, type of food for children according to age. | Qualitative | NGT | To develop the household and community strategy | NGT discussion guide<br><br>Annexure A3 |
| Observe | The instruments of data collection (objectives 1 and 2) were adapted from the FOCAL project. For objective three they were created by the principal investigator. | | | | | |

### 1.6.3 Ethical Considerations

The proposal for the present study was submitted to the University of Pretoria Ethical Committee for Health, with legal and ethical considerations before the commencement of the study, and the research started only after clearance from the health authorities. All ethical principles were followed, including those of beneficence, respect for human dignity, and justice. According to the principle of beneficence, study participants should not be harmed physically, and in the case of observed harm during the study, the investigator should prioritize and remove the embarrassment caused to the participant during the study. All the participants voluntarily participated in the study regarding their respect for human dignity. None of the participants was forced or free to abandon the study, even after signing an informed consent form. Participants were allowed to ask questions and clarify whether they needed clarification. The investigator ensured that no discrimination occurred during the study period. To follow the principle of justice, all participants were part of the study by fulfilling all inclusion criteria. None of the participants were excluded if they refused to participate in the study. The investigator ensured confidentiality and guaranteed the use of the information only for the study. However, because of the study type, it was not possible to secure anonymity for the entire study as it was also composed of steps requiring direct contact with the participants. In this case, the names would not appear and codes were used instead of names.

All study participants were informed about the purpose, objectives, and right to participate in the surveillance activities (see “Participant information sheet and informed voluntary consent” attached to appendices D and E). At the beginning of the research, all concerned organizations (administration, health offices, and local leaders) were informed about the research and permission was secured. Informed, voluntary written and signed consent was obtained from all participants in the study or their guardians/caretakers. Confidentiality of the data was assured by electronic data storage using tablets in the field. All the data were transferred to a password-protected database. Only the principal investigator had access to the

identifiable personal information. The data shared with other researchers within the study were anonymized. The participants' privacy, confidentiality, and data security were maintained throughout the study period. Data assistants and other investigators handling individually identifiable information were required to sign a data use and confidentiality agreement.

## 1.7 CHAPTER OUTLINE

This thesis follows a thesis-by-manuscript format. The remainder of this paper is organized as follows.

**Section A**

Section A will comprise chapters 1 and 2

- Chapter 1 includes the introduction, background, research aims, objectives, and an outline of the research design and methods.
- Chapter 2: will entail the Literature review and theoretical framework

**Section B**

Section B will include the Manuscripts

- Chapter 3: Phase I: Assessment of diagnosis and treatment practices for foodborne diarrhea in children under five years of age in Maputo-Mozambique (published manuscript)
- Chapter 4: Phase II - Household factors for foodborne diarrhea in children under five in two districts of Maputo, Mozambique (published manuscript)
- Chapter 5: Phase II -Household and community strategy for preventive measures of foodborne diarrhea in children under five in two districts of Maputo, Mozambique (draft manuscript)

**Section C**

It will be comprised of the conclusions of the study and recommendations

- Chapter 6: Conclusion and recommendations

## 1.8 SUMMARY

This chapter briefs readers about foodborne diarrhea, the primary factors and concerns about foodborne diarrhea, the magnitude of the disease around the world in African countries, particularly in Mozambique, and the need for foodborne diarrhea. The background briefly discusses the primary knowledge of foodborne diarrhea, the rationale for the problem, the problem statement, and the significance of the study, where all together catch-up concerns and importance of foodborne diarrhea, the impact of the well-known and intervention, and the socioeconomic well-being of the communities and children under five years of age in particular. The purpose of this study was to demonstrate the contribution of this research to different segments of society. The research objectives were what the researcher proposed to achieve, the research methodology used to show how the study was conducted, the ethical considerations guiding the study, and an outline of the thesis. The theoretical framework for the study and the literature review are discussed in Section 2.

## 1.9 REFERENCES

Alex, T. 2018. *Theoretical modelling of temperature and rainfall influence on Schistosoma species population dynamics*. Master's dissertation. Available at: uzspace.unizulu.ac.za. (Accessed: June 6/6 2020).

Alsayeqh, A. 2015. Foodborne disease risk factors among women in Riyadh, Saudi Arabia. *Food Control*, 50:85-91**:** doi: 10.1016/j.foodcont.2014.08.036.

Arendt, S, Rajagopal, L, Strohbehn, C, Stokes, N, Meyer, J & Mandernach, S. 2013. Reporting of foodborne illnesses by U.S. consumers and healthcare professionals. *International Journal of Environmental Research and Public Health*, 10(8):3684-3714. doi: 10.3390/ijerph10083684.

Australian Institute of Food Safety. 2020. What is food safety? Available at: https://www.foodsafety.com.au/blog/what-is-food-safety. Accessed August 10, 2020.

Berendes, D, Leon, J., Kirby A.Clennon, J., Raj, S., Yakubu, H., Robb, K., Kartikeyan, A., Hemavathy, P., Gunasekaran, A., Roy, S., Ghale, B.C., Kumar, J.S., Mohan, V.R., Kang, G.,· Moe, C. 2017. ousehold sanitation was associated with a lower risk of bacterial and protozoal enteric infections, but not viral infections and diarrhea in a cohort study in a low-income urban neighborhood in Vellore. *India Tropical Medicine and International Health.* 22(9):1119-1129. *doi*, 10.1111/tmi.12915.

Black, R. E., Walker, C. F. 2020. Do Water, Sanitation, and Hygiene Interventions Prevent Childhood Diarrhea? *The Journal of Infectious Diseases* 221:1241-243

CDC Diarrheal Disease Collaborators. 2017. Global, regional, and national morbidity, mortality, and etiologies of diarrheal diseases: A systematic analysis for the Global Burden of Disease Study. Lancet Infect Disease 17:909–948.

Creswell, J. W. (2012). Educational research: Planning, conducting, and evaluating quantitative and qualitative research. (4th Ed.). Boston, MA: Pearson.

Cumming, O., Arnold, B. F., Ban, R., Clasen, T., Mills, J. E., Freeman, M. C., Bruce Gordon, B., Guiteras, R., Howard, G., Hunter, P. R., Johnston, R. B., Pickering, A. J., Prendergast, A. J., Prüss-Ustün, A., Rosenboom, A. W., Spears, D., Sundberg, S., Wolf, J., Null, C., Luby, S. P., Humphrey, J. H., Colford Jr., JM. 2020. The implications of three major new trials for the effect of water, sanitation, and hygiene on childhood diarrhea and stunting: A consensus statement. *BMC Medicine* 17:173 https://doi.org/10.1186/s12916-019-1410-x.

de Graaf, M., Beck, R., Caccio, S.M., Duim, B., Fraaij, P., Le Guyader, F.S., Lecuit, M., Le Pendu, J., de Wit, E., Schultsz, C. 2017. Sustained oral human-to-human fecal transmission following a zoonotic event. *Current Opinion in Virology*, doi:10.1016/j.coviro.2016.11.001, 1–6.

Dewey-Mattia, D., Manikonda, K., Hall, A.J., Wise, M.E., Crowe, S.J. 2018. Surveillance for Foodborne Disease Outbreaks, United States, 2009–2015. *MMWR Surveill Summ*, doi: http://dx.doi.org/10.15585/mmwr.ss6710a167(No. SS-10), 1–11. *Diarreicas e malária*. AID-OAA-I-14-00013. 1-16.

du Toit, L., Venter, I. 2005. Food practices are associated with an increased risk of bacterial food-borne diseases in female students living in self-catering residences at Cape Peninsula University of Technology. *Journal of Family Ecology and Consumer Sciences*, 33, ISSN 0378-5254.

FDA (Food and Drug Administration). 2018. *Report on the risk factors in fast food and full-occurrence of foodborne illness service restaurants, prepared by the FDA national retail food TEAM*, Available at http://www.fda.gov/Retailfoodprotection, 2013-2014, (accessed on 10/02/2020).

Folha de Maputo. 2017. *INAE encerra 20 estabelecimentos por falta de higiene*. Available at: URL:http://www.folha de maputo.co.mz/pt/noticias/nacional/inaepede-melhor-colaboracao-dos-agentes-econômicos/, (Accessed 18 November. 2019).

Hald, T.; Aspinall, W.; Devleesschauwer, B.; Cooke, B.; Corrigan,T.; Havelaar, A. H.; Gibb, H. J.; Torgerson, P. R.; Kirk, M. D.; Angulo, F. J.; Lake, R. J.; Speybroeck, N.; Hoffmann, S. 2016. The World estimates the relative contributions of food to the burden of disease due to selected foodborne hazards: a structured expert elicitation, *PLoS ONE*. doi: 10.1371/journal.pone.0145839.

Havelaar, A.H., Kirk, M.D., Torgerson, P.R., Gibb, H.J., Hald, T., Lake, R.J., Praet, N., Bellinger, D.C., de Silva, N.R., Gargouri, N., Speybroeck, N., Cawthorne, A., Mathers, C., Stein, C., Angulo, F.J., Devleesschauwer, B. 2015. World Health Organization global estimates and regional comparisons of the burden of foodborne diseases in 2010. *PLoS Medicine*, doi:10.1371/journal.pmed.1001923.

INE, 2019. *Resultados definitivos do IV Recenseamento Geral da População e Habitação de 2017 (Censo 2017)*, *Instituto Nacional de Estatística (INE)*.

INE, 2019. Resultados definitivos do IV Recenseamento Geral da População e Habitação de 2017 (Censo 2017), Instituto Nacional de Estatística (INE).

INE. 2016. *Statistical Yearbook 2016 MOÇAMBIQUE.*Instituto Nacional de Estatística. Avalible in: Web: www.ine.gov.mz. Accessed February 20, 2020.

INE. 2017. Inquéritos — Instituto Nacional de Estatistica Available at: http://www.ine.gov.mz/operacoesestatisticas/inqueritos/inquerito-sobre-causa-de-mortalidade/ inquerito-nacional-sobre-causa-de-mortalidade-2007-8-pdf/view. Accessed July 10, July2020.

Kirk, M.D., Pires, S.M., Black, R.E., Caipo, M., Crump, J.A., Devleesschauwer, B., Döpfer, D., Fazil, A., Fischer-Walker, C.L., Hald, T., Hall, A.J., Keddy, K.H., Lake, R.J., Lanata, C.F., Torgerson, P.R., Havelaar, A.H., Angulo, F.J. 2015. The World Health Organization estimates the global and regional disease burden

of 22 foodborne bacterial, protozoal, and viral diseases in 2010: data synthesis, *PLoS Med*. doi: http://dx.doi. org/10.1371/journal.pmed.1001921, 12.

Knee, J., Sumner, T., Adriano, Z., Berndes, D., de Bruijn. E., Schmidt, W.P., Nala, R., Cumming, O., Brown, J. 2018. Risk factors for childhood enteric infection in urban Maputo, Mozambique: a cross-sectional study. *PLoS Neglected Tropical Diseases*, doi:10.1371/journal.pntd.0006956.

Liu L., Oza S., Hogan, D., Chu Y., et al.. 2016. Global, regional, and national causes of under-5 mortality in 2000-15: an updated systematic analysis with implications for sustainable development goals. Lancet 388:3027–3035.

Mills, A. 2014. Health care systems in low- and middle-income countries. *N Engl J Med,* 370**:** 552–57.

Morais, M. B., Tahan, S., and Mello, C. S. (2013). *Diarreia aguda: Probióticos e outros coadjuvantes na terapêutica. Atualidades em clínica cirúrgica intergastro e trauma 2012*, 3 ed, São Paulo: Atheneu, 539-549.

Morgan, DL. 2014. Integrating qualitative and quantitative methods: A pragmatic approach. Sage Publications Inc.

Morse, J. M. and Niehaus, L. (2016). Mixed method design: Principles and procedures. Routledge, Taylor and Francis Group, London and New York.

Naghavi, M., Abajobir, A.A., Abbafati, C., Abbas, K.M., Abd-Allah, F., Abera, S.F., *et al.* 2017. Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: A Systematic Analysis for the Global Burden of Disease Study 2016, *Lancet,* 17:32152-321529.

Nhampossa, T., Mandomando, I., Acacio, S., A. et al., 2013. Health care utilization and attitudes survey in cases of moderate-to-severe diarrhea among children ages 0-59 months in the district of Manhiça, Southern Mozambique. *American Journal of Tropical Medicine and Hygiene* 89(1):41-48.

Oloruntoba, O. O., Folarin, T. B., Ayede, AI. 2014. Hygiene and sanitation risk factors of diarrheal disease among under-five children in Ibadan, Nigeria. *Afr Health Sci*. 14: 1001–1011.

ONU News. (2019) *Em Moçambique, mais de 500 mil pessoas tiveram doenças causadas por consumo de alimentos inseguros* https://news.un.org/pt/story/2019/06/1675251, (asseded in 03-03-2020)

Osei-Tutu, B., Anto, F. 2016. Trends of reported foodborne diseases at the Ridge Hospital, Accra, Ghana: a retrospective review of routine data from to 2009-2013., *BMC Infectious Diseases* DOI 10.1186/s12879-016-1472-8. 16:139.

Oxford. 1993. *In: Wordpower Dictionary; for learners of English*. Edited by Sally Wehmeier, New York.

Pires S.M., Fischer-Walker C.L., Lanata C.F., Devleesschauwer B., et al.. 2015. Etiology-specific estimates of global and regional incidence and mortality of diarrheal diseases are commonly transmitted through food. *PLoS ONE,* 10(12):1-17.

Polit, D. F., Beck, C. T., 2017. Nursing Research: Generating and Assessing Evidence for Nursing Practice.10th Ed. New York: Wolters Kluwer.

Scharf RJ., Deboer MD., Guerrant RL. 2014. Recent advances in understanding the long-term sequelae of childhood infectious diarrhea. *Curr Infect Dis* 16: 408.

Shariati, Fallah, Pormohammad, A., Taghipour, A., Safari, H., Chirani, A. S., Azimi, T. (2019). Possible roles of bacteria, viruses, and parasites in IBS initiation and exacerbation Journal of Cellular Physiology 234(6), 8550-8569.

Torgerson, P. R., de Silva, N. R., Fevre, E. M., Kasuga, F., Rokni, B., Zhou, X. N., Sripa, B., Gargouri, N., Willingham, A.L., & Stein, C. (2014). Global burden of foodborne parasitic diseases: an update. Trends Parasitol. *PMID*. doi:10.1016/j.pt.2013.11.002.

UN-Habitat. 2014. *The State of African Cities 2014: Re-Imagining Sustainable Urban Transitions*. *Journal of Asian and African Studies* 51(4):389-397.

UNICEF. 1998. *The state of the world's children. United Nations Children's Fund*. Available from: http://www.unicef.org/sowc/archive/ENGLISH/The%20State%20of%20the%20World's%20Children% 201998.pdf. (Acceded 20 February 20, 2020).

USAID/INS. 2017.*Mudanças climáticas e vulnerabilidade da saúde: Impacto nas doenças*

WHO. 2012. Initiative to estimate the Global Burden of Foodborne Diseases. In: Information and publications. Available at: http://www.who.int/foodsafety/foodborne_disease/ferg/en/index7.html. Accessed 10th July 10, 2020.

WHO. 2015. *WHO estimates of the global burden of foodborne diseases. Foodborne disease burden epidemiology reference group 2007-2015*. World Health Organisation. doi: 10.1016/j.fm.2014.07.009.

WHO. 2019. Promoting safe food handling. Available online: https://www.who.int/activities/promoting-safe-food-handling. Accessed 10th in August 2020.

WHO/UNICEF. 2017. *Progress on Drinking Water, Sanitation and Hygiene: 2017 Update and SDG Baseline*. World Health Organisation. doi: 10.1016/j.pnpbp.2017.06.016.

# CHAPTER TWO

# LITERATURE REVIEW AND THEORETICAL FRAMEWORK

## 2.1 INTRODUCTION

This chapter provides an understanding of the contribution of this investigation to the knowledge of foodborne diarrhea in children under 5. Here, we summarize the previous research on foodborne diarrhea in children and the ideas derived from this research. This chapter allows readers to critically assess the assumptions of foodborne diarrhea in children and address questions and other aspects. It also demonstrates the philosophical basis of foodborne diarrhea in children, how different interventions undertake their investigations, the methodology chosen, and the procedures used to perform this specific research.

## 2.2 LITERATURE REVIEW

### 2.2.1 Burden of Foodborne Illnesses

Unsafe foods are responsible for more than 200 diseases including acute and chronic diseases. The World Health Organization (WHO) report of 2015 analyzed approximately 31 risks responsible for approximately 600 million cases of foodborne diseases in 2010, corresponding to 33 million DALYs. The availability of food in quantity and safe conditions, as well as adequate nutritional content, is a way to maintain good health and prevent foodborne diseases including diarrhea. The WHO estimates that one in ten people become ill after consuming unsafe food. The consumption of unsafe food can also negatively affect socioeconomic development, overload the health system, and harm the economy, trade, and tourism in countries worldwide (FAO/WHO 2018).

Despite the availability of simple and effective treatments, diarrhea is a leading cause of death in children worldwide. In 2017, approximately 8% of all deaths among children under five were due to diarrhea, which translated to over 1 300 young children dying each day or about 480 000 children a year, with South Asia and Sub-Saharan Africa countries accounting for most deaths from diarrhea in children less than two years (UNICEF, 2019). In Mozambique, in 2015, approximately 900 000 cases of diarrhea were reported in 2015, of which more than 400 000 were in children younger than five years of age. Across the country, the most frequently reported foodborne diarrhea is cholera. The cholera epidemic burden varied between the years 2008 and 2015. For example, in 2009, the burden increased, accounting for more than 19 thousand cases, whereas in 2014, a decrease was registered for approximately 483 cases; however, in 2015, the number of cases increased to approximately 10 thousand (MISAU, 2016).

### 2.2.2 Sources and Factors for Foodborne Illnesses

Sources of foodborne illnesses and risk factors are mostly related to food safety behaviors and practices that translate into deprived personal hygiene, inadequate food handling (time and temperature), contaminated equipment and/or utensils, improper cooking, and food obtained from unsafe sources (Estaurants, 2018). Considering the previous statement, the risk factors and sources of foodborne illnesses are multiform and include other socioeconomic and natural factors. According to UNICEF (2020), children in low-income families eat low-quality food, putting them at risk of diseases. Food, water, and sanitation environments are essential for children's health and disease prevention (UNICEF, 2020).

The Ministry of Health of Mozambique (MISAU) reported that the leading risk factor for diarrhea is the country’s epidemiological profile, which is characterized by a large number of diseases of environmental origin. A risk area for diarrheal disease is considered an area with an absence, deficiency, or intermittent water supply; deficient sewage system included, absence or lack of treatment of waste; and households living in wet soil contaminated with fecal material, including high

population density with low socio-economic income and deficient access to information (MISAU, 2016). In Maputo, the country's capital, 85% of children live in poor sanitation conditions. Latrines are considered to be potential risk factors for enteric and diarrheal diseases (Knee *et al.*, 2018).

### 2.2.3 Diagnosis of foodborne diarrhea

Clinical, demographic, and epidemiological features are recommended for diagnosing diarrheal diseases (Shane *et al*., 2017). It is essential to investigate the conditions that may suggest specific causes of contagious diarrhea, including the consumption of shellfish, raw milk, unpasteurized juice, undercooked meat, fish, eggs, contaminated fruits and vegetables, drinking and recreational water, contact with animals and their feces, recent antimicrobial therapy, international travel, and institutional exposure (Morris, 2003; Voetsch *et al.*, 2004; Bintsis, 2017). During the diagnosis process, health professionals have to detail clinical and historic exposure from people with diarrhea, ask people around the home/neighborhood with the same illness, if the people with diarrhea attend or work in child care centers, and evaluate the exposure conditions, such as foodborne outbreaks (Shane *et al*., 2017).

The causative agent of diarrheal episodes (Sociedade Brasileira de Pediatria, 2017). As diarrheal disease is most often an infection of the digestive tract caused by viruses, bacteria, or protozoa, it is recommended to investigate the pathogens in people with diarrhea and analyze stool and blood samples to diagnose diarrheal pathogens, which are related to the source of contamination (Shane *et al.*, 2017). During the diagnosis of diarrheal infections, it is fundamental to verify the consequences of diarrhea such as dehydration and protein-energy malnutrition (Shane *et al*., 2017).

### 2.2.4 Preventive measures of foodborne diseases

Preventive measures for foodborne diseases are fundamentally based on hygiene and environmental sanitation, which translates into clean water, toilet availability, and good hygiene practices during food handling. Hand washing is essential for preventing the transmission of microbes from person to food, food preparation utensils, and equipment. Water Sanitation and Hygiene (WASH) interventions reduce around 27% and 53% of cases of diarrhea in children under five years of age, mainly in low- and middle-income countries (LMICs), where the diarrhea infections are more predominant (Darvesh *et al*., 2017).

It has been reported that the education of principal food preparers for young children reduces the incidence, morbidity, and mortality of foodborne diarrhea in children, and consequently reduces the cost related to the treatment of these infections. The message regarding the education of food preparers for children should focus on cleaning, separate cooking, and cleaning (MISAU 2016).

Improvements in wellbeing have been found to reduce foodborne infections in communities. People living in extremely poor regions face higher rates of foodborne diarrhea, and children in these poor communities are at higher risk of developing foodborne diarrhea *(*Newman *at al., 2015).* According to WHO (2019), all countries have to adopt five (Keep clean; separate raw and cooked; cook thoroughly; keep food at safe temperatures and use safe water and raw materials) key actions strategic for food safety to combat foodborne diseases.

### 2.2.5 Types of diarrhoea

#### 2.2.5.1 Acute watery diarrhoea

Acute watery diarrhea frequently presents with unexpected stooling, typically liquid. Additional symptoms include vomiting, fever, nausea, and abdominal discomfort (Dipasquale et al., 2018). In the gastrointestinal tract, absorption of over

90% of the physiologic remaining liquid is absorbed in the proximal small intestine. The pathogenic mechanism that causes diarrhea occurs when enteric pathogens enter the proximal small intestine (Thiagarajah et al., 2015). Acute watery diarrhea is caused by enterotoxin-secreting bacteria such as enterotoxigenic *Escherichia coli* (ETEC) and *Vibrio cholerae*, which cause liquid loss without causing cellular injury (Willey et al., 2013). Viruses, such as rotaviruses and caliciviruses, that harm the intestinal epithelium also cause liquid loss. They also tend to cause fever, vomiting, and liquid stool in the absence of blood and mucus (Tagbo et al., 2019). Generally, cases of watery diarrhea course acutely; nevertheless, within one–three days.

#### 2.2.5.2 Dysentery

Dysentery is a diarrhea in which loose or watery stools contain visible blood (UNICEF and WHO, 2009); dysentery is most often caused by Shigella species or *Entamoeba hystolytica*. Dysentery begins with the unexpected onset of repeated stooling. Nonetheless, unlike acute watery diarrhea, stools are commonly lesser and are characterized by blood and pus. Thus, it is referred to as acute bloody diarrhea. Dysentery frequently presents with fever, tenesmus, abdominal pain, and cramps, while vomiting occurs less often (Wang et al., 2019). Inflammation of the large intestine, which extends from the cecum to the rectum (colon), is caused by infection with one of several enteric pathogens, which leading to dysentery. Shigellae are the central origin of dysentery in children (Tickell et al., 2017). *Campylobacter jejuni* and invasive *E. coli* or Salmonella serotypes are relatively rare. *Entamoeba histolytica* rarely causes dysentery in young children (Khan and Jahan, 2017: Delfino Vubil et al., 2018). Dysentery frequently requires antimicrobial therapy (Williams and Berkley, 2018).

### 2.2.5.3 Persistent Diarrhea

Persistent diarrhea is severe and prolonged (at least 14 days) rather than brief and is also referred to as chronic diarrhea (Centers for Disease Control and Prevention 2016a, b). The case may begin with the route of frequent watery or bloody stool, nevertheless proceeding for an extended period, thus resulting in weight (Bandsma et al., 2019). Persistent diarrhea has causes that are either infectious or noninfectious. Infectious diseases include intestinal parasites (Cryptosporidium, Cyclospora, *E. histolytica*, Giardia, and Microsporidia), bacteria (Aeromonas, Campylobacter, *C. difficile, E. coli*, Plesiomonas, Salmonella, and Shigella), and viruses (norovirus and rotavirus). Noninfectious causes include altered immune function, disorders of the pancreas, medications (antibiotics), heritable metabolic disorders (enzyme deficiency), intolerance to food products, intestinal complaints, disorders of the thyroid, and blood flow to the intestines (Centres for Disease Control and Prevention, 2016a, b; Holtman et al., 2016; Spitz et al., 2016; El-Chammas et al., 2017). Enteroaggregative *E. coli*, Shigella, and Cryptosporidium are the main organisms responsible for persistent diarrhea (DuPont, 2016). The pathogenesis of persistent diarrhea can be multifactorial and is essentially based on incessant damage to the mucosal lining of the intestine due to several infections with different pathogens (Giannattasio et al., 2016). Malnutrition also increases the risk of death in children with persistent diarrhea. Evidence-based studies have recognized a strong connection between chronic diarrhea and HIV-positive patients in developing countries (Agholi et al., 2013; Gebremedhin et al., 2013; Kumurya and Gwarzo, 2013; Rostami et al., 2014).

## 2.2.6 Management of foodborne diarrhea

Communal management options for diarrheal diseases include liquid replacement and antimicrobial treatments. Liquid replacement treatment, also called oral rehydration therapy (ORT), is especially necessary for young children (Bruzzese et al., 2018). In some cases, diarrhea can be self-limiting. Nevertheless, antimicrobial

agents are vital in severe cases of infection (persistent diarrhea or dysentery) (Breurec et al., 2016). The first-line antimicrobial agents for childhood diarrhea therapy are co-trimoxazole and metronidazole, which can be empirically administered. Other antibiotics include penicillin, erythromycin, amoxicillin, ampicillin, cefuroxime, ceftriaxone, tetracycline, chloramphenicol, ampicillin, cloxacillin, azithromycin, ciprofloxacin, and rifaximin (Udoh and Meremikwu, 2017; Bruzzese et al., 2018). Howteerakul et al. (2004) reported co-trimoxazole, norfloxacin, colistin sulfate (Ugboko et al. 2019) and nalidixic acid, which are commonly recommended antibiotics for infant treatment in Thailand. A study in Nigeria revealed that metronidazole was the most commonly administered antibiotic, followed by co-trimoxazole and gentamycin (Udoh and Meremikwu, 2017). Parenteral management with ceftriaxone or ciprofloxacin has been suggested for severe diarrhea cases (Bruzzese et al., 2018). Infantile diarrhea initiated by Shigella is responsible for most cases of mortality in non-bloody diarrhea (Liu et al., 2016a, b) and morbidity in moderate diarrhea (Anderson et al., 2019) among children younger than five years of age in developing countries. Nevertheless, the emergence and re-emergence of antibiotic-resistant strains of enteric pathogens are an attractive and vast threat (Willey et al., 2013). Universally, there is news on multidrug-resistant strains of enteropathogenesis isolated from the stools of children younger than five years (Elsherif et al., 2016). For example, multidrug-resistant *Shigella spp* have been reported in Ethiopia (Gebreegziabher et al., 2018), Mozambique (Vubil et al., 2018), and Nigeria (Ajayi et al., 2019). Other management options include immunotherapy (Thu et al., 2017; Nagata et al., 2018; Zhao et al., 2019). Fortified nutrition includes iron fortification and zinc replacement therapy (Paganini et al., 2016; Van Der Kam et al., 2016; Wessells et al., 2018), lactose-free diet, and probiotics. However, there is limited awareness in Nigeria (Ajanya et al., 2018; Mokomane et al., 2018; Efunshile et al., 2019), and fecal microbiota transplantation, which has been used mainly for Clostridium difficile-associated diarrhea (Austin et al., 2014; Colman and Rubin, 2014; Barnes and Park, 2017). Oral zinc therapy could reduce the severity and duration of diarrhea in children older than six months of age but may not

significantly affect children under this age (Lazzerini and Wanzira, 2016). In addition, zinc absorption during diarrhea may be reduced and vomiting may be a possible side effect (Ogunlesi et al., 2017). In Bangladesh, a combination of ORS and zinc and vitamin A supplementation effectively reduces the number of deaths caused by diarrhea in children (Billah et al., 2019).

## 2.3 THEORETICAL FRAMEWORK

The present study was conceptualized based on the 1998 UNICEF framework TRIPLE A CYCLE, which focuses on three principal actions: assessment, analysis, and action (Figure 6). The UNICEF framework was developed to organize scientific knowledge, promote public understanding, and develop rational strategies to address nutrition in children. The UNICEF framework for undernutrition was useful for this study.

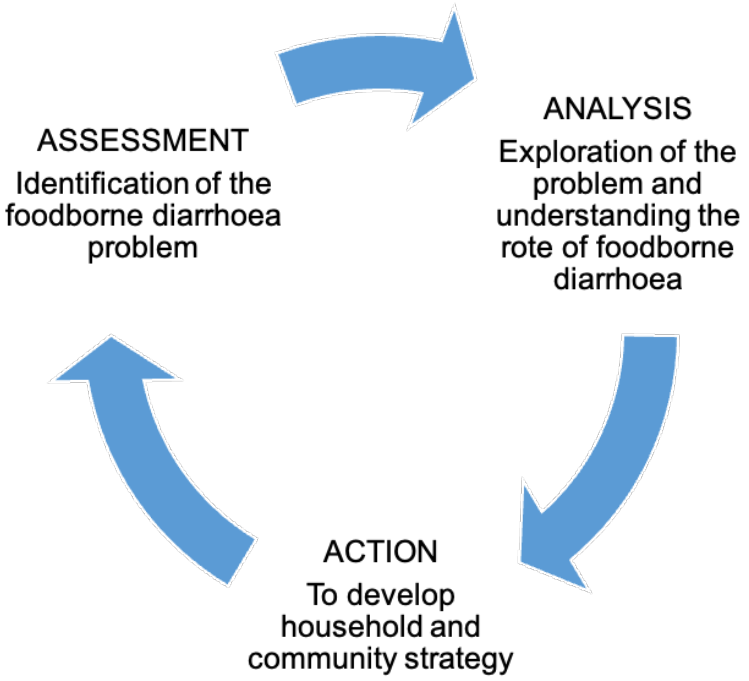


*Figure 6. Triple action framework*

Source: Adapted from UNICEF (1998)

According to the Triple Action Framework in Phase One (assess), this study assessed the practices of diagnosis of foodborne diarrhea in children under five years of age implemented at referral health facilities in Maputo to identify foodborne diarrheal problems. Phase Two (analysis) explored and described the household factors contributing to the origin of foodborne diarrhea in children younger than years old to understand the factors and routes of transmission of foodborne diarrhea. Finally, Phase 3 (action) was developed as a household and community strategy for food safety preventive measures for foodborne diarrhea that can be implemented by children's food preparers/handlers ( Figure 6).

## 2.4 PARADIGM AND PERSPECTIVE

The study was based on a pragmatic paradigm, which is concerned with the research problem in the social sciences and uses a pluralistic system to obtain knowledge about the problem (Creswell and Creswell, 2017). Pragmatism is committed to the methods of philosophy and reality. This applies mixed methods research, in that inquirers draw liberally from quantitative and qualitative assumptions to construct knowledge. This study takes a pragmatic approach because the only solution to the problem is to utilize multiple realities, such as children's food preparers/handlers and health professionals. Paradigms and worldviews have three major dimensions: ontological (beliefs about the nature of reality and humanity), epistemological (the nature of knowledge that informs research), and methodological (how to access that knowledge). Therefore, to understand why certain research designs were chosen over others, it is essential to be aware of the following fundamental philosophical assumptions.

### 2.4.1 Ontological Assumptions

Ontological assumptions are a branch of philosophy that deals with the nature of reality (Botma et al., 2010). The reality is that there is currently no monitoring of the factors that cause diarrhea in children under five years of age by health professionals in the community. They only focused on the treatment of the signs and symptoms of diarrhea.

### 2.4.2 Epistemological Assumptions

Epistemology is a branch of philosophy that deals with the nature of knowledge (Botma et al., 2010). In this study, an interaction was established between children's food preparers/handlers to determine what is known about the factors of foodborne diarrhea. It was assumed that food preparers/handlers knew how to prevent foodborne diarrhea.

### 2.4.3 Methodological Assumptions

Methodological assumptions consist of directions and procedures that specify how a researcher must investigate a phenomenon (Botma et al., 2010). This study was conducted using mixed methods, where Phase One was retrospective in identifying the practices implemented by health professionals in foodborne diarrhea infections and to estimate the gender- and age-specific burden of foodborne diarrhea infections. Phase 2 explored household risk factors contributing to foodborne diarrhea in children younger than 5 years. A source attribution study was conducted to identify the household factors for foodborne diarrhea origins. Phase Three was based on the results of phases one and two, where a Nominal Group Technique (NGT) composed of children's food preparers/handlers, community leaders, and health professionals (nurses, health technicians, and doctors) was used to design a strategy, discuss the factors, and

find good practices for the prevention of foodborne diarrheal infections in children younger than five.

## 2.6 SUMMARY

This chapter provides a literature review and presents existing evidence on foodborne diarrhea, preventive measures, type of diarrhea, management of foodborne diarrhea, theoretical framework, and research paradigm and perspective. Chapter Three focuses on Phase One of the studies published in the International Journal of African Nursing Sciences. Appendix 4 provides the instructions for the authors. Chapter Four presents the findings of Phase Two of the study published in the International Journal of Environmental Research and Public Health. The authors' instructions are illustrated in Figure 5. The final phase of this study was drafted and published in the International Journal of African Nursing Sciences. The authors' instructions are illustrated in Figure 6.

## 2.7 REFERENCES

Agholi, M., Hatam, G.R., Motazedian, M.H. 2013. HIV/AIDS associated opportunistic protozoan diarrhea. AIDS Res. Hum. Retrovir. 29 (1), 35–41.

Ajanya, B. U., Attah, F., Mahmud, M. E., Owolabi, B. I., Adetoro, R. O., Adeniyi, K. A., Oyibo Usman, K. A. (2018). Therapeutic potency of probiotics for the treatment of gastrointestinal parasites. J. Publ. Health Dent. 1 (2), 22–30

Ajayi, O.I., Ojo, D.A., Akinduti, P.A., Akintokun, A.K., Akinrotoye, K.P., 2019. Prevalence and antibiotic resistance profiles of Shigella serotypes isolated from children in Odeda local government, Ogun State. J. Environ. Treat. Tech. 7 (3), 270–281.

Anderson IV, J.D., Bagamian, K.H., Muhib, F., Amaya, M.P., Laytner, L.A., Wierzba, T., Rheingans, R., 2019. Burden of enterotoxigenic Escherichia coli and Shigella nonfatal diarrheal infections in 79 low-income and lower-middle-income countries: A modelling analysis. Lancet Global Health 7 (3), e321–e330

Androw, S & Halcomb, EJ. 2009. Mixed methods research in nursing and health sciences. From rigour to trustworthiness: Validation of mixed methods. London: Wiley Blackwell.

Austin, M., Mellow, M., Tierney, W.M. 2014. Fecal microbiota transplantation for the treatment of Clostridium difficile infection. Am. J. Med. 127 (6), 479–483

Bandsma, R. H., Sadiq, K., Bhutta, Z. A. (2019). Persistent diarrhea: Current knowledge and novel concepts. Pediatrics and International Child Health, 39(1), 41-47

Barnes, D., Park, K.T., 2017. Donor considerations for fecal microbiota transplantation. Curr. Gastroenterol. Rep. 19 (3), 10.

Becker-Dreps, S., Allali, I., Monteagudo, A., Vilchez, S., Hudgens, M.G., Rogawski, E.T., et al., 2015. Gut microbiome composition in young Nicaraguan children during diarrhea episodes and recovery. Am. J. Trop. Med. Hyg. 93 (6), 1187–1193

Billah, S. M., Raihana, S., Ali, N. B., Iqbal, A., Rahman, M. M., Khan, A. N. S. et al., 2019. Bangladesh: A case of successful treatment of childhood diarrhea. J. Global Health 9 (2). Black, R.E., 1993. Persistent diarrhea in children in developing countries. *Pediatr. Infect. Dis. J.* 12, 751–761.

Bintsis, T. 2017. Foodborne pathogens. AIMS Microbiology 3(3): 529.

Botma, Y., Greef, M., Mulaudzi, F.M., Wright, S.C.D. 2010. Research in Health Sciences. 4th Ed. Cape Town, South Africa: Pearson Education.

Breurec, S., Vanel, N., Bata, P., Chartier, L., Farra, A., Favennec, L., et al., 2016. Etiology and epidemiology of diarrhea in hospitalized children from low-income countries: A matched case-control study in the Central African Republic. PLoS Neglected Trop. Dis. 10 (1).

Bruzzese, E., Giannattasio, A., Guarino, A. 2018. Antibiotic treatment of acute gastroenteritis in children. F1000Research 7, 193–196.

Centers for Disease Control and Prevention 2016a. *Water, Sanitation, and Environmentally-Related Hygiene*. https://www.cdc.gov/healthywater/hygiene/disease/chronic_diarrhea.html. (Accessed January 30, 2021).

Centers for Disease Control and Prevention 2016b. *National Centre for Emerging and Zoonotic Infectious Diseases (NCEZID). Division of Foodborne, Waterborne, and Environmental Diseases*, https://www.cdc.gov/ncezid/dfwed/edeb/index.html. (Accessed February 19, 2021).

Colman, R.J., Rubin, D.T., 2014. Fecal microbiota transplantation as a therapy for inflammatory bowel disease: A systematic review and meta-analysis. J. Crohn's Colitis 8 (12), 1569–1581

Creswell, J.W., Creswell, J.D., 2017. Research design: Qualitative, quantitative, and mixed-methods approaches. Sage publications.

Creswell JW. and Plano CVL. 2007. Design and Conducting Mixed Methods Thousand Oaks, CA. Sage.

Darvesh, N., Das, J. K., Vaivada, T., Gaffey, M. F., Rasanathan, K., and Bhutta, Z. A. (2017). Water, sanitation, and hygiene interventions for acute childhood diarrhea: a systematic review to provide estimates for the Lives Saved Tool, *BMC Public Health*, DOI 10.1186/s12889-017-4746-1 (Suppl 4):776.

Delfino Vubil, SA., Quinto, L., Ballest e-Delpierre, C., Nhampossa, T., Kotloff, K., Levine, MM., et al., 2018. Clinical features, risk factors, and impact of antibiotic treatment of diarrhea caused by Shigella in children aged < 5 years in Manhiça District, rural Mozambique. Infect. Drug Resist. 11, 2095.

Desmennu, A., Oluwasanu, MM, John-Akinola, Y. O., Oladunni, O. Adebowale, S. A. (2017). Maternal education and diarrhea in children aged 0-24 months in Nigeria. Afr. J. Reprod. Health 21 (3), 27–36.

Dipasquale, V., Corica, D., Gramaglia, SM., Valenti, S., Romano, C., 2018. *Gastrointestinal symptoms in children: primary care and specialist interface*. Int. J. Clin. Pract. 72 (6), e13093.

DuPont, H.L., 2016. *Persistent diarrhea: a clinical review*. Jama 315 (24), 2712–2723. e 17: 909–948.

Efunshile, A.M., Ezeanosike, O., Nwangwu, C.C., Konig, B., Jokelainen, P., Robertson, L.J. 2019. Apparent overuse of antibiotics in the management of watery diarrhea in children in Abakaliki, Nigeria. BMC Infect. Dis. 19 (1), 275.

El-Chammas, K., Williams, S., Miranda, A., 2017. *Disaccharidase deficiencies in children with chronic abdominal pain.* J. Parenter. Enteral Nutr. 41 (3), 463–469

Elsherif, R. H., Ismail, D. K., El-Kholy, Y. S., Gohar, N. M., Elnagdy, S. M., Elkraly, O. A. (2016). Integron-mediated multidrug resistance in extended-spectrum β-lactamase-producing Escherichia coli and Klebsiella pneumoniae isolated from fecal specimens in Egypt. J. Egypt. Publ. Health Assoc. 91 (2): 73–79.

Estaurants, S.E.R. (2018). Food and FDA report on the occurrence of foodborne illness risk factors in fast food and full 2013–2014.

Gebreegziabher, G., Asrat, D., Hagos, T. 2018. Isolation and antimicrobial susceptibility profile of Shigella and Salmonella species from children with acute diarrhea in Mekelle Hospital and Semen Health Center, Ethiopia. Ethiop. J. Health Sci. 28 (2), 197–206.

Gebremedhin, A., Gebremariam, S., Haile, F., Weldearegawi, B., Decotelli, C. 2013. *Predictors of mortality among HIV infected children on anti-retroviral therapy in Mekelle Hospital, Northern Ethiopia: a retrospective cohort study*. BMC Publ. Health 13 (1),1047

Giannattasio, A., Guarino, A., Vecchio, A. L. (2016). Management of Children with Prolonged Diarrhea. F1000Research 5. Giri, S., Nair, N.P., Mathew, A., Manohar, B., Simon, A., Singh, T., et al., (2019) Rotavirus gastroenteritis in Indian children< 5 years hospitalized for diarrhea, 2012–2016. BMC Publ. Health 19 (1),69.

Holtman, G.A., Kranenberg, J.J., Blanker, M.H., Ott, A., Lisman-van Leeuwen, Y., Berger, M.Y., 2016. *Dientamoeba fragilis colonization is not associated with gastrointestinal symptoms in children at the primary care level*. Fam. Pract. cmw111.

Howteerakul, N., Higginbotham, N., Dibley, M. J., 2004. Antimicrobial use in children under five years of age with diarrhea in a central Region Province, Thailand. Hu, Y., Yang, X., Qin, J., Lu, N., Cheng, G., Wu, N., et al., 2013. Metagenome-wide analysis of antibiotic-resistance genes in a large cohort of human gut microbiota. Nat. Commun. 4, 2151

Khan, N.T., Jahan, N., (2017). Prevalence of E. histolytica-associated dysentery in children in a satellite town, Quetta. Epidemiology (Sunnyvale) 7 (290), 2161-1165.

Kumurya, A. S. and Gwarzo, M. Y. (2013). *Cryptosporidiosis in HIV infected patients with diarrhea in Kano state, North-western Nigeria*. J. AIDS HIV Res. 5 (8), 301–305.

Lazzerini, M., Wanzira, H., 2016. Oral zinc supplementation for diarrhea treatment in children. Cochrane Database Syst. Rev. 12 (12). CD005436.

MISAU. 2016. *Manual de prevenção e controlo da cólera e de outras diarreias agudas*, 4ª ed, Maputo-Moçambique.

Mokomane, M., Kasvosve, I., Melo, E.D., Pernica, J.M., Goldfarb, D.M., 2018. The global problem of childhood diarrheal diseases: Emerging strategies for prevention and management. Therapeut. Adv. Infect. Dis. 5 (1), 29–43.

Morris, J.G. Jr. 2003 Cholera and other types of vibriosis: A story of human pandemics and oysters on the half-shell. *Clinical Infectious Diseases* 37:272-80.

Newman, K.L., Leon, J.S., Rebolledo, P.A., Scallan, E., 2015. Impact of socioeconomic status on foodborne illnesses in high-income countries: a systematic review. *Epidemiology and Infection* 143(12):2473-2485.

Ogunlesi, T.A., Olowonyo, M.T., Runsewe-Abiodun, T.I., 2017. Pre-hospital use of oral rehydration therapy and zinc, and the risk of dehydration in childhood diarrhea. J. Adv. Med. Med. Res. 1–8.

Paganini, D., Uyoga, M.A., Zimmermann, M.B. 2016. Iron fortification of foods for infants and children in low-income countries: Effects on the gut microbiome, gut inflammation, and diarrhea. Nutrients 8 (8):494.

Potter, M., Gordon, S., Hamer, P., 2004. Nominal Group Technique: A useful consensus methodology in physiotherapy research. New Zealand Journal of Physiotherapy 32 (3):126-130.

Rostami, MN., Nikmanesh, B., Haghi-Ashtiani, MT., Monajemzadeh, M., Douraghi, M., Ghalavand, Z., Kashi, L., 2014. *Isospora belli associated recurrent diarrhea in a child with AIDS*. J. Parasit. Dis. 38 (4), 444–446.

Shane, A. L.; Mody, R. K.; Crump, J. A.; Tarr, P. I.; Steiner, T. S.; Kotloff, K.; Langley, J.M.; Wanke, C.; Warren, C.A.; Cheng, A.C.; Cantey, J.; Pickering, L.K. 2017. Infectious Diseases Society of America Clinical Practice Guidelines for the Diagnosis and Management of Infectious Diarrhea, *Clinical Infectious Diseases*, 65:45-80.

Sociedade Brasileira de Pediatria. 2017. *Guia Prático de Atualização - Diarreia aguda: diagnóstico e tratamento*. Nº 1, Brasil.

Spitz, MA., Nguyen, MA., Roche, S., Heron, B., Milh, M., De Lonlay, P., et al., 2016. *Chronic diarrhea in L-amino acid decarboxylase (AADC) deficiency: a prominent clinical finding among a series of ten French patients.* In: JIMD Reports, 31. Springer, Berlin, Heidelberg, pp. 85–93.

Tagbo, B. N., Chukwubike, C. M., Ifeyinwa, R., IR., Ani, E. O. 2019. *Adenovirus and rotavirus associated diarrhea in fewer than 5 children from Enugu rural communities, Southeast Nigeria*. World J. Vaccine. 9 (3): 71.

Thiagarajah, J. R., Donowitz, M., Verkman, A. S., 2015. *Secretory diarrhea: mechanisms and emerging therapies*. Nat. Rev. Gastroenterol. Hepatol. 12 (8), 446.

Thu, H. M., Myat, T. W., Win, M. M., Thant, K. Z., Rahman, S., Umeda, K. et al., 2017. Chicken egg yolk antibodies (IgY) for prophylaxis and treatment of rotavirus diarrhea in human and animal neonates: A concise review. Kor. J. Food Sci. Anim. Resour. 37 (1), 1.

Tickell, K. D., Brander, R. L., Atlas, H. E., Pernica, J. M., Walson, J. L., Pavlinac, B. 2017. *Identification and management of Shigella infection in children with*

*diarrhea: a systematic review and meta-analysis*. Lancet Global Health 5 (12), e1235–e1248.

Udoh, E.E., Meremikwu, M.M., 2017. Antibiotic prescriptions in the management of acute watery diarrhea in children under five years of age. *Int. J. Contemp. Pediatr.* 4 (3), 691–695.

Ugboko, H.U., Nwinyi, C.O., Oranusi, S.U., Fatoki, T.H., Akinduti, P.A., Enibukun, J.M., 2019. In silico screening and analysis of broad-spectrum molecular targets and lead compounds for childhood diarrhea therapy. *Bioinf. Biol. Insights 12*, 1–11.

UNICEF, WHO, 2009. *Why Children Are Still Dying and What Can Be Done*? United Nations Children's Fund (UNICEF).

UNICEF. 2019. *Diarrhea remains a leading killer of young children, despite the availability of a simple treatment solution*. UNICEF, New York, 2019

UNICEF. 2020. *State of the World's Children 2019: children, food and nutrition.* United Nations.

Van Der Kam, S., Salse-Ubach, N., Roll, S., Swarthout, T., Gayton-Toyoshima, S., Jiya, N. M., et al., 2016. Effect of short-term supplementation with ready-to-use therapeutic food or micronutrients for children after illness for prevention of malnutrition: A randomized controlled trial in Nigeria. PLoS Med. 13 (2), e1001952

Voetsch, A.C., Van Gilder, T.J., Angulo, F, J., et al. 2004. FoodNet Estimate of the Burden of Illness caused by nontyphoidal Salmonella infections in the United States. *Clinical Infectious Disease* 38(Sup3): S127–S134.

Vubil, D., Balleste-Delpierre, C., Mabunda, R., Acacio, S., Garrine, M., Nhampossa, T., et al., 2018. Antibiotic resistance and molecular characterization of Shigella isolates recovered from children aged less than 5 years in Manhiça, Southern Mozambique. *Int. J. Antimicrob*. Agents 51 (6), 881–887

Wang, J., Sun, H., Qi, L., Shi, X.H., Zhou, Y., Min, K.Y., et al., 2019. *The surveillance of Yersiniosis among children in central area of Beijing from 2011 to 2018*. *Zhonghua yu fang yi xue za zhi* [Chin. J.Prev. Med.] 53 (10), 1027–1031.

Wessells, K.R., Brown, K.H., Kounnavong, S., Barffour, M.A., Hinnouho, G.M., Sayasone, S., et al., 2018. Comparison of two forms of daily preventive zinc supplementation versus therapeutic zinc supplementation for diarrhea in young children's physical growth and risk of infection: Study design and rationale for a randomized controlled trial. *BMC Nutrition 4* (1):39

WHO. 2015. *WHO estimates of the global burden of foodborne diseases. Foodborne disease burden epidemiology reference group 2007-2015*. World Health Organisation. doi: 10.1016/j.fm.2014.07.009.

Willey, J., Sherwood, L., Wolverton, C. 2013. *Prescott's Microbiology*, ninth ed. McGraw-Hill, New York, pp. 51–84.

Willey, J., Sherwood, L., Wolverton, C. 2013. Prescott's Microbiology, ninth ed. McGraw-Hill, New York, pp. 51–84. Williams, P.C., Berkley, J.A., 2018. Guidelines for the treatment of dysentery (shigellosis): a systematic review of evidence. Paediatr. *Int. Child Health 38* (sup1), S50–S65

Williams, P.C., Berkley, J.A., 2018. *Guidelines for the treatment of dysentery (shigellosis): a systematic review of the evidence*. Paediatr. Int. Child Health, 38 (sup1), S50–S65.

Zhao, W., Torabi, B., Duncan, L., Ke, D., Cohen, C.G., Ben-Shoshan, M., Mazer, B.D. 2019. Serological profiles of children who underwent oral immunotherapy with cow's milk Immunol. 143 (2), AB253.

# CHAPTER THREE

# ASSESSMENT OF DIAGNOSIS AND TREATMENT PRACTICES OF DIARRHEA IN CHILDREN UNDER FIVE IN MAPUTO-MOZAMBIQUE

## 3.1 INTRODUCTION

This chapter focuses on Stage 1 of the study, which is available as an article published in the International Journal of African Nursing Sciences (Elsevier). Appendix 4 provides the instructions for the authors. This chapter reports a retrospective study of how healthcare providers diagnose foodborne diarrheal diseases, the research methodology used to collect the data, the findings and discussions, and the conclusions and limitations of the research.

## 3.2 ARTICLE PUBLISHED

International Journal of Africa Nursing Sciences 17 (2022) 100507

Contents lists available at ScienceDirect

International Journal of Africa Nursing Sciences

journal homepage: www.elsevier.com/locate/ijans

# Assessment of diagnosis and treatment practices of diarrhoea in children under five in Maputo-Mozambique

Nórgia Elsa Machava [a,*], Elsa Maria Salvador [b], Fhumulani Mulaudzi [a]

[a] Department of Nursing Sciences, Faculty of Health Sciences, University of Pretoria, South Africa
[b] Department of Biological Sciences, Faculty of Sciences, Eduardo Mondlane University, Maputo, Mozambique

ARTICLE INFO

*Keywords:*
Children under five
Diarrhoea
Diagnosis
Treatment

ABSTRACT

*Background:* Although diagnosis and treatment of diarrhoea are considered easy, statistics show that 525,000 children worldwide die annually due to diarrhoea, 90% of the deaths are in Sub-Saharan Africa and South Asia, and Mozambique account for 6.9%. Assessment of practices of diagnosis and treatment of diarrhoea in children under five were con-ducted in Maputo, Mozambique.

*Design and method:* The study was retrospective – source of information: record books from 2015 to 2019. All statements about age, gender, signs and symptoms, diagnoses, and treatment were collected to assess practices implemented by the health professionals to diagnose diarrhoea in children under five.

*Results:* A total of 9,041 cases were found, where 4,052 (44, 8 %) were female, urban area accounts for 7,668 (74.8 %). Children younger than 6 months 1,013 (11,2%); from 6 to 11 months 1,370 (15,2%); from 12 to 23 months 2,535 (28 %); from 24 to 35 months 1,674 (18.5 %), from 36 to 47 months 1,239 (13.7 %) and from 48 to 59 months 1,210 (13.4 %). About 3,644 (40.3 %) had fever, 3,467 (38 %) vomit, 1,999 (22 %) blood in stool and other symptoms; only 5 (1 %) of the children's stools were submitted for laboratory analysis. The clinical diagnoses were diarrhoea 3,905 (43 %), diarrhoea and vomit 2,037(22 %) and others. The main treatment was oral rehydration salts 7,118 (79 %) and 21 % antibiotics.

*Conclusion:* Even when the signs and symptoms (fever and blood in stool) suggested or required laboratory exams, this was not done. Nevertheless, the children were treated with antibiotic without the screening of etiological agent.

## 1. Introduction

In 2017, the World Health Organization (WHO) reported nearly 1.7 billion cases of diarrhoea in children worldwide; the disease is the second most frequent cause of death in children younger than five (Abebe et al., 2018, Workie et al., 2019, Getachew et al., 2018). It amounts to one in eight deaths in children under five years of age (Kotloff, 2017). About 525,000 children continue to die each year because of the disease. Among the children who die each year 90 % happen to be in Sub-Saharan Africa and South Asia (Karambizi et al., 2021, Aziz et al., 2018). And diarrhoea is a common disease in children younger than five years of age in some communities of Mozambique (Nhampossa et al., 2015, Chissaque et al., 2018). Along the country, diarrhoeal diseases are considered to be the third leading cause of hospital admission in rural areas among children and the fourth cause of death among children aged 12–59 months (Nhampossa et al., 2015). According to WHO (2017) diarrhoea is defined as the loss of fluid or watery stools at least three times per day, or more frequently than normal (Levine et al, 2017); diarrhoea is also considered as a common symptom of gastrointestinal disorder caused by a wide range of pathogens, including parasites, bacteria, and viruses (Morais et al., 2013; WHO, 2015).

Diagnosis of diarrhoea is centred on anamnesis, complete clinical examination, and adequate laboratory exam (Shane et al., 2017, Long et al., 2003, Guarino et al., 2018). Generally, the health providers use signs and symptoms to diagnose diarrhoeal diseases without confirmation of the laboratory results (Arendt et al., 2013). Signs and symptoms, such as the regularity and arrival of watery stools, incidences of vomiting, abdominal pain and related ailments, are used specifically to

*Abbreviations:* HIV, Human Immunodeficiency Virus; INE, Instituto NAcional de Estatistica; ORS, Oral Rehydration Solution; SPSS, Statistical Package for the Social Sciences; WHO, World Health Organization.

* Corresponding author.
*E-mail addresses:* norgiaelsamachava@gmail.com, u19406429@tuks.co.za (N.E. Machava).

https://doi.org/10.1016/j.ijans.2022.100507
Received 24 March 2022; Received in revised form 24 October 2022; Accepted 25 October 2022
Available online 26 October 2022

diagnose diarrhoeal diseases and to determine the treatment thereof. In addition, a physical examination is conducted and the observation of the skin turgor and elasticity is done. It is important to conduct laboratory examinations to assess and determine serum values of potassium, sodium, clorox, acid-base status, creatinine, glucose, biochemical limits of inflammation, normal urine analysis, and in certain cases, homo culture as well (Shane et al., 2017, Long et al., 2003, Farthing et al., 2013) Having laboratory results could confirm and assist the health provider in the treatment of diarrhoeal diseases and prevent complications, such as severe dehydration, loss of electrolytes and ultimately, death. A person with fever or bloody diarrhoea should be clinically evaluated and start on antibiotics treatment after confirmation of the agent.

The practice of pharmacologic treatments, such as antibiotics and antidiarrhoeal agents, is not recommended because the disease is normally self-limiting and their practice can be destructive for the organism of the children (Shane et al., 2017). Diarrhoeal diseases are treated with fluid therapy mostly oral rehydration. The solution is administered to treat diarrhoea by replacing the lost fluid and electrolytes, to give the body energy and to retain fluid. Health providers are advised to rehydrate children under the age of five immediately, using an oral rehydration solution to prevent increased chances of disability and death (Shane et al., 2017, WHO, 2004). According to WHO, in developing countries, half of diarrhoeal diseases are treated with antibiotics (de la Cabada Bauche et al., 2011, Belderok et al., 2011, Chakraborty et al., 2021). And most prescriptions of antibiotics are provided empirically without any previous screening of the agent (Chakraborty et al., 2021).

If diarrhoeal diseases are not treated properly, the children become malnourished, more vulnerable to diarrhoea and other infections and these increases their risk of death (Tickell et al., 2017).The question is, why is diarrhoea still being treated with antibiotics without laboratory screening. To address the question, retrospective data was collected and the information was used to assess how the health providers perform diagnoses and treatment of diarrhoea in children under five as the disease remains a health problem in this age group.

## 2. Methods

### 2.1. Study place

The study took place in four public referral health facilities of Maputo-Mozambique, one rural and three urban health facilities. The rural Health Centre is located in Marracuene District, Eastern part of Maputo City and provides primary health care services to around 12,000 people with several illnesses. Malaria is among the main diseases pointed out. However, many other health care services and programmes are offered, which include diarrhoeal diseases, sexual transmitted infections, antenatal care, family planning and non-communicable diseases (diabetes and high blood pressure) among other programmes and services. All three urban health facilities are in Maputo City, located in the extreme South of the country which occupies 346 $km^2$, with 1,124,988 people, according to the National Institute of Statistics (INE, 2020a; 2020b). Mavalane General Hospital and Mavalane Health Centre are two hospitals on the same premises. The Mavalane Health Centre is part of 10 health centres which refer patients to Mavalane General Hospital and they are responsible for providing curative and preventive medical health assistance. The Central Hospital of Maputo is the major hospital of Mozambique. It receives patients from all parts of the country and offers all health services. Mozambique accounts for 58.124 health professionals and the Central Hospital of Maputo holds 3.431 (5.9 %). In the whole country the proportion health worker per 100.000 inhabitants is 109.3 (INE, 2020a; 2020b).

A quantitative method was used to assess the diagnosis and treatment of diarrhoeal diseases by the health providers (nurses, health technicians and doctors) at the selected health facilities in Maputo. The study used retrospective data available in the record books of the hospital from 2015 to 2019. Data was collected from the records of the health facilities in 2021, during 8 months (March to December) on working days from 8 AM to 2 PM. The collected data was categorized into five sections, namely, A-Biography, B-Main signals (signs) and symptoms, C-Laboratory examination, D-Treatment and E- Diagnosis. All records without information about age, gender, diagnosis and treatment were excluded. The study also excluded cases of diarrhoea determined by non-infectious origins, known or documented human immunodeficiency virus (HIV), and/or other immunocompromised status and known serious medical diseases.

### 2.2. Data collection

For the data collection, a check list was used and placed in Excel sheet to facilitate labelling of data during the collection. A team of three data collectors' assistants entered the data on the computer. For quality control, piloting was done with about five instruments of each data collector's tools. The objective of piloting was to verify probable mistakes on the data collection tools, and familiarise research assistants with the instruments. Before the main study, all research assistants were trained by the principal investigator to ensure understanding of the instruments, criteria of inclusion and exclusion, as well as other aspects of data collection. Comments and suggestions identified from the pilot study were incorporated in the final tools and concerns from the research assistants were resolved. After the piloting, the developed instruments for data collection were evaluated for consistency and plausibility by the researcher and supervisors. Every-one in the research team (research assistants trained by the principal investigator) was aware of the objectives of the study and how the data should be collected to guarantee the success of the study.

### 2.3. Data analysis

The data was analysed using the Statistical Package for the Social Sciences (SPSS) software, version 23, and the Microsoft Excel database and the analysis was done with the support of a statistician. Descriptive statistics were performed to organise, interpret, and communicate the numeric information.

### 2.4. Ethical considerations

Ethical clearance was obtained from the Ethical Review Committee of the University of Pretoria. Permission was sought and obtained from the Central Hospital of Maputo, District Directorate for Women's Health and Social Action of Marracuene, and the Maputo City Health Directorate. The study started after clearance from the health authorities and all ethical commitments were observed and respected during the study.

## 3. Results

### 3.1. Socio-demographic characteristics

The present study assessed the diagnosis and treatment of diarrhoea in children under the age of five from 2015 to 2019. The records with missing information and damaged pages were not quantified. According to the results, 9,041 records had information about children with diarrhoeal diseases in the four health facilities of the study. Table 1 shows the cases of diarrhoea per health facility and the gender of children affected.

The Table 2 describes the cases of diarrhoea per age group. It can be seen that the cases concentrated in three age group (2, 3 and 4).

### 3.2. Signs and symptoms and laboratory analyses

Table 3 shows the signs and symptoms found in the record books. Stools of only five (0, 1 %) children were submitted to laboratory analysis, whereas the majority 9, 036 (99, 9 %) was not submitted.

**Table 1**
Cases reported per health facility per area and gender.

| Area | Health facility | Cases reported | % of cases reported | Cases (%) | Gender | |
|---|---|---|---|---|---|---|
| | | | | | Male | Female |
| Rural | Marracuene health centre | 1,373 | 15,2 | 1,373 (25.2) | 736 (8.1 %) | 637 (7 %) |
| Urban | Mavalane health centre | 1,209 | 13.4 | 7,668 (74.8) | 680 (7.5 %) | 729 (5, 9 %) |
| | Mavalane general hospital | 3,004 | 33,2 | | 1,533 (17 %) | 1,471 (16.3) |
| | Maputo Central Hospital | 3,455 | 38.2 | | 2,040 (22 %) | 1,415 (15,7) |
| Total | | 9,041 | 100 | 9,041 | 4,989 (55, 2 %) | 4,052 (44, 8 %) |

**Table 2**
Cases of diarrhoea reported per age group.

| N | Age group (months) | No of reported cases | % of reported cases |
|---|---|---|---|
| 1 | <6 | 1,013 | 11.2 |
| 2 | 6–11 | 1,370 | 15.2 |
| 3 | 12–23 | 2,535 | 28.0 |
| 4 | 24–35 | 1,674 | 18.5 |
| 5 | 36–47 | 1,239 | 13.7 |
| 6 | 47–59 | 1,210 | 13.4 |
| Total | | 9,041 | 100 |

**Table 3**
Sign and symptoms of the children with diarrhoea.

| Signs and symptoms | Reported | | |
|---|---|---|---|
| | yes | No | Total |
| Vomit | 3,467(38.3 %) | 5,574 (61.7 %) | 9,041 (100 %) |
| Fiver | 3,644 (40.3 %) | 5,397 (59.7) | 9,041 (100 %) |
| Blood in stool | 1,999 (22.1 %) | 7,042 (77.9 %) | 9,041 (100 %) |
| Combined signs and symptoms | 9,038 (100 %) | 3 (0, 01 %) | 9,041 (100 %) |

### 3.3. Treatment

For the treatment for diarrhoea drugs such as zinc sulphate, oral rehydration salts (ORS), metronidazole, cotrimoxazole and others not specified were used (Table 4).

### 3.4. Diagnosis

Table 5 describes the type of diagnosis reported in the record books.

**Table 4**
Drugs used to treat children with diarrhoea.

| Drugs | Reported treatment | | |
|---|---|---|---|
| | Yes | No | Total |
| Zinc Sulphate | 5,399 (59.7 %) | 3,642 (40.3 %) | 9,041 (100 %) |
| ORS | 7,118 (78.7 %) | 1,923 (21.3 %) | 9,041 (100 %) |
| Metronidazole | 1,325 (14.7 %) | 7,716 (85.3 %) | 9,041 (100 %) |
| Cotrimoxazole | 608 (6.7 %) | 8,432 (93.3 %) | 9,041 (100 %) |
| Antibiophilo | 3,831 (42.4 %) | 5210 (57.6 %) | 9,041 (100 %) |
| Other Combined drugs | 8179 (90.5 %) | 862 (9.5 %) | 9,041 (100 %) |

**Table 5**
Diagnosis reported in the record books.

| Diagnose | Frequency | % |
|---|---|---|
| Diarrhoea | 3905 | 43.2 |
| Diarrhoea + Vomiting | 2037 | 22.5 |
| Diarrhoea + Cough | 1680 | 18.6 |
| Diarrhoea + Upper airway infections | 557 | 6.2 |
| Diarrhoea + Vomiting + Cough | 103 | 1.1 |
| Dysentery | 225 | 2.5 |
| Others | 533 | 5.9 |
| Total | 9041 | 100 |

It can be observed that diarrhoea can occur alone or combined with other symptoms.

## 4. Discussion

According to the results of the present study, there seem to be more cases of diarrhoea in urban areas which were three times more than the cases reported in the rural areas. Comparing the two referral hospitals, Marracuene (Rural), and Mavalane General Hospital (urban), it can observed that cases in urban areas continue to be higher against rural. This finding could be due to the higher agglomeration of population in the urban regions, whereas the population in rural areas lives dispersed from each other. In addition, the users of Mavalane General Hospital mostly come from neighbourhoods with poor water and sanitation conditions. The findings of the present study could be supported by previous studies reporting the poorest sanitation conditions and hygiene in Maputo City (Mottelson, 2020), taking into consideration that Mavalane General Hospital, Mavalane Health Centre and Maputo Central Hospital are located in this city.

In this study, diarrhoea was higher among children from 6 to 35 months of age. This could be due the underdeveloped immune system of the children in addition the fact that in this age group children are starting to eat complementary food. The new foods could cause certain gastrointestinal disorders, which may result in diarrhoea. Furthermore, the hygiene quality of complementary food and water used for its preparation are other elements that could be taking into account, as poor hygiene of food and water could result in diarrhoea in children. It is well known that, in this age group, children begin to crawl then walk which result in more contact with the ground; where whatever they find they put in their mouths. Both the ground and objects could be contaminated by microorganisms that cause diarrhoea. Cases of diarrhoea in children under six months are not common. However, some cases were found in the record books, which could be due to early stopping of breastfeeding and early introduction of complementary food. The findings of this study are supported by previous researches which reported that in Mozambique diarrhoea infections in children under five particularly in age from 0 to 24 months are still a problem (Nhampossa et al., 2015; Chissaque et al., 2018; Chissaque et al., 2021). The cases of diarrhoea reported in the group from 36 to 59 months are considered normal, because the immunity system starts to consolidate and children start to be aware of the principles of hygiene such as how to wash hands and distinguish dirty and clean. A previous study reported similar findings (Gupta et al., 2015, Stephen et al., 2017).

Fever and vomiting were the main symptoms reported in children with diarrhoea. These symptoms could be the main cause of electrolyte disorder which consequently results in diarrhoea and if not treated in time, could end up in hypoglycaemia, convulsions and death. In the record books cases of blood in the stool were reported. When there is blood in the stool and fever, laboratory analysis to identify the agent is required. In this study, this recommendation was not followed, because only a few cases with blood in the stool were sent for laboratory exam. The practice reported was against the guideline of the Society of America Clinical Practices and WHO (Shane et al., 2017, WHO, 2004). This attitude of not screening for the agent even when the stool shows

blood and the child had fever seems to be harmful as it can result in incorrect diagnoses.

Generally, the children were reported to be treated correctly as there were cases that were given oral rehydration salts and zinc sulphate which is in accordance with the universal guideline for diarrhoea treatment (WHO, 2004). Other types of treatment were given, but the use of antibiotics calls for attention. Following the procedures of looking for the diagnoses, antibiotics cannot be given without first knowing the agent. It can be considered that the procedures of treatment and diagnoses were not healthy as the study did not allow or determining whether the antibiotics were properly taken. All these together can result in antibiotic resistance. Previous studies have reported that empiric antimicrobial treatment is not recommended for diarrhoea (Shane et al., 2017, Mohanan et al., 2015). In Mozambique, antibiotic resistance have been reported (Vubil et al., 2018), as well as in other developing countries around the world (Mohanan et al., 2015, Mediratta et al., 2010, Carvajal-Velez et al., 2016, Wilson et al., 2012), what could be the arbitrary use of antibiotic.

Diarrhoea infection was common in the record books, and this was found alone or combined with other symptoms. The clinical diagnoses were reported as diarrhoea with vomiting, cough, dysentery and others. These diagnoses were found based on reported signs and symptoms without laboratory confirmation.

### *4.1. Limitations*

Due to the covid-19 pandemic it was not possible to collect data in some health facilities previously selected for the study, some data was not found because of inappropriate conservation of the record books some data was not correctly filed and other was omitted there were books with missing pages. As way to surpass the constrains other health facilities were identified. Inappropriate conservation or missed information influenced the coverage of the research.

## 5. Conclusion

All in all, diarrhoea is diagnosed without screening for the etiological agent even in children with fever and blood in the stool. Treatment is done according to universal recommendations. However, some cases were treated with antibiotics without knowing the cause. It is advisable to create conditions to screen diarrhoeal agents especially in case of fever and blood in the stool.

## Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

## References


Abebe, W., Earsido, A., Taye, S., Assefa, M., Eyasu, A., & Godebo, G. J. B. P. (2018). Prevalence and antibiotic susceptibility patterns of Shigella and Salmonella among children aged below five years with Diarrhoea attending Nigist Eleni Mohammed memorial hospital, South Ethiopia. *BMC Pediatrics, 18*, 1–6. https://doi.org/10.1186/s12887-018-1221-9

Arendt, S., Rajagopal, L., Strohbehn, C., Stokes, N., Meyer, J., Mandernach, S., & Health, P. (2013). Reporting of foodborne illness by US consumers and healthcare professionals. *International Journal of Environmental Research and Public Health, 10*, 3684–3714. https://doi.org/10.3390/ijerph10083684

Aziz, F. A. A., Ahmad, N. A., Razak, M. A. A., Omar, M., Kasim, N. M., Yusof, M., Sooryanarayana, R., Jamaludin, R. & Ying, C. Y. J. B. P. H. 2018. Prevalence of and factors associated with diarrhoeal diseases among children under five in Malaysia: a cross-sectional study. BMC public health. (2018) 18:1363. https://doi.org/10.1186/s12889-018-6266-z.

Belderok, S.-M., Van Den Hoek, A., Kint, J. A., Van Der Loeff, M. F. S., & Sonder, G. (2011). Incidence, risk factors and treatment of diarrhoea among Dutch travellers: Reasons not to routinely prescribe antibiotics. *BMC Infectious Diseases, 11*, 295. http://www.biomedcentral.com/1471-2334/11/295.

Carvajal-Velez, L., Amouzou, A., Perin, J., Maiga, A., Tarekegn, H., Akinyemi, A., … Newby, H. (2016). Diarrhea management in children under five in sub-Saharan Africa: Does the source of care matter? A Countdown analysis. *Bmc Public Health, 16*, 830. https://doi.org/10.1186/s12889-016-3475-1

Chakraborty, D., Debnath, F., Kanungo, S., Chakraborty, N., Basu, R., Das, P., Datta, K., Ganguly, S., Banerjee, P. & Dutta, S. 2021. Pattern of prescription practices in acute respiratory infection and diarrhoea cases in out patient department of tertiary care hospitals in West Bengal, India; A Cross Sectional Analysis through Rational Use of Medicine Consensus Approach. Reserch Square. doi: https://doi.org/10.21203/rs.3.rs-799005/v1.

Chissaque, A., Cassocera, M., Gasparinho, C., Langa, J. S., Bauhofer, A. F. L., Chilaule, J. J., Joao, E. D., Munlela, B. A., Sambo, J. A. M., Boene, S. S., Djedje, M. B., Anapakala, E. M., Guimaraes, E. L., Bero, D. M., Manhique-Coutinho, L. V., Cossa-Moiane, I., Kellogg, T. A., Goncalves, L. A. P. & De Deus, N. 2021. Rotavirus A infection in children under five years old with a double health problem: undernutrition and diarrhoea – A cross-sectional study in four provinces of Mozambique. Bmc Infectious Diseases, 21 doi-101186/s12879-020-05718-9.

Chissaque, A., De Deus, N., Vubil, D., & Mandomando, I. (2018). The epidemiology of diarrhea in children under 5 years of age in Mozambique. *Current Tropical Medicine Reports, 5*, 115–124. https://doi.org/10.1007/s40475-018-0146-6

De La Cabada Bauche, J., Dupont, H. L. J. G., & Hepatology. (2011). New developments in traveler's diarrhea. *Gastroenterology & Hepatology, 7*, 88. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3061023/.

Farthing, M., Salam, M. A., Lindberg, G., Dite, P., Khalif, I., Salazar-Lindo, E., … Khan, A. G. (2013). Acute diarrhea in adults and children: A global perspective. *Journal of Clinical Gastroenterology, 47*, 12–20. https://doi.org/10.1097/MCG.0b013e31826df662

Getachew, A., Guadu, T., Tadie, A., Gizaw, Z., Gebrehiwot, M., Cherkos, D. H., … Gebrecherkos, T. (2018). Diarrhea prevalence and sociodemographic factors among under-five children in rural areas of North Gondar Zone, Northwest Ethiopia. *International Journal of Pediatrics, 2018*. https://doi.org/10.1155/2018/6031594

Guarino, A., Lo Vecchio, A., Dias, J. A., Berkley, J. A., Boey, C., Bruzzese, D., Cohen, M. B., Cruchet, S., Liguoro, I., Salazar-Lindo, E., Sandhu, B., Sherman, P. M. & Shimizu, T. 2018. Universal recommendations for the management of acute diarrhea in nonmalnourished children. Journal of Pediatric Gastroenterology and Nutrition, 67, 586-593. 01;. doi:10.1097/MPG.0000000000002053.

Gupta, A., Sarker, G., Rout, A. J., Mondal, T., & Pal, R. (2015). Risk correlates of diarrhea in children under 5 years of age in slums of Bankura, West Bengal. *Journal of Global Infectious Diseases, 7*(1), 23. https://doi.org/10.4103/0974-777X.150887

INE Instituto Nacional de Estatística, 2020. Anuario Estatistico 2020- Cidade de Maputo.

INE Imstituto Nacional de Estatística. 2020. Anuário Estatístico de Saúde 2019. Maputo.

Karambizi, N. U., Mcmahan, C. S., Blue, C. N., & Temesvari, L. A. J. P. O. (2021). Global estimated Disability-Adjusted Life-Years (DALYs) of diarrheal diseases: A systematic analysis of data from 28 years of the global burden of disease study. *PloS One, 16*, e0259077.

Kotloff, K. L. (2017). The burden and etiology of diarrheal illness in developing countries. *Pediatric Clinics of North America, 64*, 799–814.

Levine, G. A., Walson, J. L., Atlas, H. E., Lamberti, L. M., & Pavlinac, P. B. (2017). Defining pediatric diarrhea in low-resource settings. *Journal of the Pediatric Infectious Diseases Society, 6*(3), 289–293.

Long, S. S., Pickering, L. K., & Prober, C. G. (2003). *Principles and practice of pediatric infectious diseases*. LWW.

Mediratta, R. P., Feleke, A., Moulton, L. H., Yifru, S., & Sack, R. B. (2010). Population, & Nutrition 2010, Risk factors and case management of acute diarrhoea in North Gondar Zone, Ethiopia. *Journal of Health, Population, and Nutrition, 28*, 253. https://doi.org/10.3329/jhpn.v28i3.5552

Mohanan, M., Vera-Hernández, M., Das, V., Giardili, S., Goldhaber-Fiebert, J. D., Rabin, T. L., … Seth, A. J. J. P. (2015). The know-do gap in quality of health care for childhood diarrhea and pneumonia in rural India. *AMA Pediatrics, 169*, 349–357. https://doi.org/10.1001/jamapediatrics.2014.3445

Morais, M.B., Tahan, S., Mello, C.S. 2013. Diarreia aguda: Probióticos e outros coadjuvantes na terapêutica. Atualidades em clínica cirúrgica intergastro e trauma 2012, 3 ed, São Paulo: Atheneu, 539–549.

Mottelson, J. Urban densification of informal settlements in Sub-Saharan Africa: an analysis of recent developments in Maputo, Mozambique. ISUF 2020 Virtual Conference Proceedings, 2021.

Nhampossa, T., Mandomando, I., Acacio, S., Quintó, L., Vubil, D., Ruiz, J., … Nhacolo, A. J. P. O. (2015). Diarrheal disease in rural Mozambique: Burden, risk factors and etiology of diarrheal disease among children aged 0–59 months seeking care at health facilities. *PloS One, 10*, e0119824.

Shane, A. L., Mody, R. K., Crump, J. A., Tarr, P. I., Steiner, T. S., Kotloff, K., … Cheng, A. C. (2017). 2017 Infectious Diseases Society of America clinical practice guidelines for the diagnosis and management of infectious diarrhea. *Clinical Infectious Diseases, 65*, e45–e80. https://doi.org/10.1093/cid/cix669

Stephen, A. J., Murila, F., & Wamalwa, D. (2017). Management of acute diarrhoea among children aged 6–59 months admitted at Juba Teaching Hospital. *South Sudan Medical Journal, 10*, 8–11.

Tickell, K. D., Pavlinac, P. B., John-Stewart, G. C., Denno, D. M., Richardson, B. A., Naulikha, J. M., … Hygiene 2017. (2017). Impact of childhood nutritional status on pathogen prevalence and severity of acute diarrhea. *The American Journal of Tropical Medicine and Hygiene, 97*, 1337. https://doi.org/10.4269/ajtmh.17-0139

Vubil, D., Acácio, S., Quintò, L., Ballesté-Delpierre, C., Nhampossa, T., Kotloff, K., … Resistance, D. (2018). Clinical features, risk factors, and impact of antibiotic treatment of diarrhea caused by Shigella in children less than 5 years in Manhiça District, rural Mozambique. *Infection and Drug Resistance, 11*, 2095–2106. https://doi.org/10.2147/IDR.S177579

WHO, U. J. W. H. A. G. 2004. WHO-UNICEF Joint statement on the clinical management of acute diarrhea.

Who. (2015). *WHO estimates of the global burden of foodborne diseases. Foodborne disease burden epidemiolgy reference group 2007–2015*. World Health Organization, 10.1016/j.fm.2014.07.009.

Wilson, S. E., Ouédraogo, C. T., Prince, L., Ouédraogo, A., Hess, S. Y., Rouamba, N., … Brown, K. H. J. P. O. (2012). Caregiver recognition of childhood diarrhea, care seeking behaviors and home treatment practices in rural Burkina Faso: A cross-sectional survey. *PloS One, 7*, e33273.

Workie, G. Y., Akalu, T. Y., & Baraki, A. G. (2019). Environmental factors affecting childhood diarrheal disease among under-five children in Jamma district, South Wello zone, Northeast Ethiopia. *BMC Infectious Diseases, 19*, 1–7. https://doi.org/10.1186/s12879-019-4445-x

# CHAPTER FOUR

# HOUSEHOLD FACTORS FOR FOODBORNE DIARRHEA IN CHILDREN UNDER FIVE IN TWO DISTRICTS OF MAPUTO- MOZAMBIQUE

## 4.1 INTRODUCTION

This chapter focuses on Phase Two, published in the International Journal of Environmental Research and Public Health by MDPI. The authors' instructions are provided in Appendix 5 provides instructions for the authors. This chapter emphasizes the main factors of foodborne diarrhea in households reported by the caregivers in the study area (Marracuene and Kamaxaquene districts), the research methodology used to collect the data, the findings, the discussions of the findings, and the relationships between previous research and the conclusions.

## 4.2 ARTICLE PUBLISHED

International Journal of
*Environmental Research and Public Health*

MDPI

*Article*

# Household Factors of Foodborne Diarrhea in Children under Five in Two Districts of Maputo, Mozambique

**Nórgia Elsa Machava [1,*], Fhumulani Mavis Mulaudzi [1] and Elsa Maria Salvador [2]**

[1] Department of Nursing Science, Faculty of Health Sciences, University of Pretoria, Pretoria 0028, South Africa
[2] Department of Biological Sciences, Faculty of Science, Eduardo Mondlane University, Maputo P.O. Box 257, Mozambique
* Correspondence: norgiaelsamachava@gmail.com; Tel.: +258-843832777

**Abstract:** Household factors involved in the disease of diarrhea are multifaceted. This study aimed to explore and describe the household factors affecting foodborne diarrhea in children younger than 5 years old using structured questionnaire data based on quantitative tools. The sample size was calculated based on a binomial distribution. A total of 300 children, together with their caregivers, participated, and the data were descriptively and mathematically analyzed using Epi Info modelling. The caregivers were mostly female and included 93.3% rural and 84% urban dwellers of ages between 18 and 38, who were single but living with someone. Of the children who were under six months of age, 23.3% in rural areas and 16.6% in urban areas had diarrhea, while of the children between 12 and 23 months of age, 36.6% in urban areas and 30% in rural areas had diarrhea. The relatives had similar symptoms before the child became ill, with 12.6% of relatives in rural areas and 13.3% in urban areas reporting this. Before receiving medical assistance, 51.3% of children in rural areas and 16% of children in urban areas were treated with traditional medication. Water was not treated before drinking in 48% of rural cases and 45.3% of urban cases. A total of 24.6% of infants in urban areas and 12.6% of infants in rural areas used a bottle for feeding. The factors affecting foodborne diarrhea were the use of traditional medication in rural areas, bottle feeding in urban areas and untreated water used for drinking in both areas.

**Keywords:** foodborne diarrhea; caregivers; children under five; factors



**Citation:** Machava, N.E.; Mulaudzi, F.M.; Salvador, E.M. Household Factors of Foodborne Diarrhea in Children under Five in Two Districts of Maputo, Mozambique. *Int. J. Environ. Res. Public Health* **2022**, *19*, 15600. https://doi.org/10.3390/ijerph192315600

Academic Editor: Paul B. Tchounwou

Received: 8 September 2022
Accepted: 19 November 2022
Published: 24 November 2022



## 1. Introduction

Diarrhea is the most important foodborne communicable disease among children under five. It is the fifth main cause of death in children under five, and about 2.5 million children die annually in the world due to it [1,2]. Diarrhea is considered the third commonest cause of disease in children globally [3]. Diarrhea is more critical in developing countries, where it is considered the second commonest cause of death, and around 22% of childhood deaths are attributable to diarrhea [4].

In sub-Saharan Africa, the morbidity of diarrhea is associated with poverty and other socio-demographic factors [5]. Appropriate drinking water, food handlers, poor sanitation, deficient hygiene behaviors (WASH) and unclean environmental sanitary conditions are the principal factors that cause diarrhea [6–8]. Among these factors, insufficient WASH is the main factor. In total, 30% of people around the world do not use a safely managed drinking water service. In places where water services are available, in many cases, the water is contaminated. Approximately 2.3 billion people lack elementary sanitation services, and more than 60% do not consume appropriate water and dispose of their excreta in an inadequate way [9].

In Mozambique, 56% of households have adequate access to water, and 39% of households have access to improved sanitation [10]. Various studies on low- and middle-income countries (LMICs) have shown high levels of microbial contamination in children's

foods [11,12]. Children are quickly exposed to fecal material, unclean foods and other contaminated substances, such as water, human hands, soil and objects. Recurrent contact with contaminated materials can cause foodborne diarrhea in young children [13].

Among children under five, the age group between 6 and 11 months are most commonly affected by diarrhea because, in this age group, the children start to eat complementary foods, which can also be contaminated. Furthermore, this is the age when children come into contact with soil and test things by mouth [14].

There are many factors of foodborne diarrhea. There is a need to know these factors in order to intervene in three aspects of the disease, namely its prevention, treatment and control. The question of the present research was: what are the household factors of the origin of foodborne diarrhea in children younger than five? To address the question of the research, we explore and describe the household factors of foodborne diarrhea in children younger than five years of age.

## 2. Materials and Methods

The study took place in two districts of Maputo, namely the rural area known as the Marracuene district, with 230,530 inhabitants, of which 29,277.32 are children under five, and the urban area known as the Kamaxakeni district, with 203,660 inhabitants, of which 20,930 are children under five years of age. The data were collected using face-to-face interviews based on a structured questionnaire. The data collection questionnaire was piloted to reduce probable inaccuracy and eliminate possible incongruences. Caretakers attending the health facility with children with diarrhea infections were interviewed. The sample size was calculated based on a binomial distribution. A total of 300 children, together with their caregivers, participated in the study, with 150 children from urban areas and 150 children from rural areas. The calculations were based on an assumption of an average prevalence of less than 10%, assuming a sensitivity and specificity of 60% and 99%, respectively, and a precision of 5% at the 95% confidence level. The sample size calculations were conducted with Epitool (http://epitools.ausvet.com.au/content.php?page=home, accessed on 10 February 2020).

All the children under five with diarrhea infections at the health facility who were accompanied by their caregivers were required to have lived in the same household for at least 3 months. The data were analyzed based on descriptive and mathematical modelling (Epi Info). Prior to the study, the protocol was approved by the ethical committee of the Faculty of Health Science at the University of Pretoria, South Africa, with the registration number 595/2020-Line 1. The research was authorized by the health facility where the study took place. The confidentiality of all the data collected was secured, and anonymity was ensured by using codes to identify the participants.

## 3. Results

### *3.1. Socio-Demographic Characteristics*

The children were mostly accompanied by their mothers (Table 1). The age and gender of the caregivers can be seen in Table 1. The marital status of the caregivers was single but living with someone for 76.6% (115) of individuals in rural areas and 68.6% (103) of individuals in urban areas and married for 18% (27) of individuals in urban areas and 14% (21) of individuals in rural areas. The age and gender distribution of the children with foodborne diarrhea can be seen in Table 1. Table 2 describes the occupations and monthly income of the caregivers. In the household, the income provider was male in 48.6% (73) of cases and female in 17.3% (26) of cases in rural areas and male in 57.3% (86) of cases and female in 26.6% (40) of cases in urban areas. A description of the rooms and number of individuals per room used for sleeping can be found in Table 3. The construction materials of the houses visited in the present study are described in Table 4.

**Table 1.** Genders and ages of caretakers and children.

| Gender *n* = 300 | | | | | Age *n* = 300 | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Caregivers | | Children | | | Caregivers | | | Children | |
| | Rural | Urban | Rural | Urban | Interval (Years) | Rural | Urban | Interval (Months) | Rural | Urban |
| Male | 10 (6.7%) | 24 (16%) | 78 (52%) | 88 (58.7%) | 18 to 2 | 39 (25.7%) | 41 (27.5%) | <6 | 35 (23.3%) | 25 (16.6%) |
| | | | | | 23 to 27 | 46 (31.1%) | 51 (34.2%) | 6 to 11 | 29 (19.1%) | 28 (18.6% |
| | | | | | 28 to 32 | 30 (20.9%) | 12 (22.1%) | 12 to 23 | 45 (30%) | 55 (36.6%) |
| | | | | | 33 to 37 | 16 (10.1%) | 12 (8.1%) | 24 to 35 | 19 (12.7%) | 18 (12%) |
| | | | | | 38 to 42 | 15 (9.5%) | 3 (2.0%) | 36 to 47 | 11 (7.3%) | 9 (6%) |
| | | | | | 43 to 47 | 3 (2.0%) | 2 (1.3%) | 48 to 59 | 11 (7.3%) | 15 (10%) |
| Female | 140 (93.3%) | 125 (84%) | 72 (48%) | 62 (41.3%) | 48 to 52 | 0 | 1 (0.7%) | | | |
| | | | | | 53 to 57 | 1 (0.7%) | 4 (2.7%) | | | |
| | | | | | >63 | 0 | 2 (1.3%) | | | |
| Total | 150 | 150 | 150 | 150 | | 150 | | | 150 | 150 |

**Table 2.** Caregivers' occupations and incomes.

| Occupation | | | Monthly Income, Metical | | |
|---|---|---|---|---|---|
| | Rural | Urban | | Urban | Rural |
| Housewife | 20 (13%) | 29 (19%) | <4000 | 4 (3%) | 3 (2%) |
| Unemployed | 88 (59%) | 78 (52%) | 4000 to 8000 | 6 (4%) | 9 (6%) |
| Merchant | 13 (9%) | 12 (8%) | 8000 to 12,000 | 2 (1%) | 3 (1%) |
| Outdoor manual worker | 6 (4%) | 7 (5%) | 12,000 to 16,000 | 1 (1%) | 0 |
| Guard/police officer | 6 (4%) | 7 (5%) | 16,000 to 20,000 | 2 (1%) | |
| | | | 20,000 to 24,000 | 0 | 0 |
| Driver | 5 (3%) | 6 (4%) | 24,000 to 28,000 | 0 | 0 |
| Gardener | 5 (3% | 5 (3%) | 28,000 to 32,000 | 0 | 0 |
| Teacher | 4 (3%) | 3 (2%) | 32,000 to 36,000 | 1 (1%) | 0 |
| Soldier | 3 (2%) | 3 (2%) | >36,000 | 1 (1%) | 0 |
| | | | Do not Know | 133 | 135 |
| Total | 150 | 150 | | 100 | 100 |

**Table 3.** Number of rooms and average number of people living in the household.

| Rooms | | | Average Number of People Living in the Household | | |
|---|---|---|---|---|---|
| | Rural | Urban | | Rural | Urban |
| 1 | 59 (39%) | 37 (25%) | 2 to 3 | 48 (32%) | 26 (17%) |
| 2 | 51 (34%) | 24 (16%) | 4 to 5 | 61 (41%) | 50 (33%) |
| 3 | 28 (19%) | 41 (27%) | >6 | 41 (27%) | 74 (49%) |
| >4 | 12 (8%) | 48 (32%) | | | |
| Total | 150 | 150 | | 150 | 150 |

**Table 4.** Building materials and fuel used for cooking.

| Floor Material | | | Roof Material | | | Wall Material | | | Fuel for Cooking | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Urban | Rural | | Urban | Rural | | Urban | Rural | | Urban | Rural |
| Cement | 93 (62%) | 79 (53%) | Iron plate | 102 (68%) | 110 (73%) | Cement block | 108 (72%) | 98 (65%) | Charcoal | 45 (30%) | 49 (33%) |
| Ceramic tiles | 54 (36%) | 53 (35%) | Cement | 22 (15%) | 29 (19%) | Straw | 20 (13%) | 40 (27%) | Coal | 35 (23%) | 14 (9%) |
| Sand | 3 (2%) | 17 (11%) | Melamine | 23 (15%) | 10 (%) | bricks | 22 (15%) | 12 (8%) | Cooking gas | 33 (22%) | 31 (21%) |
| Others | 0 | 1 | Others | 3 (2%) | 1 (1%) | | | | Electricity | 25 (17%) | 18 (12%) |
| | | | | | | | | | Wood | 9 (6%) | 32 (21%) |
| | | | | | | | | | Others | 3(2%) | 6(4%) |
| Total | 150 | 150 | | 150 | 150 | | 150 | 150 | | 150 | 150 |

### *3.2. Disease-Related Questions*

Table 5 provides a description of the actions that the caregivers performed at the household level when the children became ill with diarrhea and the time taken before they received medical assistance. In addition, before medical assistance, the children were treated in the household with traditional medications, such as leaves and roots in 51.3% (77) of cases in rural areas and 16% (24) of cases in urban areas. Three months before the commencement of diarrhea, a few caregivers administered antibiotics to their children. These were given for the treatment of cough and diarrhea. The majority of children were vaccinated according to their age, following the Mozambican program of vaccination that includes the rotavirus vaccine at two and four months of age. Only 18.6% (28) of rural children and 19.3% (29) of urban children were not vaccinated. It was found that a small proportion of the children were admitted to hospital because of diarrhea, including only 2% (3) of rural children and 8.6% (13) of urban children. It was found that before the child became sick, there were other relatives with similar symptoms in the same household in 12.6% (19) of rural and 13.3% (20) of urban cases. After the sickness of the child, other individuals within the household became sick in 4.6% (7) of rural cases, and only one person was sick in the urban areas.

**Table 5.** Events before receiving medical assistance.

| Days before Medical Assistance | | | Home Treatment | | | Signs and Symptoms | | |
|---|---|---|---|---|---|---|---|---|
| | Rural | Urban | | Rural | Urban | | Rural | Urban |
| 0 to 3 | 122 (81%) | 57 (38%) | Antibiotic | 0 | 2 (1%) | Diarrhea | 150 | 150 |
| 4 to 6 | 6 (4%) | 4 (3%) | Do not know | 77 (51%) | 141 (94%) | Vomit | 28 (19%) | 37 (25%) |
| >7 | 13 (9%) | 6 (4%) | Nothing | 47 (31%) | 4 (3%) | Fever | 18 (12%) | 22 (15%) |
| Do not know | 9 (6%) | 83 (55%) | ORS (oral rehydration solution) | 1 (1%) | 0 | Cough | 25 (17%) | 24 (16%) |
| | | | Paracetamol | 2 (1%) | 0 | Cold | 24 (16%) | 15 (10%) |
| | | | Traditional medicine | 22 (15%) | 3 (2%) | Loss of appetite | 28 (19%) | 30 (20%) |
| | | | Water | 1 (1%) | 0 | Abdominal pain | 12 (8%) | 6 (4%) |
| | | | | | | Bright stools | 5 (3%) | 2 (%) |
| | | | | | | Others | 1 (1%) | 3 (2%) |
| | | | | | | Headache | 7 (%%) | 3 (2%) |
| | | | | | | Weakness | 1 (1%) | 2 (1%) |
| | | | | | | Dizziness | 0 | 1 (1%) |
| | | | | | | Obstipation | 0 | 1 (1%) |
| | | | | | | Fatigue | 1 (1%) | 2 (1%) |
| | | | | | | Joint pain | 0 | 1 (1%) |
| | | | | | | Dysuria | 0 | 1 (1%) |
| Total | 150 | 150 | | 150 | 150 | | 150 | 150 |

The majority of the caregivers reported having acquired food at the local market. The possible sources of diarrhea infection are described in Table 6, and the places where raw and cooked meat were acquired for the household are described in Table 7. Allergies to shellfish in the children were reported at a rate of 13.3% (40) in both districts.

**Table 6.** Possible sources of diarrhea.

| Source | Rural | Urban |
|---|---|---|
| Cloudy water | 4 (3%) | 10 (7%) |
| Sandwich | 5 (3%) | 1 (1%) |
| Fermented food | 7 (5%) | 6 (4%) |
| Teething | 23 (15%) | 8 (5%) |
| Artificial milk | 5 (3%) | 0 |
| Moon | 11 (7%) | 6 (4%) |
| Mango | 9 (6%) | 1 (1%) |
| I do not know | 47 (31%) | 105 (70%) |
| Others in small frequency (0–4) | 39 (26%) | 13 (9%) |
| Total | 150 | 150 |

**Table 7.** Places of food purchase.

| | Raw Meat | | Cooked Meat | |
|---|---|---|---|---|
| Purchase Place | Rural | Urban | Rural | Urban |
| Local Market | 113 (75%) | 57 (65%) | 32 (21%) | 14 (9%) |
| Supermarket | 26 (17%) | 23 (15%) | 2 (1%) | 5 (3%) |
| Butcher | 8 (5%) | 6 (4%) | 8 (5%) | 2 (1%) |
| Others | 2 (1%) | 5 (3%) | 6 (4%) | 0 |
| Not applicable (do not eat meat) | 1 (1%) | 13 (9%) | 6 (4%) | 14 (9%) |
| Directly from the producer | 0 | 0 | 0 | 1 (1%) |
| Self-sufficient | 0 | 0 | 0 | 0 |
| No answer | | | 96 (64%) | 114 (76%) |
| Total | 150 | 150 | 150 | 150 |

In the rural area, about 73% (109) of children were infants, and 72% (108) were infants in the urban areas. Different types of water were used for the preparation of the infants' food depending on the region, as follows: rural area: tap water 26% (39), boiled 13% (20), and other 3.3% (5); urban area: 50% (75) tap water, boiled 20.6% (31), and other 0.6% (1). The description of the kinds of foods given to the infants is in Table 8. Some infants were fed using a bottle, including 24.6% (37) in the urban area and 12.6% (19) in the rural area. Table 9 shows the water sources for home activities such as dinking, cooking and washing clothes. With regard to the water treatment of drinking water, 48% (72) and 45.3% (68) of cases did not treat drinking water in the rural and urban areas, respectively. The toilet system differed from one household to another, as described in Table 10. It was found that certain households had domestic animals, and the children had contact with them (Table 10).

**Table 8.** Types of food given to the infant.

| Infant Food | Urban | Rural |
|---|---|---|
| Biscuits | 48 (44%) | 37 (34%) |
| Fermented cereals | 3 (3%) | 18 (17%) |
| Breastfeeding | 10 (9%) | 19 (17%) |
| Fruit or vegetable juices | 5 (5%) | 4 (4%) |
| Infant formula | 18 (17%) | 14 (23%) |
| Pre-prepared meals | 10 (9%) | 7 (6%) |
| Fruit puree | 3 (3%) | 2 (2%) |
| Other foods | 2 (2%) | 4 (4%) |
| Formula for < 6 months | 9 (8%) | 4 (4%) |
| Total Number of Infants | 108 | 109 |

**Table 9.** Water sources for house activities.

| | Drinking | | Washing | | Food Preparation | |
|---|---|---|---|---|---|---|
| **Type of Water** | **Urban** | **Rural** | **Urban** | **Rural** | **Urban** | **Rural** |
| Tap water | 116 (73%) | 138 (92%) | 116 (73%) | 138 (92%) | 116 (73%) | 138 (92%) |
| Public/community well or pump | 22 (15%) | 12 (8%) | 22 (15%) | 12 (8%) | 22 (15%) | 12 (8%) |
| Bottled water | 5 (3%) | 0 | 5 (3%) | | 5 (3%) | |
| Private well or pump with lid | 4 (3%) | 0 | 4 (3%) | | 4 (3%) | |
| Pond | 1 (1%) | 0 | 1 (1%) | | 1 (1%) | |
| Other | 1 (1%) | 0 | 1 (1%) | | 1 (1%) | |
| Tank | 1 (1%) | 0 | 1 (1%) | | 1 (1%) | |
| Total | 150 | 150 | 150 | 150 | 150 | 150 |

**Table 10.** Type of sanitary equipment in the household and animals in the household.

| Toilet System | | | Animal in Household | | | Child Had Direct Contact with Animals | |
|---|---|---|---|---|---|---|---|
| | **Urban** | **Rural** | | **Rural** | **Urban** | **Rural** | **Urban** |
| Toilet with septic tank | 85 (57%) | 138 (92%) | Chickens | 20 (13%) | 26 (17%) | 6 (4%) | 6 (4%) |
| Latrine with roof protection | 30 (20%) | 9 (6%) | Ducks | 10 (7%) | 13 (9%) | 7 (5%) | 7 (5%) |
| Improved latrine with ventilation | 28 (19%) | 2 (1%) | Pigs | 2 (1%) | 2 (1%) | 1 (1%) | 0 |
| Latrine without roof protection | 4 (3%) | 1 (1%) | Cats | 15 (10%) | 13 (9%) | 11 (7%) | 11 (11%) |
| Others | 2 (1%) | 0 | Dogs | 8 (5%) | 8 (5%) | 4 (3%) | 2 (1%) |
| No sanitary system | 1 (1%) | 0 | Other | 20 (13%) | 2 (1%) | | |
| | | | No animals | 75 (50%) | 86 (57%) | 121 (80%) | 126 (84%) |
| Total | 150 | 150 | | 150 | 150 | 150 | 150 |

## 4. Discussion

### *4.1. Socio-Demographic Characteristics*

According to the results, male children were more affected by diarrhea than females. This means that the males were more prone to foodborne diarrhea. The finding is in accordance with [15], who found that, in Mozambique, the morbidity and mortality rates in children under

five are higher in males than in females. The study shows that the age group with the most cases of foodborne diarrhea were the children under six months from the rural area, compared with the same age group in the urban area, which was unlike in this age group, as the children in this age group were supposed to be exclusively breastfeeding. One should take into account that breastfeeding protects children because it is clean and provides immune supplements to them to prevent diarrhea. However, the safety of exclusive breastfeeding is supported by the good hygiene of the mother. The cases in this age group can be related to the lack of exclusive breastfeeding or poor hygiene of the caretakers. These findings are not in agreement with previous studies. For example, refs. [16,17] found more cases in children above the age of six months. On the other hand, the cases of foodborne diarrhea were concentrated in the groups aged between 12 and 23 months, with more cases in the whole group from the urban area. Adding together both districts, the majority of cases were identified in children under 2 years of age. This may be because children from the age six months start to be introduced to complementary foods, which can cause intolerance and reactions that result in diarrhea. In addition, the children start crawling, walking and making contact with the ground and adopt a tendency to take objects in their mouths. All these conditions can expose the children to the probable agents of diarrhea. This observation is in agreement with previous studies [17–22], which reported more cases of diarrhea in children from zero to two years of age.

It was found that the majority of the children were cared for by mothers aged 18 to 32 years. Women at this age are considered as adults who are able to take better care of their children, and they are children's natural caretakers. The majority of the caregivers were single but living with their partners. Nevertheless, the men were the income providers in the household, and the women were the most likely to be unemployed. Thus, they were supposed to have more time to look after the children. According to [23], children of employed mothers are more susceptive to becoming sick.

Some houses were built with precarious materials, mainly in the rural area, which can be an indicative of the poorest and weakest environmental sanitation that can be a source of the outbreak of diarrhea infections. The finding corroborates with [24], a study conducted in Nigeria. Furthermore, the majority of the households in both regions used charcoal as a fuel for cooking, which can spoil the air and affect the immunity of children, who subsequently become more susceptive to respiratory diseases and more vulnerable to other diseases, including diarrhea. Previous studies also showed the relationship between the type of fuel used in the household and episodes of respiratory diseases in children [25–28].

### *4.2. Disease-Related Questions*

The caregivers in the rural area took the children for medical assistance earlier compared to the urban, and this allowed for quick medical care. The findings show greater concern for children's health in rural than in urban areas. This fact may be explained by the fact that caregivers in urban areas do not have time to take care of their children, as they work outside the home. This fact is in accordance with [23]. Another study conducted in Pakistan reported that caretakers mostly prefer to take care of children with diarrhea at home in the first 48 h before seeking medical assistance [29]. On the other hand, it was found that the caregivers in the rural area first gave their children traditional medicine before seeking medical assistance. This can put the children at risk, as many traditional medicines have no defined dose and can be given in sub- or overdose quantities and exacerbate the diarrhea, especially if the child is under six months, bearing in mind the fact that the study found more children under six months with diarrhea in the rural area. The findings of this study are similar to the [30] on research performed in Ethiopia.

In all the children with diarrhea, other symptoms were observed, such as vomiting, fever, cough, cold and loss of appetite, among others. Diarrhea and vomiting expose the children to the risk of dehydration and malnutrition, with subsequent death. The symptoms observed in this study may be related to food or water contamination, as some caregivers reported having given spoiled food and unsafe water to the children. In addition, the respiratory symptoms (cough, cold) can be related to environment contamination due to

the kinds of fuel used in the households. These findings do not differ from those found in previous studies [16,31,32], associating respiratory symptoms with the use of firewood and charcoal as fuels for cooking meals.

The findings also show that the majority of the children with foodborne diarrhea were not hospitalized. This means that diarrhea infection can be treated easily, without the need for much attention and special care in the hospital. On the other hand, it was observed that the caregivers were concerned with seeking medical assistance as early as possible when the children became ill, and this facilitated the rapid treatment and decreased the need for hospitalization. In this study, more than half of the children were vaccinated for different diseases, including rotavirus, which is considered the main cause of diarrhea infection in children under six months, and this gave them with immunity and minimized the risk of hospitalization due to diarrhea and other infectious diseases. This observation is in agreement with [33–35], studies which observed that complete vaccination reduces the risk of death in children under two years, taking into account the fact that rotavirus vaccination is given to children under six months.

In this study, it was also observed that there was direct transmission from one person to another in the same household, where the child became ill before anyone else. Another fact which could increase the spread of diarrhea might be the living conditions, as it was shown that, in rural areas, the house had only one sleeping room. Similar results were reported in previous studies [36,37], reporting that a greater number of individuals in the household is a factor contributing to the increase in diarrheal infection because it compromise the hygiene and sanitation of the household. In addition, [38] emphasized that the presence of caregivers or other persons with diarrhea in the same household can be factor leading to children becoming ill.

According to the caregivers in the rural area, diarrhea in the children was related to spoiled food, traditional beliefs, such as those related to the moon, and teeth growth. Due to these beliefs, the children were treated with traditional remedies, with poor hygiene. Furthermore, in the urban area, there were caregivers who pointed to the consumption of spoiled food and unsafe water as factors associated with diarrhea in the children. The same factors were found in other studies [30,39–41]. The place where raw and cooked meat received attention as a probable source of foodborne diarrhea, because in most cases, the local market conditions were not safe, affected by dirt, flies and stagnant water. These findings are in agreement with [42], which observed that the consumption of undercooked meat, especially that from markets with precarious sanitation, could be a health risk.

The type of food given to the infants and the way in which it was given could be other factors affecting the outbreak of foodborne diarrhea. As we observed in the urban region, the children were fed with biscuits, infant formula and pre-prepared food, and they used a bottle washed with untreated water. It is recommended that children under the age of two be fed on semi-solid foods that are easy to digest. Pre-prepared food is not advisable, because the preparation method is not well known, and this can be a possible source of diarrhea in infants. These results are similar with those of other studies [43,44], which reported that incorrect feeding—mainly the introduction of complementary foods—can cause diarrhea in children under two years of age.

With regard to the safety of the water in the urban households, cases of the consumption of unsafe water were observed, even though there is supposed to be clean and safe water in this region. The sources were ponds, which pose a risk of water and foodborne diseases, including diarrhea. The results were similar with those reported in previous studies [45–47]. In addition, previous studies reported that, in Mozambique, despite the government's determination to decrease the numbers of waterborne diseases, there are still many cases of diarrhea due to the ingestion of contaminated water [18,21,46]. A study conducted in Maputo city showed that there is high contamination of fecal microorganisms in the water used for consumption, even if it is piped [48]. It is important to advise the population to treat water before its consumption, especially water used for children's food and hygiene.

The use of septic tanks in the sanitary systems of the households was found to be positive in terms of diarrhea prevention. However, in the urban area, some families used latrines without lids, which can be a source of flies and other vectors of food and water contamination. This observation corroborates with the studies performed by the authors of [23,49,50]. Furthermore, this study did not enquire about the stage of the tank, but there was a study performed in Maputo which showed that the majority of households reported having never emptied their septic tanks [51]. This can be considered another risk factor for the development of vectors, with the consequent appearance of foodborne diarrhea.

The existence of domestic animals within the households was reported, where most animals were in contact with children and others played with them, principally in rural area. This contact with domestic animals may be a factor affecting diarrhea in children, as the transmission of the disease from animals to human is well known. This finding is in agreement with [52,53], reporting the relationship between animal contact and human being diseases, including diarrhea infection.

## 5. Conclusions

All in all, children under two years of age were more affected by foodborne diarrhea. The mothers were the main caregivers of the children. In the rural area, the children received medical assistance earlier compared to those in the urban area. The diarrhea infections in the rural area were also related to traditional beliefs. Unsafe water, spoiled food, low household income, poor sanitary systems, the type of infant food and the method of preparation, contact with domestic animals, the number of people sleeping in a room were also considered as factors affecting foodborne diarrhea. The study recommends the development of local strategies with caregivers for the prevention and control of foodborne diarrhoea.

**Author Contributions:** N.E.M.: research concept and design; collection and assembly of data; analysis and interpretation of data; and writing the article. F.M.M. and E.M.S.: research concept and design; supervision of data collection; and critical review of the paper. All authors have read and agreed to the published version of the manuscript.

**Funding:** This research was funded by the Bill & Melinda Gates Foundation. Grant agreement investment ID: OPP1195617.

**Institutional Review Board Statement:** The study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Pretoria (protocol code: 596/2020; line 1 was approved by the Research Ethics Committee of the Faculty of Health Sciences on 2022-01-19 for studies involving humans).

**Informed Consent Statement:** Informed consent was obtained from all subjects involved in the study.

**Data Availability Statement:** Not applicable.

**Acknowledgments:** Bill & Melinda Gates Foundation and Foreign, Commonwealth & Development Office (FCDO), Foodborne Disease Epidemiology Surveillance and Control in African Low- and Middle-Income Countries (FOCAL) Project, and Eduardo Mondlane University. We are grateful for the funding and technical assistance provided to support the research. We are also grateful to the health providers who helped to identify the children and their caregivers. We appreciate the availability of the caretakers who were interviewed and for allowing us to visit their households. We are thankful to the Technical University of Denmark and Mambo for creating the database and the University of Pretoria for the opportunity to conduct the study. We would also like to thank Jamo for the language review.

**Conflicts of Interest:** The authors declare no conflict of interest, all authors participated in the conception and design, drafting of the article and its critical revising for important intellectual content, and the approval of the final version. This manuscript has not been submitted to, nor is under review by, another journal or publishing platform.

## References


1. World Health Organization. *WHO Estimates of the Global Burden of Foodborne Diseases: Foodborne Disease Burden Epidemiology Reference Group 2007–2015*; World Health Organization: Geneva, Switzerland, 2015.
2. Havelaar, A.H.; Kirk, M.D.; Torgerson, P.R.; Gibb, H.J.; Hald, T.; Lake, R.J. World Health Organization Foodborne Disease Burden Epidemiology Reference Group. In *World Health Organization Global Estimates and Regional Comparisons of the Burden of Foodborne Disease in 2010*; World Health Organization: Geneva, Switzerland, 2015.
3. Vos, T.; Lim, S.S.; Abbafati, C.; Abbas, K.M.; Abbasi, M.; Abbasifard, M.; Abbasi-Kangevari, M.; Abbastabar, H.; Abd-Allah, F.; Abdelalim, A.; et al. Global burden of 369 diseases and injuries in 204 countries and territories, 1990–2019: A systematic analysis for the Global Burden of Disease Study 2019. *Lancet* **2020**, *396*, 1204–1222. [CrossRef]
4. Troeger, C.E.; Khalil, I.A.; Blacker, B.F.; Biehl, M.H.; Albertson, S.B.; Zimsen, S.R.; Seyedmousavi, S. Quantifying risks and interventions that have affected the burden of diarrhoea among children younger than 5 years: An analysis of the Global Burden of Disease Study 2017. *Lancet Infect. Dis.* **2020**, *20*, 37–59. [CrossRef]
5. Turyare, M.D.; Mativo, J.N.; Kerich, M.; Ndiritu, A.K. Prevalence and socio-demographic determinants of diarrhea among children below 5 years in Bondhere district Somalia. *Pan Afr. Med. J.* **2021**, *38*, 391. [CrossRef] [PubMed]
6. Forouzanfar, M.H.; Afshin, A.; Alexander, L.T.; Anderson, H.R.; Bhutta, Z.A.; Biryukov, S.; Brauer, M.; Burnett, R.; Cercy, K.; Charlson, F.J.; et al. Global, regional, and national comparative risk assessment of 79 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2015: A systematic analysis for the Global Burden of Disease Study 2015. *Lancet* **2016**, *388*, 1659–1724. [CrossRef] [PubMed]
7. Gakidou, E.; Afshin, A.; Abajobir, A.A.; Abate, K.H.; Abbafati, C.; Abbas, K.M.; Abd-Allah, F.; Abdulle, A.M.; Abera, S.F.; Aboyans, V.; et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks, 1990–2016: A systematic analysis for the Global Burden of Disease Study 2016. *Lancet* **2017**, *390*, 1345–1422. [CrossRef] [PubMed]
8. Stanaway, J.D.; Afshin, A.; Gakidou, E.; Lim, S.S.; Abate, D.; Abate, K.H.; Abbafati, C.; Abbasi, N.; Abbastabar, H.; Abd-Allah, F.; et al. Global, regional, and national comparative risk assessment of 84 behavioural, environmental and occupational, and metabolic risks or clusters of risks for 195 countries and territories, 1990–2017: A systematic analysis for the Global Burden of Disease Study 2017. *Lancet* **2018**, *392*, 1923–1994.
9. World Health Organization. 2017 annual report WHO/UNICEF joint monitoring programme for water supply, sanitation and hygiene. In *2017 Annual Report WHO/UNICEF Joint Monitoring Programme for Water Supply, Sanitation and Hygiene*; World Health Organization: Geneva, Switzerland, 2017; p. 20.
10. Instituto Nacional de Estatísticas (INE). *IV Recenseamento Geral da População e Habitação 2017*; Resultados Definitivos: Maputo, Moçambique, 2019.
11. Gautam, O.P.; Schmidt, W.-P.; Cairncross, S.; Cavill, S.; Curtis, V. Trial of a Novel Intervention to Improve Multiple Food Hygiene Behaviors in Nepal. *Am. J. Trop. Med. Hyg.* **2017**, *96*, 1415–1426. [CrossRef]
12. World Health Organization. *Safer Water, Better Health*; World Health Organization: Geneva, Switzerland, 2019.
13. World Health Organization. *Burden of Foodborne Diseases in the South-East Asia Region*; World Health Organization: Geneva, Switzerland, 2016.
14. Ojuri, O.T.; Ezekiel, C.N.; Eskola, M.K.; Šarkanj, B.; Babalola, A.D.; Sulyok, M.; Hajšlová, J.; Elliott, C.T.; Krska, R. Mycotoxin co-exposures in infants and young children consuming household- and industrially-processed complementary foods in Nigeria and risk management advice. *Food Control* **2018**, *98*, 312–322. [CrossRef]
15. UNICEF. *A Situação das Crianças em Moçambique: Resumo do Relatório*; UNICEF: New York, NY, USA, 2021.
16. Acácio, S.; Mandomando, I.; Nhampossa, T.; Quintó, L.; Vubil, D.; Sacoor, C.; Kotloff, K.; Farag, T.; Nasrin, D.; Macete, E.; et al. Risk factors for death among children 0–59 months of age with moderate-to-severe diarrhea in Manhiça district, southern Mozambique. *BMC Infect. Dis.* **2019**, *19*, 322. [CrossRef] [PubMed]
17. Getachew, B.; Mengistie, B.; Mesfin, F.; Argaw, R. Factors associated with acute diarrhea among children aged 0–59 months in Harar town, eastern Ethiopia. *East Afr. J. Health Biomed. Sci.* **2018**, *2*, 26–35.
18. Nhampossa, T.; Mandomando, I.; Acacio, S.; Quintó, L.; Vubil, D.; Ruiz, J.; Alonso, P. Diarrheal disease in rural Mozambique: Burden, risk factors and etiology of diarrheal disease among children aged 0–59 months seeking care at health facilities. *PLoS ONE* **2015**, *10*, e0119824. [CrossRef]
19. Cossa-Moiane, I.; Cossa, H.; Bauhofer, A.; Chilaúle, J.; Guimarães, E.; Bero, D.; Cassocera, M.; Bambo, M.; Anapakala, E.; Chissaque, A.; et al. High Frequency of *Cryptosporidium hominis* Infecting Infants Points to A Potential Anthroponotic Transmission in Maputo, Mozambique. *Pathogens* **2021**, *10*, 293. [CrossRef] [PubMed]
20. Melese, B.; Paulos, W.; Astawesegn, F.H.; Gelgelu, T.B. Prevalence of diarrheal diseases and associated factors among under-five children in Dale District, Sidama zone, Southern Ethiopia: A cross-sectional study. *BMC Public Health* **2019**, *19*, 1235. [CrossRef]
21. Chissaque, A.; de Deus, N.; Vubil, D.; Mandomando, I. The Epidemiology of Diarrhea in Children Under 5 Years of Age in Mozambique. *Curr. Trop. Med. Rep.* **2018**, *5*, 115–124. [CrossRef]
22. Kotloff, K.L.; Nasrin, D.; Blackwelder, W.C.; Wu, Y.; Farag, T.; Panchalingham, S.; O Sow, S.; Sur, D.; Zaidi, A.K.M.; Faruque, A.S.G.; et al. The incidence, aetiology, and adverse clinical consequences of less severe diarrhoeal episodes among infants and children residing in low-income and middle-income countries: A 12-month case-control study as a follow-on to the Global Enteric Multicenter Study (GEMS). *Lancet Glob. Health* **2019**, *7*, e568–e584. [PubMed]

23. Bashiru, M.; Mahama. Assessment of the trend and risk factors of under-five diarrhea morbidity and mortality in two selected communities in the West-Mamprusi District. *Int. J. Med. Med. Sci.* **2019**, *11*, 27–35. [CrossRef]
24. Yaya, S.; Hudani, A.; Udenigwe, O.; Shah, V.; Ekholuenetale, M.; Bishwajit, G. Improving Water, Sanitation and Hygiene Practices, and Housing Quality to Prevent Diarrhea among Under-Five Children in Nigeria. *Trop. Med. Infect. Dis.* **2018**, *3*, 41. [CrossRef] [PubMed]
25. Buchner, H.; Rehfuess, E.A. Cooking and Season as Risk Factors for Acute Lower Respiratory Infections in African Children: A Cross-Sectional Multi-Country Analysis. *PLoS ONE* **2015**, *10*, e0128933. [CrossRef] [PubMed]
26. Khan, M.N.; B Nurs, C.Z.; Mofizul Islam, M.; Islam, M.R.; Rahman, M.M. Household air pollution from cooking and risk of adverse health and birth outcomes in Bangladesh: A nationwide population-based study. *Environ. Health* **2017**, *16*, 57. [CrossRef] [PubMed]
27. Woolley, K.E.; Bagambe, T.; Singh, A.; Avis, W.R.; Kabera, T.; Weldetinsae, A.; Mariga, S.T.; Kirenga, B.; Pope, F.D.; Thomas, G.N.; et al. Investigating the association between wood and charcoal domestic cooking, respiratory symptoms and acute respiratory infections among children aged under 5 years in Uganda: A cross-sectional analysis of the 2016 demographic and health survey. *Int. J. Environ. Res. Public Health* **2020**, *17*, 3974. [CrossRef] [PubMed]
28. Mondal, D.; Paul, P. Effects of indoor pollution on acute respiratory infections among under-five children in India: Evidence from a nationally representative population-based study. *PLoS ONE* **2020**, *15*, e0237611. [CrossRef] [PubMed]
29. Rabbani, F.; Khan, H.A.; Piryani, S.; Pradhan, N.A.; Shaukat, N.; Feroz, A.S.; Perveen, S. Changing Perceptions of Rural Frontline Workers and Caregivers about Management of Childhood Diarrhea and Pneumonia despite Several Inequities: The Nigraan Plus Trial in Pakistan. *J. Multidiscip. Health* **2021**, *14*, 3343–3355. [CrossRef] [PubMed]
30. Keto, T.; Alemu, Y.; Mamo, A. Mothers' perception and management preference of acute diarrheal disease. *Int. J. Public Health Sci.* **2020**, *9*, 338. [CrossRef]
31. Switaj, T.L.; Winter, K.J.; Christensen, S.R. Diagnosis and Management of Foodborne Illness. *Am. Fam. Phys.* **2015**, *92*, 358–365.
32. Conlon, B.P.; Rowe, S.E.; Gandt, A.B.; Nuxoll, A.S.; Donegan, N.P.; Zalis, E.A.; Clair, G.; Adkins, J.N.; Cheung, A.L.; Lewis, K. Persister formation in Staphylococcus aureus is associated with ATP depletion. *Nat. Microbiol.* **2016**, *1*, 16051. [CrossRef] [PubMed]
33. Ngabo, F.; Tate, J.E.; Gatera, M.; Rugambwa, C.; Donnen, P.; Lepage, P.; Mwenda, J.M.; Binagwaho, A.; Parashar, U.D. Effect of pentavalent rotavirus vaccine introduction on hospital admissions for diarrhoea and rotavirus in children in Rwanda: A time-series analysis. *Lancet Glob. Health* **2016**, *4*, e129–e136. [CrossRef]
34. Reiner, R.C., Jr.; Wiens, K.E.; Deshpande, A.; Baumann, M.M.; Lindstedt, P.A.; Blacker, B.F.; Troeger, C.E.; Earl, L.; Munro, S.B.; Abate, D.; et al. Mapping geographical inequalities in childhood diarrhoeal morbidity and mortality in low-income and middle-income countries, 2000–2017: Analysis for the Global Burden of Disease Study 2017. *Lancet* **2020**, *395*, 1779–1801. [CrossRef] [PubMed]
35. Bar-Zeev, N.; King, C.; Phiri, T.; Beard, J.; Mvula, H.; Crampin, A.C.; Heinsbroek, E.; Lewycka, S.; Tate, J.E.; Parashar, U.D.; et al. Impact of monovalent rotavirus vaccine on diarrhoea-associated post-neonatal infant mortality in rural communities in Malawi: A population-based birth cohort study. *Lancet Glob. Health* **2018**, *6*, e1036–e1044. [CrossRef] [PubMed]
36. Omona, S.; Malinga, G.M.; Opoke, R.; Openy, G.; Opiro, R. Prevalence of diarrhoea and associated risk factors among children under five years old in Pader District, northern Uganda. *BMC Infect. Dis.* **2020**, *20*, 37. [CrossRef]
37. Wasihun, A.G.; Dejene, T.A.; Teferi, M.; Marugán, J.; Negash, L.; Yemane, D.; McGuigan, K.G. Risk factors for diarrhoea and malnutrition among children under the age of 5 years in the Tigray Region of Northern Ethiopia. *PLoS ONE* **2018**, *13*, e0207743. [CrossRef] [PubMed]
38. Asfaha, K.F.; Tesfamichael, F.A.; Fisseha, G.K.; Misgina, K.H.; Weldu, M.G.; Welehaweria, N.B.; Gebregiorgis, Y. Determinants of childhood diarrhea in Medebay Zana District, Northwest Tigray, Ethiopia: A community based unmatched case–control study. *BMC Pediatr.* **2018**, *18*, 120. [CrossRef]
39. Odo, C.; Onalu, C.; Nwatu, U.; Nwafor, N.; Ebimgbo, S. Factors associated with the prevalence of diarrhoea among children in rural areas of Enugu State, Nigeria: Practice considerations for social workers. *Int. Soc. Work* **2021**. [CrossRef]
40. Moroole, M.A.; A Materechera, S.; Otang-Mbeng, W.; O Aremu, A. African indigenous contraception: A review. *Afr. J. Reprod. Health* **2020**, *24*, 173–184.
41. Källander, K.; Counihan, H.; Cerveau, T.; Mbofana, F. Barriers on the pathway to survival for children dying from treatable illnesses in Inhambane province, Mozambique. *J. Glob. Health* **2019**, *9*, 010809. [CrossRef] [PubMed]
42. Sharma, K.P.; Chattopadhyay, U.K.; Naskar, K. Prevalence of Campylobacter species in raw meat samples sold in open markets of Kolkata city. *Int. J. Agric. Environ. Biotechnol.* **2016**, *9*, 535. [CrossRef]
43. Ogbo, F.A.; Agho, K.; Ogeleka, P.; Woolfenden, S.; Page, A.; Eastwood, J. Global Child Health Research Interest Group. Infant feeding practices and diarrhoea in sub-Saharan African countries with high diarrhoea mortality. *PLoS ONE* **2017**, *12*, e0171792. [CrossRef]
44. Dhami, M.V.; Ogbo, F.A.; Diallo, T.M.; Agho, K.; on behalf of the Global Maternal and Child Health Research Collaboration (GloMACH). Regional Analysis of Associations between Infant and Young Child Feeding Practices and Diarrhoea in Indian Children. *Int. J. Environ. Res. Public Health* **2020**, *17*, 4740. [CrossRef] [PubMed]
45. Apetoh, E.; Tilly, M.; Baxerres, C.; Le Hesran, J.-Y. Home treatment and use of informal market of pharmaceutical drugs for the management of paediatric malaria in Cotonou, Benin. *Malar. J.* **2018**, *17*, 354. [CrossRef] [PubMed]

46. Knee, J.; Sumner, T.; Adriano, Z.; Berendes, D.; de Bruijn, E.; Schmidt, W.-P.; Nalá, R.; Cumming, O.; Brown, J. Risk factors for childhood enteric infection in urban Maputo, Mozambique: A cross-sectional study. *PLOS Negl. Trop. Dis.* **2018**, *12*, e0006956. [CrossRef] [PubMed]
47. Ugboko, H.U.; Nwinyi, O.C.; Oranusi, S.U.; Oyewale, J.O. Childhood diarrhoeal diseases in developing countries. *Heliyon* **2020**, *6*, e03690. [CrossRef] [PubMed]
48. Salamandane, A.; Vila-Boa, F.; Malfeito-Ferreira, M.; Brito, L. High fecal contamination and high levels of antibiotic-resistant Enterobacteriaceae in water consumed in the city of Maputo, Mozambique. *Biology* **2021**, *10*, 558. [CrossRef] [PubMed]
49. Issa, R. Musca domestica acts as transport vector hosts. *Bull. Natl. Res. Cent.* **2019**, *43*, 73. [CrossRef]
50. Bell, M.J. The Impact of Latrine Construction on Densities and Pathogen Infection Rates of Synanthropic Flies and Culex quinquefasciatus Mosquitoes in Odisha, India. 2020. Ph.D. Thesis, London School of Hygiene & Tropical Medicine, London, UK.
51. Capone, D.; Adriano, Z.; Berendes, D.; Cumming, O.; Dreibelbis, R.; Holcomb, D.A.; Knee, J.; Ross, I.; Brown, J. A localized sanitation status index as a proxy for fecal contamination in urban Maputo, Mozambique. *PLoS ONE* **2019**, *14*, e0224333. [CrossRef] [PubMed]
52. Exum, N.G. Beyond Diarrhea: Fecal-Oral Pathogen Transmission and Environmental Enteropathy in Iquitos, Peru. Ph.D. Thesis, The Johns Hopkins University, Baltimore, MD, USA, 2016.
53. Acke, E. Campylobacteriosis in dogs and cats: A review. *N. Z. Veter. J.* **2018**, *66*, 221–228. [CrossRef] [PubMed]

# CHAPTER FIVE

# LOCAL STRATEGY OF PREVENTIVE MEASURE FOR FOODBORNE DIARRHEA IN CHILDREN UNDER FIVE IN MAPUTO-MOZAMBIQUE

## 5.1 INTRODUCTION

This chapter focuses on Phase Three of the study submitted for publication in the International Journal of African Nursing Sciences (Elsevier). The authors' instructions are illustrated in Fig. 6. This chapter underlines the strategy built in the study area to prevent foodborne diarrhea in children under five years of age. The methodology used involved different stakeholders in the process, main discussions, conclusions, and limitations of the research.

## 5.2 ARTICLE SUBMITTED

International Journal of Africa Nursing Sciences

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# International Journal of Africa Nursing Sciences

## Local strategy of Preventive Measure for Foodborne Diarrhoea in Children under five in Maputo-Mozambique

--Manuscript Draft--

| | |
|---|---|
| **Manuscript Number:** | |
| **Article Type:** | Review Article |
| **Keywords:** | Foodborne, diarrhoea, stakeholder, strategy. |
| **Corresponding Author:** | Norgia Machava, M.D.<br><br>Pretoria, Gautrein SOUTH AFRICA |
| **First Author:** | Norgia Elsa Machava, M.D. |
| **Order of Authors:** | Norgia Elsa Machava, M.D. |
| | Fhumulani Mavis Mulaudzi |
| | Elsa Maria Salvador, PhD |
| **Abstract:** | Background: Foodborne diarrhoea prevention in children under five is simple, but it is critical to address the infection's three components prioritised for preventive intervention. This study has developed a local strategy of preventive measures for foodborne diarrhoea in children under five in collaboration with stakeholders (caregivers, community lieders, nurses, doctors and health techniques).<br>Design and method: A Nominal Group Technique (NGT) was used to develop the strategy in two districts, and 31 stakeholders participated. In the rural area (Marracuene), 16 stakeholders participated, while in the urban area (KaMaxaqueni), 15 stakeholders participated. In each area, the NGT session with stakeholders generated ideas and reached a consensus on what should be done in the strategy as measures to prevent foodborne diarrhoea in children under the age of five. The process was inclusive, and the strategy summarised the general agreement.<br>Findings: In rural areas, stakeholders emphasised the importance of hand washing, improving traditional medicine storage conditions, and not giving traditional medicine to children under six months. The measures in urban areas were environmental hygiene, water treatment, and putting ash inside latrines.<br>Conclusion: The stakeholders prioritised foodborne diarrhoea prevention measures based on the reality of the household. The inclusion of stakeholders in the strategy design brings measures that allow for the mitigation of factors. |
| **Suggested Reviewers:** | Kuku Voyi<br>kuku.voyi@up.ac.za |
| | Judith Bruce<br>Judith.Bruce@wits.ac.za |
| | Joana Salia Salia<br>joanasalia@gmail.com |
| | Maurine Musei<br>maurine.musie@up.ac.za |
| **Opposed Reviewers:** | |

Nórgia Elsa Machava,
Faculty of Health Sciences,
Room 8-38, level 8, Building University of Pretoria,
Private Bag X20, Hatfield 0028, South Africa.
Contact: norgiaelsamachava@gmail.com or
u19406429@tuks.co.za
+258843832777
Date: April 04, 2022

**Name of the Journal:** International Journal of Africa Nursing Sciences

**Editor in Chief:** Professor Hester Klopper

Dear Sir/ Madam

I would like to submit the manuscript entitled "**Local strategy of Preventive Measure for Foodborne Diarrhoea in Children under five in Maputo- Mozambique"** by Nórgia Elsa Machava, Elsa Maria Salvador, and Fhumulani Mavis Mulaudzi to be considered for publication as an original article in the *Current Research in Food Science (CRFS).*

Foodborne diarrhoea prevention in children under five is simple, but it is critical to address the three components of the infection (individual, agent, and environment), w. It should be specified within these components which components should be prioritised for preventive intervention. Diarrhoeal illnesses continue to be a problem in children under five in Africa, particularly in developing countries, despite the proper diagnosis and treatment. To prevent foodborne diarrhoea, it is critical to involve a key stakeholder. This study developed a local strategy for foodborne diarrhoea prevention. s.

We declare that this manuscript is original, has not been published before, and is not currently being considered for publication; the research is part of a doctoral project at the School of Health Care Sciences, University of Pretoria, South Africa. .

We are not aware of any conflict of interest associated with the publication. As the corresponding author, I confirm that all name authors' manuscripts have been read and approved for submission.

Thank you for your consideration

You sincerely

Nórgia Elsa Machava

**Abstract:**

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**Findings:** In rural areas, stakeholders emphasised the importance of hand washing, improving traditional medicine storage conditions, and not giving traditional medicine to children under six months. The measures in urban areas were environmental hygiene, water treatment, and putting ash inside latrines.

**Conclusion:** The stakeholders prioritised foodborne diarrhoea prevention measures based on the reality of the household. The inclusion of stakeholders in the strategy design brings measures that allow for the mitigation of factors.

**Keywords:** Foodborne, diarrhoea, stakeholder, Strategy.

**Title**

# Local strategy of Preventive Measure for Foodborne Diarrhoea in Children under five in Maputo-Mozambique

**Authors**

Nórgia Elsa **Machava***[1], Elsa Maria **Salvador**[2], Fhumulani Mavis **Mulaudzi**[1]

**Affiliations**

[1]Department of Nursing Sciences, Faculty of Health Sciences, University of Pretoria, South Africa.

[2]Department of Biological Sciences, Faculty of Sciences, Eduardo Mondlane University, Maputo, Mozambique.

**Corresponding author:**

*Nórgia Elsa Machava, Faculty of Health Sciences, Room 8-38, level 8, Building University of Pretoria, Private Bag X20, Hatfield 0028, South Africa.

Email: norgiaelsamachava@gmail.com or u19406429@tuks.co.za

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**Keywords:** Foodborne, diarrhoea, stakeholder, strategy.

**What is already known about the topic?**

- The preventive measure of foodborne diarrhoea are easily
- Diarrhoea is a common disease in children under five

**What does this paper add?**

- The local strategy for preventing foodborne diarrhoea has to consider the local culture and traditional behaviours
- For the design of an effective strategy of preventive measures for foodborne diarrhoea, it is important to involve the principal stakeholder.

## 1. INTRODUCTION

Foodborne diarrhoea in children is a disease that can be avoided and treated. Hand washing, safe drinking water, and improved individual and environmental hygiene are among the preventive measures (WHO, 2017). Foodborne diseases are a public health concern worldwide (Talaei et al., 2015). It is estimated that 600 million people eat unclean food and 420 000 die each year, with 40% being children under the age of five and 125 000 dying each year, and that 33 million healthy days of life are lost globally due to foodborne diseases (WHO, 2019; WHO, 2022).

Foodborne diarrhoea prevention in children under five is simple, but it is critical to address the three components of the infection (individual, agent, and environment). Within these components, it should be specified which components should be prioritised for preventive intervention. The primary preventive measures for foodborne diseases are centred on asepsis and environmental hygiene practises, which should be translated into safe drinking water, toilet accessibility, and decent cleanliness practices during food management. Hand washing is critical for preventing the spread of microbes from person to food, utensils, and food preparation equipment (Darvesh et al., 2017). According to the previous authors, one of the most important preventive measures is Water, Sanitation, and Hygiene (WASH). It is reported to reduce diarrhoea cases in children under five by between 27% and 53%, primarily in low and middle-income countries (LMICs) where diarrhoea contagions are more common (Darvesh et al., 2017).

Actions within communities and households to promote hygiene in food handling effectively reduce the risk of foodborne diarrhoea (Assefa et al., 2015; Wambui et al., 2017). Different strategies should be used depending on the age of the children. The preventive approach for children older than six months to prevent foodborne contaminations is to feed them with safe complementary foods. For children older than six months, the preventive approach to preventing foodborne contaminations is to feed with safe complementary foods in addition to breastfeeding (Fischer et al., 2013).

The Ministry of Health in Mozambique has been implementing food preparation education for young children, focusing on hygiene, raw and cooked food separation, and environmental sanitation, in order to reduce the incidence, morbidity, and mortality of children due to foodborne diarrhoea, as well as the rate of infection treatment (MISAU, 2016). Because food safety is a global concern, the World Health Organization has recommended the following five vital critical actions to promote safe food handling: Maintain cleanliness; separate raw and cooked foods; thoroughly cook; keep food at safe temperatures; and use safe water and raw materials (WHO, 2019).

A local strategy of preventive measures was developed to address foodborne diarrhoea in children under five. The current strategy was developed using UNICEF's (1998) TRIPLE A CYCLE outline; the main actions are assessment, analysis, and action (Figure 1). First (A one), the study assessed the practices of diagnosing and treating foodborne diarrhoea in children under five that were implemented at referral health facilities (Machava et al., 2022a). Second (A two), to understand the factors and routes of transmission of foodborne diarrhoea, Machava et al. (2022b) investigated and described the household factors for the origins of foodborne diarrhoea in children younger than 5 five years old. To complete action (A three), the study developed a household and community strategy of preventive measures for foodborne diarrhoea.

## 2. MATERIALS AND METHODS

A Nominal Group Technique (NGT) was used to develop household and community strategies for preventive measures for foodborne diarrhoea in Marracuene and KaMaxaqueni. Marracuene is classified as rural, with a population of approximately 230,530 people, 29 277.32 of whom are children under five (INE, 2017). KaMaxaqueni district is a city in Maputo Municipality with a population of approximately 203,660 people, 20 930 of whom are children under five (INE, 2017). According to NGT procedures, a day workshop with stakeholders (carers, community leaders, nurses, doctors, and health techniques) generates ideas and achieves consensus on what should be done in the strategy as measures to prevent foodborne diarrhoea in children under the age of five. The process was inclusive, and the strategy reflected the consensus of all stakeholders. .

### 2.1 Participants of NGT

Three types of stakeholders attended the NGT. The first category included healthcare providers (nurses, health technicians, and doctors), the second included carers or mothers, and the third included community leaders. The stakeholders were chosen based on the inclusion criteria.

### 2.2 Sampling of the NGT participants

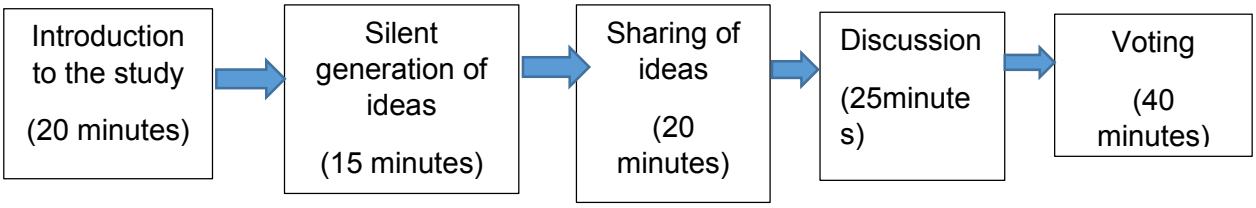
The participants for the current study were invited by phone. Thirty-one (31) people responded and participated in the NGT sections, with 15 from rural areas and 16 from urban areas. Nurses, doctors, health technicians, mothers, and community leaders were among those who took part. Participants were able to share ideas and provide valuable input to a common interpretation of what should be included in the strategy to prevent foodborne diarrhoea disease due to its diverse composition.

### 2.3 Nominal Group Technique process

The NGT section was held in a large enough room with tables and chairs to accommodate all participants comfortably. To facilitate interaction during the section, the participants were seated in U-shapes. Each participant received a pen and an A5 notepad to take notes with. A flip chart was placed in the room to record the

participants' ideas. The NGT was held in the rural areas on October 6, 2022, and in the urban areas on October 18, 2022, with all meetings lasting more than 2 hours in each location. . Each participant introduced themselves so that everyone could get to know one another, and then the findings of the previous two research pieces were presented. Figure 7 depicts how the NGT sections were carried out. The five steps to take are illustrated.

**Figure 7:** Steps of the Nominal Group Technique




**Step 1: Introduction**

Participants were asked to fill out a registration form with their name, contact information, and occupation during the introduction. The purpose of the NGT and the significance of each participant's contribution were explained to the participants. Participants signed an informed consent form to indicate their willingness to participate in the study. Participants were also informed that the researcher had obtained ethical approval from the Faculty of Health Sciences, the University of Pretoria's ethics committee and authorization from the local Health Director. . At the end of this step, a PowerPoint with the title "assessment of diagnosis and treatment practises of diarrhoea in children under five in Marracuene and Kamaxaqueni Districts" and phase Phase II with the title "household factors for foodborne diarrhoea in children under five in the referred districts" was presented.''

**Step 2: Silent generation of ideas**

In this step, questions focusing on preventive measures for foodborne diseases were written on the flip chart and read aloud as follows:

*What do the participants do to ensure the safety of the food in order to prevent foodborne diarrhoea in children?*

*What strategy are you using to implement the previously identified actions to prevent diarrhoea?*

*What are the priority actions to prevent diarrhoea in the household and the district?*

Each participant independently wrote down his/her answers to the questions on the notepad and stopped after fifteen minutes.

**Step 3: Sharing of ideas**

During this step, the answers of all participants were written on the flip chart using each participant's exact words. It was made certain that everyone contributed and provided answers regarding the measures to prevent foodborne diarrhoea diseases. .

**Step 4: Discussion**

This was an open debate and discussion step, t. There was time for questions, answers, explanations, and clarifications of various ideas regarding preventive measures. The discussion is then summarised. In conclusion, a discussion summary was written down. Based on what was written in the summary, participants were asked if anything was missing, comments, or a point to be added to ensure that the participants' contributions are reflected in the summary, as it will be part of the strategy of foodborne diarrhoeal disease prevention measures.

**Step 5: Voting**

This was the voting stage, where the summary information was used to select ten priority measures that could be part of the foodborne diarrhoea disease prevention strategy.

**2.4 Data processing and analysis**

The qualitative approach was used for data processing and analysis. During the NGT sections, the data was noted on the flip chart, on Notepad, and transcribed information from the audio that contextualised participants' answers. The key responses were then organised into categories based on the voting results. To ensure agreement, the organised answers were read multiple times, reanalyzed, and ranked based on the importance expressed by the participants. The most important outcome received a

score of 3, the second most important received a score of 2, the third most important received a score of 2, and the fourth most important received a score of one (1). These scores reflected the participants' perceived importance of the outcomes. The verification of similarity was carried out using inductive content analysis (Patton, 2015). Then, at the end of the discussion, an interactive approach was combined with similar responses to create a list of 17 preventive measures for foodborne diarrhoea. After the discussion, 17 preventive measures for foodborne diarrhoea were composed. Only the top ten were included in the local strategy of preventive measures for foodborne diseases that could be implemented at home, communities, and health facilities in the Marracuene and Kamaxaqueni districts of Maputo Province.

## 3. RESULTS

Thirty-one people from the two districts attended the NGT sessions: 16 from Marracuene, the rural region, and 15 from KaMaxaqueni, the urban region. As shown in Table 1, the participants (stakeholders) included mothers or carers, medical doctors, nurses, community leaders, and health technicians.

Table 1: Description of stakeholders who participated in NGT sessions

| | | Rural | | | Urban | | |
|---|---|---|---|---|---|---|---|
| N | Occupation | **N (%)** | **Male (N-%)** | **Female (N-%)** | **N (%)** | **Male (N-%)** | **Female (N-%)** |
| 1 | Mothers/Caregivers | 2 (13) | 0 | 2 (13) | 2 (13%) | 0 | 2 (13%) |
| 2 | Doctors | 2 (13) | 1 (6) | 1 (6%) | 2 (13%) | 1(6%) | 1 (6%) |
| 3 | Nurses | 2 (13) | 0 | 2 (13%) | 2 (13%) | 0 | 2 (13%) |
| 4 | Health technicians | 6 (38) | 2 (13) | 4 (25%) | 4 (27%) | 0 | 4 (27%) |
| 5 | Community Leaders | 4 (25) | 3 (19) | 1 (6%) | 5 (33%) | 3 (20%) | 2 (13%) |
| Total | | 16 (51,6) | 6 (38) | 10 (63%) | 15 (48,4) | 4 (26%) | 11 (73%) |

The conversation with the stakeholders started with the first question related to preventive measures: *What do the participants do to ensure the safety of the food in order to prevent foodborne diarrhoea in children? This reflects the five key actions for promoting* safe food handling; Table 2 shows the key actions and the stakeholders' opinions in this regard.

Table 2_ Five key actions and opinions of stakeholders.

| N | Actions | Stakeholder Statements | |
|---|---|---|---|
| | | **Rural Area** | **Urban Area** |
| 1 | Keep clean | *Advise the mothers to put food and traditional medicine in cool and clean places, but with regards to traditional medicine, there is a belief that it should not be covered as it is most efficient and works better with mould and spoiled.* | *Talk to mothers to observe proper food hygiene before eating, principally if it is for the children.* |
| 2 | Separate raw and cooked | *Always wash food before consuming and giving it to children.* | *Wash food well before consuming raw foods such as fruits and uncooked salads.* |
| 3 | cook thoroughly | *Mothers should make sure to cook well the food* | *Let the food cook well before giving it to the children* |
| 4 | keep food at safe temperatures | *Always keep the food children in a cool place and heat it the next day before eating it* | *Whenever there is leftover food, we store it in a cool place and heat it the next day before eating it.* |
| 5 | Use safe water and raw materials | *Talk about the need to boil water, but it is difficult. People cannot afford it because of the expensive fuel and heating materials cost.* | *It is to have clean water for consumption because here in Maxaqueni, the water comes from the public network. The problem is that the tubes that take water to the houses are all broken, and the streets and backyards are full of stagnant water that enters the tubes and contaminate the water. It is advisable to treat water for drinking with ''certeza'' (chlorine), boiling it or using other effective methods for water treatment.* |

Proceeding with the study, the stakeholders made their statements regarding the second question: "*What strategy are you using to implement the previously identified actions to prevent diarrhoea?"*

**Rural area**

**One:** I*n the community, people use traditional medicines before going to the hospital because there are common beliefs about diseases in children caused by the appearing or disappearing of the moon in the sky. As shared by a mother/caregiver, even the day before her child had a crisis, the first thing she did was to give traditional medicine, but the child did not get better, so the mother went to a health facility later on.*

**Two:** *Lectures are given in the community where people are taught about diarrhoea and its treatment. However, mothers often do not have a concept/definition of diarrhoea. They go to the hospital even in cases of one defecation. Elementary*

*community workers usually do domiciliary health assistance called APEs, who are in few numbers to cover all homes in the community.*

**Three:** *The mothers say that the longer the traditional medicine stays, the more efficient it is. However, the APEs started to visit the homes and discovered that rotten traditional medicine with mould was still being administered to the children. This practice can cause diarrhoea or other types of intoxication. According to the nurses, there are cases of intoxication by traditional medicines assisted at health facilities since the dosage is unknown and given arbitrarily. According to beliefs, when the child is sick, they should be given more significantmore traditional medicine. Most traditional medicines are of two types, leaves (dipped) and roots (boiled). However, both are dry, and should not be washed.*

**Four:** *Conservation and hygiene practices should be reinforced, and boiling all traditional medicine before being given to the children. It is essential to advise mothers to adopt exclusive breastfeeding and administer traditional medicine from six months onwards to children. Use improved latrines and cover. Reduce doses of traditional medicine, especially "dlhaia nhoka", given in the neonatal period.*

**Five:** *To prevent diarrhoea, it is to consider hygiene measures such as hand washing, sanitation and a clean environment.*

**Urban area**

**One:** *Good food conservation, water treatment with chlorine "certeza" or boiling water, adequate sanitation, wash hands before and after consuming food.*

**Two:** *Check the hygiene conditions of the house and personal hygiene, food hygiene, and family education and discuss the need for latrine hygiene and covering.*

**Three:** *Boil water for drinking, wash food well before consuming principally raw foods such as salads and fruits, wash hands after using the toilet, and always keep water and food in a cool and clean place.*

**Four:** *Hand washing before and after contact with food. Wash food properly, if possible, with treated water, and properly pack food. Teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home.*

**Five:** *House cleaning, washing and covering the toilets, washing food, hand washing, always cleaning the yard, cleaning the house well, boiling water. The child has to drink boiled water.*

**Six:** *Individual and collective hygiene at home, if possible, in the general community, food hygiene before consumption or cooking, hand hygiene before picking up food and after using the toilet, water treatment for safe drinking, boiling water or using other effective methods, pay attention to the child and feed properly.*

**Seven:** *Wash food well before giving it to the child, wash the child's bottle with boiled water, have adequate toilets, and keep pets in the right place. Hold talks and cleanup journals about diarrhoea prevention, wash hands thoroughly, supervise the children so they do not touch dirty places, and wash their hands.*

**Eight:** *Identify the food that causes diarrhoea, wash hands always with soap and water before and after meals, and wash food well. Boil water or treat with chlorine (certeza) before consuming, cook food well, ensure the cleanliness of toilets and clean the yard, and wash children's hands frequently. Maintain hygiene in the patio, living room, kitchen, and bathroom.*

**What are the priority actions to prevent diarrhoea in the household and the district?**

In this step, the stakeholders mentioned the measures considered as priorities taking into account what has been mentioned before. The priorities are as follows for the two districts:

**Rural priorities**

1. Hand washing;

2. Consumption of treated water;

3. Cooking food;

4. Give hygiene speeches;

5. Make home visits;

6. Inform mothers about the causes of diarrhoea;

7. Teach children to wash their hands before meals. Many children eat without washing their hands and also pick up food on the floor;

8. Cover the latrines and properly pack the waste;

9. Cover the food and reduce the traditional medicine and reinforce conservation and hygiene practices;

10. Give lectures in places with gatherings of people;

11. Boil food to kill microbes that rats, cockroaches and flies can introduce;

12. Cover food and dishes;

13. Wash dishes with water and soup;

14. Do not give spoiled food to children. Ensure mother has tasted it;

15. Awareness the caregivers to soak the traditional medicine with boiled water. Perhaps it can minimize the effect of microorganisms;

16. Negotiate the postponement of the administration of traditional medication to be later after six months;

17. Keep the house clean.

**Urban priorities**

1. Boil water and wash food

2. Keep the yard clean

3. Do not leave trash anyhow

4. Wash children's hands

5. Treat the water

6. Cover the toilet and put ash in the latrine

7. Boil baby bottles, wash hands, cut children's nails

8. Improve the toilets in the houses

9. Maintain house and toilets hygiene and wash food

10. Create channels for water flow,

11. Boil the water to prepare milk for children, do not give cold milk to the children, and teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home.

12. Do not allow the child to go to the toilet alone and without slippers

13. To any child with diarrhoea, always prepare homemade oral rehydration salts

14. Do not give the child water directly from the tap

15. Keep domestic animals in the right place

16. Cook the food well

17. Give family talks about environmental sanitation and hygiene and the proper use of latrines.

Table 3 shows the top ten priorities for foodborne diarrhoea disease prevention measures determined by stakeholders during NGT sessions and forms part of the basis of the local strategy.

Table 3: The ten priority measures of the strategy of preventive measures for foodborne diarrhoea in children under five in Marracuene and Kamaxaqueni districts.

| Nº | Marracuene district (rural Area) | Kamaxaqueni district (urban Area) |
|---|---|---|
| 1 | Hand washing | Boil water and wash food |
| 2 | Consumption of treated water | Keep the yard clean |
| 3 | Cooking the food well | Do not leave waste anyhow |
| 4 | Give hygiene awareness | Washing children's hands |
| 5 | Domiciliary assistance by APE's | Teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home. |
| 6 | Inform mothers about the causes of diarrhoea | Cover the toilet and put ash in the latrine |
| 7 | Teach children to wash their hands before meals | Cook the food well |
| 8 | Cover latrines and give talks in places with gatherings of people | Improve the toilets in the houses |
| 9 | Store food in a cool and clean place | Maintain house hygiene and personal hygiene |
| 10 | Awareness the caregivers to soak the traditional medicine with boiled water, store and cover it, and postpone the administration of traditional medicines until the child is six months. | Create channels for water flow |

## 4. DISCUSSION

The study aims to develop a household and community strategy for preventing foodborne diarrhoea in children under five in Marracuene and Kamaxaqueni. According to the outcomes of the NGT sessions, a wide range of preventive measures for foodborne diarrhoea were discussed with stakeholders in each district. Looking at the results, it was unfortunate that carers' (mothers') participation in the discussion sessions was low because they are the primary stakeholders. After all, they are the ones caring for the children in cases of the disease, particularly foodborne diarrhoea; in some ways, this factor could be a constraint in the implementation of the local strategy of preventive measures for foodborne diarrhoea. . Previous research has emphasised the importance of carers in sessions like this; a study conducted in Malaysia found that carer participation is critical in performing good hygiene practices for children (Sofi et al., 2022).

According to the findings, stakeholders in both study areas are aware of WHO's five key food safety actions (2019). The level of awareness was observed during their intervention in the NGT sessions. The question is why they do not carry out these actions properly at home or in the community. Perhaps the poor implementation is due to traditional beliefs, such as what was discovered concerning administering and managing traditional medicine to children in rural areas. In contrast, in urban areas, it is due to environmental sanitation that should be provided by the government administration, such as providing good channels for water flow and maintaining water nets.

Traditional beliefs were discovered to be so strong in rural areas that they not only interfere with the prevention of foodborne diarrhoea but are also factors in the outbreak of other infections in children, such as children intoxication, as reported by health workers who participated in the NGT sessions. To address this, it was agreed that carers should be educated on the importance of delaying the administration of traditional medicines to children until they are six months old because mothers report that the medicine is given even to newborn children. . The current study's findings are consistent with previous studies conducted in Nepal and Nigeria (Budhathoki et al., 2016; Odo et al., 2021), which reported the interference of traditional beliefs in preventing diseases in communities, including foodborne diarrhoea.

The results of the urban area show a lack of environmental and sanitary conditions, as well as personal and community hygiene; in this area, educational or awareness about personal and community hygiene is stated to be very important, as is behavioural change in terms of adopting good hygiene practises in order to prevent foodborne diseases and other infections. Similar findings have been reported in other studies where personal, community, and environmental factors interfere with the implementation of disease prevention measures (Imoh, 2013; Odo et al., 2021).

The outcome demonstrates the difference between the two districts; for example, in the rural area, the first action strategy was hand washing, whereas, in the urban area, it was water treatment or boiled water. These findings suggest that actions to prevent foodborne diarrhoea should be carried out following the reality of each region's beliefs and that different actors should be involved to make the actions simple and practical. However, the two districts recognise that in order to be successful in implementing the

action strategy, their strategy must focus on improving hygiene practises and carer education, the best practises of hand washing, safe water and raw materials, keeping food at safe temperatures, separating raw and cooked food, cooking thoroughly, and taking into account the local environment and culture. This finding is consistent with findings from other studies (Imoh, 2013; Wasonga et al., 2016; Budhathoki et al., 2016) that considered WASH.

### 4.1 Limitations

Due to the distance required for COVID-19 prevention measures and having it available on the same day, finding a large room to accommodate all participants was difficult. Local language was used during data collection to explain the study's objectives. Because some participants had difficulty writing, the facilitators had to ask them to dissect their opinions orally before writing them down.

## 5. CONCLUSION

Foodborne diarrhoea prevention should take into account community realities. For the strategy to be effective, households and the community should be involved in its development. Elementary assistance for health (APEs) in the community should support the households because they are members of the communities, know about the beliefs and realities, and can easily positively influence the change of behaviour in the household or community.

**Competing interests:**

The authors declare that they have no competing interests

## 6. REFERENCES


Ajayi, O. A., Oluwoye, J. O., 2015. Sustainable street vended foods and food safety: a conceptual framework. *International Journal of Food Safety, Nutrition & Public Health*, *5*(3-4), 195-216.

Assefa, T., Tasew, H., Wondafrash, B., & Beker, J., 2015. Contamination of bacteria and associated factors among food handlers working in the student cafeterias of Jimma University Main Campus, Jimma, South West Ethiopia. *Alternative & Integrative Medicine, 4*(1):1-8.

Budhathoki, S. S., Bhattachan, M., Yadav, A. K., Upadhyaya, P., & Pokharel, P. K., 2016. Eco-social and behavioural determinants of diarrhoea in under-five children of Nepal: a framework analysis of the existing literature. *Tropical medicine and health*, *44*(1), 1-7.

Darvesh, N., Das, J. K., Vaivada, T., Gaffey, M. F., Rasanathan, K., & Bhutta, Z. A., 2017. Water, sanitation and hygiene interventions for acute childhood diarrhea: a systematic review to provide estimates for the Lives Saved Tool. *BMC Public Health*, *17*(4), 101-111.

Fasoro, A. A., Faeji, C. O., Oni, O. I., & Oluwadare, T., 2016. Assessment of food safety practices in a rural community in Southwest Nigeria. *Food & Public Health*, *6*(3), 1-6.

Walker, C. L. F., Rudan, I., Liu, L., Nair, H., Theodoratou, E., Bhutta, Z. A., & Black, R. E., 2013. Global burden of childhood pneumonia and diarrhoea. *The Lancet*, *381*(9875), 1405-1416.

Government. Available online at: https://www.caldwellcountync.org/article/59-social-workers-role-inpublic-health (accessed February 14, 2021).

Grace, D., 2015. Food safety in developing countries: An overview. Hemel Hempstead, UK: *Evidence on Demand*. DOI: https://doi.org/10.12774/eod_er.oct2015.graced.

Imoh, G., 2013. Community strategies for the control of diarrhoea diseases (CDD) in Africa. *International Journal of Development and Sustainability, 2*(2), 1142–55.

Machava, N. E., Salvador, E. M., & Mulaudzi, F., 2022. Assessment of diagnosis and treatment practices of diarrhoea in children under five in Maputo-Mozambique. *International Journal of Africa Nursing Sciences, 17*, 100507.

Machava, N. E., Mulaudzi, F. M., & Salvador, E. M., 2022. Household Factors of Foodborne Diarrhea in Children under Five in Two Districts of Maputo, Mozambique. *International Journal of Environmental Research and Public Health, 19*(23), 15600. https://doi.org/10.3390/ijerph192315600.

MISAU. 2016. Manual de prevenção e controlo da cólera e de outras diarreias agudas, 4ª ed, Maputo, Moçambique.

Odo, C., Onalu, C., Nwatu, U., Nwafor, N., & Ebimgbo, S., 2023. Factors associated with the prevalence of diarrhoea among children in rural areas of Enugu State, Nigeria: Practice considerations for social workers. *International Social Work, 66*(2), 518-533.

Patton, C. V., Sawicki, D. S., & Clark, J. J., 2015. Basic methods of policy analysis and planning. New York: Routledge.

Sofi, M. M., & Yassin, M. H. M., 2022. Parental Involvement in the Implementation of Personal Hygiene Practices for Students with Special Needs. *Journal of ICSAR, 6*(1), 20-29.

Talaei, M., Holakouie-Naieni, K., Rahimi-Foroushani, A., & Masoumi-Asl, H., 2015. Knowledge, attitude and practice of people about foodborne outbreak in Isfahan city, Iran. *Journal of Food Safety and Hygiene, 1*(2), 39-45.

UNICEF. 1998. *The state of the world's children 1998*. Oxford: Oxford University Press.

Wambui, J., Karuri, E., Lamuka, P., & Matofari, J., 2017. Good hygiene practices among meat handlers in small and medium enterprise slaughterhouses in Kenya. *Food Control, 81*, 34-39. https://doi.org/10.1016/j.foodcont.2017.05.036.

Wasonga, J., Okowa, M., & Kioli, F. (2016). Sociocultural determinants to adoption of safe water, sanitation, and hygiene practices in Nyakach, Kisumu County, Kenya: a descriptive qualitative study. *Journal of Anthropology*, 2016 7434328, 5 http://dx.doi.org/10.1155/2016/7434328.

World Health Organisation. 2022. *Food Saf*ety. World Health Organization Report. https://www.who.int/news-room/factsheets/detail/food-safety. Accessed November 15, 2022.

World Health Organisation. 2019. *Food Saf*ety. World Health Organization Report. https://www.who.int/teams/nutrition-and-food-safety/multisectoral-actions-in-food-systems/five-keys-to-safer-food-poster. Accessed May 10, 2020.

Conflict of Interest and Authorship Confirmation Form

Please check the following as appropriate:

- All authors have participated in (a) conception and design, analysis and interpretation of the data; (b) drafting the article or revising it critically for important intellectual content; and (c) approval of the final version.
- This manuscript has not been submitted to, nor is it under review at, another journal or other publishing venue.
- The authors have no affiliation with any organization with a direct or indirect financial interest in the subject matter discussed in the manuscript
- The following authors have affiliations with organizations with a direct or indirect financial interest in the subject matter discussed in the manuscript:

| Author's name | Affiliation |
|---|---|
| Norgia Elsa Machava | University of Pretoria |
| Elsa Maria Salvador | Eduardo Mondlane University |
| Fhumulani Mulaudzi | University of Pretoria |

**Authors' contributions**

Nórgia Elsa Machava was involved in the research concept and design, data collection, data assembly, data analysis and interpretation, and article writing. Fhumulani Mavis Mulaudzi and Elsa Maria Salvador contributed to the research concept and design, as well as data collection supervision and critical review of the paper. The final version of the paper for submission was read and approved by all authors.

Table 1: Description of stakeholders who participated in NGT sessions

| | | Rural | | | Urban | | |
|---|---|---|---|---|---|---|---|
| N | Occupation | **N (%)** | **Male (N-%)** | **Female (N-%)** | **N (%)** | **Male (N-%)** | **Female (N-%)** |
| 1 | Mothers/Caregivers | 2 (13) | 0 | 2 (13) | 2 (13%) | 0 | 2 (13%) |
| 2 | Doctors | 2 (13) | 1 (6) | 1 (6%) | 2 (13%) | 1(6%) | 1 (6%) |
| 3 | Nurses | 2 (13) | 0 | 2 (13%) | 2 (13%) | 0 | 2 (13%) |
| 4 | Health technicians | 6 (38) | 2 (13) | 4 (25%) | 4 (27%) | 0 | 4 (27%) |
| 5 | Community Leaders | 4 (25) | 3 (19) | 1 (6%) | 5 (33%) | 3 (20%) | 2 (13%) |
| Total | | 16 (51,6) | 6 (38) | 10 (63%) | 15 (48,4) | 4 (26%) | 11 (73%) |

Table 2_ Five key actions and opinions of stakeholders.

| | | Stakeholder Statements | |
|---|---|---|---|
| **N** | **Actions** | **Rural Area** | **Urban Area** |
| 1 | Keep clean | *Advise the mothers to put food and traditional medicine in cool and clean places, but with regards to traditional medicine, there is a belief that it should not be covered as it is most efficient and works better with mould and spoiled.* | *Talk to mothers to observe proper food hygiene before eating, principally if it is for the children.* |
| 2 | Separate raw and cooked | *Always wash food before consuming and giving it to children.* | *Wash food well before consuming raw foods such as fruits and uncooked salads.* |
| 3 | cook thoroughly | *Mothers should make sure to cook well the food* | *Let the food cook well before giving it to the children* |
| 4 | keep food at safe temperatures | *Always keep the food children in a cool place and heat it the next day before eating it* | *Whenever there is leftover food, we store it in a cool place and heat it the next day before eating it.* |
| 5 | Use safe water and raw materials | *Talk about the need to boil water, but it is difficult. People cannot afford it because of the expensive fuel and heating materials cost.* | *It is to have clean water for consumption because here in Maxaqueni, the water comes from the public network. The problem is that the tubes that take water to the houses are all broken, and the streets and backyards are full of stagnant water that enters the tubes and contaminate the water. It is advisable to treat water for drinking with ''certeza'' (chlorine), boiling it or using other effective methods for water treatment.* |

Proceeding with the study, the stakeholders made their statements regarding the second question: "*What strategy are you using to implement the previously identified actions to prevent diarrhoea?"*

**Rural area**

**One:** I*n the community, people use traditional medicines before going to the hospital because there are common beliefs about diseases in children caused by the appearing or disappearing of the moon in the sky. As shared by a mother/caregiver, even the day before her child had a crisis, the first thing she did was to give traditional medicine, but the child did not get better, so the mother went to a health facility later on.*

**Two:** *Lectures are given in the community where people are taught about diarrhoea and its treatment. However, mothers often do not have a concept/definition of diarrhoea. They go to the hospital even in cases of one defecation. Elementary community workers usually do domiciliary health assistance called APEs, who are in few numbers to cover all homes in the community.*

**Three:** *The mothers say that the longer the traditional medicine stays, the more efficient it is. However, the APEs started to visit the homes and discovered that rotten traditional medicine with mould was still being administered to the children. This practice can cause diarrhoea or other types of intoxication. According to the nurses, there are cases of intoxication by traditional medicines assisted at health facilities since the dosage is unknown and given arbitrarily. According to beliefs, when the child is sick, they should be given more significantmore traditional medicine. Most traditional medicines are of two types, leaves (dipped) and roots (boiled). However, both are dry, and should not be washed.*

**Four:** *Conservation and hygiene practices should be reinforced, and boiling all traditional medicine before being given to the children. It is essential to advise mothers to adopt exclusive breastfeeding and administer traditional medicine from six months onwards to children. Use improved latrines and cover. Reduce doses of traditional medicine, especially "dlhaia nhoka", given in the neonatal period.*

**Five:** *To prevent diarrhoea, it is to consider hygiene measures such as hand washing, sanitation and a clean environment.*

**Urban area**

**One:** *Good food conservation, water treatment with chlorine "certeza" or boiling water, adequate sanitation, wash hands before and after consuming food.*

**Two:** *Check the hygiene conditions of the house and personal hygiene, food hygiene, and family education and discuss the need for latrine hygiene and covering.*

**Three:** *Boil water for drinking, wash food well before consuming principally raw foods such as salads and fruits, wash hands after using the toilet, and always keep water and food in a cool and clean place.*

**Four:** *Hand washing before and after contact with food. Wash food properly, if possible, with treated water, and properly pack food. Teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home.*

**Five:** *House cleaning, washing and covering the toilets, washing food, hand washing, always cleaning the yard, cleaning the house well, boiling water. The child has to drink boiled water.*

**Six:** *Individual and collective hygiene at home, if possible, in the general community, food hygiene before consumption or cooking, hand hygiene before picking up food and after using the toilet, water treatment for safe drinking, boiling water or using other effective methods, pay attention to the child and feed properly.*

**Seven:** *Wash food well before giving it to the child, wash the child's bottle with boiled water, have adequate toilets, and keep pets in the right place. Hold talks and cleanup journals about diarrhoea prevention, wash hands thoroughly, supervise the children so they do not touch dirty places, and wash their hands.*

**Eight:** *Identify the food that causes diarrhoea, wash hands always with soap and water before and after meals, and wash food well. Boil water or treat with chlorine (certeza) before consuming, cook food well, ensure the cleanliness of toilets and clean*

*the yard, and wash children's hands frequently. Maintain hygiene in the patio, living room, kitchen, and bathroom.*

**What are the priority actions to prevent diarrhoea in the household and the district?**

In this step, the stakeholders mentioned the measures considered as priorities taking into account what has been mentioned before. The priorities are as follows for the two districts:

**Rural priorities**

1. Hand washing;

2. Consumption of treated water;

3. Cooking food;

4. Give hygiene speeches;

5. Make home visits;

6. Inform mothers about the causes of diarrhoea;

7. Teach children to wash their hands before meals. Many children eat without washing their hands and also pick up food on the floor;

8. Cover the latrines and properly pack the waste;

9. Cover the food and reduce the traditional medicine and reinforce conservation and hygiene practices;

10. Give lectures in places with gatherings of people;

11. Boil food to kill microbes that rats, cockroaches and flies can introduce;

12. Cover food and dishes;

13. Wash dishes with water and soup;

14. Do not give spoiled food to children. Ensure mother has tasted it;

15. Awareness the caregivers to soak the traditional medicine with boiled water. Perhaps it can minimize the effect of microorganisms;

16. Negotiate the postponement of the administration of traditional medication to be later after six months;

17. Keep the house clean.

**Urban priorities**

1. Boil water and wash food

2. Keep the yard clean

3. Do not leave trash anyhow

4. Wash children's hands

5. Treat the water

6. Cover the toilet and put ash in the latrine

7. Boil baby bottles, wash hands, cut children's nails

8. Improve the toilets in the houses

9. Maintain house and toilets hygiene and wash food

10. Create channels for water flow,

11. Boil the water to prepare milk for children, do not give cold milk to the children, and teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home.

12. Do not allow the child to go to the toilet alone and without slippers

13. To any child with diarrhoea, always prepare homemade oral rehydration salts

14. Do not give the child water directly from the tap

15. Keep domestic animals in the right place

16. Cook the food well

17. Give family talks about environmental sanitation and hygiene and the proper use of latrines.

Table 3: The ten priority measures of the strategy of preventive measures for foodborne diarrhoea in children under five in Marracuene and Kamaxaqueni districts.

| Nº | Marracuene district (rural Area) | Kamaxaqueni district (urban Area) |
|---|---|---|
| 1 | Hand washing | Boil water and wash food |
| 2 | Consumption of treated water | Keep the yard clean |
| 3 | Cooking the food well | Do not leave waste anyhow |
| 4 | Give hygiene awareness | Washing children's hands |
| 5 | Domiciliary assistance by APE's | Teach the caregivers how to prepare oral rehydration salts for children with diarrhoea at home. |
| 6 | Inform mothers about the causes of diarrhoea | Cover the toilet and put ash in the latrine |
| 7 | Teach children to wash their hands before meals | Cook the food well |
| 8 | Cover latrines and give talks in places with gatherings of people | Improve the toilets in the houses |
| 9 | Store food in a cool and clean place | Maintain house hygiene and personal hygiene |
| 10 | Awareness the caregivers to soak the traditional medicine with boiled water, store and cover it, and postpone the administration of traditional medicines until the child is six months. | Create channels for water flow |

**ACKNOWLEDGEMENT**

We are grateful to the Foodborne Disease Epidemiology, Surveillance, and Control in African Low and Middle-Income Countries (FOCAL) Project and Eduardo Mondlane University for funding and research assistants. We are also grateful for the financial assistance provided by the Bill and Melinda Gates Foundation. Thank you to the Instituto Superior de Ciências de Sade (ISCISA) for allowing me to participate in this study. Many thanks to the mothers and carers of children who participated in the study. Thanks to health workers, and community leaders who assisted with data collection. .

# CHAPTER SIX

# GENERAL DISCUSSION AND CONCLUSION

## 6.1. OVERVIEW

This study investigated the factors of foodborne diarrhea and developed a preventive strategy for foodborne diarrhea in children younger than five years of age in two districts, marracuene (rural) and Kamaxaqueni (urban) in Mozambique. This study was based on the theoretical framework of the, -A Action of UNICEF 1982. For a better structuring and understanding, the study was divided into three phases, which are detailed in different chapters.

The main interest in this study was that, in Mozambique, foodborne diarrhea infections are overlooked and only given importance and attention in the rainy season due to the outback of cholera. These diseases are not constantly prioritized for surveillance, prevention, and control, although diagnosis and treatment are easy. Morbidity and mortality rates in the country are higher in children under five years of age. However, it is well known that the co-factors of foodborne diarrhea are complex and coexist, making intervention difficult. Regarding previous statements, the research questions raised in the present study were as follows: (i) How do health professionals diagnose and treat foodborne diarrhea in children younger than five years? (ii) What are the household factors for the origin of foodborne diarrhea in children younger than five years? (iii) What strategies should be developed at the household and community levels as preventive measures for foodborne diarrhea in children younger than five years of age in the Kamaxaqueni and Marracuene Districts of Maputo, Mozambique?

To understand how health professionals diagnose and treat foodborne diarrhea in children under five years of age, the first triple-A (Assess) was used for a

quantitative retrospective study, and data from five years of record books were collected based on a checklist organized in Microsoft Excel. This section of the study deals with the observation of the general guidelines regarding the diagnosis and treatment of foodborne diarrhea in children under five years of age, where health workers implemented anamnesis and oral rehydration. The principal incongruence observed was the use of antibiotics to treat diarrhea without screening for the agent. This led to the conclusion that antibiotics were administered arbitrarily to the health facilities where the study was conducted.

The household factors of foodborne diarrhea in the Marracuene and Kamaxaqueni districts were investigated to respond to a second A (analysis), using a quantitative structured questionnaire to respond to the present study's second research question. The main factors were related to water sanitation and hygiene (WASH) in both districts. However, in Marracuene (rural), apart from WASH, the use of traditional medicine was found to be an additional factor. Comparing the load of factors in the two districts, the rural population weighed more in administering traditional medicines to children, including those under six months of age, to whom it was expected to be exclusively breastfeeding to children that age. In Kamaxaqueni, the lack of safe water increased. This impairs the food chain in children, including in adults.

Finally, a strategy for preventive measures against foodborne diarrhea at the household and community levels was developed according to the third A (Action) from the theoretical framework based on the nominal group technique called NGT. It gathered stakeholders (professionals, mothers and/or caregivers, and community leaders) in the same room in two separate sessions, one in Marracuene and the other in Kamaxaqueni, to build a strategy of preventive measures for foodborne diarrhea with the participation of all interventions, with the assumption that if the implementers are included and are aware of the probability of the strategy function being higher. The NGT sessions were based on the results of a retrospective study and investigation of the factors associated with foodborne diarrhea. During the NGT sessions, the stakeholders were asked

questions about measures to prevent foodborne diarrhea, and several responses were provided. As there were many responses, there was a need to prioritize the measures because the strategy was supposed to be of ten preventive measures built based on the consensus of the stakeholders.

## 6.2 DISCUSSION

Considering the theoretical framework used in the study, it was possible to apply all stages of the framework (Assess, Analyze, and Action) because, according to the theoretical framework, the first action is to assess how health professionals treat and diagnose foodborne illnesses. The study's motivation was related to the fact that foodborne diarrhea in children younger than five years is still a concern, although previous studies considered the diagnosis and treatment easy (Switaj et al., 2015; LaRocque & Harris, 2021). During the study, the ease of diagnosis and treatment of foodborne diarrhea in children under five years of age was confirmed. However, there was a lack of screening of agents as an auxiliary to the diagnosis procedure, even when there was substantial evidence, such as blood in the stools of children. Treatment of foodborne diarrhea. The World Health Organization guidelines have been used to treat foodborne diarrhea (WHO, 2017). However, empirically, the administration of antibiotics calls for attention to the fact that this attitude is disapproved as a brink consequence for treatment lines of children in the future owing to the possibility of the emergence of antibiotic resistance (Chukwu et al., 2019; Yue et al., 2020).

Second, we understand the reasons for the problem (analysis), according to the theoretical framework. Within the population group of the study, cases of diarrhea in children under five years of age were concentrated in children under two years of age, and factors such as introducing complementary food, administration of traditional medicine poorly stored in children under six months, unsafe water, and

lack of environmental and personal hygiene exacerbated the vulnerability of children to foodborne diarrhea. Due to these factors, the frequency of diarrhea in this age group has been reported in previous studies (Langa et al., 2016; Chissaque et al., 2018; Chissaque et al., 2021; Messa et al., 2021).

Having identified the factors of food-borne diarrhea in children under five years of age, there is a need to establish local preventive measures at the local and community levels, looking for local solutions and actions to solve the problem using a third A from the theoretical framework. According to the stakeholders, the WASH principle and observation of hygiene practices while following traditional beliefs about the care of children were debated in the NGT sessions. The preventive measures stated by stakeholders corroborate those reported previously (Foddai et al., 2016; UNICEF, 2020; Ejemot-Nwadiaro et al., 2021). As the objective of the NGT sessions was to elaborate on local strategies of preventive measures for foodborne diarrhrea based on the factors identified on the ground, this objective was reached, and the strategy was composed of 10 preventive measures found to be a priority according to the stakeholders. The main benefit of this strategy is that it works because the principal preventive measures were stated by the proper stakeholders based on the realities in the community, together with the traditional beliefs that the proper stakeholders found that they needed some improvement in order not to cause diarrhea in children under five. According to previous studies, some traditional beliefs interfere with preventive measures against several diseases, including foodborne diarrhea (Budhathoki et al., 2016; Odo et al., 2021).

## 6.3 CONCLUSION

It was possible to apply the theoretical framework of UNICEF and respond to the research questions posed at the beginning of this study. Health professionals are expected to consider the need for screening agents and arbitrary administration of antibiotics for the treatment of diarrhea because there is a feedback session on the study results with health workers. This study demonstrated that factors within the community are related to foodborne diarrhea. It was also possible to create a local strategy for preventive measures for foodborne diarrhea, where stakeholders could prioritize the measures that matter and the cause of constraints within the household and community.

## 6.4 RECOMMENDATION and LIMITATION

It recommends screening for the agent of diarrhea when the signs and symptoms suggest, such as blood in the stools and fever, and not administering antibiotics arbitrarily. Further studies are recommended to assess the implementation and functionality of the preventive measures for foodborne diarrhea developed in this study.

The main strength of the present study was that it addressed a health problem related to a vulnerable population group (children under five) who depend essentially on caregivers for the protection and prevention of foodborne diarrheal diseases. Additionally, stakeholders can identify the factors faced at home or in the community. The involvement of stakeholders resulted in a local strategy of preventive measures for foodborne diarrhea in children under five years of age, with priority measures that are thought to be implemented at home or in the community.

Owing to the covid-19 pandemic, it was not possible to collect data from some health facilities previously selected for the study, inappropriate conservation of the record books, and incorrect filling and/or missing unable to obtain data from these records. Constituted limitations on accessibility to remote areas during fieldwork, mainly in rural areas, and the means of transport were other constraints in the present study. The lack of faith on the part of some mothers or caregivers of the urban area prevented them from visiting the house because they gave the wrong address, and it was not possible to locate them. In the sections of the NGT, few participations of mothers or caregivers were observed, whereas it was the core for the care and assistance of children.

## 6.5 DIRECTIONS OF FUTURE

The results of the present study were presented to where the study took place, the Marracuene and Kamaxaqueni districts, as feedback to the community during the NGT sessions with stakeholders. These results were published in different peer-reviewed journals as articles and in oral communications in the XVII Scientific Journal of Instituto Superior de Ciências de Saúde (ISCISA) Maputo, Mozambique. One manuscript has been submitted to a peer-reviewed journal for publication. In the future, the actor intends to implement the strategy built in this study with stakeholders, and then conduct research to assess the impact of strategy implementation at the household and community levels. If the impact is good. It can spread the initiative of making a strategy of preventive measures for foodborne diarrhea, hearing that stakeholders consider local beliefs, as Mozambique is huge and has different beliefs throughout the country.

## 6.6 REFERENCES

LaRocque, R., & Harris, J. B. 2021. Patient education: foodborne illnesses (food poisoning) (Beyond the Basics).

Switaj, T. L., Winter, K. J., & Christensen, S. 2015. Diagnosis and management of foodborne illnesses. American Family Physician 92(5), 358-365.

Budhathoki, S. S., Bhattachan, M., Yadav, A. K., Upadhyaya, P., & Pokharel, P. K. 2016. Eco-social and behavioral determinants of diarrhea in under-five children in Nepal: A framework analysis of the existing literature. Tropical Medicine and Health 44(1), 1-7.

Chissaque, A., Cassocera, M., Gasparinho, C., Langa, J. S., Bauhofer, A. F. L., Chilaúle, J. J., de Deus, N., 2021. Rotavirus A infection in children under five years old with a double health problem: undernutrition and diarrhea: A cross-sectional study in four provinces of Mozambique. BMC Infectious Diseases, 21(1), 1-13.

Chissaque, A., de Deus, N., Vubil, D., & Mandomando, I. 2018. Epidemiology of diarrhea in children under five years of age in Mozambique. Current Tropical Medicine Reports, 5(3), 115-124.

Chukwu, M. O., Abia, A. L. K., Ubomba-Jaswa, E., Obi, L. C., & Dewar, J. B. (2019). Antibiotic resistance profile and clonality of E. coli isolated from water and pediatric stool samples from the northwest province of South Africa. J. Pure Appl. Microbiol, 13, 517-530.

Cissé, G. 2019. Foodborne and waterborne diseases under climate change in low- and middle-income countries: Further efforts are required to address the environmental health exposure risks. Acta tropica, 194, 181-188.

Ejemot-Nwadiaro, R. I., Ehiri, J. E., Arikpo, D., Meremikwu, M. M., & Critchley, J. A. 2021. Handwashing promotion to prevent diarrhea. Cochrane Database of Systematic Reviews (1).

Foddai, A. C., Grant, I. R., & Dean, M. 2016. Efficacy of instant hand sanitizers against foodborne pathogens compared with hand washing with soap and water in food preparation settings: A systematic review. Journal of Food Protection 79(6), 1040-1054.

Holcomb, D. A., Knee, J., Sumner, T., Adriano, Z., de Bruijn, E., Nalá, R., & Stewart, J. R. 2020. Human fecal contamination of water, soil, and surfaces in households sharing poor-quality sanitation facilities in Maputo, Mozambique. International Journal of Hygiene and Environmental Health, 226, 113496.

Jiang, X. Q., Mei, X. D., & Feng, D. 2016. Air pollution and chronic airway diseases: What people should know and do? Journal of Thoracic Disease 8(1): E31.

Langa, J. S., Thompson, R., Arnaldo, P., Resque, H. R., Rose, T., Enosse, S. M., & Leite, J. P. G. 2016. Epidemiology of rotavirus A diarrhea in Chókwè, Southern Mozambique, from February to September 2011. Journal of Medical Virology, 88(10), 1751-1758.

Merali, H. S., Morgan, M. S., and Boonshuyar, C. (2018). Diarrheal knowledge and preventative behaviors among caregivers of children under five years of age in Tonle Sap Lake, Cambodia. Research and Reports in Tropical Medicine 9, 35.

Messa Jr, A., Köster, P. C., Garrine, M., Gilchrist, C., Bartelt, L. A., Nhampossa, T., & Mandomando, I. 2021. Molecular diversity of Giardia duodenalis in children under 5 years from the Manhiça district, Southern Mozambique, enrolled in a matched case-control study on the aetiology of diarrhea. PLoS neglected tropical diseases, 15(1), e0008987.

Odo, C., Onalu, C., Nwatu, U., Nwafor, N., & Ebimgbo, S. 2021. Factors associated with the prevalence of diarrhea among children in rural areas of Enugu State, Nigeria: Practice considerations for social workers. International Social Work, 00208728211034229.

Ogbeyi, G. O., Onyemocho, A., & Ogbonna, C. 2016. Assessment of caregiver's knowledge of diarrhoea and practice of home management of diarrhoea disease among under two children in Opialu, a rural community in Benue State, Nigeria. Glob J Med Public Health, 5, 3-13.

Raji, M. O., Abdullahi, U., Raji, I. A., Oladigbolu, R. A., Kaoje, A. U., & Awosan, K. J. 2017. Caregivers' knowledge, home treatment of diarrhoea disease and predictors of child diarrhoea disease in a semi urban community of Sokoto, North-west, Nigeria. Journal of Public Health and Epidemiology, 9(2), 16-23.

Thiam, S., Diène, A. N., Fuhrimann, S., Winkler, M. S., Sy, I., Ndione, J. A., & Cissé, G. 2017. Prevalence of diarrhoea and risk factors among children under five years old in Mbour, Senegal: a cross-sectional study. Infectious diseases of poverty, 6(04), 43-54.

Todd, E. C., & Grieg, J. D. 2015. Viruses of foodborne origin: a review. Virus Adaptation and Treatment, 7, 25.

UNICEF 2022, Situation of the Children in Mozambique. Available at https://www.unicef.org/mozambique/en/children-mozambique.

UNICEF MOZAMBIQUE. 2020. Hand hygiene for all. OCTOBER 2020. Available in https://www.unicef.org/mozambique/media/2876/file/Mozambique-publication-hand-hygiene-for-all.pdf.

Wasihun, A. G., Dejene, T. A., Teferi, M., Marugán, J., Negash, L., Yemane, D., & McGuigan, K. G. 2018. Risk factors for diarrhoea and malnutrition among children under the age of 5 years in the Tigray Region of Northern Ethiopia. PloS one, 13 (11), e0207743.

World Health Organization WHO. 2015. Estimates of the global burden of foodborne diseases: foodborne disease burden epidemiology reference group 2007-2015. World Health Organization,

World Health Organization. 2016. The burden of foodborne diseases in the South-East Asia Region.

Yue, M., Li, X., Liu, D., & Hu, X. 2020. Serotypes, antibiotic resistance, and virulence genes of Salmonella in children with diarrhoea. Journal of Clinical Laboratory Analysis, 34(12), e23525.

# APPENDICES

## APPENDIX A - Retrospective data collection form

Factors of Foodborne Diarrhea in Children Under 5 Years of Age in Marracuene and Kamaxaqueni Districts, Maputo-Mozambique

| | |
|---|---|
| **Date** | |
| **Data collector** | |

Cases of diarrhea in children and adults registered in the Health Units of [city, country] _____ between 2015 and 2019 [current date].

Health Unit _____

Year _____

Patient registration-number _____

Date of attendance ____/_____/_____

Patient origin: Home ___ transferred from another health unit: ____

Age of the patient_____ months /years

Sex_____

Clinical history

- Diarrhea: Y __ N__
- Bloody diarrhea: Y __ N__
- Vomiting: Y __ N__

- Fever (>38°C) : Y __ N__

Other:_____

_____

_____

_____

_____

Laboratory confirmation of agent: Y__ N__

If yes, agent: _____

Clinical procedure

_____

_____

_____

_____

_____

Administered treatment

_____

_____

_____

_____

_____Final diagnosis

_____

_____

_____

Outcome: Medical discharge ___

Transferred to another health unit___

Death ___

## APPENDIX B - Questionnaire for Child Food Preparation/Handling

Factors of Foodborne Diarrhea in Children Under 5 Years of Age in Marracuene and Kamaxaqueni Districts, Maputo-Mozambique

Sources of diarrheal diseases in children under five years of age

### 1 GENERAL AND DEMOGRAPHIC QUESTIONS

### QUESTIONS TO BE PRE-FILLED

1.1 Data collector/interviewer:

1.2 Healthcare institution/facility:

1.3 Child case number/ID:

1.4 Parent/caretaker number/ID:

1.5 Laboratory ID:
1.6 Interview date: __ /__ / __ (d/mm/y)

1.7 Did the case die?

• Yes, on __ /__ / __ *(dd/mm/year)*

• No

Start of the interview

**Interviewer:** *Thank you for agreeing to participate in the study. We are going to start by asking you some questions about your child, your household, your livelihood, and any livestock you may have.*

*Please let me know if you need me to clarify any of my questions, and feel free to ask any questions you may have during the interview, which will take approximately 15 minutes.*

### DEMOGRAPHICS

1.7 Child case number:

1.8 Gender child:

€ Female

€ Male

1.9 Age of child: *(Consult baby card, if available)*
_____ years _____ months

Birthday ___/___/___ *(dd/mm/year)*

1.10 Parent/caretaker number:
1.11 Gender of parent/caretaker:
• Female

• Male

1.12 Age of parent/caretaker:
_____ years

Birthday: ___/: _/: _ *(dd/mm/year)*

1.13 Relationship with child:
• Mother

• Father

• Relative, specify: _____

• Other, specify: _____

1.14 Address/household identifiers

| |
|---|
| Rural area |
| Urban area |
| |
| |
| |
| |
| |

## 2 DISEASE-RELATED QUESTIONS

**15.**

**Interviewer: We will continue this interview with questions about your child's diarrheal illness.**

2.1 Date of illness onset: ___/___/___ *(mm/dd/year)*

Or approximately how many days ago: _____ days

2.2 How long did the illness last? ____ days or • Still ill

2.3 What were the symptoms?

| | Yes | Onset date | Comments |
|---|---|---|---|
| Diarrhea | • | __ /__ / __ | If yes, what was the maximum number of stools in 24 hours: ____ |
| Light (coloured) stools | • | __ /__ / __ | |
| Nausea | • | __ /__ / __ | |
| Vomiting | • | __ /__ / __ | |
| Abdominal pain/cramps | • | __ /__ / __ | |
| Fever (>38℃) | • | __ /__ / __ | If yes, how many degrees? ____℃ |
| Joint pain | • | __ /__ / __ | |
| Muscle aches | • | __ /__ / __ | |
| Unusual fatigue/tiredness | • | __ /__ / __ | |

| | | | |
|---|---|---|---|
| Constipation | • | __ /__ / __ | |
| Flatulence | • | __ /__ / __ | |
| Headache | • | __ /__ / __ | |
| Jaundice/yellow eyes | • | __ /__ / __ | |
| Dark urine | • | __ /__ / __ | |
| Eye problems | • | __ /__ / __ | |
| Difficulty swallowing (Dysphagia) | • | __ /__ / __ | |
| Painful urination (Dysuria) | • | __ /__ / __ | |
| Weakness or impaired movement (Paresis/paralysis of limb(s)) | • | __ /__ / __ | |
| Running nose | • | __ /__ / __ | |
| Coughing | • | __ /__ / __ | |
| Loss of appetite | • | __ /__ / __ | |
| Dizziness | • | __ /__ / __ | |
| Other symptoms | • | __ /__ / __ | If yes, which |

2.4 When was the first consultation with healthcare professionals (e.g., doctors or nurses) for the illness?

__ /__ / __ *(dd/mm/year)*

2.5 Was your child admitted to the hospital due to the illness?

- Yes
- No

If yes,

What was/is the name of the hospital?

Admission date? __ /__ / __ *(dd/mm/year)*

Still in the hospital?

- Yes
- No, specify discharge date. __ /__ / __ *(dd/mm/year)*

2.6 Was a stool sample taken?

- Yes
- No
- Do not know

If so, what were the identified pathogen(s)?

_____

or • Don't know

2.7 Was a blood sample taken?

- Yes
- No
- Don't know

If so, what were the identified pathogen(s)?

_____

or • Don't know

2.8 Did you experience anything else during the course of your illness you would like to share with us?

_____
_____

## CHILD CASE HISTORY

2.9 Does your child wear a diaper?

- Yes
- No

2.10 Has your child been vaccinated against any disease? *(Consult vaccination card or baby card, if available)*

- Yes, the list below

  _____ when __ /__ / __ *(dd/mm/year)*

  _____ when __ /__ / __ *(dd/mm/year)*

  _____ when __ /__ / __ *(dd/mm/year)*

- No
- Don't know

2.11 Has your child been treated with herbs before you sought medical help?

- Yes, which kind of herbs:

_____

- No
- Don't know

2.12 How many days did your child have diarrhea before you sought medical help?

2.13 Did your child receive any antibiotics in the three months preceding this illness? *(Ask to see bottles or containers, if available)*

• Yes, for which illness _____

Name of the antibiotic: _____ provided when __ /__ / __ *(dd/mm/year)*

Name of the antibiotic: _____ provided when __ /__ / __ *(dd/mm/year)*

Name of the antibiotic: _____ provided when __ /__ / __ *(dd/mm/year)*

• No

• Don't know

2.14 Did your child receive any other type of medicine in the three months preceding this illness? *(Ask to see bottles or containers, if available)*

• Yes, for which illness _____

Name of medicine: _____ provided when __ /__ / __ *(dd/mm/year)*

Name of medicine: _____ provided when __ /__ / __ *(dd/mm/year)*

Name of medicine: _____ provided when __ /__ / __ *(dd/mm/year)*

• No

• Don't know

2.15 Were your children hospitalised or similar in the period before illness?

• Yes

• No

If yes,

Which hospital/institutional institution?

_____

For how long? From __ /__ / __ *(0071b)* until __ /__ / __ *(dd/mm/year)*

**CONTACT WITH OTHER CASES**

**<u>Interviewer:</u> To get a view of other possible cases, I will now ask some questions about your household and social contacts.**

2.16 How many rooms do you have in your house? _____

2.17 How many people, including you, live in your household?
___ people for which there are

___ adults,

___ children aged 2-16 years,

___ children aged under two years old.

2.18 How many people sleep per room?

- 1
- 2-3
- 3-4
- More than 4
- Don't know

2.19 Has anyone in your household had similar symptoms? *(0073)*

- Yes
- No
- Do not know/Do not remember

If yes, how many persons became ill (excluding the child case)

Symptoms started before the child: __ persons

Symptoms started after the child: before __ persons

2.20 Excluding your household, are you aware of your child having had contact with someone else with similar symptoms within one week before the onset of symptoms?

- Yes
- No/do not know/do not remember.

2.21 If other people were ill at the same time as their child, did their child share meals or events with him/her/them?

- Yes
- No
- Do not know/Do not remember

If so, what is shared?

_____

2.22 Has your child had contact with other children attending daycare during the week before symptom onset?

- Yes, specify
- No
- Do not know/Do not remember

If yes,

What are the names and addresses of day care facilities?

_____

Are you aware of any related illnesses in the daycare facilities?

_____

- Yes, specify _____
- No

2.23 Do you have any other relevant information about contact with other ill people?

_____
_____

_____
_____

**POSSIBLE SOURCE/VEHICLE OF INFECTION**

2.24 According to you, what do you think caused your child's illness?

_____
_____

2.25 Did your child consume food or drinks that smelled or tasted as they could have been spoiled in your opinion?

- Yes
- No

If yes, what food/drink was it:

_____

when was it:_____

where was it:

_____

## 3 FOOD HABITS, ALLERGIES AND DIET

3.1 Does your child have any food allergy/intolerance or follows a special diet for medical, religious, or other reasons? *(Check all that apply)*

Food allergies or intolerance

- Yes, specify _____
- Vegans (no meat, fish, eggs, dairy, or honey)
- Vegetarian, specify
  - No meat
  - No fish
  - No eggs
  - No dairy
- No pork or pork product
- No beef or beef product
- Halal

- Kosher
- Medical diet, specify

_____

- No food allergies, intolerances, or specific diets

## 4 SHOPPING

4.1 Where does your household buy or obtain raw meat from cattle, pigs and/or goats/sheep? *(Check all that apply)*

- Butchery, specify
- Market, specify
- Supermarket, specify
- Directly at a farm, specify
- Self Sufficient, specify
- Other, specify
- Not applicable (does not eat meat)

4.2 Where does your household normally buy or obtain cooked/prepared meat products from cattle, pigs, and/or goats/sheep? *(Check all that apply)*

- Butcher, specify
- Market, specify
- Supermarket, specify
- Directly at a farm, specify
- Self Sufficient, specify
- Other, specify
- Not applicable (does not eat meat)

4.3 Where does your household buy or obtain raw poultry meat? *(Check all that apply)*

- Butchery, specify
- Market, specify
- Supermarket, specify
- Directly at a farm, specify

- Self Sufficient, specify
- Other, specify
- Not applicable (does not eat poultry meat).

4.4 Where does your household buy or obtain cooked/prepared poultry meat? *(Check all that apply)*

- Butchery, specify
- Market, specify
- Supermarket, specify
- Directly at a farm, specify
- Self Sufficient, specify
- Other, specify
- Not applicable (do not eat poultry)

4.5 Where does your household normally buy or obtain eggs from the hens? *(Check all that apply)*

- Butchery, specify
- Market, specify
- Supermarket, specify
- Directly at a farm, specify
- Self Sufficient, specify
- Other, specify
- Not applicable (do not eat eggs)

4.6 Where does your household buy or obtain milk and dairy products normally? *(Check all that apply)*

- Market, specify
- Cheese shop, specify
- Directly at a farm, specify
- Supermarket, specify
- Self-sufficient, specify
- Other, specify
- Not applicable (did not eat dairy).

4.7 Where does your household normally buy or obtain vegetables and fruit? *(Check all that apply)*

- Greengrocer, specify
- Market, specify
- Deli shop, specify
- Directly at the farm, specifying.
- Self Sufficient, specify

€ Supermarket, specify
- Other, specify

4.8 Where does your household buy or obtain fish and shellfish normally? *(Check all that apply)*

- Fish shop, specify
- Market, specify
- Supermarket, specify
- Self-sufficient, specify
- Other, specify
- Not applicable (do not eat fish or shellfish)

## 5 FOOD EATEN IN THE HOUSEHOLD

5.1 What type of food did your child eat a week before the illness onset? *Click all that apply and specify from where the food was bought/obtained*

| **Meat and eggs** | | **Cooked** | **Semi-cooked** | **Raw** | **Food bought/obtained from** |
|---|---|---|---|---|---|
| Beef | • | • | • | • | |
| Pork | • | • | • | • | |
| Lamb/sheep meat | • | • | • | • | |
| Goat meat | • | • | • | • | |
| Chicken meat | • | • | • | • | |

| | | | | |
|---|---|---|---|---|
| Eggs | • | • | • | • |
| Other poultry, specify_____ _ | • | • | • | • |
| Fish or shellfish, specify | • | • | • | • |
| Other meats specify | | | | |

| Dairy | | Pasteurised | Fermented | Raw | Food bought/obtained from |
|---|---|---|---|---|---|
| Milk | • | • | • | • | |
| Yoghurts | • | • | • | • | |
| Cheese | • | • | • | • | |
| Other dairies, specify | • | • | • | • | |

| Vegetables and fruit | | Food bought/obtained from |
|---|---|---|
| Cooked vegetables specify | • | |
| Raw vegetables (e.g. leafy green salads), specify_____ | • | |
| Berries, specify | • | |
| Other fruits, specify_____ | • | |

5.2 Who usually prepares food for the family/household members?

- You
- Your spouse
- Other, specify _____

## 6 FOOD PRODUCTS FOR VERY YOUNG CHILDREN (< 2 YEARS)

6.1 What did your child eat and drink in the week before the illness?

| | | Where was it bought (Name and location of the shop/place) | How was the nature of it (e.g. powder, liquid) | How was it prepared/eaten? |
|---|---|---|---|---|
| Milk (breastfeeding) | • | Not applicable | Not applicable | Not applicable |
| Infant formula | • | | | |
| Follow-on formula | • | | | |
| Fermented cereals | • | | | |
| Ready-to-eat meal | • | | | |
| Fruit puree | • | | | |
| Biscuits, rusks, cookies | • | | | |
| Fruit or vegetable juices | • | | | |
| Other food, specify___ | • | | | |
| - Specify, _____ | | | | |

6.2 Does your child drink any of the above products from baby bottles?

□ Yes, specify which

_____

□ No

□ Don't know

6.3 What kind of water is used for preparing the products mentioned above?

- Bottled water, specify the brand _____
- Water boiled from the household's usual supply ( boiling point)
- Water (not boiled) from household water supply
- □ Other, specify

6.4 Average time between bottle preparation and consumption: ____h/____ h/min.

6.5 How is the prepared bottle kept?

- At room/ambient temperature
- In the refrigerator
- Other, specify _____

6.6 How is the bottle heated before consumption?

- In warm water

€ Not heated, served at room/ambient temperature
€ Electric bottle warmer
- Microwave
- Other, specify_____

6.7 How is the bottle cleaned/disinfected?

- Hand washed with water

€ Handwashing with detergent/soap
- Dishwasher
- Boiled
- Other, specify_____

## 7 FOOD EATEN OUTSIDE THE HOUSEHOLD

7.1 Did your child eat outside of your home the week before the illness? *(Yes (Y)/No (N)/unknown (?))*

| | What food |
|---|---|
| Canteen in school/day-care | • |
| Canteen in hospital/health facility | • |
| Street vendors/food trucks | • |
| Shopping mall food courts | • |
| Takeaway (including when home delivered) | • |
| Other, specify____ | • |

## 8 WATER SUPPLY

**Interviewer: The following questions are about water supply and contact with water.**

### DRINKING WATER

8.1 What kind of water do you use in your household for **drinking**?

| Drinking water source | Primary source (choose only one) | Secondary source (choose only one) | Other sources (tick all that apply) |
|---|---|---|---|
| Piped water into the home | ☐ | ☐ | • |
| Public/communal well/ or standpipe | ☐ | ☐ | • |
| Lake, name: _____ | ☐ | ☐ | • |
| River, name: _____ | ☐ | ☐ | • |
| Creek | ☐ | ☐ | • |
| Pond or dam (standing water) directly | ☐ | ☐ | • |
| Private well or pump, protected | ☐ | ☐ | • |
| Private well or pump, unprotected | ☐ | ☐ | • |

| | | | |
|---|---|---|---|
| Spring, protected | □ | □ | • |
| Spring, unprotected | □ | □ | • |
| Rainwater | □ | □ | • |
| Tanker truck | □ | □ | • |
| Cart or wheelbarrow with small tank or drum | □ | □ | • |
| Bottled water | □ | □ | • |
| Other, specify_____ | □ | □ | • |

8.2 Is drinking water treated before consumption (e.g., disinfection with chlorine or UV, filtration )?

• Yes

• No

• Do not know/Do not remember

If yes,

€ Boiling

” Strains it through cloth

Addition of disinfectants such as chlorine or bleach

Sedimentation and decantation

€ Filtering

€ Solar disinfection

€ Other, specify

8.3 Did you notice anything unusual about your household drinking water before your child became ill? For example, unusual changes occur in odor, color, taste, and turbidity.

• Yes

• No

• Do not know/Do not remember

If this is the case, what is unusual for your tap water?_____

8.4 What kind of water do you use in your household for **food preparation (e.g. washing and adding water to meals)**?

| Water source for food preparation | Primary source (choose only one) | Secondary source (choose only one) | Other sources (tick all that apply) |
|---|---|---|---|
| Piped water into the home | ☐ | ☐ | • |
| Public/communal well/ or standpipe | ☐ | ☐ | • |
| Lake, name: _____ | ☐ | ☐ | • |
| River, name: _____ | ☐ | ☐ | • |
| Creek | ☐ | ☐ | • |
| Pond or dam (standing water) directly | ☐ | ☐ | • |
| Private well or pump, protected | ☐ | ☐ | • |
| Private well or pump, unprotected | ☐ | ☐ | • |
| Spring, protected | ☐ | ☐ | • |
| Spring, unprotected | ☐ | ☐ | • |
| Rainwater | ☐ | ☐ | • |
| Tanker truck | ☐ | ☐ | • |
| Cart or wheelbarrow with small tank or drum | ☐ | ☐ | • |
| Bottled water | ☐ | ☐ | • |
| Other, specify_____ | ☐ | ☐ | • |

8.5 Is drinking water treated before it is used for food preparation (e.g., disinfection with chlorine or UV, filtration)?

• Yes

• No

• Do not know/Do not remember

If yes,

€ Boiling

” Strains it through cloth

Addition of disinfectants such as chlorine or bleach

Sedimentation and decantation

€ Filtering

€ Solar disinfection

€ Other, specify

8.6 What kind of water do you use in your household to **washing clothes and cleaning**?

| The water source for clothes and cleaning | Primary source (choose only one) | Secondary source (choose only one) | Other sources (tick all that apply) |
|---|---|---|---|
| Piped water into the home | □ | □ | • |
| Public/communal well/ or standpipe | □ | □ | • |
| Lake, name: _____ | □ | □ | • |
| River, name: _____ | □ | □ | • |
| Creek | □ | □ | • |
| Pond or dam (standing water) directly | □ | □ | • |
| Private well or pump, protected | □ | □ | • |
| Private well or pump, unprotected | □ | □ | • |
| Spring, protected | □ | □ | • |
| Spring, unprotected | □ | □ | • |
| Rainwater | □ | □ | • |

| | | | |
|---|---|---|---|
| Tanker truck | □ | □ | • |
| Cart or wheelbarrow with small tank or drum | □ | □ | • |
| Bottled water | □ | □ | • |
| Other, specify_____ | □ | □ | • |

## WATER CONTACT

8.7 What kind of water do you use in your household for **bathing**?

| Water source for bathing | Primary source (choose only one) | Secondary source (choose only one) | Other sources (tick all that apply) |
|---|---|---|---|
| Piped water into the home | ☐ | ☐ | • |
| Public/communal well/ or standpipe | ☐ | ☐ | • |
| Lake, name: _____ | ☐ | ☐ | • |
| River, name: _____ | ☐ | ☐ | • |
| Creek | ☐ | ☐ | • |
| Pond or dam (standing water) directly | ☐ | ☐ | • |
| Private well or pump, protected | ☐ | ☐ | • |
| Private well or pump, unprotected | ☐ | ☐ | • |
| Spring, protected | ☐ | ☐ | • |
| Spring, unprotected | ☐ | ☐ | • |
| Rainwater | ☐ | ☐ | • |
| Tanker truck | ☐ | ☐ | • |
| Cart or wheelbarrow with small tank or drum | ☐ | ☐ | • |
| Bottled water | ☐ | ☐ | • |
| Other, specify_____ | ☐ | ☐ | • |

8.8 What kind of water do you use for **recreation, e.g. swimming, playing**?

| The water source for recreation/swimming | Primary source | Secondary source (choose | Other sources (tick |
|---|---|---|---|

| | (choose only one) | only one) | all that apply) |
|---|---|---|---|
| Lake, name: _____ | □ | □ | • |
| River, name: _____ | □ | □ | • |
| Creek | □ | □ | • |
| Pond or dam (standing water) directly | □ | □ | • |
| Spring, protected | □ | □ | • |
| Spring, unprotected | □ | □ | • |
| Swimming pool | □ | □ | • |
| Other, specify_____ | □ | □ | • |

## 9 TOILET SYSTEM

9.1 What type of toilet system do members of your household use at home? *(chose only one)*

| Bathing water source | Primary source (choose only one) | Secondary source (choose only one) | Other sources (tick all that apply) |
|---|---|---|---|
| Flush or pour the toilet with a septic tank, including a squat toilet. | □ | □ | • |
| Flush or pour the toilet connected to the sewer pipe. | □ | □ | • |
| Pit latrine with covering slab | □ | □ | • |
| Pit latrine without covering slab | □ | □ | • |
| Ventilated improved pit latrine (VIP) | □ | □ | • |
| Buckets or plastic bags | □ | □ | • |
| No facilities or field or bush | □ | □ | • |
| Other, specify_____ | □ | □ | • |

9.2 What type of toilet system do members of your household use away from home (e.g., work or school)?

| Bathing water source | Tick all that apply | Public/communal | Private |
|---|---|---|---|
| Flush or pour the toilet with a septic tank, including a squat toilet. | • | □ | □ |
| Flush or pour the toilet connected to the sewer pipe. | • | □ | □ |
| Pit latrine with covering slab | • | □ | □ |

| | | | |
|---|---|---|---|
| Pit latrine without covering slab | • | ☐ | ☐ |
| Ventilated improved pit latrine (VIP) | • | ☐ | ☐ |
| Buckets or plastic bags | • | ☐ | ☐ |
| No facilities or field or bush | • | ☐ | ☐ |
| Other,<br>- specify_____ | • | ☐ | ☐ |

## 10 CONTACT WITH ANIMALS

**Interviewer: Animals can sometimes be the source of agents causing diarrhea. To investigate this possibility, I will ask questions about contact with animals in the household or elsewhere.**

10.1 Does anyone in your household own any of these animals?

| | Yes | How many | Location of animals | | |
|---|---|---|---|---|---|
| | | | Inside your house | Around your house | Distant location |
| Cattle | • | | ☐ | ☐ | ☐ |
| Goats | • | | ☐ | ☐ | ☐ |
| Sheep | • | | ☐ | ☐ | ☐ |
| Pigs | • | | ☐ | ☐ | ☐ |
| Chicken | • | | ☐ | ☐ | ☐ |
| Ducks | • | | ☐ | ☐ | ☐ |
| Dogs | • | | ☐ | ☐ | ☐ |
| Cats | • | | ☐ | ☐ | ☐ |
| Horses | • | | ☐ | ☐ | ☐ |
| Donkeys | • | | ☐ | ☐ | ☐ |
| Rabbits | • | | ☐ | ☐ | ☐ |
| Other | • | | ☐ | ☐ | ☐ |
| - Specify | | | | | |

10.2 Do you know if any of the animals had diarrhea the week before your child became ill?

- Yes
- No

If this is the case, which animal(s)? _____

10.3 Do you know if any of the animals died the week before your child became ill?

- Yes
- No

If this is the case, which animal(s)? _____

10.4 Do your children have contact with the following animals? Contact refers to feeding or touching an animal, or contact with droppings or manure from the animals.

| | | Contact Frequency | | | |
|---|---|---|---|---|---|
| | Yes | Daily | 4-6 times per week | 1-3 times per week | Less than one time per week |
| Cattle | • | ☐ | ☐ | ☐ | ☐ |
| Goats | • | ☐ | ☐ | ☐ | ☐ |
| Sheep | • | ☐ | ☐ | ☐ | ☐ |
| Pigs | • | ☐ | ☐ | ☐ | ☐ |
| Chicken | • | ☐ | ☐ | ☐ | ☐ |
| Ducks | • | ☐ | ☐ | ☐ | ☐ |
| Dogs | • | ☐ | ☐ | ☐ | ☐ |
| Cats | • | ☐ | ☐ | ☐ | ☐ |
| Horses | • | ☐ | ☐ | ☐ | ☐ |
| Donkeys | • | ☐ | ☐ | ☐ | ☐ |
| Rabbits | • | ☐ | ☐ | ☐ | ☐ |
| Other | • | ☐ | ☐ | ☐ | ☐ |
| - Specify | | | | | |

10.5 Did your child have the possibility of being in contact with any wild or free-roaming animal? Contact refers to feeding or touching an animal, or contact with droppings or manure from the animals.

| | Contact Frequency | | | | |
|---|---|---|---|---|---|
| | Yes | Daily | 4-6 times per week | 1-3 times per week | Less than one time per week |
| Caged wild animals, specify | • | □ | □ | □ | □ |
| Wild birds, specify | • | □ | □ | □ | □ |
| Bats | • | □ | □ | □ | □ |
| Wild bears | • | □ | □ | □ | □ |
| Deer | • | □ | □ | □ | □ |
| Foxes | • | □ | □ | □ | □ |
| Rats | • | □ | □ | □ | □ |
| Mice | • | □ | □ | □ | □ |
| Rabbits | • | □ | □ | □ | □ |
| … | • | □ | □ | □ | □ |
| … | • | □ | □ | □ | □ |
| Other, specify | • | □ | □ | □ | □ |

10.6 Do you live near a farm, field/park/forest?

- Yes, next to the farm (agricultural).
- Yes, next to a farm (livestock).
- Yes, next to pastures with grazing livestock.
- Yes, next to a park
- Yes, next to a forest

- No
- Don't know

## 11 HOUSING CONDITIONS

11.1 What is the floor material of your house? Select all that apply:

- Earth, sand or dung
- Rudimentary wood plank
- Adobe
- Polished wood
- Ceramic tiles/bricks
- Cement
- Don't know
- Other, please specify:

_____

11.2 What is the wall material of your house? Select all that apply:

- No walls
- Grass/thatch/mud
- Tin/cardboard/paper/bag
- Masica sticks
- Casca
- Wood or metal planks
- Adobe
- Brick
- Cement block
- Don't know
- Other, please specify:

_____

11.3 What is the roof material of your house? Select all that apply:?

- No roof
- Grass/thatch/mud
- Iron sheet
- MCalamine/Cement fibre
- Tiles
- Cement/Concrete
- Don't know
- Other, please specify:

_____

11.4 What type of fuel do you use for cooking? Select all that apply:

- Electricity
- Kerosene
- Coal/Lignite
- Charcoal
- Firewood
- Dung
- Cooking gas
- Does not cook
- Don't know
- Other, please specify:

_____

11.5 Do you have an electricity supply?

- Yes
- No
- Don't know

11.6 Do you own one of the following goods?

| | Yes | No | Don't know |
|---|---|---|---|
| Television | | | |

| | | | |
|---|---|---|---|
| Radio | □ | □ | □ |
| Refrigerator | □ | □ | □ |
| Mobile phone | □ | □ | □ |
| Computer/tablet | □ | □ | □ |
| Watch | □ | □ | □ |

11.7 Which type of vehicle do you own? Select all that apply:

- Bicycle
- Motor bicycle/scooter
- Car/truck
- Boat with motor
- Animal-drawn cart
- Don't own any
- Don't know
- □ Other, please specify:

_____

11.8 Do you own a house?

- Yes
- No
- Don't know

11.9 Do you own land?

- Yes
- No
- Don't know

If yes, is it agriculturally-usable land

- Yes
- No
- Don't know

11.10 Do you have a bank account?

- Yes
- No
- Don't know

## 12 OCCUPATION

12.1 What is the average monthly income of the primary earner in the household?
Enter amount: _____

Enter currency: _____.

- Don't know/not sure
- Prefer not to respond

12.2 What are the leading professional activities taken on by adult household members?

| Household members above 16 years | | | | | | |
|---|---|---|---|---|---|---|
| | You 1 | Spouse 2 | Member 3 | Member 4 | Member 5 | Member 6 |
| Rancher/livestock attendant | O | O | O | O | O | O |
| Farmer/field or agricultural worker | O | O | O | O | O | O |
| Gardener | O | O | O | O | O | O |
| Miner | O | O | O | O | O | O |
| Soldier | O | O | O | O | O | O |
| Butcher/abattoir | O | O | O | O | O | O |

| | | | | | | |
|---|---|---|---|---|---|---|
| worker | | | | | | |
| Housewife | O | O | O | O | O | O |
| Wildlife worker | O | O | O | O | O | O |
| Milk supplier | O | O | O | O | O | O |
| Outdoor manual labour | O | O | O | O | O | O |
| Artisan/craftsman | O | O | O | O | O | O |
| Veterinarian | O | O | O | O | O | O |
| Office worker | O | O | O | O | O | O |
| Student | O | O | O | O | O | O |
| Health care worker | O | O | O | O | O | O |
| Merchant/trader | O | O | O | O | O | O |
| Teacher | O | O | O | O | O | O |
| Driver | O | O | O | O | O | O |
| Sewer worker | O | O | O | O | O | O |
| Guard/police officer | O | O | O | O | O | O |
| Unemployed | O | O | O | O | O | O |
| Other, | O | O | O | O | O | O |
| - Specify _____ | | | | | | |

## 13 CLOSURE QUESTIONS

13.1 May we contact you again if we have more questions?

- No
- Yes, contact information (how we can contact you)

13.2 Is there any additional information you would like to share?

_____
_

**Interviewer:** **On behalf of the study team, thank you for taking the time to respond to this questionnaire.**

**If you have questions about the investigation, please contact […..]**

## APPENDIX C - Questions for Children's Food Preparers/Handlers, Health Professionals and Community Leaders

**Factors of Foodborne Diarrhea in Children Under 5 Years of Age in Marracuene and Kamaxaqueni Districts, Maputo-Mozambique**

Nominal group technique guide

- What do participants ensure food safety to prevent foodborne diarrhea in children?
- What strategy are you using to implement the previously identified actions to prevent diarrhea?
- What are the priority actions to prevent diarrhea in the household and the district?

## APPENDIX D - Participant informed consent form for voluntary attribution study questionnaire.

My name is [ ]. I am working as an interviewer and data collector to study the factors of foodborne diarrheal diseases in children under five years of age [ ]. I kindly ask you to explain the study to you and what it entails being selected as a study participant.

1. Title of study: Factors of foodborne diarrhea in children under 5 years of age in Marracuene and Kamaxakeni Districts, Maputo-Mozambique.

Purpose of the study:

This study aimed to investigate the factors associated with foodborne diarrhea and develop a household- and community-level strategy for food safety preventive measures in children younger than five years of age in two Districts of Maputo, Mozambique.

Procedure and duration:

We asked you to participate because you have a child below or at five years of age with diarrhea, which may be caused by pathogens that are often transmitted through food or water. Therefore, information about your child's latest exposure sources is valuable for our research. I will interview you using a questionnaire to obtain pertinent data about you, your child, and your family, which will be helpful in this study. If you agree to participate in the study, I will complete the questionnaire during the interview, which will take approximately 15 min. I also ask you to allow me to visit your home so that I can write down how you live, your water supply and sanitation, your animals, and where you usually obtain food.

2. Risks and benefits:

No health risks were associated with participation in this study. There were no payments for participating in the study. We will use the findings of this study to guide families on how to prevent diarrhea in their children. In the long term, the benefit of this research to the

participating community will be improved surveillance of foodborne diseases and appropriate health interventions, based on the evidence generated from this research.

3. Confidentiality:

All information provided will be confidential. No published information identified a child. The study's findings will be generalized to the study community and will not reflect anything particular about individual persons or housing. The questionnaire was coded to exclude showing the name and address/household identifier codes. No reference will be made to oral or written reports that could link the participants to the research.

4. Rights:

Participation in the study was voluntary. You have the right to declare that you have participated in the study. If you decide to participate, you will have the right to withdraw from the study at any given time. You do not have to answer any questions that you do not want to answer.

5. Contact address:

If you have any questions or inquiries regarding the study or its procedures, please contact Nórgia Elsa Machava.

Institute: University of Pretoria, student number 19406429

Email/tel: norgiaelsamachava@gmail.com Mobile: +258843832777 or +258 827086090

You may also contact the [name of the National Ethics Committee] at…. Email/tel.: _____

6. Declaration of informed, voluntary consent:

__I read the participant's information sheet.

__I have clearly understood the purpose of the research, procedures, risks and benefits, confidentiality issues, rights to participate, and contact addresses for any queries.

__I have been given the opportunity to ask questions regarding things that may have been unclear.

__I was informed that I have the right to withdraw from the study at any time or not answer any questions I do not want.

Therefore, I declared my voluntary consent to participate in this study with my initials (signatures).

I consent to be interviewed.

Date: _____ Name and signature or fingerprint of the head of the mother/caretaker:

_____Wh

at is your relationship with your child? □ Mother □ Father □ Relative □ Caretaker □ Other:

_____

## APPENDIX E - Participant informed consent form for Nominal Group Technique

My name is [the name of the data interviewer]. I am the investigator of the study on factors of foodborne diarrheal diseases in children under five years of age in [name of the district]. Part of the study conducted in this community was led by [title and name]. I kindly ask you to explain the study to you and what it entails being selected as a study participant.

1. Title of study: Factors of foodborne diarrhea in children under 5 years of age in Marracuene and Kamaxakeni Districts, Maputo-Mozambique.

Purpose of the study:

This study aimed to investigate the factors associated with foodborne diarrhea. In this section, we develop a strategy that can be implemented at the household and community levels for food safety preventive measures in children younger than five years of age in two Districts of Maputo, Mozambique.

Procedure and duration:

We asked you to participate because you are a caregiver/community leader/health professional, and you may have seen a child below or at five years of age with diarrhea, which could be prevented based on several measures. However, unsafe food and water may cause diarrhea in children. You can provide your opinion about preventive measures for foodborne diarrhea in children under five years of age. We will discuss your opinions in a group of 10 participants using a Nominal Group Technique guide to obtain the best strategy to prevent diarrhea in children under five years of age. If you agree to participate in the study, the meeting will take at least two hours.

2. Risks and benefits:

No health risks were associated with participation in this study. There were no payments for participating in the study. We will use the findings of this study to guide families on how to prevent diarrhea in their children. In the long term, the benefit of this research to the participating community will be improved surveillance of foodborne diseases and appropriate health interventions, based on the evidence generated from this research.

3. Confidentiality:

All information provided will be confidential. No published information identified a child. The study's findings will be general for the study community and will not reflect anything, in particular, about individuals or housing. The discussion will be coded to exclude showing your name and the address/household identifier codes. No reference will be made to oral or written reports that could link the participants to the research.

4. Rights:

Participation in the study was voluntary. You have the right to declare that you have participated in the study. If you decide to participate, you will have the right to withdraw from the study at any given time. You do not have to answer any questions that you do not want to answer.

5. Contact address:

If you have any questions or inquiries regarding the study or its procedures, please contact Nórgia Elsa Machava.

Institute: University of Pretoria, student number 19406429

Email/tel: norgiaelsamachava@gmail.com Mobile: +258843832777 or +258 827086090

You may also contact the [name of the National Ethics Committee] at…. Email/tel.: _____

__

6. Declaration of informed, voluntary consent:

__I read the participant's information sheet.

__I have clearly understood the purpose of the research, procedures, risks and benefits, confidentiality issues, rights to participate, and contact addresses for any queries.

__I have been given the opportunity to ask questions regarding things that may have been unclear.

__I was informed that I have the right to withdraw from the study at any time or not answer any questions I do not want.

Therefore, I declared my voluntary consent to participate in this study with my initials (signatures).

I consent to be inter

Date:_____Name and signature or fingerprint of participant: _____

__

## ANNEXURE 1 - Letter from a statistician

**To whom it may concern**

## Letter of Approval

30 June 2020
tiha

I hereby confirm that the questionnaire intended to be used in the cross-sectional study by PhD-student Norgia Elsa Machava for studying household risk factors for diarrheal disease in young children is appropriate for the purpose.

For the risk factor analysis, logistic and generalized mixed regression models will be applied. The outcome variable is confirmed infection with one of the target pathogens, and the explanatory variables are the potential risk factors enquired about in the questionnaire such as food consumed, contact with animals, and sanitary and living conditions. The questionnaire also enquires about potential confounders (age, weight, and socio-economic factors), which can then be controlled for in the analytical phase of the study.

The data collected through the questionnaire will also be used in the source attribution analysis, where a supervised machine-learning model trained by the samples from the exposure sources will be applied to predict the most likely infection sources of diarrhea in children under 5 years of age by comparing the genetic profiles of the pathogens isolated from the various exposure sources and the human child cases.

If you have any question to the above, please, do not hesitate to contact the undersigned.

**Best regards,**

**Tine Hald**
Professor
Genomic Epidemiology
Principal Investigator of the FOCAL project.



**DTU Food**
National Food Institute

Kemitorvet
Building 204
2800 Kgs. Lyngby
Denmark

Tel.. +45 35 88 70 00
Dir. +45 51 15 74 85

tiha@food.dtu.dk
www.food.dtu.dk

## ANNEXURE 2 - Ethical Approval for the FOCAL Project

# Comité Institucional de Bioética em Saúde da Faculdade de Medicina/Hospital Central de Maputo

## (CIBS FM&HCM)

*Dr. Jahit Sacarlal, Presidente do Comité Institucional de Bioética em Saúde da Faculdade de Medicina/Hospital Central de Maputo (CIBS FM&HCM)*

*CERTIFICA*

*Que este Comité avaliou a proposta do (s) Investigador (es) Principal (is):*

***Nome (s): Elsa Maria Salvador e Tine Hald***
***Protocolo de investigação: sem versão de 12 de Setembro de 2019***
***Consentimentos informados: sem versão e sem data***
***Questionários: sem versão e sem data***
***Guião de entrevista: N/A***

*Do estudo:*

***TÍTULO: "Doenças de origem Alimentar: Epidemiologia, Epidemio-vigilância e Controlo em Maputo, Moçambique."***

*E faz constar que:*

*1º Após revisão pelos membros do Comité do protocolo durante a reunião do dia 14 de Novembro de 2019, e que foram incluídas na acta nº 10/2019, o CIBS FM&HCM, emite este informe notando que não há nenhuma inconveniência de ordem ética que impeça o início do estudo.*

*2º Que a revisão se realizou de acordo com o Regulamento do Comité Institucional da FM&HCM – emenda 2 de 28 de Julho de 2014.*

*3º Que o protocolo está registado com o número CIBS FM&HCM/092/2019.*

*4º Que a composição actual do CIBS FM&HCM está disponível na secretária do Comité.*

*5º Não foi declarado nenhum conflito de interesse pelos membros do CIBS FM&HCM.*

*6º O CIBS FM&HCM faz notar que a aprovação ética não substitui a aprovação científica nem a autorização administrativa.*

*7º A aprovação tem validade de 1 ano e termina a 11 de Dezembro de 2020. Um mês antes dessa data o Investigador deve enviar um pedido de renovação se necessitar.*

*8º Recomenda aos investigadores que mantenham o CIBS informado do decurso do estudo no mínimo uma vez ao ano.*

*9º Solicitamos aos investigadores que enviem no final de estudo um relatório dos resultados obtidos.*

***E emite***

*RESULTADO:* ***APROVADO***

CIBS FM & HCM

*Assinado em Maputo aos 12 de Dezembro de 2019*

## ANNEXURE 3 - Research ethics committee approval certificate

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

**Institution:** The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.

- FWA 00002567, Approved dd 22 May 2002 and Expires 03/20/2022.
- IORG #: IORG0001762 OMB No. 0990-0279 Approved for use through February 28, 2022 and Expires: 03/04/2023.

**1 February 2021**

**Approval Certificate**
**New Application**

**Ethics Reference No.: 596/2020**
**Title: FACTORS OF FOODBORNE DIARRHEAL IN CHILDREN UNDER 5 YEARS OF AGE IN MARRACUENE AND KAMAXAQUENI DISTRICTS, MAPUTO-MOZAMBIQUE**

**Dear Miss NE Machava**

The **New Application** as supported by documents received between 2020-09-01 and 2021-01-27 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2021-01-27 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Ethics Approval is valid for 1 year and needs to be renewed annually by 2022-02-01.
- Please remember to use your protocol number (596/2020 ) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

**Ethics approval is subject to the following:**

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

**Yours sincerely**

**Dr R Sommers**
MBChB MMed (Int) MPharmMed PhD
**Deputy Chairperson** of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria

*The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health)*

Research Ethics Committee
Room 4-60, Level 4, Tswelopele Building
University of Pretoria, Private Bag x323
Gezina 0031, South Africa
Tel +27 (0)12 356 3084
Email: deepeka.behari@up.ac.za
www.up.ac.za

Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tša Maphelo

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

**Institution:** The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.

- FWA 00002567, Approved dd 22 May 2002 and Expires 03/20/2022.
- IORG #: IORG0001762 OMB No. 0990-0279 Approved for use through February 28, 2022 and Expires: 03/04/2023.

## Faculty of Health Sciences **Research Ethics Committee**

20 January 2022

**Approval Certificate**
**Annual Renewal**

Dear Miss NE Machava,

**Ethics Reference No.: 596/2020 – Line 1**
**Title: FACTORS OF FOODBORNE DIARRHEAL IN CHILDREN UNDER 5 YEARS OF AGE IN MARRACUENE AND KAMAXAQUENI DISTRICTS, MAPUTO-MOZAMBIQUE**

The **Annual Renewal** as supported by documents received between 2021-12-07 and 2022-01-19 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2022-01-19 as resolved by its quorate meeting.

Please note the following about your ethics approval:

- Renewal of ethics approval is valid for 1 year, subsequent annual renewal will become due on 2023-01-20.
- Please remember to use your protocol number (596/2020) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

**Ethics approval is subject to the following:**

- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

**Yours sincerely**

**On behalf of the FHS REC, Dr R Sommers**
MBChB, MMed (Int), MPharmMed, PhD
***Deputy Chairperson*** *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

*The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health)*

Research Ethics Committee
Room 4-60, Level 4, Tswelopele Building
University of Pretoria, Private Bag x323
Gezina 0031, South Africa
Tel +27 (0)12 356 3084
Email: deepeka.behari@up.ac.za
www.up.ac.za

Fakulteit Gesondheidswetenskappe
Lefapha la Disaense tša Maphelo

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Faculty of Health Sciences

**Institution**: The Research Ethics Committee, Faculty Health Sciences, University of Pretoria complies with ICH-GCP guidelines and has US Federal wide Assurance.
- FWA 00002567, Approved dd 18 March 2022 and Expires 18 March 2027.
- IORG #: IORG0001762 OMB No. 0990-0278 Approved for use through August 31, 2023.

## Faculty of Health Sciences **Research Ethics Committee**

19 January 2023

**Approval Certificate**
**Annual Renewal**

Dear Miss NE Machava,

**Ethics Reference No.: 596/2020 – Line 3**
**Title: FACTORS OF FOODBORNE DIARRHEAL IN CHILDREN UNDER 5 YEARS OF AGE IN MARRACUENE AND KAMAXAQUENI DISTRICTS, MAPUTO-MOZAMBIQUE**

The **Annual Renewal** as supported by documents received between 2022-11-16 and 2023-01-18 for your research, was approved by the Faculty of Health Sciences Research Ethics Committee on 2023-01-18 as resolved by its quorate meeting.

Please note the following about your ethics approval:
- Renewal of ethics approval is valid for 1 year, subsequent annual renewal will become due on 2024-01-19.
- Please remember to use your protocol number (596/2020) on any documents or correspondence with the Research Ethics Committee regarding your research.
- Please note that the Research Ethics Committee may ask further questions, seek additional information, require further modification, monitor the conduct of your research, or suspend or withdraw ethics approval.

**Ethics approval is subject to the following:**
- The ethics approval is conditional on the research being conducted as stipulated by the details of all documents submitted to the Committee. In the event that a further need arises to change who the investigators are, the methods or any other aspect, such changes must be submitted as an Amendment for approval by the Committee.

We wish you the best with your research.

**Yours sincerely**

**On behalf of the FHS REC, Dr R Sommers**
MBChB, MMed (Int), MPharmMed, PhD
***Deputy Chairperson*** *of the Faculty of Health Sciences Research Ethics Committee, University of Pretoria*

*The Faculty of Health Sciences Research Ethics Committee complies with the SA National Act 61 of 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 and 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes, Second Edition 2015 (Department of Health)*

Research Ethics Committee
Room 4-60, Level 4, Tswelopele Building
University of Pretoria, Private Bag x323
Gezina 0031, South Africa
Tel +27 (0)12 356 3084
Email: deepeka.behari@up.ac.za
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Lefapha la Disaense tša Maphelo

## ANNEXURE 4 - Author guidelines International Journal of Africa Nursing Sciences

# INTERNATIONAL JOURNAL OF AFRICA NURSING SCIENCES

AUTHOR INFORMATION PACK

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**ISSN:** 2214-1391

## DESCRIPTION

**International Journal of Africa Nursing Sciences (IJANS)** is an international scientific open access journal published by Elsevier. The broad-based journal was founded on two key tenets, i.e. to publish the most exciting research with respect to the subjects of **Nursing** and **Midwifery** in **Africa**, and secondly, to advance the international understanding and development of **nursing** and **midwifery** in **Africa**, both as a profession and as an academic discipline.

The fully refereed journal provides a forum for all aspects of **nursing** and **midwifery sciences**, especially new trends and advances. The journal call for original research papers, systematic and scholarly review articles, and critical papers which will stimulate debate on research, policy, theory or philosophy of **nursing** as related to **nursing** and **midwifery** in **Africa**, technical reports, and short communications, and which will meet the journal's high academic and ethical standards. Manuscripts of **nursing practice**, education, management, and research are encouraged. The journal values critical scholarly debate on issues that have strategic significance for educators, practitioners, leaders and policy-makers of **nursing** and **midwifery** in **Africa**. The journal publishes the highest quality scholarly contributions reflecting the diversity of **nursing**, and is also inviting international scholars who are engaged with **nursing** and **midwifery** in **Africa** to contribute to the journal. We will only publish work that demonstrates the use of rigorous methodology as well as by publishing papers that highlight the theoretical underpinnings of **nursing** and **midwifery** as it relates to the **Africa** context. The journal employs a double blind peer review process for all submissions and is working towards inclusion of the journal on the Thomson Reuters Journal Citation Reports.

## ABSTRACTING AND INDEXING

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## EDITORIAL BOARD

# GUIDE FOR AUTHORS

## INTRODUCTION

Dr Hester Klopper, Editor, welcomes manuscripts for consideration for publication in the journal.

### *Submission checklist*

You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

**Ensure that the following items are present:**

One author has been designated as the corresponding author with contact details:
• E-mail address
• Full postal address

All necessary files have been uploaded:
*Manuscript*:
• Include keywords
• All figures (include relevant captions)
• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print
*Graphical Abstracts / Highlights files* (where applicable)
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Further considerations
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• All references mentioned in the Reference List are cited in the text, and vice versa
• Permission has been obtained for use of copyrighted material from other sources (including the Internet)
• A competing interests statement is provided, even if the authors have no competing interests to declare
• Journal policies detailed in this guide have been reviewed
• Referee suggestions and contact details provided, based on journal requirements

For further information, visit our Support Center.

## BEFORE YOU BEGIN

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Please see our information pages on Ethics in publishing and Ethical guidelines for journal publication.

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Authors should include a statement in the manuscript that informed consent was obtained for experimentation with human subjects. The privacy rights of human subjects must always be observed.

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## Reporting sex- and gender-based analyses

### Reporting guidance

For research involving or pertaining to humans, animals or eukaryotic cells, investigators should integrate sex and gender-based analyses (SGBA) into their research design according to funder/sponsor requirements and best practices within a field. Authors should address the sex and/or gender dimensions of their research in their article. In cases where they cannot, they should discuss this as a limitation to their research's generalizability. Importantly, authors should explicitly state what definitions of sex and/or gender they are applying to enhance the precision, rigor and reproducibility of their research and to avoid ambiguity or conflation of terms and the constructs to which they refer (see Definitions section below). Authors can refer to the Sex and Gender Equity in Research (SAGER) guidelines and the SAGER guidelines checklist. These offer systematic approaches to the use and editorial review of sex and gender information in study design, data analysis, outcome reporting and research interpretation - however, please note there is no single, universally agreed-upon set of guidelines for defining sex and gender.

### Definitions

Sex generally refers to a set of biological attributes that are associated with physical and physiological features (e.g., chromosomal genotype, hormonal levels, internal and external anatomy). A binary sex categorization (male/female) is usually designated at birth ("sex assigned at birth"), most often based solely on the visible external anatomy of a newborn. Gender generally refers to socially constructed roles, behaviors, and identities of women, men and gender-diverse people that occur in a historical and cultural context and may vary across societies and over time. Gender influences how people view themselves and each other, how they behave and interact and how power is distributed in society. Sex and gender are often incorrectly portrayed as binary (female/male or woman/man) and unchanging whereas these constructs actually exist along a spectrum and include additional sex categorizations and gender identities such as people who are intersex/have differences of sex development (DSD) or identify as non-binary. Moreover, the terms "sex" and "gender" can be ambiguous—thus it is important for authors to define the manner in which they are used. In addition to this definition guidance and the SAGER guidelines, the resources on this page offer further insight around sex and gender in research studies.

## Author contributions

For transparency, we encourage authors to submit an author statement file outlining their individual contributions to the paper using the relevant CRediT roles: Conceptualization; Data curation; Formal analysis; Funding acquisition; Investigation; Methodology; Project administration; Resources; Software; Supervision; Validation; Visualization; Roles/Writing - original draft; Writing - review & editing. Authorship statements should be formatted with the names of authors first and CRediT role(s) following. More details and an example.

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Authors should include the Clinical Trial Registration number in the Conflict of Interest statement (see above) at original submission stage, and will be required to transfer the number into the manuscript file for revised articles.

*Registration of clinical trials*

Registration in a public trials registry is a condition for publication of clinical trials in this journal in accordance with International Committee of Medical Journal Editors recommendations. Trials must register at or before the onset of patient enrolment. The clinical trial registration number should be included at the end of the abstract of the article. A clinical trial is defined as any research study that prospectively assigns human participants or groups of humans to one or more health-related interventions to evaluate the effects of health outcomes. Health-related interventions include any intervention used to modify a biomedical or health-related outcome (for example drugs, surgical procedures, devices, behavioural treatments, dietary interventions, and process-of-care changes). Health outcomes include any biomedical or health-related measures obtained in patients or participants, including pharmacokinetic measures and adverse events. Purely observational studies (those in which the assignment of the medical intervention is not at the discretion of the investigator) will not require registration.
Authors should include the Clinical Trial Registration number in the Conflict of Interest statement (see above) at original submission stage, and will be required to transfer the number into the manuscript file for revised articles.

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It is important that the file be saved in the native format of the word processor used. The text should be in single-column format. Keep the layout of the text as simple as possible. Most formatting codes will be removed and replaced on processing the article. In particular, do not use the word processor's options to justify text or to hyphenate words. However, do use bold face, italics, subscripts, superscripts etc. When preparing tables, if you are using a table grid, use only one grid for each individual table and not a grid for each row. If no grid is used, use tabs, not spaces, to align columns. The electronic text should be prepared in a way very similar to that of conventional manuscripts (see also the Guide to Publishing with Elsevier). Note that source files of figures, tables and text graphics will be required whether or not you embed your figures in the text. See also the section on Electronic artwork.
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Headings in the article should be appropriate to the nature of the paper. Research papers should follow the standard structure of: Introduction (including review of the literature), Methods, Findings and Discussion.

*Introduction*
State the objectives of the work and provide an adequate background, avoiding a detailed literature survey or a summary of the results.

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Provide sufficient details to allow the work to be reproduced by an independent researcher. Methods that are already published should be summarized, and indicated by a reference. If quoting directly from a previously published method, use quotation marks and also cite the source. Any modifications to existing methods should also be described.

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Results should be clear and concise.

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This should explore the significance of the results of the work, not repeat them. A combined Results and Discussion section is often appropriate. Avoid extensive citations and discussion of published literature.
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Highlights are optional yet highly encouraged for this journal, as they increase the discoverability of your article via search engines. They consist of a short collection of bullet points that capture the novel results of your research as well as new methods that were used during the study (if any). Please have a look at the examples here: example Highlights.

Highlights should be submitted in a separate editable file in the online submission system. Please use 'Highlights' in the file name and include 3 to 5 bullet points (maximum 85 characters, including spaces, per bullet point).

## Abstract

A concise and factual abstract is required. The abstract should state briefly the purpose of the research, the principal results and major conclusions. An abstract is often presented separately from the article, so it must be able to stand alone. For this reason, References should be avoided, but if essential, then cite the author(s) and year(s). Also, non-standard or uncommon abbreviations should be avoided, but if essential they must be defined at their first mention in the abstract itself.

## Keywords

Immediately after the abstract, provide a maximum of 6 keywords.

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*General points*
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• Aim to use the following fonts in your illustrations: Arial, Courier, Times New Roman, Symbol, or use fonts that look similar.
• Number the illustrations according to their sequence in the text.
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• Provide captions to illustrations separately.
• Size the illustrations close to the desired dimensions of the published version.
• Submit each illustration as a separate file.
• Ensure that color images are accessible to all, including those with impaired color vision.

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TIFF (or JPEG): Color or grayscale photographs (halftones), keep to a minimum of 300 dpi.
TIFF (or JPEG): Bitmapped (pure black & white pixels) line drawings, keep to a minimum of 1000 dpi.
TIFF (or JPEG): Combinations bitmapped line/half-tone (color or grayscale), keep to a minimum of 500 dpi.
**Please do not:**
• Supply files that are optimized for screen use (e.g., GIF, BMP, PICT, WPG); these typically have a low number of pixels and limited set of colors;
• Supply files that are too low in resolution;
• Submit graphics that are disproportionately large for the content.

*Figure captions*
Ensure that each illustration has a caption. Supply captions separately, not attached to the figure. A caption should comprise a brief title (**not** on the figure itself) and a description of the illustration. Keep text in the illustrations themselves to a minimum but explain all symbols and abbreviations used.

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Please submit tables as editable text and not as images. Tables can be placed either next to the relevant text in the article, or on separate page(s) at the end. Number tables consecutively in accordance with their appearance in the text and place any table notes below the table body. Be sparing in the use of tables and ensure that the data presented in them do not duplicate results described elsewhere in the article. Please avoid using vertical rules and shading in table cells.

## References
*Citation in text*
Please ensure that every reference cited in the text is also present in the reference list (and vice versa). Any references cited in the abstract must be given in full.

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As a minimum, the full URL should be given and the date when the reference was last accessed. Any further information, if known (DOI, author names, dates, reference to a source publication, etc.), should also be given. Web references can be listed separately (e.g., after the reference list) under a different heading if desired, or can be included in the reference list.

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Arrange two or more works by the same author by year of publication. Place In Press citations last eg. Past research (Gogel, 1990, 2006, in press)

Identify works by the same author (or by the same two or more authors in the same order) with the same publication date by the suffixes a, b, c, and so forth, after the year; repeat the year, eg. Several studies (Derryberry & Reed, 2005a, 2005b, in press-a; Rothbart, 2003a, 2003b)

*Reference List:* references should be arranged first alphabetically and then further sorted chronologically if necessary. More than one reference from the same author(s) in the same year must be identified by the letters 'a', 'b', 'c', etc., placed after the year of publication.
*Examples:* Reference to a journal publication: Van der Geer, J., Hanraads, J. A. J., & Lupton, R. A. (2010). The art of writing a scientific article. *Journal of Scientific Communications*, 163, 51-59.

*Data references*
For reference style 5 APA:[dataset] Oguro, M., Imahiro, S., Saito, S., Nakashizuka, T. (2015). Mortality data for Japanese oak wilt disease and surrounding forest compositions. Mendeley Data, v1. http://dx.doi.org/10.17632/xwj98nb39r.1.
Reference to a book: Strunk, W., Jr., & White, E. B. (2000). The elements of style. (4th ed.). New York: Longman, (Chapter 4).
Reference to a chapter in an edited book: Mettam, G. R., & Adams, L. B. (2009). How to prepare an electronic version of your article. In B. S. Jones, & R. Z. Smith (Eds.), *Introduction to the electronic age* (pp. 281-304). New York: E-Publishing Inc.

*Journal abbreviations source*
Journal names should be abbreviated according to the List of Title Word Abbreviations.

## Supplementary material
Supplementary material such as applications, images and sound clips, can be published with your article to enhance it. Submitted supplementary items are published exactly as they are received (Excel or PowerPoint files will appear as such online). Please submit your material together with the article and supply a concise, descriptive caption for each supplementary file. If you wish to make changes to supplementary material during any stage of the process, please make sure to provide an updated file. Do not annotate any corrections on a previous version. Please switch off the 'Track Changes' option in Microsoft Office files as these will appear in the published version.

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Below are a number of ways in which you can associate data with your article or make a statement about the availability of your data when submitting your manuscript. If you are sharing data in one of these ways, you are encouraged to cite the data in your manuscript and reference list. Please refer to the "References" section for more information about data citation. For more information on depositing, sharing and using research data and other relevant research materials, visit the research data page.

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## AFTER ACCEPTANCE

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## ANNEXURE 5 - Author guidelines International Journal of Environmental Research and Public Health

International Journal of
*Environmental Research and Public Health*

MDPI

*Type of the Paper (Article, Review, Communication, etc.)*

# Title

**Firstname Lastname [1], Firstname Lastname [2] and Firstname Lastname [2,*]**

[1] Affiliation 1; e-mail@e-mail.com
[2] Affiliation 2; e-mail@e-mail.com
* Correspondence: e-mail@e-mail.com; Tel.: (optional; include country code; if there are multiple corresponding authors, add author initials)

**Abstract:** A single paragraph of about 200 words maximum. For research articles, abstracts should give a pertinent overview of the work. We strongly encourage authors to use the following style of structured abstracts, but without headings: (1) Background: Place the question addressed in a broad context and highlight the purpose of the study; (2) Methods: briefly describe the main methods or treatments applied; (3) Results: summarize the article's main findings; (4) Conclusions: indicate the main conclusions or interpretations. The abstract should be an objective representation of the article and it must not contain results that are not presented and substantiated in the main text and should not exaggerate the main conclusions.

.

**Keywords:** keyword 1; keyword 2; keyword 3 (List three to ten pertinent keywords specific to the article yet reasonably common within the subject discipline.)

## 0. How to Use This Template

The template details the sections that can be used in a manuscript. Note that each section has a corresponding style, which can be found in the "Styles" menu of Word. Sections that are not mandatory are listed as such. The section titles given are for articles. Review papers and other article types have a more flexible structure.

Remove this paragraph and start section numbering with 1. For any questions, please contact the editorial office of the journal or support@mdpi.com.

## 1. Introduction

The introduction should briefly place the study in a broad context and highlight why it is important. It should define the purpose of the work and its significance. The current state of the research field should be carefully reviewed and key publications cited. Please highlight controversial and diverging hypotheses when necessary. Finally, briefly mention the main aim of the work and highlight the principal conclusions. As far as possible, please keep the introduction comprehensible to scientists outside your particular field of research. References should be numbered in order of appearance and indicated by a numeral or numerals in square brackets—e.g., [1] or [2,3], or [4–6]. See the end of the document for further details on references.

## 2. Materials and Methods

The Materials and Methods should be described with sufficient details to allow others to replicate and build on the published results. Please note that the publication of your manuscript implicates that you must make all materials, data, computer code, and protocols associated with the publication available to readers. Please disclose at the submission stage any restrictions on the availability of materials or information. New methods and

**Citation:** To be added by editorial staff during production.

Academic Editor: Firstname Lastname

Received: date
Revised: date
Accepted: date
Published: date

protocols should be described in detail while well-established methods can be briefly described and appropriately cited.

Research manuscripts reporting large datasets that are deposited in a publicly available database should specify where the data have been deposited and provide the relevant accession numbers. If the accession numbers have not yet been obtained at the time of submission, please state that they will be provided during review. They must be provided prior to publication.

Interventionary studies involving animals or humans, and other studies that require ethical approval, must list the authority that provided approval and the corresponding ethical approval code.

## 3. Results

This section may be divided by subheadings. It should provide a concise and precise description of the experimental results, their interpretation, as well as the experimental conclusions that can be drawn.

### *3.1. Subsection*

#### 3.1.1. Subsubsection

Bulleted lists look like this:

1. First bullet;
2. Second bullet;
3. Third bullet.

Numbered lists can be added as follows:

First item;
Second item;
Third item.

The text continues here.

### *3.2. Figures, Tables and Schemes*

All figures and tables should be cited in the main text as Figure 1, Table 1, etc.

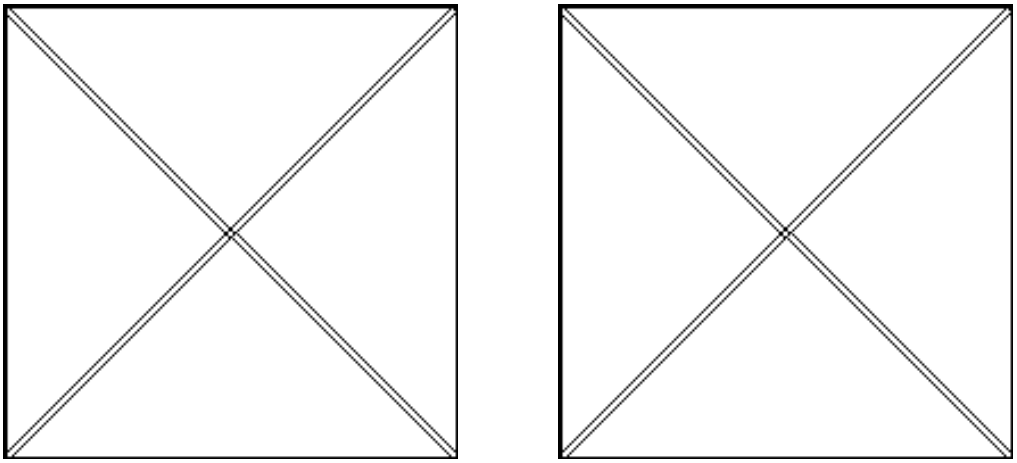

**Figure 1.** This is a figure. Schemes follow the same formatting.

**Table 1.** This is a table. Tables should be placed in the main text near to the first time they are cited.

| Title 1 | Title 2 | Title 3 |
|---|---|---|
| entry 1 | data | data |
| entry 2 | data | data [1] |

[1] Tables may have a footer.

The text continues here (Figure 2 and Table 2).



(**a**) (**b**)

**Figure 2.** This is a figure. Schemes follow another format. If there are multiple panels, they should be listed as: (**a**) Description of what is contained in the first panel; (**b**) Description of what is contained in the second panel. Figures should be placed in the main text near to the first time they are cited.

**Table 2.** This is a table. Tables should be placed in the main text near to the first time they are cited.

| Title 1 | Title 2 | Title 3 | Title 4 |
|---|---|---|---|
| entry 1 * | data | data | data |
| | data | data | data |
| | data | data | data |
| entry 2 | data | data | data |
| | data | data | data |
| entry 3 | data | data | data |
| | data | data | data |
| | data | data | data |
| | data | data | data |
| entry 4 | data | data | data |
| | data | data | data |

* Tables may have a footer.

### *3.3. Formatting of Mathematical Components*

This is example 1 of an equation:

$$a = 1, \tag{1}$$

the text following an equation need not be a new paragraph. Please punctuate equations as regular text.

This is example 2 of an equation:

$$a = b + c + d + e + f + g + h + i + j + k + l + m + n + o + p + q + r + s + t + u + v + w + x + y + z \tag{2}$$

the text following an equation need not be a new paragraph. Please punctuate equations as regular text.

Theorem-type environments (including propositions, lemmas, corollaries etc.) can be formatted as follows:

**Theorem 1.** *Example text of a theorem. Theorems, propositions, lemmas,* etc. *should be numbered sequentially (i.e., Proposition 2 follows Theorem 1). Examples or Remarks use the same formatting, but should be numbered separately, so a document may contain Theorem 1, Remark 1 and Example 1.*

The text continues here. Proofs must be formatted as follows:

**Proof of Theorem 1.** Text of the proof. Note that the phrase "of Theorem 1" is optional if it is clear which theorem is being referred to. Always finish a proof with the following symbol. □

The text continues here.

## 4. Discussion

Authors should discuss the results and how they can be interpreted from the perspective of previous studies and of the working hypotheses. The findings and their implications should be discussed in the broadest context possible. Future research directions may also be highlighted.

## 5. Conclusions

This section is not mandatory but can be added to the manuscript if the discussion is unusually long or complex.

## 6. Patents

This section is not mandatory but may be added if there are patents resulting from the work reported in this manuscript.

**Supplementary Materials:** The following supporting information can be downloaded at: www.mdpi.com/xxx/s1, Figure S1: title; Table S1: title; Video S1: title.

**Author Contributions:** For research articles with several authors, a short paragraph specifying their individual contributions must be provided. The following statements should be used "Conceptualization, X.X. and Y.Y.; methodology, X.X.; software, X.X.; validation, X.X., Y.Y. and Z.Z.; formal analysis, X.X.; investigation, X.X.; resources, X.X.; data curation, X.X.; writing—original draft preparation, X.X.; writing—review and editing, X.X.; visualization, X.X.; supervision, X.X.; project administration, X.X.; funding acquisition, Y.Y. All authors have read and agreed to the published version of the manuscript." Please turn to the CRediT taxonomy for the term explanation. Authorship must be limited to those who have contributed substantially to the work reported.

**Funding:** Please add: "This research received no external funding" or "This research was funded by NAME OF FUNDER, grant number XXX" and "The APC was funded by XXX". Check carefully that the details given are accurate and use the standard spelling of funding agency names at https://search.crossref.org/funding. Any errors may affect your future funding.

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Written informed consent for publication must be obtained from participating patients who can be identified (including by the patients themselves). Please state "Written informed consent has been obtained from the patient(s) to publish this paper" if applicable.

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## Appendix A

The appendix is an optional section that can contain details and data supplemental to the main text—for example, explanations of experimental details that would disrupt the flow of the main text but nonetheless remain crucial to understanding and reproducing the research shown; figures of replicates for experiments of which representative data is shown in the main text can be added here if brief, or as Supplementary data. Mathematical proofs of results not central to the paper can be added as an appendix.

## Appendix B

All appendix sections must be cited in the main text. In the appendices, Figures, Tables, etc. should be labeled starting with "A"—e.g., Figure A1, Figure A2, etc.

181

182 References
183 must be numbered in order of appearance in the text (including citations in tables and legends) and listed individually at the
184 end of the manuscript. We recommend preparing the references with a bibliography software package, such as EndNote, Ref-
185 erenceManager or Zotero to avoid typing mistakes and duplicated references. Include the digital object identifier (DOI) for all
186 references where available.
187
188 Citations and references in the Supplementary Materials are permitted provided that they also appear in the reference list here.
189
190 In the text, reference numbers should be placed in square brackets [ ] and placed before the punctuation; for example [1], [1–3]
191 or [1,3]. For embedded citations in the text with pagination, use both parentheses and brackets to indicate the reference number
192 and page numbers; for example [5] (p. 10), or [6] (pp. 101–105).
193
194 1. Author 1, A.B.; Author 2, C.D. Title of the article. *Abbreviated Journal Name* **Year**, *Volume*, page range.
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196 Country, 2007; Volume 3, pp. 154–196.
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202 Conference, Country, Date of Conference (Day Month Year).
203 7. Author 1, A.B. Title of Thesis. Level of Thesis, Degree-Granting University, Location of University, Date of Completion.
204 8. Title of Site. Available online: URL (accessed on Day Month Year).

## ANNEXURE 6 - Author guidelines International Journal of Africa Nursing Sciences

# INTERNATIONAL JOURNAL OF AFRICA NURSING SCIENCES

AUTHOR INFORMATION PACK

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**ISSN:** 2214-1391

## DESCRIPTION

**International Journal of Africa Nursing Sciences (IJANS)** is an international scientific open access journal published by Elsevier. The broad-based journal was founded on two key tenets, i.e. to publish the most exciting research with respect to the subjects of **Nursing** and **Midwifery** in **Africa**, and secondly, to advance the international understanding and development of **nursing** and **midwifery** in **Africa**, both as a profession and as an academic discipline.

The fully refereed journal provides a forum for all aspects of **nursing** and **midwifery sciences**, especially new trends and advances. The journal call for original research papers, systematic and scholarly review articles, and critical papers which will stimulate debate on research, policy, theory or philosophy of **nursing** as related to **nursing** and **midwifery** in **Africa**, technical reports, and short communications, and which will meet the journal's high academic and ethical standards. Manuscripts of **nursing practice**, education, management, and research are encouraged. The journal values critical scholarly debate on issues that have strategic significance for educators, practitioners, leaders and policy-makers of **nursing** and **midwifery** in **Africa**. The journal publishes the highest quality scholarly contributions reflecting the diversity of **nursing**, and is also inviting international scholars who are engaged with **nursing** and **midwifery** in **Africa** to contribute to the journal. We will only publish work that demonstrates the use of rigorous methodology as well as by publishing papers that highlight the theoretical underpinnings of **nursing** and **midwifery** as it relates to the **Africa** context. The journal employs a double blind peer review process for all submissions and is working towards inclusion of the journal on the Thomson Reuters Journal Citation Reports.

## ABSTRACTING AND INDEXING

Scopus
Directory of Open Access Journals (DOAJ)

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You can use this list to carry out a final check of your submission before you send it to the journal for review. Please check the relevant section in this Guide for Authors for more details.

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• Full postal address

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• All tables (including titles, description, footnotes)
• Ensure all figure and table citations in the text match the files provided
• Indicate clearly if color should be used for any figures in print
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*Supplemental files* (where applicable)

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• Journal policies detailed in this guide have been reviewed
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