ASSESSMENT OF FACTORS INFLUENCING THE OCCURRENCE OF TYPHOID FEVER AMONG ADULTS IN UGUNJA SUB COUNTY, SIAYA COUNTY, KENYA

ROSE AWINO YOGO

A THESIS SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR THE AWARD OF MASTER OF PUBLIC HEALTH IN EPIDEMIOLOGY AND DISEASE CONTROL OF

MOUNT KENYA UNIVERSITY

MARCH 2025

DECLARATION AND APPROVAL

Declaration by Student

I declare that this thesis is my original work and has not been presented for a degree in any other University or for any other award"

Signature: _____ Date: _26/03/2025_____

Rose Awino Yogo

MPH/2016/59541

Confirmation by Supervisors

We confirm that the candidate under our supervision did the work reported in this thesis.

Signature: _____ Date: 26/03/2025_____

Dr. Dominic M. Mogere, PhD

School of Public Health

Mount Kenya University

Signature: _____ Date: ___26/03/2025_____

Dr. Nyamai Juma (PhD)

School of Public Health

Mount Kenya University

DEDICATION

I dedicate this research to my lovely family, my husband and children

ACKNOWLEDGMENT

I would like to express my gratitude to my supervisors Dr. Mogere and Dr. Juma for their invaluable guidance and patience throughout the period of my research. I also could have not undertaken this journey without my research assistants who generously invested positive energies in data collocation and analysis. I am also grateful to my colleagues and employer for understanding my study schedule and providing humble time. Lastly, I owe my family, husband, and children whose strong beliefs in me empowered my motivation to this effect.

ABSTRACT

Typhoid fever is described as a severe gastrointestinal infection that is caused by the gram-negative *bacillus Salmonella entericatyphi*, and can be transmitted from one individual to another through the fecal-oral route, mostly due to poor hygienic practices especially non-washing of hands before and after meals and upon visiting toilets. The bacteria is also carried on vegetables and fruits and thus consumption of non-properly cooked or washed foods predisposes and individual to typhoid infections. Similarly, the bacteria can easily spread from the intestine through the bloodstream to the intestinal organs like the liver, and spleen through the blood. Globally Typhoid fever disease burden is estimated at 11 to 20 million cases annually which results in about 140,000 deaths a year. In Africa, the typhoid fever disease burden is estimated at 7.6% of typhoid fever cases, where it affects about 12.5 million persons annually. In Kenya, the prevalence of typhoid fever is less than one (1%) annually. The main purpose of this study will be to assessment of factors influencing the occurrence of typhoid fever in Ugunja Sub-county, Siaya County, Kenya. The objective of the study was to find out the Socio-economic factors that influence the occurrence of typhoid, to determine the environmental factors that influence the occurrence of typhoid, and to establish treatment and care factors that influence the occurrence of typhoid fever in the Ugunja sub-county. The study adopted a descriptive cross-sectional research design. The target population was 88,458 people with a sample of 370 households drawn from the total population. The studies employed multistage sampling to achieve the calculated sample size of 370 persons from the total population. Questionnaires and interview guides were used to collect data for the study. The data collected was analyzed using SPSS version 29. Univariate analysis was used to assess the socio-economic, environmental, and facility on the occurrence of typhoid. Data was then presented using frequency tables and graphs. The study revealed that 93% of households were aware of food and water safety management, with 96% using water treatment methods. However, 37% did not practice handwashing, aligning with UNICEF's finding that only 25% of Kenyans have handwashing facilities. Poor sanitation, open defecation, and inadequate health facility testing (67%) contributed to typhoid cases. Encouraging proper hygiene, sanitation, and healthcare access is crucial in reducing typhoid fever in Ugunja Sub-County. The study highlights the strong awareness of food and water safety management among households. However, poor sanitation, inadequate handwashing, and limited diagnostic capacity in health facilities contribute to typhoid cases in Ugunja Sub-County. Enhancing sanitation facilities, promoting handwashing, and improving healthcare diagnostic capabilities are essential to reducing typhoid fever prevalence in the region.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS AND ACRONYMS

BMC: Biomed Central

ESR: Epidemic Surveillance and Response

KDHS: Kenya Demographic and Health Survey

KNBS: Kenya National Bureau of Statistics

MOH: Ministry of Health

SATO: Smart Fresh Toilet

SBCC: Social Behaviour Change Communication

TVC: Typhoid Conjugate Vaccine

UNHCR: United Nations High Commissioners for Refugees

UNICEF: United Nations Children's Fund

WASH: Water, Sanitation and Hygiene

WHO: World Health Organisation

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Typhoid fever is a severe gastrointestinal infection caused by the gram-negative bacillus Salmonella entericatyphi, according to the World Health Organisation (WHO) Fact Sheet. It can be spread from person to person through the fecal-oral route, primarily as a result of inadequate hand hygiene, particularly failing to wash hands before and after meals and when using the lavatory. The bacterium is also carried on vegetables and fruits and thus consumption of non-properly washed and/or cooked such foods predisposes one to typhoid infection. Food handlers, especially in public eateries, play a major role in typhoid spread, and are as such important in its control (WHO, 2018a).

The bacteria can spread through the bloodstream from the intestine to the intestinal organs like the liver, and spleen.Typhoidis a global health problem that mostly occurs in poorer states where food production and preparation hygiene and uncontaminated water are deficient. The lack of management on the infection leads to illness that may take between 2 and 4 weeks with its death rate ranging between 11% and 30%. Further provides the documented statistics approximating the global magnitude of typhoid fever as 15 million illnesses and 500,000 deaths annually (WHO, 2018b).

Typhoid remains a public health problem affecting most of the low and medium-income countries Kenya being one of them. The disease is among the leading cause of morbidity and mortality globally which is approximated to 12-40 million cases leading to about 216,000 to 600,000 deaths in a year (DeRoeck 2007). It is also rated to be among the disease that is consuming a lot of resources in its management across developing countries. The global

prevalence rate annually is estimated to be about 26.9 million cases with a mortality rate estimated to be at 128,000 to 160,000 per year (Lancet,2015).

Typhoid fever is more common in South America, Africa, India, and Southeast Asia, where it affects approximately 26 million individuals annually. The annual incidence of typhoid fever in sub-Saharan Africa is estimated to be 762 cases per 100,000 people.Typhoid fever is a public health issue that often affects nearly everyone in both rural and urban settings. Diseases that are water related such as typhoid fever kill about four million children yearly and exposes one fifth of world's population sick. Hover, the said world cascade of typhoid fever is not properly documented because facilities capable of carrying out the Salmonella antigen tests essential for diagnosis are not available from many regions (WHO, 2018a).

Sub-Saharan Africa does not, however, have any data on invasive salmonella disease. In order to determine the rates of typhoid fever prevalence, the WHO attempted to find further epidemiological info on the disease in 2008. In order to give new incidence cases of typhoid fever in sub-Saharan Africa, the Typhoid Fever Surveillance in Africa Program (TSAP) carried out investigations from 2010 to 2014 (Florian, Vera, Yaw, Muna, Mohammad, & al., 2017). In Africa, the typhoid incidences rate was at 59/100,000, while Kenya had an incidence of 39/100,000. However, the existing figures maybe underestimated due to under-reporting, as only severely sick people sought treatment in hospitals *(Florian, Vera, Yaw, Muna, Mohammad, & al., 2017).*

Typhoid fever incidence data from studies on 22 countries representing about 1.8 million person-years of reported cases showed that only about 29% of countries had national typhoid fever surveillance systems that normally used blood culture confirmation and detections of cases by enhanced passive surveillance. Between 2007 and 2009, Kenya had an occurrence

of typhoid fever in Kibera, Nairobi at the highest among children aged 2-4 years with 2,143 sick children per 100,000 observed (CDC 2009). Further, typhoid prevalence for the years 1998, 1999, and 2000 were estimated at 1830, 1429, and 4172 respectively, while typhoid-related deaths were reported at 288 in 1998, which reduced to 183 in 1999. The values increased to 309 in 2000 (Mahiri, 2011).

Typhoid is mostly spread through food or contaminated water. Those who are infected transmit germs in their urine and stool. Initial signs and symptoms are many that comprise of abdominal pain, fever and general body malaise. As this illness develops, the general body malaise becomes complex, and diarrheal develops, and, feebleness, intense fatigue, restlessness, and extremely unpleasant spots develop. A rash, signs only of typhoid and called "rose spots," presents in many cases of typhoid. These spots are small (1/8 inch) and they can be seen mostly on the abdomen and chest. In many cases, young children have complications that ate mild compared to adults. (Pietrangelo, 2018)

However, correct and dependable discovery of typhoid fever infections in our country Kenya has been faced with a lot of challenges. Some unverified health data have a number of times have shown unimaginable infection rates in most parts of the country. The utmost mutual testing device in a number of health amenities is mostly on clinical assumption. However, Widal tests mostly isolation of the causative agent through culture has been carried out during routine practice. It has hence been challenging to estimate accurately the prevalence rate and disease burden associated with typhoid in Kenya from records maintained by Regional and some selected referral Hospitals (Kariuki, et al., 2010).

Multidrug resistance (MDR) the common antibiotics prescribed against *Salmonella-entericaserovartyphi* (*S. typhi*) is growing. The prevalence rate and mortality rate have

increased due to the introduction of strains such as H58, an older type of Salmonella typhi that causes typhoid, which has pushed out other strains to become resistant to more than 60% of locally accessible and reasonably priced antibiotics. Because it causes intestinal perforations that are not sensitive to commonly prescribed medicines in the treatment of typhoid, the strain H58 has the potential to be lethal, indicating the emergence of variations that are not treatable by known antibiotics (Kariuki et al., 2004).

The Government of Kenya and some private bodies direct their efforts and their resources towards the control of water and sanitation related diseases such as cholera, typhoid among others. Nevertheless, typhoid fever is still a problem in many parts of the country with Kisumu County leading followed closely with Siaya County KEMRI/CDC (2017). According to this research, in Siaya County, which has a total six sub-counties (Ugunja, Ugenya, Gem, Rarieda, Bondo and Alego Usonga), among which Ugunja is still taking the lead on new cases of typhoid that were reported. MOH 705a & b (2015) further clarifies that among the 3682 new typhoid cases that were reported in the entire Siaya County between 2015 and 2017, Ugunja Sub-County took the lead with 1311 cases reported.[*KHIS Siaya*]

The burden of typhoid fevers is still a problem in the third world countries especially the Sub-Saharan Africa. However, a number of efforts have been put in place that aims at reducing the virulence of this fever, the connection between this disease burden and the socio-economic status has been insignificant at community level and personal levels. (Jacob & Justice, 2012). Unclean drinking work is the leading typhoid fever, but the better part of the population who at risk of typhoid fever results from being exposed to unsafe water will be useful in knowing those population that are more at risk, modelling typhoid disease burden, and designing prevention and control measures Vijayalaxmi et al., 2018).

Typhoid fever is regarded as a leading cause of death worldwide, with developing nations accounting for a larger proportion of cases (Dewan, Corner, Hashizume, & Ongee, 2013).Although the overall incidence of typhoid fever is still significant, more public understanding of health issues, improved health facilities, and improved public waste disposal methods by the county governments are said to have contributed to its decline. Typhoid fever is widespread in these nations due to a number of factors, including inadequate medical facilities, poor laboratory standards, and inefficient treatment methods (Bharmoria, Shukla, & Sharma, 2017).

Prevalence of typhoid fever can be contained by improving hygiene and sanitary practices and access to uncontaminated water which is being done by both national and county governments, nevertheless it is still reported that typhoid frequency is still high. However, it can be extremely difficult to control and eradicate typhoid fever if uninfluenced water bodies, hygienic facilities, and recommended hygiene measures are not maintained (Sharma & Shukla, 2012).

Ugunja Sub County has a problem of high occurrence of cholera and typhoid fever cases. According to the daily Nation 18th March 2016, there were 146 cases reported in Siaya since May 2015, a case which health management officials in the county attributed to substandard hygiene as well as inhabitation of urban slums, consuming poorly cooked foods at funerals and absence of latrines in many households. The under-five mortality rate associated to typhoid fever is estimated at 234 per 1000 mortality against the National typhoid prevalence which is at 74 per 1000, Ugunja constituency working document for the Member of County Assemblies and Health Committee (2014).

Typhoid epidemics do occur if control and precautionary or mitigating procedures are not undertaken within a time frame that is recommended. Ineffective disposal of waste and sanitation of personnel in food preparation and management sector offer an apparent contamination means. The condition is intricate in that some public might be potential carriers this typhoid fever whereby, though display none noticeable signs and symptoms of the disease their faeces carry the bacteria. Inappropriate data of statistics may give an incorrect picture on the prevalence of typhoid fever in a given area of study.

Global Burden of Typhoid.

Every year, some 16 million people contract typhoid, which is brought on by Salmonella Typhi and results in an estimated 600,000 fatalities. A major cause of morbidity and death in countries with low or middle incomes (LMICs), typhoid fever is a potentially deadly illness that primarily affects children and early adolescents. Disease surveillance is impeded by a lack of laboratory facilities and, use of diagnostic tests with poor specificity, which results in consideration of alternative diagnoses, and under-reporting of cases. Cilial technique has been shown to have 91% sensitivity and 100% specificity for diagnosis but is not widely available, although it has been integrated into the WHO toolkit for the detection of enteric pathogens. The burden of typhoid fever is likely higher than estimated. (Kaluse et al.2021)

The simultaneous management of typhoid fever and fever cases could lead to a decrease in other febrile illnesses such as influenza and meningitis. The past two decades have seen unprecedented developments in enteric pathogen diagnostics and drug susceptibility monitoring, as well as significant advancements in the development of new typhoid vaccines. New tools and vaccines are likely to help bring typhoid fever back under control. Key strategies and collaborative partnerships centered on global diseases such as typhoid fever

are essential for curbing preventable illnesses. A renewed commitment and mobilization of resources focused on the prevention of infectious diseases by leveraging existing technologies are also crucial for protecting future generations, including a focus on clean water, sanitation, hygiene, and access to vaccines.

The Indian subcontinent, China, Southeast Asia, Eastern Europe, and portions of Africa and South America are all endemic for typhoid fever. The disease varies seasonally and geographically, and reports of a growing incidence trend have come from Indian cities like Delhi and Kolkata. It is important to have a sound understanding of the epidemiology of typhoid fever to optimize resources and develop locally applicable control strategies. Bacterial load, disease progression, and complication type/number differ in different age groups. Furthermore, it may be expected that the etiology of fever in endemic areas recently exposed to the reintroduction of water, environmental, and hygiene-related bacteria intervention that fail to meet their goals may differ from those wherein the past prevalent disease has recently been controlled through improved environmental and hygiene conditions.

1.2 Statement of the Problem

With many instances recorded in underdeveloped nations, typhoid fever is regarded as a leading cause of death worldwide (Dewan, Corner, Hashizume, & Ongee, 2013). Approximately 11.9 million cases and 129,000 deaths are attributed to the disease worldwide in low- and middle-income nations (Mogasale et al., 2018). Africa is not left behind since the issue requires immediate action to be resolved. This could however be achieved through broad economic developments, ensuring sustainable and improved WASH, strengthening health care systems and food safety policies to ensure reduced burden on the typhoid fever

(Steele, 2016).Inadequate health facilities, substandard laboratories and ineffective treatment practices are some of the reasons behind the extensiveness of typhoid fever in these countries (Bharmoria, Shukla, & Sharma, 2017). Prevalence of typhoid fever can be contained by improving hygiene and sanitary practices and access to uncontaminated water. However, if uncontaminated water bodies, hygiene facilities and recommended hygiene practices are not sustained then it can be very challenging to control and eradicate typhoid fever successfully (Sharma & Shukla, 2012).There has been an increase in public health awareness, improved health facilities and enhanced public waste disposal by both the national and county governments meant to manage high number typhoid fever occurrences in Ugunja Sub-county recently but typhoid prevalence rate is still high.

According to the M.O.H (2016) report, Siaya reported 146 cases of typhoid fever in May of 2015 alone. The report attributed this to substandard hygiene, consuming poorly cooked foods at funerals and absence of latrines in many households. The under-five mortality rate associated to typhoid fever was estimated at 234 per 1000 mortality against the National typhoid prevalence which stand at 74 per 1000(Ugunja constituency Health Committee 2014). Typhoid epidemics do occur if control and precautionary or mitigating procedures are not undertaken within a time frame that is recommended. Ineffective disposal of waste and sanitation of personnel in food preparation and management sector may offer an apparent contamination means. The research seeks to assessment of aspects influencing the occurrence of typhoid fever in Ugunja Sub- County, Siaya County, Kenya. With better knowledge of the factors influencing typhoid fever leads to proper management of the disease. [*KHIS Siaya*]

1.3 Objectives of the Study

1.3.1 General Objectives

The general objective of the study was to investigate the factors influencing the occurrence of typhoid fever among adults in Ugunja Sub County, Siaya County.

1.3.2 Specific Objectives

1. To determine the Socio-economic factors that influences the occurrence of typhoid fever among adults in Ugunja sub-county.
2. To determine the environmental factors that influences the occurrence of typhoid fever among adults in Ugunja sub-county.
3. To determine treatment and care factors that influences the occurrence of typhoid among adults fever in Ugunja sub-county.

1.4 Research Questions

1. What were the Socio-economic factors that influenced the occurrence of typhoid fever among adults in Ugunja sub-county?
2. What were the environmental factors that influenced the occurrence of typhoid fever among adults in Ugunja sub-county?
3. What were the treatment and care factors that influenced the occurrence of typhoid fever among adults in Ugunja sub-county?

1.5 Justification of the Study

In Kenya, typhoid fever is a serious public health issue, especially in areas like Ugunja Sub County where access to safe water and inadequate sanitation make waterborne illnesses more likely to spread. The results of this study can guide focused initiatives that enhance community health outcomes and are essential for comprehending the precise elements influencing the prevalence of typhoid fever in this area. The study's influence on public health

is among its most obvious and significant accomplishments. The Salmonella typhi bacteria is the cause of typhoid fever, which may be mainly avoided with better hygiene, immunisation, and availability to potable water. However, understanding the local factors—such as infrastructure deficits, community hygiene practices, or socioeconomic conditions—that influence its occurrence in Ugunja Sub County allows health authorities to design more precise and effective interventions. This study can inform the Siaya County public health departments and non-governmental organizations (NGOs) on where to allocate resources, how to prioritize public health campaigns, and what specific behaviors or conditions require urgent attention. Moreover, the study can provide data that could prompt policy changes aimed at improving water safety, sanitation, and healthcare accessibility.

The socioeconomic consequences of typhoid fever are significant, particularly in rural and semi-urban communities like Ugunja. Typhoid fever often leads to loss of productivity, as infected individuals are unable to work or attend school. This, in turn, can strain family resources and hinder overall economic development. By identifying the factors contributing to typhoid outbreaks, this study can help mitigate these economic challenges. Targeted interventions that reduce the prevalence of typhoid fever will ultimately improve community productivity and enable local families to direct their resources toward economic growth rather than medical expenses.

The findings from this research can provide critical insights for policy makers at both county and national levels. For instance, identifying whether certain groups, such as children or low-income households, are disproportionately affected by typhoid can inform equitable public health policies. Additionally, if environmental factors like the quality of drinking water or poor sanitation are found to be significant contributors, county officials can advocate for the

construction of more boreholes, water treatment plants, or public health campaigns on hygiene. Policy makers could also use the study's findings to push for stricter enforcement of public health regulations concerning food safety and environmental cleanliness.

Understanding the factors influencing the spread of typhoid fever also has direct implications for local healthcare systems. In rural settings, health facilities often face challenges such as inadequate medical supplies, staff shortages, and a lack of diagnostic tools for early detection. The results of this investigation can identify regions where investments are needed to improve the delivery of health services and highlight medical care deficiencies that contribute to the development of typhoid. For example, if the research indicates that late diagnosis or mismanagement of typhoid cases is common, this could lead to advocacy for better training for healthcare workers or investment in better diagnostic tools, which would improve patient outcomes. The study will contribute to the broader body of knowledge on the epidemiology of typhoid fever, particularly in rural African contexts. While there is ample research on typhoid globally, understanding how region-specific factors—such as climate, local customs, and infrastructure—affect disease spread is essential for crafting tailored public health solutions. The study can also contribute to the growing understanding of how environmental changes, such as flooding or droughts, impact the occurrence of typhoid fever, thus providing a more comprehensive picture of the disease's dynamics in a changing world.

Finally, the study has the potential to raise awareness among local communities regarding the prevention of typhoid fever. Through dissemination of the study's findings, communities in Ugunja Sub County can gain a deeper understanding of how their everyday practices—such as water sourcing, food handling, and waste disposal—affect their health. Community involvement is essential for any successful public health intervention, and this study could

lay the groundwork for empowering residents to take ownership of their health outcomes by adopting better hygiene practices and supporting local health initiatives.

In conclusion, the study on the factors influencing the occurrence of typhoid fever in Ugunja Sub County is of paramount importance. It has the potential to improve public health, bolster socioeconomic development, inform policy-making, strengthen local health infrastructure, and contribute to scientific knowledge. Furthermore, by fostering community involvement, the study can ensure sustainable health improvements that benefit Ugunja and Siaya County at large.

This study provided critical insights into the factors influencing the occurrence of typhoid fever in Ugunja Sub-County, Siaya County, highlighting key environmental, socio-economic, and infrastructural determinants. The findings contributed to evidence-based policymaking by identifying gaps in sanitation, water quality, food hygiene, and healthcare accessibility that drive typhoid infections.

By offering a localized analysis, the study served as a model for similar settings in Kenya facing comparable public health challenges. Counties with inadequate water supply, poor waste disposal, and limited healthcare services can apply the study's recommendations to design targeted interventions. The findings also informed preventive measures such as improved sanitation programs, strengthened disease surveillance, and enhanced public awareness campaigns. Additionally, health authorities and policymakers in other regions can utilize the study's methodology to assess and mitigate typhoid risk factors in their communities, ultimately reducing disease burden and improving overall public health outcomes in Kenya.

1.6 Rationale

Typhoid fever is a global health problem with high-poverty areas being the biggest sufferers due to insufficient supply of hygienic domestic water, rampant outdoor food preparation, and inadequate waste disposal facilities. Ugunja sub-county in Siaya County is such an area. The disease continues to worsen the health conditions and wellbeing of area residents. Typhoid fever attacks have led to avoidable deaths in several instances, government and community efforts notwithstanding! The study was to identify the core loopholes in typhoid management within and around Ugunja sub-county and develop suitable strategies to eradicate its prevalence.

This study tried to find the gaps that were fuelling the occurrence of typhoid in Ugunja Sub County amidst the interventions that have been put in place. Subsequently, the study intended to advise the Ministry of Health on risk factors in the prevention and control of typhoid.

1.7 Scope of the Study

The research was conducted in Ugunja Sub- County which is among the six sub-counties in Siaya County. The Sub-county bounders Ugenya in the northern part, Alego Sub-county in the southwest, Gem sub-county to the southeast, and Butere/Mumias sub-county to the east. The total area of the constituency is approximately 198.8sq.km. The whole population of this study area comprises about 88,458 people (41,014 males and 47,444 are females) living in 25,120 households across Ugunja Sub County (MOH, 2017; KNBS, 2010).

1.8 Study limitations

The language barrier caused problems for the investigator. Thus, the study was restricted to the respondents' familiar language. Due to the harsh weather conditions and uncooperative respondents encountered the researcher resorted to a proper introduction to the main purpose

of the study. False information, the researcher assured the respondent of confidentiality and anonymity.

1.9 Limitations of the Study

A suitable sampling technique was employed to gather a sufficient sample for the study in order to guarantee that it encompassed the entire Sub-county and that the findings accurately represented the typhoid prevalence status. The random sample size that was employed accurately reflected the entire population. The goal of the study was clearly communicated to resistant participants in order to increase the response rate. The present investigation had a number of logistical and time-related restrictions. The data collection period was limited, restricting the ability to conduct long-term monitoring of typhoid fever trends. A longer study duration would have provided a more comprehensive understanding of seasonal variations and outbreak patterns.

Logistically, financial and resource constraints impacted the scope of data collection. Limited funding restricted access to advanced diagnostic tools and broader geographical coverage, which could have strengthened the study's findings. Additionally, reaching remote areas in Ugunja Sub-County was challenging due to inadequate transport infrastructure, affecting timely data collection. Some participants were also unavailable or unwilling to participate within the set timeframe, potentially introducing response bias.

Despite these challenges, the study effectively provided valuable insights into the factors influencing typhoid fever in the region. Future research with extended timelines and improved logistical planning could enhance data accuracy and generalizability.

1.10 Operational definition of Terms

BMC: BioMed Central

Carrier: A person or animal that transmits a disease-causing organism to others without suffering any symptoms

ESR: Epidemic Surveillance and Response

KDHS: Kenya Demographic and Health Survey

KHIS Kenya Health Information System

KNBS: Kenya National Bureau of Statistics

MOH: Ministry of Health

Prevalence: Measurement of all individuals affected by a disease at a particular time

Resistance: The ability not to be affected by something

Salmonella typhi: The bacteria that causes typhoid fever in humans

SATO: Smart Fresh Toilet

SBCC: Social Behaviour Change Communication

Specificity: The quality of belonging uniquely to a particular subject

TVC: Typhoid Conjugate Vaccine

Typhoid Fever: This is an infectious bacterial fever with an eruption of red spots on the chest and abdomen and severe intestinal irritation

UNHCR: United Nations High Commissioners for Refugees

UNICEF: United Nations Children's Fund

Vaccination: Treatment with a vaccine to produce immunity against a disease

WASH: Water, Sanitation and Hygiene

WHO: World Health Organisation

CHAPTER TWO

LITERATURE REVIEW

2.1 Introduction

Reviewing earlier works that are relevant to the topic of research is the main goal of this chapter. It focuses on the theoretical framework that encompasses typhoid fever treatment and care considerations, socioeconomic factors, environmental variables, and empirical data. The infectious bacterium Salmonella enterica serotype Typhi (S. Typhi) is the cause of typhoid, sometimes known as typhoid fever, a systemic illness that affects people all over the world It is a waterborne disease often spread by faecal pollution of drinking water or food and manifests through a prolonged, insidious febrile illness. Typhoid is endemic in some of the less developed communities in the world and is characterized by poor sanitation and hygiene conditions. Active S. Typhi can persist in the environment for months or even years, and circulating anti-Salmonella antibodies are found in diseased communities. Typhoid is mainly transmitted through the fecal-oral route from chronic carriers who shed the bacterium

in water or food consumed by humans. Transmission can also occur directly through the fecal-oral route among family members or indirectly through flies and domestic animals. Pathogenesis is largely mediated by polysaccharide Vi, which inhibits the inhibition of phagosome-lysosome fusion. (Stanaway et al.2020) (Andrews et al.2020).

Contaminated food and drink invade the epithelial cells of the intestinal mucosa, where bacilli multiply and translocate to the lamina propria with the aid of an invasin. After penetration of the epithelial barrier, the bacilli enter the submucosal Peyer's patches and are subsequently taken up by macrophages, where they survive and multiply extensively. These macrophages migrate to nearby mesenteric lymph nodes and drain into the right thoracic duct, releasing bacilli into the circulation. Shortly after translocating to the bloodstream, the bacilli invade various organs, including the liver, spleen, bone marrow, and kidneys, causing a systemic disease. Virulence factors such as lipopolysaccharide, polysaccharide Vi, and specialized secretion systems have been investigated and described, as well as important components of innate and adaptive antimycobacterial immunity. Virulence genes regulated by the PhoP/PhoQ two-component system are involved in the survival and multiplication of intracellular S. Typhi in macrophages and in biofilm formation on different surfaces. (Jahan et al.2022)

Endomembrane trafficking of S. Typhi in epithelial and macrophage cells is downregulated after internalization due to bacterial-induced cellular activities. The host environment, including non-oxidative and oxidative stresses, is modified for its survival and multiplication. A variety of innate pathways are activated resulting in the production and/or secretion of host effector molecules that counteract the virulence mechanism employed by S. Typhi. In this regard, S. Typhi is subjected to lysosomal delivery and subsequent killing or elimination by

phagocytes, including autophagy enzymes and mediators. Additionally, there have been important advances in the understanding of adaptive immune mechanisms against S. Typhi as a parenteral pathogen. CD4 T lymphocytes recognize intracellular antigens presented by MHC class II molecules, leading to the production of various cytokines such as interleukin-2, interleukin-10, interferon-γ, and tumour necrosis factor-α. CD8 T lymphocytes acquire peptide-MHC class I molecules intracellular after bacterial phagocytosis or cell infection, recognizing cytosolic antigens encoded by the bacterial genome and usually secreting high levels of preforming and granzymes. (Chatterjee et al.2023)

Salmonella enterica serovar Typhi, often known as "Salmonella Typhi," is a bacterium that spreads through the fecal-oral route and causes typhoid, a systemic infection. Typhoid is becoming more prevalent in recently industrialised areas, while it remains endemic in many underdeveloped countries. Travellers to these nations are at risk if sanitary precautions are not undertaken. Concurrently, the organism must cross the intestinal mucosa by the epithelial cells lining the gut, evading the mucosal immune response. Typhoid fever is a potentially deadly disease. However, it can be treat with antibiotics, and there is a vaccine available for people traveling to endemic areas. The focus of the current review is primarily pathogenic mechanisms of delivery. (Shakya et al.2021)

Enteric fever, another name for the fever known as typhoid, is a highly dangerous illness brought on by the Salmonella Typhi bacteria. Abdominal pain, a protracted and persistent fever, and the emergence of a characteristic rash called rose spots are its hallmarks. It is a serious public health issue since it can cause life-threatening complications in extreme circumstances. The disease burden of typhoid fever is particularly high in South Asia, where an estimated 30 million new cases and 250,000 deaths occur each year. Among these cases,

children between the ages of 1 and 4 are the most vulnerable, with higher incidence rates documented among impoverished populations. The transmission of Salmonella Typhi occurs through the ingestion of contaminated food or water. Once ingested, the bacteria pass through the intestinal lumen and employ complex mechanisms to infect the host. Due to its exclusive human pathogenicity, Salmonella Typhi has acquired several virulence factors that contribute to its successful colonization, survival, immune evasion, and proliferation within the host. In recent years, researchers have utilized high-throughput screening methods to identify crucial virulence factors, investigate pathogenic mechanisms, and discover potential targets for vaccines and drug development. These advancements have expanded our understanding of how Salmonella Typhi invades the host and establishes a persistent infection within immune cells. By unraveling the intricate interplay between the bacterium and the host immune system, scientists have made significant progress in identifying promising strategies for preventing and treating typhoid fever. This review focuses on these recent advances and provides valuable insights into the mechanisms that allow Salmonella Typhi to invade the host and evade immune responses. By expanding our knowledge of the pathogenesis of typhoid fever, we can better combat this global health threat and work towards the development of more effective preventive measures, therapeutic interventions, and improved control strategies. (Sarin et al.2020)

2.2 Theoretical Framework

This helps the research to express the various phenomenon aspects by either description or even identification on the extremes it can reach. Through validation and confronting the assumptions of an theory, this will enable better understanding of the concept and variable involves according to its definition and exposes new knowledge.

This study employed the epidemiological triad concept to assess the factors that affect the incidence of typhoid fever in Siaya County's Ugunja Sub-County. The epidemiologic triad, or triangle, for infectious illnesses is composed of an external agent, a host that is susceptible and an environment that combines the host and agent. This hypothesis states that illness arises when an agent comes into touch with a vulnerable host in an environment that makes it easier for the agent to spread from a source to that host.

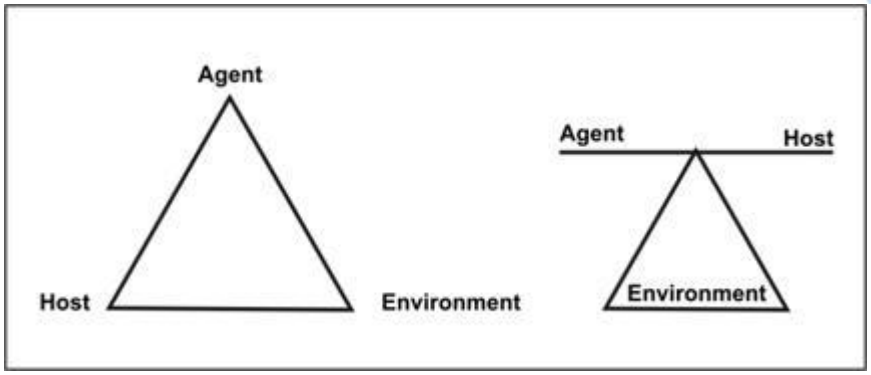


Figure 1: Epidemiologic triad or triangle

Agent, host, and environmental aspects interact in a variety of complex ways in figure 1 above. Multiple illnesses require distinct interactions and balances between these three components. In order to establish suitable, feasible, and successful public health strategies to control or prevent disease, it is usually necessary to assess all three factors and their interplay.

2.3 The Epidemiological Triad Framework

In order to simplify the creation of systematic and structured knowledge bases—which are crucial for the construction of models—the epidemiologic modelling of diseases employed the epidemiologic problem orientated approach (EPOA) methodology. A thorough comprehension of a disease's epidemiology allowed for the establishment of the models' basic and detailed structures and supplied the necessary framework for model development (David et al., 2011).

A conceptual paradigm known as the epidemiological triad links the many components of a health issue and facilitates the implementation of problem-solving measures. Scientists have created a model for examining the majority of communicable diseases called the Epidemiologic Triangle. The model identifies the person who is at risk, what causes the disease and environmental factors that favours the relationship between the agent and the host (CDC, 2007). The epidemiological triangle is a conceptual framework that links several aspects of a health issue and directs the implementation of a problem-solving solution. Scientists have developed the Epidemiologic Triangle as a model for analysing the majority of communicable diseases. The model identifies the susceptible individual, the disease's root cause, and environmental elements that favour the interaction between the agent and the host. (CDC, 2007).

The epidemiological triad framework is best represented diagrammatically as shown in figure 1 above. This gives a clear picture between the agent, persons and environment within a distinct time frame. The triad can also be used to non-infectious conditions where the causative agent could be ‘un-recommended behaviours, unhealthy practices, or undesired exposures to substances that are hazardous to life (Uyeki, Zane, Bodnar, Fielding, Buxton, & Miller, 2003). A "required" factor in the epidemiological triangle is the causal agent. Despite the fact that it may not always result in sickness, it is one requirement for the disease to exist. However, a combination of "sufficient" factors must exist for the disease to manifest. These would include a host, which could be an individual or group of individuals who are vulnerable to the agent. Virulence may be related to a person's sex, age, line of work, or race. (CDC, 2007).

Diarrhoeal disease is the 2nd most prevalent cause of mortality for children under five, accounting for 525,000 deaths annually. If diarrhoea continues, the body may go for days without the water and salt it needs to survive. Diarrhoea is defined as passing three or more loose or liquid stools per day, or more often than is normal for the individual. Diarrhoea usually indicates an intestinal illness caused by a variety of parasitic, bacterial, and viral species. Poor hygiene contributes to the spread of infection through tainted food, polluted water, and person-to-person contact. Environmental influences may also be significant enough to combine within a given set-up affect the disease? (Bhopal, 2007).

2.4 Treatment and Care Factor

2.4.1 Pathogenesis, Clinical Features and Complications

Typhoid fever, caused by Salmonella enterica, is characterized by its ability to evade innate immune responses and cause systemic infection, unlike non-typhoid Salmonella serovar that typically result in localized gastroenteritis (Baumler et al., 2008). Recent research has elucidated key aspects of typhoid pathogenesis, including the bacterial type III protein secretion system, virulence genes encoding Salmonella invasion proteins, and the role of Toll receptors in macrophage signalling (Andrade & Andrade Junior, 2003). The clinical features of typhoid fever and invasive non-typhoid salmonellosis (iNTS) are similar, including fever, abdominal cramps, diarrhea, headache, nausea, and vomiting (Yombi et al., 2015). However, comorbidities are more frequently associated with iNTS cases. Despite these differences, the clinical management, duration of antibiotic therapy, and outcomes, including complications and mortality rates, remain comparable between typhoid fever and iNTS patients (Yombi et al., 2015).

Salmonella enterica serotype Typhi, which enters the body through tainted food and water, is the main pathogen responsible for typhoid fever. After being consumed, Typhi makes it through the stomach's acidic environment and enters the intestinal epithelium, where it uses specific virulence factors to elude the host's immune system. After invasion, macrophages engulf the bacteria, but they might persist and multiply inside these immune cells, resulting in a systemic infection. This results in a wide range of clinical manifestations, prominently including prolonged fever as a presenting symptom (Warda Afzal et al., 2022). In severe cases, complications such as hepatitis may arise, highlighting the disease's potential severity and the importance of timely diagnosis and treatment. The rising prevalence of multidrug-resistant strains complicates management, necessitating better preventive measures at the community level (Warda Afzal et al., 2022).

Apart from the systemic infection brought on by Salmonella enterica serotype Typhi, typhoid fever can induce a number of sequelae that have a major negative influence on the well-being of the patient. Notably, hepatitis has been identified as one of the most common complications, affecting a substantial number of patients (Warda Afzal et al., 2022). The timing of these complications often correlates with the progression of the disease; many patients experience complications during the second week of illness, which underscores the need for careful monitoring during this critical period. Furthermore, the emergence of multidrug-resistant strains poses a significant challenge to treatment options, making early diagnosis and effective management essential for reducing morbidity associated with the disease (Warda Afzal et al., 2022). The clinical spectrum of typhoid fever emphasizes the importance of awareness and timely intervention to mitigate these risks.

A majority of the Typhi cases were treated at home and used private health facilities. Only a portion of the Typhi cases had taken medical leave, even though outpatient Typhi sufferers had experienced a few days off work compared to inpatients who had a longer leave of absence. Of the three treatment-related indicators, only the use of private health facilities and length of rest showed statistical significance (Youssef et al.2020). The preference for private facilities could be due to public hospitals being unable to provide an experienced health professional, free treatment, or not meeting patients' standards. This preference in public health slums, where socioeconomic status is an influential factor in the process of seeking health care, could vary based on quality, quick treatment, or methods of handling the disease (Khalid et al.2021)

Mental and skill qualifications are supported by the attitudes and awareness of the medical staff, which have a huge effect on satisfaction and the process and outcome of care. Regarding rest time, outpatients may have shorter recovery times than inpatients, as employees might not technically take medical leave and rest while waiting for typhoid fever recovery after treatment (Acharya et al.2020)

Certain forms of medicine and self-medication were not statistically significant factors in this research because autocorrelation has been accounted for when modeling. The actual cause of the teenage patient's underreporting or ignorance of the disease is that if an adolescent suffers from typhoid fever, the decision-maker may choose the fastest and most cost-effective treatment options (Kang et al.2020)

In a study by WHO (2003), upon ingestion of the microbes, 14-day incubation occurs prior to onset of disease signs and symptoms. The microbial organisms invade the lymphoid tissue through the walls of small and large intestines. Through the lymphoid tissue, the microbes

gain access to the blood vessels and organs such as liver, spleen, and gall bladder. They get their way into the bile and gut through the liver, and later excreted in stool (WHO, 2003).

The general symptoms of typhoid include fever, headache, weakness and fatigue, sore throat, and diarrhoea. The signs and symptoms are most likely to develop within a few hours of ingesting *S typhi* and usually subside before the onset of typhoid fever symptoms. Other clinical features include *enterocolitis,* enlarged spleen, maculopapular rash especially on the abdomen anorexia, malaise, and nose bleeding (Pui et al., 2011; Buzğan et al., 2007; Bhutta, 2006).

During the first week, a gradually increasing fever (highest in the evening), anorexia, myalgia, malaise and headache occur. The fever is usually accompanied with abdominal pain and a rush with spots. Vomiting and constipation or diarrhoea is present as well. If not treated, the disease proceeds to the second phase (Buzğan*et al*., 2007). The second week may present with a remittent fever (more so in the evening), increased pain in the abdomen, fatigue, weakness delirium, nausea, rash mostly on the abdomen (Buzğan*et al*., 2007; Bhutta, 2006). A person may also enter the 'typhoid state' in severe cases, where one lies motionless with eyes half – closed and appearing wasted and exhausted (Bhutta, 2006).

Although relapses may happen, a resistant fever that starts in the third week and causes growing weakness and exhaustion typically goes away by the end of the third week (Pui et al., 2011). Typhoid fever presents a lot of complications, which include intestinal perforation abscesses, cerebral thrombosis, pneumonia, meningitis, acute circulatory failure, as the most prominent. Increase in pulse and sign of shock followed by blood stool is common. Abdominal pain with rigidity and soreness and increase in body temperature also occur

frequently. Other complications include psychosis, infection of the bladder, kidney and spine (*Buzğan et al., 2007; Bhutta, 2006*).

2.4.2 Typhoid Fever Diagnosis

The bacteria Salmonella enterica serovar Typhi is the cause of typhoid fever, a dangerous disease that has to be diagnosed as soon as possible in order to be effectively treated and consequences avoided. Typhoid fever can be difficult to diagnose since its symptoms, which include exhaustion, diarrhoea or constipation, headache, stomach discomfort, and a protracted fever, can mimic those of other feverish infections like dengue or malaria. Laboratory confirmation is crucial, with blood culture being the gold standard, especially in the first week of infection. Although blood culture is definitive, it can be time-consuming and less effective if the patient has already taken antibiotics. The Widal test, which detects antibodies against *Salmonella Typhi*, is widely used but suffers from low specificity and sensitivity, often producing false positives due to cross-reactivity with other infections or vaccinations. The Typhidot test, which detects IgM and IgG antibodies, offers faster results but also faces limitations in accuracy. Polymerase Chain Reaction (PCR) is a more advanced method that provides highly sensitive and specific results by detecting bacterial DNA, but it is costly and less accessible in resource-limited areas. Stool and urine cultures can be used to detect the bacteria after the first week of infection, while bone marrow culture, though invasive, is the most sensitive method for diagnosing typhoid, especially in patients who have received prior antibiotic treatment. Emerging methods such as Loop-Mediated Isothermal Amplification (LAMP) and Next-Generation Sequencing (NGS) offer promise for more rapid and comprehensive diagnosis, but they are not yet widely available. The challenge of diagnosing typhoid fever is compounded by asymptomatic carriers and the use of antibiotics,

which can mask the presence of the bacteria. In regions with limited resources, the high cost and lack of access to advanced diagnostic tools remain significant obstacles, underscoring the need for affordable and accurate testing methods to control the spread of the disease.

Diagnosis of typhoid basically rely on the segregation of causative agent in culture, whose specimen may be obtained from blood, urine, stool, bone marrow, pus, and vomitus for the culture of *Salmonella typhi* (Neil *et al*., 2012; Lunguya*et al*., 2012). A four-fold increase in Widal test titters may indicate typhoid illness due to an agglutination response to somatic and flagella antigens. Microscopy, bacterial culture, and serological tests are common clinical diagnostic methods used to diagnose typhoid. (Bharmoria and others, 2017).

2.4.3 Typhoid Fever Treatment

Typhoid fever is a dangerous disease that has to be diagnosed as soon as possible in order to be treated well and complications can be avoided. Typhoid fever can be difficult to diagnose since its symptoms, which include exhaustion, diarrhoea or constipation, headache, stomach discomfort, and a protracted fever, can mimic those of other feverish infections like dengue or malaria. Laboratory confirmation is crucial, with blood culture being the gold standard, especially in the first week of infection. Although blood culture is definitive, it can be time-consuming and less effective if the patient has already taken antibiotics. The Widal test, which detects antibodies against *Salmonella Typhi*, is widely used but suffers from low specificity and sensitivity, often producing false positives due to cross-reactivity with other infections or vaccinations. The Typhidot test, which detects IgM and IgG antibodies, offers faster results but also faces limitations in accuracy. Polymerase Chain Reaction (PCR) is a more advanced method that provides highly sensitive and specific results by detecting bacterial DNA, but it is costly and less accessible in resource-limited areas. Stool and urine

cultures can be used to detect the bacteria after the first week of infection, while bone marrow culture, though invasive, is the most sensitive method for diagnosing typhoid, especially in patients who have received prior antibiotic treatment. Emerging methods such as Loop-Mediated Isothermal Amplification (LAMP) and Next-Generation Sequencing (NGS) offer promise for more rapid and comprehensive diagnosis, but they are not yet widely available. The challenge of diagnosing typhoid fever is compounded by asymptomatic carriers and the use of antibiotics, which can mask the presence of the bacteria. In regions with limited resources, the high cost and lack of access to advanced diagnostic tools remain significant obstacles, underscoring the need for affordable and accurate testing methods to control the spread of the disease.

Many different antimicrobial agents have been identified for use against typhoid fever. Some of the common doses administered include *chloramphenicol*, ciprofloxacin or ampicillin and third-generation *cephalosporins*, which can be administered intravenously or intramuscularly Parry et al., 2002). Like typical drug uses, continuous usage can prompt resistance. In such circumstances, *fluoroquinolones* like ciprofloxacin or third-generation cephalosporin's are recommendable (Khan *et al.*, 2008).

Glucocorticoid may be added to antibiotic therapy in the case of severe typhoid fever or when a patient is symptomatic with shock-like syndrome. Children with multi-drugs resistant strains should be treated with *cephalosporins.* Treatment should last 5-6 days and withdrawal should be gradual and tapering; early cessation may result in sharp recurrence of pyrexia and symptoms (Satoskar, Bhandarkar, & Ainapure, 2003).

Symptomatic Treatment is often useful in enhancing the therapeutic value of the drugs used, and mostly needs bed rest and additional fluids and electrolyte top-up, by drinking fluids and

observation of proper nutrition. There is also the attempt to lower the fever with cool, wet cloth..

2.4.4 Prevention and Control of Typhoid Fever

Typhoid can be controlled through protective or preventive mechanisms. This can includes a combination of public health measures, vaccination, and personal hygiene practices. Enhancing sanitation and guaranteeing access to clean water for consumption are crucial for lowering transmission of typhoid fever, as the disease is mostly transmitted through food and water that is contaminated. Safe food handling procedures, frequent hand washing with soap, and appropriate sewage disposal are essential in stopping the bacteria's spread. In high-risk locations, vaccination is essential. There are two primary vaccines available: the oral live attenuated vaccine and the injectable Vi polysaccharide vaccine. Although these vaccinations offer a reasonable level of protection, they may lose their effectiveness with time, requiring booster shots . Public health campaigns aimed at educating communities about hygiene, safe drinking water, and food safety can help curb outbreaks. In addition, surveillance systems that monitor and track cases of typhoid fever are crucial for early detection and response to potential outbreaks. For effective long-term control, improving healthcare infrastructure to diagnose and treat infections promptly, combined with efforts to combat the rise of antibiotic-resistant strains of *Salmonella Typhi*, is vital. Reducing reliance on antibiotics through improved vaccination coverage and addressing the root causes of poor sanitation are key strategies for sustainable typhoid fever prevention and control. Often, protective techniques prevent individual disease acquisition while preventive aspects focus on limiting spread of disease among patients. The former involves strategies such as supplying clean, treated domestic water, boiled drinking water, improving sanitation, and proper drainages to avoid

contamination of water supplies (Steele *et al*., 2016; Sánchez-Vargas *et al.*, 2011). Good personal hygiene also needs to be maintained, especially washing of hands after defecating or urinating. Running communal educational campaigns to teach how to control typhoid fever is critical (Steele *et al*., 2016).

The methods used to prevent the spread of typhoid in patients include wearing of gloves while disposing or handling contaminated objects and washing of hands before and after contact with the patient. The last approach teaches the patient how to wash their hands properly, especially after peeing or defecating and before, after, or while handling food.

Generally, typhoid preventive measures take the same dimensions as water and sewage management. Treatment of infected individuals must be done effectively to prevent carrier effects. Mass vaccination also offers good protection from typhoid infection (Marathe*et al*., 2012). Of critical concern is the issue of food handlers, especially in commercial food outlets, since these may serve as vehicles for disease spreading across a large population, and within the shortest time.

2.5 Socio-Economic Factors

In order to ascertain their impact on the prevalence and incidence of typhoid fever, the investigation took socioeconomic factors such parent education and profession into consideration. Various elements come into play in determining the prevalence of diseases . Socio-cultural factors are deemed significantly influential in relation to typhoid fever and the health-seeking behavior of individuals . The lack of understanding in certain communities implies that individuals are less knowledgeable about health risks and, in turn, require education on typhoid. The majority come from lower-income groups and have issues affording care. The study results provide a basis to address the underlying determinants that

can influence the spread of typhoid fever. As individuals understand more about typhoid fever, they will make more use of medical services, thus negatively influencing socioeconomic status. Long-standing ignorance of certain aspects of typhoid fever does occur, translating into extreme difficulty in developing public policies, support projects, and interventional measures aimed at controlling the disease (Cole & Nguyen, 2020)

Traditionally, sociodemographic economic characteristics like wealth, occupation, and education have been used to find patterns of medical service utilisation throughout the world. The influence of these elements on diagnosed typhoid and typhoid fever cases has shown that they have a significant effect only regarding issues of education, occupation, and wealth, which result in various health and healthcare implications (Paul et al.2022; Boakye et al.2024)

There is evidence that better-educated, employed, and wealthier communities have a higher probability of visiting healthcare facilities for diagnosis or treatment of any infection This trend highlights the critical role that socio-economic status plays in accessing healthcare services. Furthermore, disparities in income often lead to differences in health literacy, which can further exacerbate the challenges faced by lower socio-economic groups in seeking timely medical care.. The basis is that societies with more knowledge make optimal decisions about healthcare choices. The same principle is also implied in studying typhoid fever. (Buczkowska et al.2023)

To put it another way, an affected person's decision to seek medical attention is still heavily influenced by their level of money, education, and career. Perceptions of financial obstacles and the standard of medical treatment at medical institutions have an impact on individual decision-making. While individual-level factors influencing utilization were concentrated on

primary care settings or prevention or diagnostics, little is known about these people's behavior regarding the demand for medical services when diagnosed with specific diseases. Awareness of the associations between socioeconomic status and typhoid occurrence is essential for the design and delivery of equitable interventions and policies that aim to eliminate the disease. It is important to understand that the effect is bidirectional since typhoid infection can push people further into poverty, while the poor are at a greater risk of getting infected with the disease. (Egbunu & Yunusa, 2022) (Ren et al.2023)

Research shows that children that are coming from richer families reported less prevalence of fever in Nigeria, Kenya and Ghana. Results that came out of this combined data show that children from richer families were less likely to report fever. Generally, immunization against diseases that were fever-related and more so the use of improved toilet facilities brought down the prevalence of the fever. Consistence use of bed nets by mothers and children didn't show a consistent connection across the mentioned countries. (Jacob & Justice, 2012).

Typhoid fever has a significant role in the morbidity and mortality of infectious diseases in middle- and low-income countries. Commonly used therapies are becoming less effective as antibiotic resistance rises, and hospitalizations and problems are becoming more frequent occurrences. Families incur a range of social and financial consequences during a typhoid fever epidemic that are typically not recorded. When analyzing typhoid fever cases that were verified by blood culture, data revealed that there was a need to raise knowledge about health literacy because it took people a long time to seek medical assistance, burdening families with time and financial costs. These outcomes also highlighted the impact of insufficient laboratory diagnostic methods and tools on medical professionals' ability to distinguish typhoid fever from other feverish conditions and treatment challenges associated with

antibiotic resistance. These findings highlighted the urgent need to develop adequate preventative measures, implement them, and concentrate immunization campaigns on the most vulnerable populations and impacted regions, like Nepal.(Linda, Alfred, Denise, Deepak, Kshitji, & Imran, 2017).

Two of the top ten endemic illnesses in underdeveloped nations are typhoid and malaria fever in Nigeria. Both two conditions have been connected with poverty and underdevelopment with quite a number of mortality and morbidity. Typhoid fever is passed for one person to another when a person consumes food and drinks contaminated water by human waste. Typhoid fever symptoms and signs include a sudden fever, nausea, a very bad headache, etc. When environment and health are together, diseases like typhoid and malaria fever can be avoided. Due to the unfavorable environmental conditions in Nigeria, both the wealthy and the poor are susceptible to sickness. However, the environment and victim's socioeconomic status have an impact on how frequently and persistently malaria and typhoid fever attack a victim (Yahaya, 2012).

2.6 Environmental Factors

Environmental factors such as water supply, sanitation, cleanliness, and human ecology appear to have an impact on the prevalence of typhoid in developed countries. Although studies on water supply in relation to typhoid mortality were unsatisfactory, improvements in it have been followed by reductions in typhoid incidence. Work on typhoid fever prevalence showed marked differences according to gross crowding and house upkeep. Typhoid incidence was greatest where sanitary conditions were worst. (Andrews et al.2020) The use of environmental sanitation to prevent and control typhoid predates the knowledge of its transmissibility by over half a century. It has never been less than the most important

control measure, except for vaccination in times of perceived emergencies. Since the advent of efficient availability of antimicrobial agents side by side with antibiotics, sanitation has emerged as the necessary and sufficient measure for endemic control. The need to understand and manipulate socio-cultural bases for environmental knowledge was brought to the fore, and improvements from infrastructural development were inadequate with the realization of how little of known sanitation was actually labor-saving and culturally acceptable for people who did not want to change habits that ensured the survival of vested interests. (Uzzell et al.2021)

A simple model was developed, being the first to link unsanitary conditions and the worst affected socioeconomic groups, and highlighted the need to marry public health education with improved Socio-Economic conditions. Today we have a greater respect for social behavior changes that make private latrines affordable and desirable and stimulate behavior change. Water supply is by far the most important environmental measure, preferably piped with adequate protective measures to keep the water safe during storage. Hand washing with soap is at least as important as water supply, particularly when the personal hygiene knowledge base is marginal, and to buttress the shortcomings of all other strategies, since it is the necessary and most cost-effective way to protect infants and children. Slum populations are likely to remain high-risk susceptible centers of epidemicity with high-level transmission to the rest of the urban population.

Efforts are underway to increase the number of towns and cities in which the targets for improved access to safe water and basic sanitation are not only achieved for the aggregate population but also ensure universal access to these essential facilities within specified minimum distances from each and every household. Compliance with the Minimum Standard

must not be forced onto those who prefer or can afford better. In fact, an essential context-dependent minimum basket of essential good health demands innovative administration. Satisfying just the essential minimum for all who want no more detracts from the socialization of those groups who hold health-threatening values and deliberately exclude themselves from community or apartment complexes that provide the required services. In the end, poorly designed Minimum Standards could marginalize: it is the necessary and sufficient measure for endemic control.

People who were exposed to contaminated water had a three-and-a-half-fold increased chance of contracting typhoid fever compared to those who were not. To improve regional, national, and international models of the disease burden caused by typhoid fever, caution should be exercised when using the study's conclusions. Water is frequently not always equivalent to safe water (Vijayalaxmi, Enusa, Vittal, Ju Yeon, & Thomas, 2018).Typhoid incidence was found to be higher in men than women with new cases being high for the under-fives, followed by the old from 60 years and above, then 14–18 years, 18–34 years, 35–39 years and 10–14 years in 10,000 people.

Fiji has the highest recorded annual incidence of typhoid enteric. In Fiji, inadequate sanitation facilities are the main cause of Salmonella Typhi, which is spread by eating contaminated vegetables and drinking contaminated surface water. Typhoid control in Fiji has been shown to be aided by improved sanitation facilities, preservation of water sources, and improved product that isn't contaminated by human waste. (Naucukidi, Rosa, Sahu-Khan, Prasad, Jenkins, & Kama, 2018). Typhoid fever epidemics occasionally occur in African nations, such as Uganda, where cleanliness and clean water systems are still in need of improvement (Polonsky et al., 2012). According to Walters et al. (2015), filthy water was the means of

transmission during the 2009–2011 typhoid outbreak in Kesese and Bundibugyo, Uganda, which affected 8092 persons. The ingestion of tainted water from exposed groundwater sources was the most probable cause of typhoid illness in Kampala, according to an investigation conducted by Steven Ndugwa.

2.7 Empirical Evidence

Kibiru (2011) used a descriptive research methodology to investigate the variables contributing to the incidence of typhoid enteric fever among residents of Maina slum in Nyahururu, Kenya. According to the survey, 7.3% of people had typhoid. Low educational attainment, inadequate drainage systems, unclean housing, contaminated water, and dining at different restaurants were among potential risk factors identified by the investigators. According to the studies, there was a 1.4% rise in typhoid fever between 2006 and 2009. 198 (55.6%) of the participants thought they had suffered, however they may not have handled the situation well since they self-diagnosed using the information they had learnt about the illness over time (Kibiru et al 2011).

Okoth (2012) researched the application and findings of Widal test in the treatment of typhoid fever by health professionals in Migori district, Kenya. 260 individuals who were subjected Widal test, clinical officers, and laboratory technicians were interviewed using pre-tested questionnaires. Typhoid M and two regularly used test kits, together with the manufacturer's instructions, were utilized to collect and analyze samples from the people who were exhibiting the disease's signs and symptoms. According to the study, laboratory staff in healthcare facilities do not conduct the Widal test as it should, which causes findings from different labs to vary. Cross-reactivity between antibodies against Widal antigens and antibodies against malaria parasites appears to affect the outcomes of these laboratories' tests

(*Okoth et al 2012)*. Kariuki et al. (2004) indicated that there has been over-reporting due to poor methodologies of performing the Widaltest. Additionally, the report recommended adequate clinical examination in suspected cases of typhoid diagnosis. Newer improved methods that are more specific and sensitive than Widaltest were also recommended.

2.8 Research gap identification

Despite various studies on typhoid fever in Kenya, limited research has been conducted specifically in Ugunja Sub-County, Siaya County, to assess the factors influencing its occurrence. Existing literature primarily focuses on national or regional prevalence, overlooking localized environmental, socio-economic, and infrastructural determinants contributing to typhoid infections in this specific area. There is insufficient data on how factors such as sanitation, access to clean water, food hygiene practices, and healthcare infrastructure impact typhoid transmission in Ugunja. Additionally, while antibiotic resistance is a growing concern, little research has been done to evaluate the resistance patterns of *Salmonella typhi* in this region. The role of community awareness and behavioral practices in disease prevention remains inadequately explored. Addressing this research gap is crucial to designing targeted interventions and improving public health strategies for typhoid prevention and control in Ugunja Sub-County, ultimately reducing morbidity and mortality associated with the disease.

2.9 Conceptual Framework

A conceptual framework is a written or visual representation of a hypothesised relationship between variables. In a nutshell, variables are the characteristics that one wants to study. The conceptual framework was developed using a survey of the literature on previous studies and theories on the topic.

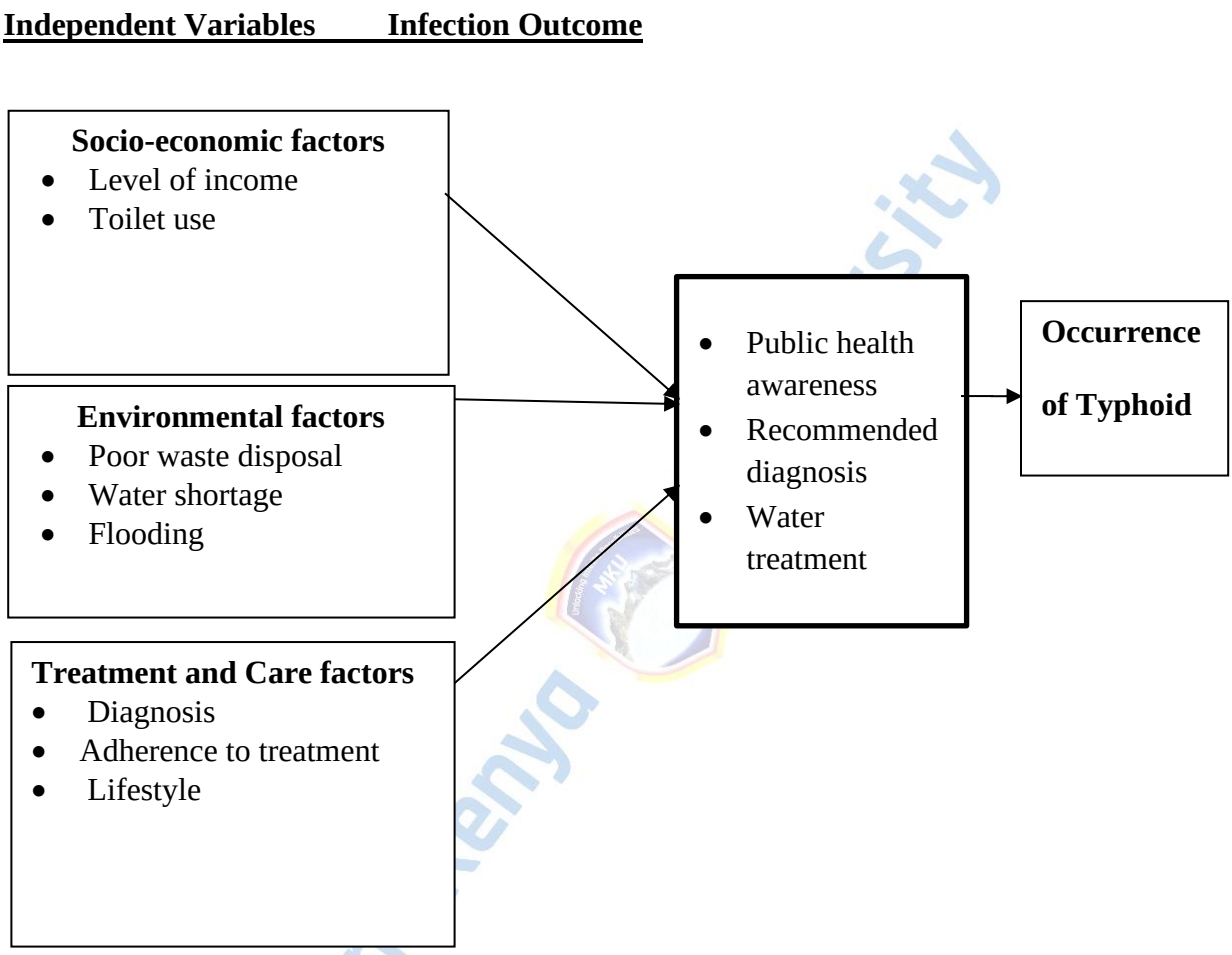


Figure 2: Conceptual Framework Source: Author (2019)

Explanation

Poor environmental hygiene might result from a lack of restroom use and inadequate funding. Water pollution can also result from inadequate sanitation in the environment. Low levels of public awareness cause hindrances in adherence to treatment and disease detection through late diagnosis; poor socioeconomic status can also lead to poor sanitation, lack of water

treatment, and food contamination. When all the factors above interact together then typhoid fever occurrence can be witnessed.

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section explained the investigation arrangements in regards to the design of the research, population which was targeted, procedures used in sampling, size of the sample, instruments used in data gathering, reliability and validity of the instruments, procedures used in data gathering, analysis of data methods, ethical considerations and operational definition of variables.

3.2 Study design

The investigation adopted a descriptive cross-sectional research design; this allowed the collection of key information about the various aspects contributing to the occurrence of typhoid fever in Ugunja Sub County.

3.3 Area of the Study

One of Siaya County's six sub-counties, Ugunja Sub-County, served as the investigation's location. Its entire size is around 198.8 square kilometres, and it has boundaries with the Ugenya sub-county to the north, the Alego sub-county to the south-west, the Gem sub-county to the south-east, and the Butere/Mumias sub-county to the east. Three wards make up the Ugunja sub-county: Ugunja, Sigomre, and Sidindi wards, respectively. It is further divided into four locations and 21 sub-locations. The locations are North Uholo, East Uholo, South

Ugenya, and Central Ugenya. High potential areas include Ugunja, Sigomere, and Sidindi which are the three political wards within Ugunja Sub-County. The site is indicated in (Appendix 6).

The main source of income in this area is mainly farming crops like millet; watermelon, cassava, maize, beans, groundnuts, and sweet potatoes which are grown on a large scale both for food and cash crops respectively. Residents of Ugunja are in both formal and informal sectors. The main sources of water in this area are tap water, boreholes, wells, and river water from River Wuoroya and River Nzoia. The latrine coverage is at 75% as per the available data from the DPHO office with dysfunctional hand washing facilities. Ugunja Sub-County is likely to have typhoid cases due to inadequate environmental sanitation and weak health infrastructure. Contaminated water sources, poor waste disposal, and inadequate sewage systems increase exposure to Salmonella typhi. Limited healthcare facilities and delayed diagnosis further exacerbate disease spread, making the population more vulnerable to frequent typhoid outbreaks.

3.4 Study population

About 88,458 persons (41,014 men and 47,444 women) made up the subject of the investigation area's total population, residing in 25,120 homes throughout Ugunja Sub County (MOH, 2017; KNBS, 2010).

3.5 Target population

The study covered all adults living in the 25,120 households who were present during the period of this research.

3.6 Sampling

The study adopted purposive sampling in choosing the study area due to the high number of typhoid fever infections. However, the study employed multistage sampling to achieve the calculated sample size from the total population. Various-stage sampling also known as multi-stage cluster sampling was a more flexible form of cluster sampling which allowed more than one stage in sample selection.

Larger portions of the population were further categorized into smaller portions in many stages to make primary data collection more manageable. The researcher subdivided the Ugunja sub-county into the 3 county assembly wards of Ugunja, Sigomere, and Sidindi. From the county wards, a few sub-locations were selected randomly. Random households were then selected from the sub-locations.

3.7 Sample Size Déterminations

Fisher's formula (1999) was applied in this research to give the researcher the size for the sample for participants in this study. $$n = \frac{z^2pq}{\delta^2}$$

Where:

n= Preferred Sample size

Z= degree of precision is the estimated standard error; usually 1.96 at CI=95%

P =Proportion of population estimated to be at risk of typhoid fever (have no piped water) =59.5%.

Q = 1-p = 40.5%

d= error (0.05)

Therefore, $n = \frac{1.96^2 * 0.595 * 0.405}{0.05^2}$ = 370

3.8 Inclusion and Exclusion Criteria

3.8.1 Inclusion criteria

Leaders of all households or their representatives above 18 years living within Ugunja Sub County who had lived in the area of study for more than six months were eligible to be included in the study. Where no adult above 18 years was available, the household was skipped.

3.8.2 Exclusion criteria

Leaders of all households or their agents above 18 years not living or have not lived within Ugunja Sub County for 6 months before the time the study was conducted.

3.9 Instruments for data collection

Data was gathered by the investigator using self-administered questionnaires. 370 questionnaires in all were distributed. In order to gather primary data, the questionnaire included both closed-ended and open-ended questions (Appendix 3). There were two primary portions to the questions. The participant's details were described in Section 1, and the factors associated with the incidence of typhoid fever were discussed in Section 2.

The number one preference for the questionnaires was mounted on the fact that respondents can complete them easily without any difficulty, anonymously, and it is cost-effective and faster compared to any other methods while covering a bigger population (Bryman, 2008; Cohen et al., 2007). The researcher also administered key informant face-to-face interviews to personnel at the selected medical facilities across the sub-county by using a key informant guide (Appendix 5).

3.10 Validity and reliability

The validity and reliability of the study on factors associated with typhoid were ensured through rigorous methodological approaches. A pretest was conducted in Alego Sub-County to assess the clarity, consistency, and feasibility of the research instruments. The pretest helped identify ambiguities in the questionnaire, allowing necessary modifications to enhance content validity. Expert review by public health professionals further strengthened the validity by ensuring the questions accurately measured the intended variables.

Reliability was established through internal consistency checks and test-retest methods. The questionnaire was administered to a small sample in Alego Sub-County, and responses were analyzed for consistency. Any discrepancies were addressed to improve coherence. Additionally, data collectors were trained to standardize data collection procedures, reducing interviewer bias. From this study, a Cronbach alpha coefficient of 0.8 was obtained meaning that data collection tools were reliable. Findings from the pretest informed the refinement of study tools, ensuring that the final data collection process in the main study site yielded accurate and dependable results.

3.11 Data Analysis

In this study, descriptive statistics described the key background characteristics of the study. In this study, univariate analysis was employed and data that was quantitative was presented using tables and pie charts. SPSS version 29 (Statistical Package for Social Science) was employed to analyse the data. Qualitative data analysis involved organizing, coding, and interpreting non-numerical data to identify patterns and themes. Researchers transcribed interviews, categorized responses, and used thematic analysis to draw meaningful insights.

Data were reviewed iteratively to ensure accuracy, and findings were presented descriptively to capture participants' experiences and perspectives effectively.

3.12 Ethical Considerations

The researcher was permitted by the concerned bodies prior to field activities as well as the Mount Kenya University postgraduate office through an introductory letter as stipulated by the policy. An investigation permit from NACOSTI to go ahead with the research was also obtained before the collection of data commenced. The researcher consequently sought authority for data collection from the Siaya County Government Department of Health. An introductory letter dispatching the questionnaire to the respondents provided information to them to the effect that participation in the research was on their own accord. The quality of the study was assured through observation of all the stipulated research ethics. To enhance confidentiality during data collection, researchers were assigned unique identification codes instead of names, used encrypted digital storage, and ensured secure physical storage for hard copies. Data was accessed only by authorized personnel, with informed consent explaining confidentiality measures. Interviews were conducted in private settings, and responses were anonymized in reports. Additionally, using password-protected devices and confidentiality agreements with data handlers further safeguarded respondent privacy.

CHAPTER FOUR

RESEARCH FINDINGS AND DISCUSSIONS

4.1 Introduction

This chapter contains study findings on demographic, socio-economic, environmental, treatment, and care factors.

4.2 Demographic characteristics

4.2.1 Descriptive statistics on demographic characteristics

Table 1 shows that most (68%) of the respondents were female while (32%) were male. This finding concurs with the findings of a study in Rwanda refugee camp in which the respondents were 56.4% female and 43.6% just slightly below and above respectively of the findings of respondents in the Ugunja sub-county. Female respondents were many simply because at the time of the study most of them were the ones who remained at home as men went to jobs. This suggests that female respondents can be easily accessed at home when carrying out data surveys, especially in rural setups like Ugunja and its outskirts. Concerning the age of the study respondents, the highest numbers of respondents were 56 years and above at 31.35% and between 36-45 years at 30% while the lowest number of respondents were between 18-25 years at 2.16%. The age bracket of 18-25 years was the least since they were not majorly considered as the target group being that most of them are not the household heads. Similarly, the same age group are economically viable and hence were engaged in various outfield activities. The age category of 56 years and above were the highest being that they are old are engaged in household activities and are taking care of the homestead. Regarding marital status above average 54.86% of the respondents were married, 31.08% of the respondents were either widows or widowers and the least number of the respondents

were separated at 5.14%. Regarding occupation status, most of the respondents were self-employed at 61% followed by formal employment at 26%, and lastly unemployed at 13%. The self-employed group was the most since the research area is a rural setup, most of the respondents engage in farming and small household businesses as their main source of income. The study also captured some of the school-going group who acted as the family heads which could have contributed to the 13% of the unemployed since some of them are dependent on their parents.

Table 1: Demographic characteristics of the study subjects

Variables	Categories	Frequency	Valid %
Gender	Male	118	32
	Female	252	68
Age	18-25	8	2.16
	26-35	41	11
	36-45	111	30
	46-55	94	25.49
	>56 years	116	31.35
Occupation	Formal employment	96	26
	Self-employment	226	61
	Unemployed	48	13
Marital Status	Single	33	8.92
	Married	203	54.86
	Separated	19	5.14
	Others	115	31.08

4.4.2 Discussion on demographic information

From the findings, most of the respondents were female and married 56 and above of years of the respondents were slightly higher than all other categories which could have contributed to the most at 61% of the respondents who are self-employed and engage in small businesses and subsistence farming. In Kenya, poverty is dynamic, with some individuals entering and others leaving. The majority of Kenya's rural economy depends on agriculture, and weather patterns affect it. Farmers escape poverty when the weather is favourable and return to it when it is unfavourable. This is consistent with the investigation's results in Ugunja Sub County, where small-scale farmers make up the bulk of the population. According to a research conducted on homes between 2010 and 2017, 20% of them rose out of poverty, 7% fell into it, 26.6% were continuously nonpoor, and 14.45% were chronically poor. The jobless index may have been influenced by the small number of young people who served as household heads, and the relatively high number of those aged 56 and above.

4.3 Factors Linked with Occurrence of Typhoid

4.3.1 Socio-Economic Factors

4.3.1.1 descriptive statistics on socio-economic factors

Table 2 shows that slightly above average (54%) have ever eaten at a given time in a food Kiosk as compared to 46% who said no to the same question. Consuming food and beverages outside the house was thought to be an anticipated risk aspect for contracting typhoid since customers have less control over their eating habits. Eating outside the house is linked to a high risk of contracting typhoid fever, according to a meta-analysis research that used the WHO 2018 case criteria. In their investigation on hygiene and sanitation practices in India, Kapur and Kumar (2012) found that 62% of those polled believed that typhoid disease in the

community is caused by public vendors' inadequate sanitation procedures. Food handlers are also a major factor in the spread of typhoid, Medical examination and vaccination as a public health measure are advised for one to be directly involved in food preparation for public consumption, the food handlers are further mandated to ensure that proper SOP are adhered to in ensuring that their premises are clean and food stored in hygienic conditions.

Table 2 shows that the majority (93%) of respondents were aware of food and water safety management at the household level whereas, 7% were not aware. This demonstrated that most people were aware of food and water safety management; nonetheless, how they behaved in this regard may have an impact on preventing and controlling typhoid fever. The transmission of infectious illnesses is significantly influenced by human behaviour, and better prevention and control of disease can result from a knowledge of how behavioural changes affect disease spread. According to CDC (2018), diarrheal diseases typhoid included, spread first among the community because of human behavior. Negligence accounts for around 14% of the fatalities caused by tainted food or drink. According to certain research conducted in sub-Saharan Africa, households with lower levels of education have a greater prevalence of diarrhoea (Yakoob et al., 2011). The necessary knowledge of the importance of hygiene and sanitation, particularly with regard to controlling and preventing infections, is provided via education.

Table 2 shows that slightly above average (58.11%) of the respondents were treating water for domestic use while 41.89% were not treating water completely. Water treatment is any process that improves the water quality by removing the disease-causing organisms that are harmful to the body. According to UNICEF (2021), diarrhoeal diseases remain the leading killer among young children with over 700 children under five dying every day due to

consumption of contaminated waters in Kenya. In the study area, 41.89 % of the households that do not treat water at all are alarming, because both children, mothers, and the elderly have remained vulnerable to the obvious dangers of consuming untreated water. "More children attending school, parents being able to work and earn money because they don't have to stay at home to care for their sick children, and other adults because so many deaths and diarrhoeal diseases are preventable" is a quotation from UNICEF. Therefore more community sensitization needs to be done to the above households to create awareness of the dangers of consuming water that is not treated, giving out to them more water treatment kits e.g. aqua tabs through Chvs.

Table 2 shows that out of 58.11% of respondents who treat water, the majority (80%) preferred chlorination as a method of treatment while only 20% preferred boiling and other methods. This finding concurs with (Sobsey et al.2008) which states that household water treatment using different chlorine-based disinfectants, filtration, solar disinfection, and boiling are suggested approaches. The effectiveness of these interventions to enhance water quality in avoiding diarrheal illnesses is typically positively correlated with compliance. Chlorine point-of-use water treatment has been demonstrated to reduce diarrhoeal infections by 29%, according to studies from the United Nations International Children Emergency Fund. However, Markel et al. (2012) discovered that over 30% of people living in cities and over 60% of people living in rural areas do not filter their water before using it (UBOS et al 2011). It went on to state that installing a piped water treatment system poses difficulties in supplying safer drinking water, buying water treatment kits for domestic use, and dispelling the myth that naturally occurring water is safe. Therefore, my investigation contradicts the conclusions of Markel and Ndugua.

Table 2 shows there were multiple responses with the majority 328 (88.65%) using Bucket followed by Pot users at 287 (77.57%), Jerrican, and others at 223 (60.27%) and 180 (48.65%) respectively. At the household level, contamination of stored water commonly happens at times. Because they may be left exposed and the same cup may be used to constantly take water from them without washing, the majority of responders who store their water in buckets and pots run the risk of contamination. In a study carried out by the CDC (2018) on water storage in compliance with WHO guidelines, only 44% stored water in compliance with the guidelines, and more than half showed post-source contamination hence a critical factor in the occurrence of typhoid fever.

Table 2: Socio-Economic Factors

Variables	Categories	Frequency	Valid %
Consuming food at a kiosk	Yes	200	54
	No	170	46
Awareness of food and water	Yes	344	93
safety management	No	26	7
Domestic water treatment	Yes	215	58.11
	No	155	41.89
Method of water treatment	Boiling	59	16
	Chlorination	296	80
	Others	15	4
Multiple responses			
Type of household water storage	Bucket	328	88.65
	Jerrican	223	60.27
	Pot	287	77.57
	Others	180	48.65

4.3.1.2 Socio-Economic factors

Even though a slight majority 58% are treating water, approximately 42% of the households who were not treating water at all represented a bigger percentage of the study area. Furthermore, other treatment methods used by the respondents including boiling may not be effective due to the likelihood of non-adherence to prescribed standards; this is supported by the verdits of *Vijayalaxmi et al, (2018)*. Despite the fact almost all the respondents at 93% were clearly aware of the food safety and water treatment, kiosk food consumption was targeted as one of the possible sources of contaminants since their water treatment culture could not be established unless water sampling was done. Furthermore, Bhunia et al. (2016) found that persons were highly linked with consuming food from stores or kiosks where an infected patient was employed, as well as with contaminating and handling food in a hazardous manner. This concurs with the report and study done by *Okoth (2011)* in the slums of Maina and Nyahururu which revealed that at least 7.3% of the population suggested that unsafe water and food consumption from various eating houses could propel the occurrence of typhoid. This could be significant to the occurrence of typhoid fever in Ugunja Sub-County. From the study, 58% of the respondents treated their water. After collecting their water, the majority of responders keep it in pots and buckets. Because slightly fewer residents of Ugunja drink unfiltered water collected from various sources than the average, this can therefore act as an indicator of risk for catching typhoid fever. This is consistent with the results of Walter et al. (2015), who reported that unclean water could be an agent of transmission of typhoid fever.

4.3.2 Environmental Factors

4.3.2.1 Descriptive statistics on environmental factors

According to Table 3 below, just 16% of the subjects live in permanent homes, while the majority (84%) do so in semi-permanent homes. This may be explained by the fact that modest domestic enterprises and small-scale farming accounted for the bulk of participants' sources of income. This supports Caincross's (2010) findings that low-income homes are primarily defined by poverty, congestion, and substandard housing—all of which are confounding factors that facilitate the spread of typhoid fever and diarrhoeal disease agents (Caincross, 20). A small minority (21.31%) had leaking drainage systems, whereas the majority (78.69%) had well-fitting and functional drainage systems. Additionally, 61 (16%) of the participants lived in permanent homes. This suggests that the slight minority with the leaking drainage could be attributed to the blockages along the channel of the drainage and some incomplete self-contained houses that could have directed their waste water majorly from the kitchen and bathroom in the open drain.

Table 3 below shows that the majority (88.92) of respondents had functional latrines whereas, only 11.08% did not. This is in line with the study documented in the Pan African Medical Journal in a study of hygiene and sanitation practices in refugee camps in Burundi in which 98.2% of the respondents use functional pit latrines for waste disposal. Siaya County having been declared an open defecation-free zone in 2018 courtesy of UNICEF, reported by the standard media in December 2021, the study findings is slightly below the 92% reported by the County Public Health Officer indicating a small drop in the implementation.

According to Caincross (2010), the primary features of low-income households are poverty, congestion, inadequate housing, and insufficient sanitation facilities. These confounding

variables promote the transmission of agents that cause diarrhoeal diseases. In 11.08% of families, there is no toilet, which makes open defecation and latrine sharing more dangerous. The fact that the disease-causing substance is exposed to flies and precipitation, which causes contamination, makes this a serious public health risk. The presence of latrines within the complex guarantees the safe disposal of human waste and boosts utilisation potential.

Table 3 shows that from the 88.92% who had functional latrines, most (71%) had improved and functional latrines while 29% had functional but improved latrines. This result concurs with the 2020 UNICEF report in Kenya which states that about 29% of the households have access to improved sanitary facilities which impacts positively on the efforts towards reducing typhoid occurrence. The likelihood of developing diarrhea is higher in homes with subpar latrines. As shown by Cairn Bridge (2010) system analyses of numerous studies, unimproved latrines frequently have poor cleanliness, operational flaws, and offensive odors that draw flies. Schilling (2010) investigated the connection between unimproved latrines and diarrhea in rural western Kenya. The county government of Siaya should develop approaches to ensure that there's uptake and acceleration of improved sustainable sanitation systems.

Table 3 below shows that most (62.97%) of the respondents had functional hand wash facilities in their households while slightly above one-third (37.03%) did not have them. Approximately 37% of the respondents do not have a functional hand washing facility since they believed that hand washing was majorly a result of COVID-19 and at any moment could use a basin for hand washing. The decline of the covid-19 could have also led to the laxity in the maintenance and use of the hand wash facility. Table 3 below shows that out of 233 (67%) with functional hand-washing facilities, a slight majority (53.22%) had only running water

while less than half (46.78%) had running water and soap. Hand washing with soap and running water when done correctly is very fundamental in typhoid fever reduction. It's the cheapest and most effective thing one can do to protect themselves from diarrheal diseases, typhoid included yet for millions even this most basic of steps is simply out of reach [UNICEF 2019]. It's important to make sure people know what steps they should take to keep themselves and their families safe. However, the research findings are slightly above the UNICEF findings of 2020 which depicted the access to hand wash facilities with soap and running water at 25% showing that strides have been made within Ugunja sub-county and its environs towards improving the access. AMREF HEALTH AFRICA states that the best method of preventing diarrhoeal illnesses in children under five is to wash your hands with soap and clean running water. The successful implementation of effective hygiene practices with soap depends on everyone having access to water and sanitation, which is why governments worldwide have worked to achieve UN Sustainable Development Goal Number 6. If we can show that a significant section of our population uses sanitation services that are safely maintained, including sinks with soap and flowing water, we can accomplish this aim. 6.1.2 the finding from the thesis showed that slightly 53.78% had hand washing but with n soap, this triggers more effort in sensitization of the community members to always have a functional hand washing facility to achieve the indicator 6.1.2. Furthermore, according to WHO 2019, Children's poor hygiene habits are less entrenched, thus it is possible to promote universal hand washing with water and soap among them because they are still young enough to form lifelong habits that will serve them well in the future.

Table 3 below shows that most 63.24% have never participated in environmental cleaning action days with only 36.76% having participated. Keeping the environment clean cannot be

overemphasized for good health and well-being, an unclean environment can harbor disease-causing pathogens including diarrheal, typhoid, worm infections, and other illnesses. If these diseases are not carefully mismanaged, they could lead to death. Therefore communities and households must maintain the cleanliness of the environment for a comfortable and enjoyable life (UNICEF 2019). The finding of 63.4% who had never participated in environmental cleaning was due to a lack of awareness of the scheduled dates, the importance of community participation in sanitation exercises, and poor mobilization. 36.76% of the respondents are aware that poor hygienic practices can lead to the occurrence of typhoid fever and other diarrheal diseases in the community hence participation in the cleaning days. According to the International Journal of Academic Research in Business and Social Science (2014), 48% of those who participated in an investigation conducted in Kisumu agreed that poor sanitation was a contributing factor. This finding can be ascribed to the sociodemographic traits of those who participated in various parts of the nation. Table 3 shows that out of the 136 participants (36.76%) who took part in environmental cleaning action days, 47% had done so twice, while 32% and 21% had done so once, three times, or more.

Table 3 below shows that 38% of the households dispose of their waste in the compost pit, 36% use Burning, and 26% prefer crude dumping. 38% of the respondents are used to composting as a method of household waste disposal since it can be used in farming as manure as a locally available material. 26% of the respondents are used to crude dumping because at the village level and household, there are no specific designated areas for disposal and there are no organized waste collection services. This therefore can act as a route of transmission for diarrheal-related diseases including typhoid.

Table 3 below shows multiple responses on moments of hand washing, nearly all 369 (99.73%) preferred washing their hands before eating with more than half 213 (57.57%) observing all the critical moments of hand washing at the household. Nearly all the respondents believe in hand washing before eating which could be a result of the norm that hand washing is critical before eating, similarly, approximately 57% of the respondents believe that hand washing could be done at all moments which could be a result of the efforts of the health department in disseminating information on proper hand washing and its benefits.43% of the respondents who do not adhere to all moments of hand washing at the household level could attribute the spread and occurrence of typhoid fever.

Table 3 below shows multiple responses where almost all 349 (94.32%) use collected water from the roof catchment while the least 52 (14.05%), collected water from other sources like ponds. Tap water is the only source of water whose protection is assured, however other sources like roof catchment used by the majority as their source of water could lead to contamination. Therefore, these results run counter to those of the WHO (2020), which found that 5.8 billion individuals worldwide used securely managed water services that were accessible when required and free of contaminants on their property.

Table 3 below shows that a slight majority 52.16% had their water sources unprotected, while nearly half 47.84% had their water sources protected. The number of respondents whose water sources are not protected is slightly higher since most of their water source naturally exists and cannot be easily protected. This study finding concurs with Markel's and Ndugwa's findings that more than 50% of the households in Kampala city consume contaminated water from unprotected water sources (Ndugwa 2015). Using water from unsafe sources may increase the risk of contracting typhoid and diarrhoea. Having access to safe and adequate

water makes it easier to practise cleanliness, which is essential for preventing acute respiratory infections, diarrhoeal illness, and many other neglected tropical illnesses. This result runs counter to WHO data that shows 5.8 billion people utilised properly managed drinking water services in 2020, meaning they utilised better on-site water sources that were accessible when required and free of contaminants (WHO, 2020).

Table 3: Descriptive statistics on environmental factors

Variables	Categories	Frequency	Valid %
Type of house	Permanent	59	16
	Semi-permanent	311	84
Drainage system in the permanent house	Leaking	13	21.3
	Well fitted	48	78.7
Funtional toilet	Yes	329	88.9

	No	41	11.1
Functional improved toilet	Improved	234	71
	Not improved	95	29
Functional handwashing facilities	Yes	233	62.97
	No	137	37.03
Handwashing facilities with soap water and or without	Running water only	124	53.2
	Running water & soap	109	46.8
Environmental cleaning day	Yes	136	36.76
	No	234	63.24
Frequency of participating in Environmental cleaning day	Once	43	32
	Twice	64	47
	Thrice and above	29	21
Method of waste disposal	Composite	14a	38
	Burning	133	36
	Crude dumping	96	26
Protection of water source	Yes	177	47.84
	No	193	52.16
Multiple Responses			
Hand washing moment	Before food preparation	217	58.65
	Before eating	369	99.73
	After visiting toilet	233	62.98
	After changing diapers	213	57.57
	All of the above	213	57.57
Type of drinking water source	Tap	121	32.7
	Roof catchment	349	94.32
	River	98	26.49
	Spring	241	65.14
	Borehole	303	81.89
	Others	52	14.05

4.3.2.2 Environmental factors

According to the survey, more than 89% of participants had latrines at home, and around 11% had upgraded restrooms. A further 63% have hand washing facilities with only 47% having hand wash facilities with soap and running water, at least 58 of the respondents

adhered to all moments of hand washing. Furthermore, about 38 % of the respondents had proper waste disposal sites. The outcomes of this thesis concur with those of Ndugwa and Jacopo; Ndugwa (2015) states that improper disposal of solid waste and excreta is a major contributor to groundwater pollution. According to Ngeno et al. (2015), young children should also be exposed to fecal pollution in the immediate surroundings of their homes. According to an investigation by Jacopo, typhoid fever may spread across the community as a result of littering, a lack of handwashing stations, and inadequate hygiene (Jacopo Zorodzail at el., 2013).

Poor drainage systems and leakages in urban and market canters could be a contributing factor due to the lack of sewerage systems and proper physical planning, this is consistent with *Steele et al (2016)* findings. Improved latrine is a requisite control method of diarrheal-related diseases and approximately 40% of the latrines in the study area have not been improved, hence could lead to the occurrence of typhoid due to uncontrolled flies, other insects, and rodents that might find their way into our food. Equally, hand washing as practice of a hygiene measures should be done at all times depending on the moment of hand washing, the study established that hand washing facilities had dropped to 63% hence most households do not practice it, especially after visiting the toilet. Water protection similarly plays a vital and fundamental role in the occurrence of typhoid within Ugunja Sub-county and Kenya at large. From the research findings, a slight majority at 52% of water sources are unprotected which could be a factor in the occurrence of typhoid. This is consistent with the outcomes of Prasad et al. (2018), who proposed that protecting water sources prevents Salmonella Typhi from spreading by contaminating unprotected drinking water sources with faeces.

4.3.3 Treatment and Care Factors

4.3.3.1 Respondents ' seeking behavior and experience of diarrhea.

Table 4 below shows that the majority of the respondents 313 (84.59%) had suffered from diarrhea or typhoid-related symptoms whereas only less than a quarter had not suffered. The majority of the respondents who had suffered diarrhoeal or typhoid could be attributed to community poor hygiene practices from the study which includes poor waste disposal like crude dumping, use of water from unprotected sources, practicing of open defecation, and poor hand washing practices. Table 4 below shows that nearly half 178 (48.11%) preferred government hospitals while 28 (7.57%) did not seek treatment at all. For example, a 2015 investigation on the risk variables associated with the transmission of Salmonella Typhi in the Mahama refugee camp in Rwanda by the Epidemic Surveillance and Response (ESR), World Health Organisation (WHO), United Nations High Commissions for Refugees (UNHCR), and school of public health of Rwanda, using a sample size of 1030, supports the investigation's findings by showing that only half of the cases (43%), presented to the medical centre within seven days after the onset of illness, and a small perc

. According to Teke et al. (2021), the aforementioned might be ascribed to the lengthy lines and waiting periods prior to treatment, as well as the deficiency of quality services.

Table 4: Respondents ' seeking behavior and experience of diarrhea

Variables	Categories	Frequency	Valid %
Suffered from typhoid or diarrhea	Yes	313	84.59
	No	57	15.41

Health seeking behavior	Government	178
	herbal	17
	Chemist	89
	No treatment	29

4.3.3.2 Heath facilities responses by designation

Figure 3 shows that out of the nine health facilities, 4 respondents were Laboratory Technicians, 3 Clinical Officers, and 2 Nurses.

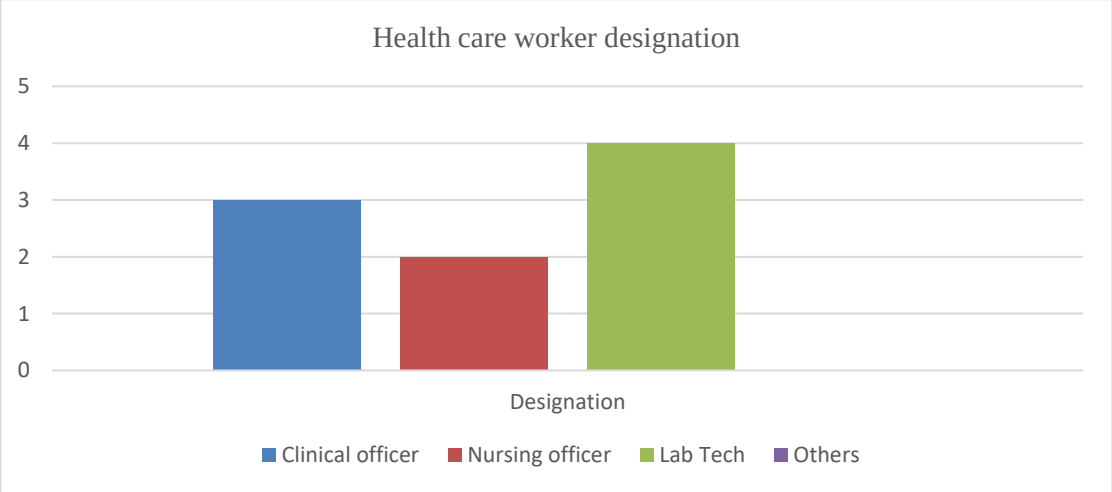


Figure 3: Heath facilities responses by designation

4.3.3.3 Healthcare provider work experience

Figure 4 shows that slightly above average 5(55.56%) have between 3-4 years of experience while only 1 (11.11%) has between 1-2 years of experience. 55.5% of the healthcare providers could have enough experience to clinically screen typhoid as opposed to those with

1-2 years of experience. The 11.11% of the health care providers could easily give the wrong diagnosis since most of the facilities do not have equipment hence the possibility of occurrence and spread of typhoid.

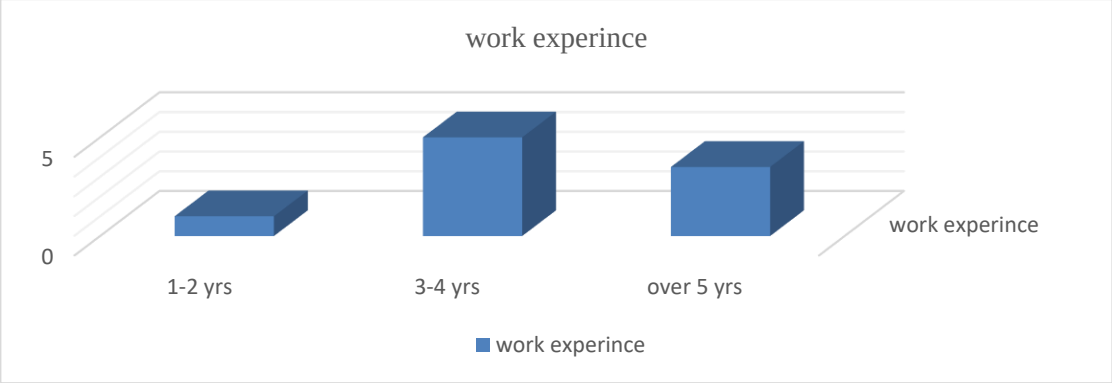


Figure 4: Respondents work experience as a Healthcare provider

4.3.3.4 Typhoid fever diagnostic test

Figure 5 above shows that $^{2}/_{3}$ of the facilities carried out Clinical diagnosis with the remaining third using stool for the test. Most level two and level three hospitals have inadequate healthcare facilities, which makes it difficult to do blood tests and necessitates a medical diagnosis based on the symptoms and indications that are present. This is the main cause of the clinical evaluation.

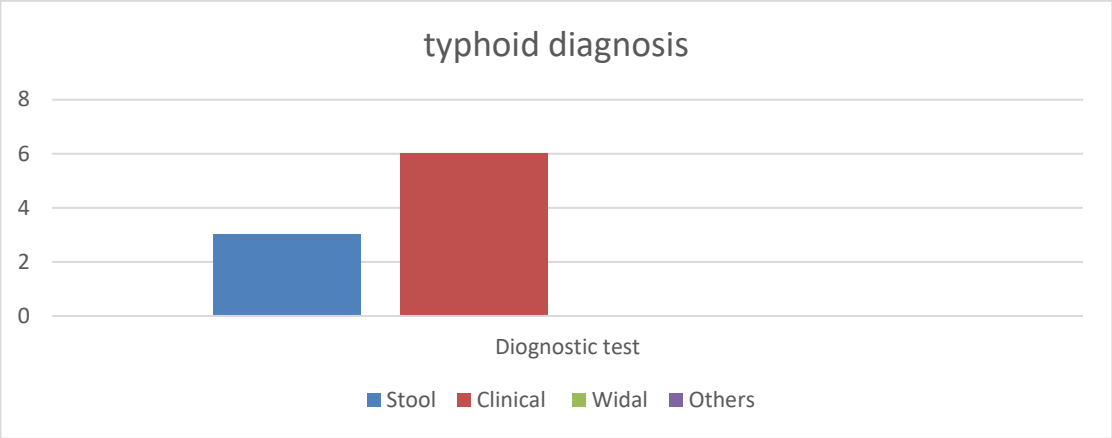


Figure 5: Respondents on Typhoid fever diagnostic test

4.3.3.5 Equipment status of the laboratory

Table 5 shows that all the facilities did not have well-equipped laboratories. All the facilities were not well equipped which poses a great threat in the detection and treatment of typhoid cases. This could happen since typhoid fever presents with almost similar signs and symptoms of malaria which could lead to misdiagnosis and spread of typhoid. This finding could also assist the County Government of Siaya in equipping its laboratory with the required equipment. According to a study by Dr. R. According to Bundalian Jnr. 2019, it is frequently insufficient to diagnose typhoid fever based solely on clinical indications. The majority of the time, symptoms are vague and may resemble those of other acute febrile disorders. Because of this, it is sometimes challenging to distinguish specific clinical signs of typhoid fever, particularly during the initial week of illness. This indicates that in order to confirm the medical diagnosis of typhoid fever, a test performed in the laboratory is required.

Table 5: Responses on the Equipment status of the laboratory

Attributes	Yes	No
Variable	0	9

4.3.3.6 signs and symptoms of Typhoid fever

At 100%, headaches and a high body temperature are the most prevalent symptoms, as seen in Figure 6. These results are consistent with an investigation conducted in 2016 at Sheshemene Referral Hospital in Ethiopia on 421 individuals suspected of having typhoid fever. Of these, 85% presented with fever, 83% with general malaise, and ultimately received a diagnosis of typhoid fever.

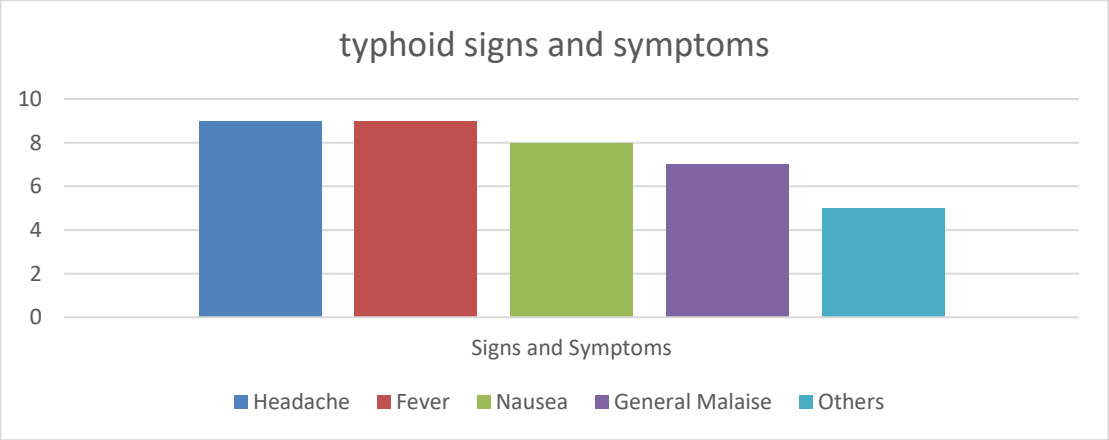


Figure 6: Responses on signs and symptoms of Typhoid fever

4.3.3.7 Factors contributing to the prevalence of Typhoid in Ugunja sub-county

Figure 7 shows that all respondents concurred that Inadequate WASH contributes to the highest number of cases while other factors such as self-diagnosis, and drug adherence among others contribute slightly below half 4 (44.44%). Improved WASH is fundamental in disrupting the transmission route of typhoid fever. The study findings show that 100% of the key informants interviewed affirm that inadequate WASH is a predominant factor

contributing to the prevalence of typhoid fever. The KDHS data, which indicates that fewer than half of Kenya's rural population has access to clean drinking water, while 66.9% of Kenyans benefit from having access to enhanced water sources, is therefore somewhat higher than these results. In the same vein, KDHS confirms that fewer than 25% of Kenyans are making use of better sanitary facilities. Likewise, community awareness could also enhance typhoid fever occurrence as stated; poor sewerage disposal to the water runways could end up in rivers, ponds, or seeps in any water source when washed by runoffs fetched and be used by the community members without treating the water. In Ugunja, misdiagnosis may also contribute to the high rate of typhoid fever; according to the study's findings, 5 out of 9 (56.6%) facility key informants expressed worry about it. This supports the results of an investigation from 2012 on potential risk aspects for typhoid fever conducted in Nyahururu's Maina slums. The results showed that self-diagnosis may have resulted in a misdiagnosis, with 56.6% of respondents believing they contracted the illness as a result of misdiagnosed experiences.

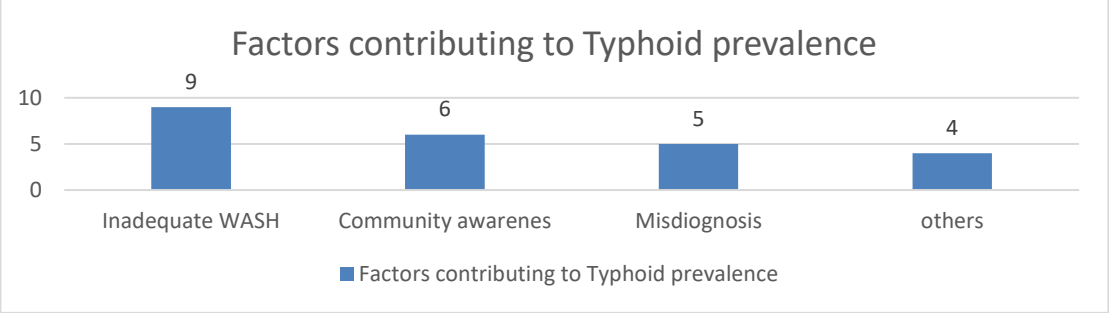


Figure 7: Responses on factors contributing to the prevalence of Typhoid in Ugunja sub-county

4.3.3.8; Typhoid vaccine administration

Table 6 shows no Typhoid vaccine administered at the health facilities. According to the CDC report, typhoid vaccine administration protects up to 80% of the recipients and hence the 0% rate of its administration in health facilities in Ugunja could to some extent be considered as a factor towards its occurrence in the sub-county. Management and treatment for typhoid-related symptoms need a concerted effort. The urge to reduce the risks of unreliable antibiotic adherence and the gradual emergence of drug-resistant typhoid strain, TCV usage, and administration as per the WHO schedule was viewed as the solution. This has been difficult, nonetheless, because of the product's insufficiency, which supports an investigation steered by BMC Health Services in Kisumu and Kakamega on the assessment of medication retail stores for the sale of typhoid fever vaccination utilizing five outlets in Kakamega and four in Kisumu. Since an assessment conducted four days later from the chosen nine stores revealed that the vaccine rapidly ran out of stock, the results are consistent with those of the Ugunja sub-county.

Table 6: Responses on Typhoid vaccine administration

Attribute	Yes	No
Variables	0	9

4.3.3.9 Discussion on Treatment and Care factor

From these study findings, at least 85% of the respondents have suffered from typhoid or diarrhoeal-related diseases. Health-seeking behavior isn’t bad as 48% of the respondents sought medication in government hospitals however sensitization needs to be done to

improve on it since about 7.5% of the respondents reported that they did not seek medication at all whenever they felt unwell. Similarly, the state of the health facilities is facing challenges in that all the key informants interviewed were in agreement that their laboratories are not well equipped to run typhoid fever diagnostic tests and had to revert to clinical diagnosis when the need arose but could be limited to only stool diagnosis if and only if the reagents are availed on the rare occasions. The common signs and symptoms among the facility informants were headache and fever at 100% while nausea and general malaise followed closely at 89% and 78% respectively. This however could prompt misdiagnosis since typhoid fever and malaria present with the same common signs and symptoms hence there is a need for improvement in the state of the hospital laboratory to minimize the chances of misdiagnosis and reduce the possible typhoid occurrence where necessary.

Treatment and care factor responses were based on major key informant interviews from the health facilities in Ugunja Sub County and partly community response. Treatment and care are fundamental in the management of Typhoid; however, the study reveals that health facility laboratories in the study area were not well equipped, hence limiting the providers to clinical diagnosis at approximately 68% this is supported by *WHO 2018 and Bharmoria, Shukla, and Sharma 2017*. In addition, three health facilities carried out stool tests subject to the availability of lab reagents which is non-reliable which agrees with *Nail et al (2012) and Bharmoria et al 2017*. The investigation found that the Typhoid fever vaccine was also not administered in any health facility in the study area. However, according *Marathe et al (2012*,) typhoid vaccination offers protection against typhoid occurrence in communities. This could explain the high number of Typhoid fever cases.

CHAPTER FIVE

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

The investigation findings are summarised, and concluded, and suggestions are made to the appropriate authorities for execution in this section.

5.2 Summary

It's noted that there is a likelihood of the spread of typhoid as a result of the consumption of food from the kiosk. This could be attributed to the preparation of food under insanitary conditions, food handlers not medically examined and not vaccinated against typhoid fever. The finding also depicts that there was a likelihood of spread of typhoid as a result of 41% of the respondents not treating their water.

Additionally, it is observed that the bulk of respondents—roughly 87% and 77%, respectively—store their water in buckets and pots. This might therefore increase the risk of typhoid fever by contaminating the water during the drawing process and by covering the storage containers. About 12% of people lack latrines and practice open defecation, which can contaminate water supplies and cause typhoid and diarrhoeal diseases. Additionally, flies and rats can contaminate food with germs from feces, which can cause typhoid incidence.

According to WHO proper hand washing is the most effective step in preventing diarrhoeal and typhoid cases. From the findings only 63% practiced hand washing of which approximately 47% practiced proper hand washing with soap and water. This therefore means that there is likelihood of the occurrence of diarrhoeal and typhoid cases as a result not practicing hand washing.

Crude dumping which is also practiced at merely 26% as a method of waste disposal encourages poor sanitation in the research area. This therefore could act as a potential source of both food and water contamination as flies and rodents carry pathogens from the dump sites hence the likelihood of occurrence of typhoid fever cases.

The majority of those surveyed gather their water for residential use from unsecured water sources, according to the investigation's findings. There may have been a chance of typhoid fever cases in Ugunja Sub County as a result of this being a significant conduit chain in the contamination process from the place of collection.

Treatment and care is also vital in curbing the reported and existing typhoid fever cases; however the findings shows that even though the majority of the respondents had proper health-seeking behavior, a slight minority at approximately 8%did not seek medication at all in any health care facility. This therefore could likely have led to the possibility of the occurrence of unknown or unreported typhoid fever cases in the sub county.

Typhoid fever is a serious infection of the gastrointestinal characterised by the Salmonella typhi bacterium; consequently for an accurate diagnosis medical care has to be well equipped with the essential diagnostic test equipments. The investigation findings however demonstrate the reverse in that none of the health institutions visited is well equipped and are unable to correctly diagnose typhoid fever when needed and therefore defaulting to the clinical diagnosis. Thus, this might have increased the likelihood of misdiagnosis and, consequently, the likelihood that typhoid fever would have occurred in the sub-county.

5.3 Conclusion

Knowing that Food and water safety management at household level is one of the key pillars in curbing the occurrence of typhoid, the importance of awareness creation at household level

cannot be overemphasized. As it comes apparent in the findings of this study, 93% of the household were aware of food and water safety management which could be linked with the 96% of households using different methods of water treatment. According to the findings by the UNICEF 59% of the Kenyans have access to safe drinking water in which 9.9 million drinking directly from contaminated water sources which could impact highly in the occurrence of typhoid fever.

The investigation established that latrine coverage is at 89% with about 37% not practicing hand washing at any instance. This concurs with the UNICEF findings that only 25% of the Kenyan population has hand-washing facilities with soap and water at households. Similarly, an estimated population of five million people practice open defecation which could also enhance the disease occurrence. Latrine improvement with either SATOs, VIP latrines and or any sustainable sanitation system which is slowly picking up as a practice in the sub county should also be emphasized as it is vital in cutting the transmission route and circle this could explain the environmental gaps that influence the occurrence of typhoid in Ugunja Sub-County.

The investigation ultimately found that while 67% of the medical facilities performed clinical typhoid diagnoses due to poor conditions and a lack of equipment to test at 100%, 92% of those surveyed sought treatment when ill. Having access to a competent and efficient medical care system in a community in undeniable, since sound health is the fundamental necessity of life. However, correct and consistent good health-seeking behavior should be encouraged since self-medication and over-the-counter medication could lead disease drug resistance or treatment of wrongly diagnosed disease which in turn can lead to the high occurrence of

typhoid fever within the sub-county, this is in line with the study findings where only 48% seek hospital treatment.

5.4 Recommendation

The government and partners supporting WASH should strengthen MBS in the uptake and up-scaling of Improved Sustainable Sanitation systems this will enable and ensure that Siaya County sustains its ODF status which in turn will reduce the diarrheal cases and typhoid fever occurrence in both Siaya County and Ugunja sub-county.

There is a need for the Siaya County government and relevant partners to capacity build the staff and equip the hospital laboratories with the requisite capacity for Typhoid diagnosis. Proper equipping of the laboratory would ensure that culture of clinical diagnosis as per the findings is reduced and proper laboratory diagnosis is done hence enabling proper and effective results within the health facilities in Ugunja Sub County.

Government, partners, and stakeholders should prioritize sensitization, and availability, and promote uptake of typhoid vaccination amongst food handlers and risk populations. This would ensure that proper approaches and protective measures are taken to avert the spread of the fever within the households and the community. On the other hand, the government, relevant stakeholders, and development partners should sensitize communities on SBCC towards good health-seeking behaviour.

There is a need for the County Government of Siaya and partners to provide safe water points to protect the existing water source and provide chlorine dispensers to the community members so as to reduce possible cases of water related disease.

REFERENCES

Acharya, S., Maharjan, K., Dongol, D., & Ghimire, A. (2020). Awareness of COVID-19 and perception of work satisfaction among healthcare workers at Patan Hospital, Nepal. Journal of Patan Academy of Health Sciences, 7(1), 31-36. nepjol.info

Ajayi, O. E., Olukunle, O. F., & Boboye, B. E. (2015). Prevalence of typhoid fever among different socio-demographic groups in Ondo State, Nigeria. Journal of Applied Life Sciences International, 3(2), 89-95.

Akullian, A., Ng'eno, E., Matheson, A. I., Cosmas, L., Macharia, D., Fields, B., ... & Montgomery, J. M. (2015). Environmental transmission of typhoid fever in an urban slum. PLoS neglected tropical diseases, 9(12), e0004212.

Amref health Africa journal 2020: introduce Health Education in All Kenyan Primary School to Inculcate Hygienic Habbits

Andrews, J. R., Yu, A. T., Saha, S., Shakya, J., Aiemjoy, K., Horng, L., ... & Luby, S. P. (2020). Environmental surveillance as a tool for identifying high-risk settings for typhoid transmission. Clinical Infectious Diseases, 71(Supplement_2), S71-S78. oup.com

Andrews, J. R., Yu, A. T., Saha, S., Shakya, J., Aiemjoy, K., Horng, L., ... & Luby, S. P. (2020). Environmental surveillance as a tool for identifying high-risk settings for typhoid transmission. Clinical Infectious Diseases, 71(Supplement_2), S71-S78. oup.com

Bhopal, R. (2007). Cause and effect: the epidemiological approach. Edinburgh: University of Edinburgh.

Bhutta, Z. A. (2006). Typhoid Fever: Current Concepts. Infectious Diseases in Clinical Practice, 14(2), 266 -272.

Boakye Okyere, P., Twumasi-Ankrah, S., Newton, S., Darko, S. N., Owusu Ansah, M., Darko, E., ... & Owusu-Dabo, E. (2024). Risk factors for typhoid fever: A desk review. medRxiv, 2024-09. medrxiv.org

Buczkowska, M., Jenkins, C., Hawker, J., Hungerford, D., Katwa, P., Kirkbride, H., & Byrne, L. (2023). Socioeconomic and ethnic inequalities in incidence and severity of enteric fever in England 2015–2019: analysis of a national enhanced surveillance system. Epidemiology & Infection, 151, e29. cambridge.org

Buzğan, T., Evirgen, Ö., Irmak, H., Karsen, H., & Akdeniz, H. (2007). A case of typhoid fever presenting with multiple complications. European Journal of General Medicine, 83-86.

CDC. (2007). Principles of Epidemiology in Public Health Practice. Atlanta: Center for Disease Control and Prevention.

Chatterjee, R., Chaudhuri, D., Setty, S. R. G., & Chakravortty, D. (2023). Deceiving the big eaters: Salmonella Typhimurium SopB subverts host cell xenophagy in macrophages via dual mechanisms. Microbes and Infection, 25(6), 105128. sciencedirect.com

Cole, M. B. & Nguyen, K. H. (2020). Unmet social needs among low-income adults in the United States: Associations with health care access and quality. Health services research. wiley.com

Cruz Espinoza, L. M., McCreedy, E., Holm, M., Im, J., Mogeni, O. D., Parajulee, P., ... & Marks, F. (2019). Occurrence of typhoid fever complications and their relation to duration of illness preceding hospitalization: a systematic literature review and meta-analysis. Clinical Infectious Diseases, 69(Supplement_6), S435-S448.

David, N., Tsegaye, H., Berhanu, T., Gemechu, G., Asseged, B., Vinaida, R., & Wanda, W. (2011). Applying the epidemiologic problem oriented approach (epoa) methodology in developing a knowledge base for the modeling of hiv/aids. PUBMED, 173 - 177.

Eba, K., & Bekele, D. (2019). Prevalence of typhoid fever and its risk factors in Lalo Assabi District, West Wollega, Oromiya, Ethiopia. Journal of Bacteriology & Parasitology, 10(365), 1.

Egbunu, D. A. & Yunusa, E. (2022). Factors determining the health seeking behaviour of rural dwellers in Dekina Local Government Area of Kogi State, Nigeria. International Medical Science Research Journal. fepbl.com

Essa, F., Hussain, S. Z. M., Batool, D., Usman, A., Khalid, U., Yaqoob, U., & Shahzad, H. (2019). Study of socio-demographic factors affecting the prevalence of typhoid. morbidity and mortality, 1(2), 9.

Florian, et al., 2017. Kenya health information system Siaya ;cases of typhoid as reported by the health facilities ugunja sub-county

Jacopo zorodzail, Daniel chirundu, Mufuta Tshimanga , Notion Gombe and Donewel bangure 2013; factors associated with contracting typhoid fever among residents of Bluegrass restlement area

Jahan, F., Chinni, S. V., Samuggam, S., Reddy, L. V., Solayappan, M., & Su Yin, L. (2022). The complex mechanism of the Salmonella typhi biofilm formation that facilitates pathogenicity: a review. International Journal of Molecular Sciences, 23(12), 6462. mdpi.com

Kaluse, P. S., Bhatt, N., & Bankar, N. (2021). Study of Typhoid Fever: A Review. Journal of Pharmaceutical Research International, 33(39A), 286-291. manuscritpub.com

Kang, L., Ma, S., Chen, M., Yang, J., Wang, Y., Li, R., ... & Liu, Z. (2020). Impact on mental health and perceptions of psychological care among medical and nursing staff in Wuhan during the 2019 novel coronavirus disease outbreak: A cross-sectional study. Brain, behavior, and immunity, 87, 11-17. nih.gov

Kariuki, S., Joyce, M., Agnes, M., Gunturu, R., & Joyce, O. A. (2004). Typhoid is over reported in Embu and Nairobi, Kenya. 11(3), 103 - 110.

Khalid, F., Raza, W., Hotchkiss, D. R., & Soelaeman, R. H. (2021). Health services utilization and out-of-pocket (OOP) expenditures in public and private facilities in Pakistan: an empirical analysis of the 2013–14 OOP health expenditure survey. BMC health services research, 21, 1-14. springer.com

Khan, K. H., Ganjewala, D., & Rao, K. B. (2008). Recent adva

Kibiru Andrew Benjamin Nguri (2016); Kibiru Andrew Benjamin 2011; Risk Factors influencing Typhoid Fever occurrence among the Adults in Maina Slums, Nyahururu Municipality, Kenya. Department of Public Health.

Lee, J. S., Mogasale, V. V., Mogasale, V., & Lee, K. (2016). Geographical distribution of typhoid risk factors in low and middle income countries. BMC infectious diseases, 16, 1-10.

Merkel L, Bicking C, Sekhar D.J; community health 2012

Paul, B., Jean Simon, D., Kiragu, A., Généus, W., & Emmanuel, E. (2022). Socio-economic and demographic factors influencing open defecation in Haiti: a cross-sectional study. BMC Public Health, 22(1), 2156. springer.com

Paul, U. K., & Bandyopadhyay, A. (2017). Typhoid fever: a review. Int J Adv Med, 4(2), 300.

Ren, X., Zhang, S., Luo, P., Zhao, J., Kuang, W., Ni, H., ... & Lv, Y. (2023). Spatial heterogeneity of socio-economic determinants of typhoid/paratyphoid fever in one province in central China from 2015 to 2019. BMC Public Health, 23(1), 927. springer.com

Saad, N. J., Lynch, V. D., Antillón, M., Yang, C., Crump, J. A., & Pitzer, V. E. (2018). Seasonal dynamics of typhoid and paratyphoid fever. Scientific reports, 8(1), 6870.

Saad, N. J., Lynch, V. D., Antillón, M., Yang, C., Crump, J. A., & Pitzer, V. E. (2018). Seasonal dynamics of typhoid and paratyphoid fever. Scientific reports, 8(1), 6870.

Sarin, S. K., Kumar, M., Eslam, M., George, J., Al Mahtab, M., Akbar, S. M. F., ... & Chen, D. S. (2020). Liver diseases in the Asia-Pacific region: a lancet gastroenterology & hepatology commission. The lancet Gastroenterology & hepatology, 5(2), 167-228. thelancet.com

Shakya, M., Neuzil, K. M., & Pollard, A. J. (2021). Prospects of future typhoid and paratyphoid vaccines in endemic countries. The Journal of infectious diseases, 224(Supplement_7), S770-S774. oup.com

Stanaway, J. D., Atuhebwe, P. L., Luby, S. P., & Crump, J. A. (2020). Assessing the feasibility of typhoid elimination. Clinical Infectious Diseases, 71(Supplement_2), S179-S184. oup.com

Uganda Bureau of startisctics, ICF international inc and Uganda demographic survey, 2011.Kampla Uganda ;UBOS and Calverton, Maryland: ICF international inc2012

UNICEF and WHO. Progress on drinking water and sanitation . 2012

Uzzell, C. B., Troman, C. M., Rigby, J., Mohan, V. R., John, J., Abraham, D., ... & Grassly, N. C. (2021). Environmental surveillance for Salmonella Typhi as a tool to estimate the incidence of typhoid fever in low-income populations. medRxiv, 2021-05. medrxiv.org

Walters MS , Ruoth J,MikoleitM KadivaneS Ouma C at el Shift in Geographic Distribution and Anti microbial Resistance during a Prolonged Typhoid Fever Outbreak-Bundibugyo and Kesese Districts, Uganda, 2009-2011.PLoSNegl Trop.Dis 2015

WHO. Typhoid and other invasive salmonellosis. Vaccine preventable diseases, surveillance standards 2018

Youssef, N., Mostafa, A., Ezzat, R., Yosef, M., & El Kassas, M. (2020). Mental health status of health-care professionals working in quarantine and non-quarantine Egyptian hospitals during the COVID-19 pandemic. East Mediterr Health J, 26(10), 1155-1164. who.int

APPENDICES

Appendix I: Letter of Transmittal

RE: REQUEST FOR RESEARCH PARTICIPATION.

Dear respondent,

My name is **Rose Awino Yogo;** I am a Master of Public Health (MPH) student at Mount Kenya University carrying out research on the **Factors influencing the Occurrence of Typhoid Fever among the general population in Ugunja Sub-County in Siaya County.** The research is carried out as one of the prerequisites requirements to obtaining a degree. So that I carry out this research accordingly, you have chosen to be part of the team that is going to respond to a few questions, whose purpose is purely academics. I hereby request you to take part by responding to the questions with at most honesty as you can and the information you avail will handled with a lot of privacy. No name is required not unless you want to do so. However, should your name appear, it will not feature in the final findings that was presented to the university.

Your assistance is highly appreciated in this study.

Much thanks in advance.

Yours Sincerely

Rose AwinoYogo MPH/2016/59541

Appendix II : Questionnaire

INSTRUCTIONS

Kindly help by answering the following questions as honestly as you can. The information you will give is strictly going to be used for academic reasons only and will be handled with a lot of confidentiality.

Kindly tick (√) where appropriate

Part I: DEMOGRAPHIC DETAILS

1) Gender: Male [] Female []
2) How old are you? (Years) 18 – 25 [ ] 26 – 35 [ ] 36 – 45 [ ] 46 – 55 [ ] 56 and above [ ]
3) Marital status: single [] married [] separated [] other []
4) Occupation: Formal employment[] self-employed [] Un employed [ ]

Part II: FACTORS LINKED WITH OCCURRENCE OF TYPHOID

SOCIO-ECONOMIC FACTORS

1) Have you ever eaten from the food kiosk Yes [ ] No [ ]
2) Are you aware of any health education pertaining food and water management? Yes [ ] No [ ]
3) Do you treat water for your domestic use? Yes [ ] No [ ]
4) If yes, how do you treat water?
   a) Chlorination [ ] b) Boiling [ ] c) Others specify

5) How do you store water in your house?

a) Bucket [ ] b) Jerrican [ ] c) Pot [] d) Others specify

ENVIRONMENTAL FACTORS

1) What kind of house do you reside in? (Based on observation)

Permanent [ ]Semi-permanent [ ]

2) If permanent in question 1) above, what is the condition of the drainage system?

a) leaking [ ] b) well fitted and functioning [ ]

3) Do you have a functional latrine Yes [ ] No [ ] (based on observation)

4) If yes in 2) above,

a) Improved (Vent pipe, SATO, Squat-hole cover)? [ ] b) Not improved? []

5) Do you have functional hand washing facility? Yes [ ] No [ ]

6) If yes, observe; a) Running water and soap? [ ] b) Running water without soap? [ ]

7) Have you participated in general cleaning of the environment Yes [ ] No [ ]

8) If yes, how often? once [ ] twice [ ]Thrice and above[ ]

9) How do you dispose of your household waste?

a) In the compost pit [] b) Burning[] d) Crude dumping []

10) At what time do you wash your hands?

a) Before food preparation [ ] b) After visiting toilets [ ] c) Before eating? [ ]

d) After changing baby's diapers? [ ] e) All of the above? [ ]

11) Where do you obtain water for drinking and general use?

Tap [ ] Roof catchment [ ] River [ ] spring [ ] bore hole [ ]

Other (please specify) …….

……

12) Are your water sources for domestic use protected? Yes [ ] No [ ]

TREATMENT AND CARE FACTORS

1. Have you ever suffered from diarrhoea or typhoid related symptoms? Yes [ ] No [ ]

2.If yes in 1 above, where do you seek medical treatment?

Government hospital [ ] b) Herbal clinic [ ] c) chemist [ ] d) No treatment sought []

3. Who are you in terms of position in this health facility?

Clinician [ ] nursing officer [ ] Lab technician [ ]

Other specify.....

4. For how long have you been working as a healthcare provider?

a) 1 – 2 years [ ] b)3 – 4 years [ ] c) Over 5 years [ ]

5.What kind of test do you use to diagnose typhoid fever in this facility?

Stool [ ] Clinical diagnosis [ ] Widaltest [ ]

Other specify.....

6. Do you have well equipped laboratory to diagnose the typhoid fever?

Yes [ ] No [ ]

7. What are some of the common signs and symptoms of typhoid fever you know

Headache [ ] Fever [ ] Nausea [ ] General malaise [ ] others [ ]

8. Which factors contribute to typhoid prevalence in Ugunja Sub County?

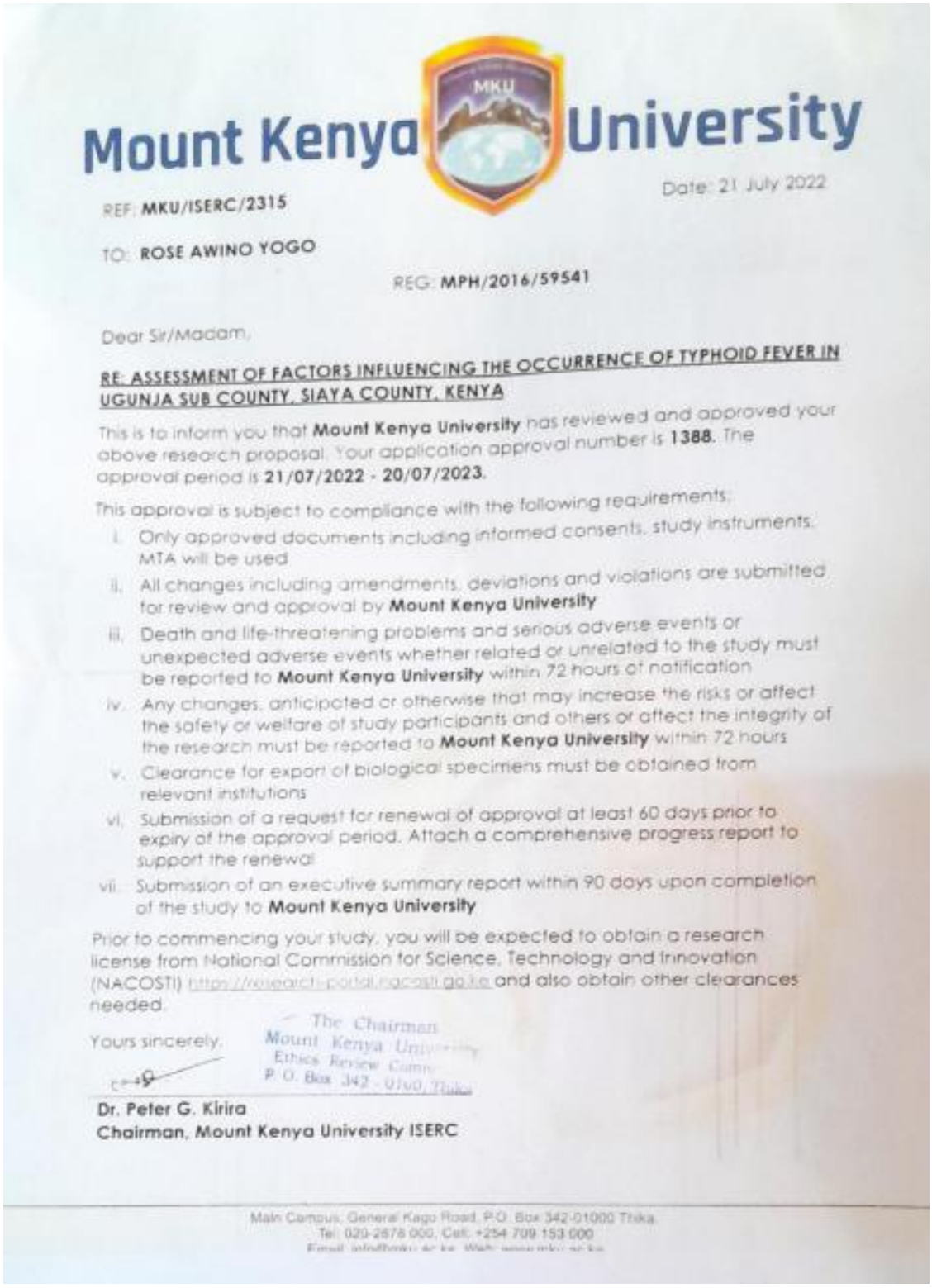
Inadequate WASH [ ] Community awareness [ ] Misdiagnosis [ ] others [ ]

9. Has any typhoid vaccine been administered in Ugunja sub county?

Yes [ ] No [ ]

End. Thank you for participating

Appendix III: ERC Approval Letter



Mount Kenya University

Date: 21 July 2022

REF: **MKU/ISERC/2315**

TO: **ROSE AWINO YOGO**

REG: **MPH/2016/59541**

Dear Sir/Madam,

RE: ASSESSMENT OF FACTORS INFLUENCING THE OCCURRENCE OF TYPHOID FEVER IN UGUNJA SUB COUNTY, SIAYA COUNTY, KENYA

This is to inform you that **Mount Kenya University** has reviewed and approved your above research proposal. Your application approval number is **1388**. The approval period is **21/07/2022 - 20/07/2023.**

This approval is subject to compliance with the following requirements:

i. Only approved documents including informed consents, study instruments, MTA will be used
ii. All changes including amendments, deviations and violations are submitted for review and approval by **Mount Kenya University**
iii. Death and life-threatening problems and serious adverse events or unexpected adverse events whether related or unrelated to the study must be reported to **Mount Kenya University** within 72 hours of notification
iv. Any changes, anticipated or otherwise that may increase the risks or affect the safety or welfare of study participants and others or affect the integrity of the research must be reported to **Mount Kenya University** within 72 hours
v. Clearance for export of biological specimens must be obtained from relevant institutions
vi. Submission of a request for renewal of approval at least 60 days prior to expiry of the approval period. Attach a comprehensive progress report to support the renewal
vii. Submission of an executive summary report within 90 days upon completion of the study to **Mount Kenya University**

Prior to commencing your study, you will be expected to obtain a research license from National Commission for Science, Technology and Innovation (NACOSTI) https://research.portal.nacosti.go.ke and also obtain other clearances needed.

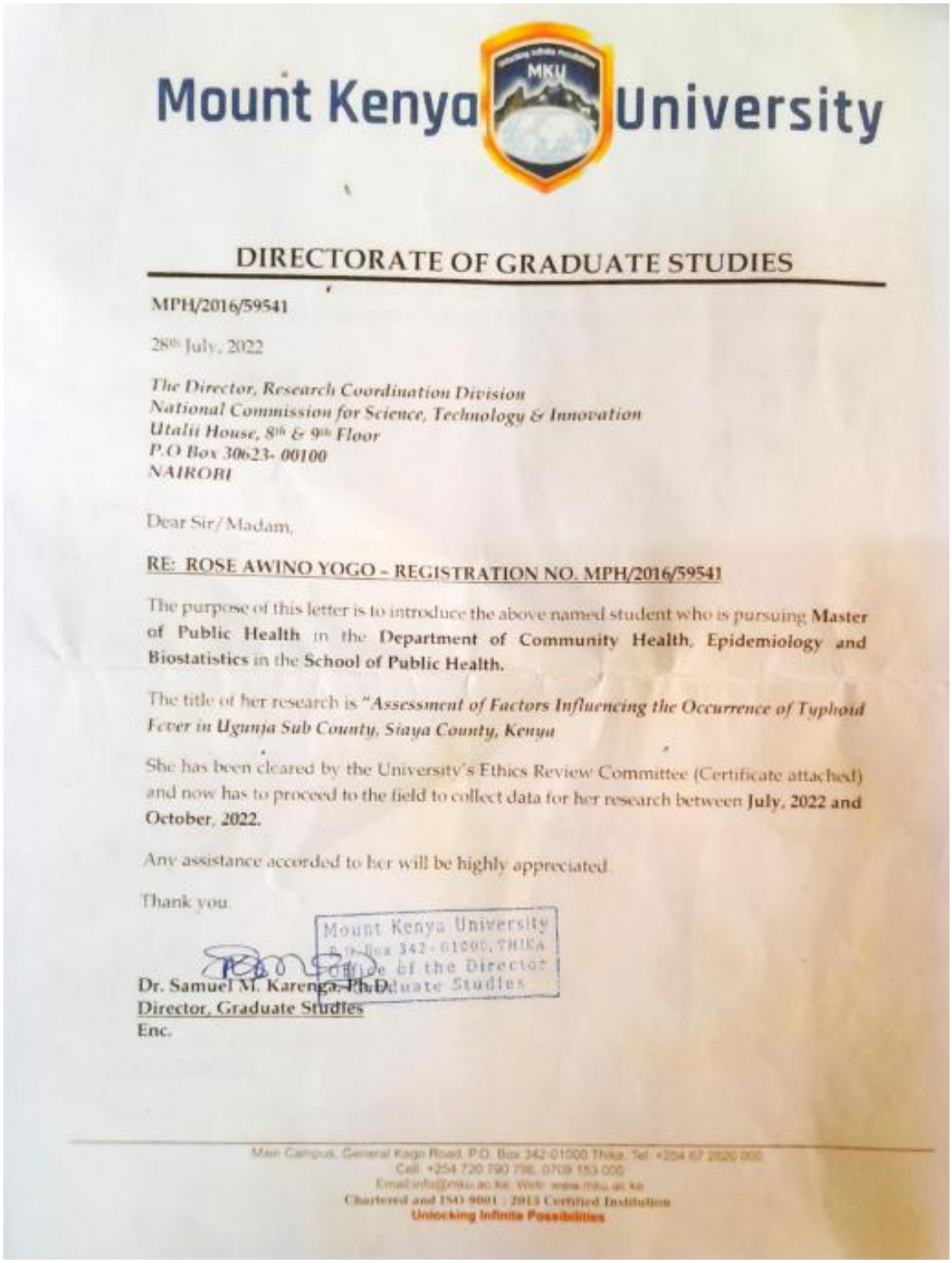
Yours sincerely,

The Chairman
Mount Kenya University
Ethics Review Committee
P. O. Box 342 - 01000, Thika

Dr. Peter G. Kirira
Chairman, Mount Kenya University ISERC

Main Campus, General Kago Road, P.O. Box 342-01000 Thika
Tel: 020-2676 000, Cell: +254 709 153 000

Appendix IV : Introduction Letter from Derectorate of Graduate Studies



Mount Kenya University

DIRECTORATE OF GRADUATE STUDIES

MPH/2016/59541

28th July, 2022

The Director, Research Coordination Division
National Commission for Science, Technology & Innovation
Utalii House, 8th & 9th Floor
P.O Box 30623- 00100
NAIROBI

Dear Sir/Madam,

RE: ROSE AWINO YOGO – REGISTRATION NO. MPH/2016/59541

The purpose of this letter is to introduce the above named student who is pursuing **Master of Public Health** in the **Department of Community Health, Epidemiology and Biostatistics** in the **School of Public Health.**

The title of her research is *"Assessment of Factors Influencing the Occurrence of Typhoid Fever in Ugunja Sub County, Siaya County, Kenya*

She has been cleared by the University's Ethics Review Committee (Certificate attached) and now has to proceed to the field to collect data for her research between **July, 2022 and October, 2022.**

Any assistance accorded to her will be highly appreciated.

Thank you.

Mount Kenya University
P.O. Box 342-01000, THIKA
Office of the Director
Graduate Studies

Dr. Samuel M. Kareng'a, Ph.D.
Director, Graduate Studies
Enc.

Main Campus, General Kago Road, P.O. Box 342-01000 Thika, Tel: +254 67 2620 000
Cell: +254 720 790 796, 0709 153 000
Email: info@mku.ac.ke, Web: www.mku.ac.ke
Chartered and ISO 9001 : 2015 Certified Institution
Unlocking Infinite Possibilities

Appendix V : Letter of Approval from NACOSTI

REPUBLIC OF KENYA

NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Ref No: **842760**

Date of Issue: **21/August/2022**

RESEARCH LICENSE

This is to Certify that Miss.. YOGO AWINO ROSE of Mount Kenya University, has been licensed to conduct research in Siaya on the topic: ASSESMENT OF FACTORS INFLUENCING THE OCCURRENCE OF TYPHOID FEVER IN UGUNJA SUB COUNTY,SIAYA COUNTY, KENYA. for the period ending : 21/August/2023.

License No: **NACOSTI/P/22/19642**

842760

Applicant Identification Number

Director General
NATIONAL COMMISSION FOR SCIENCE,TECHNOLOGY & INNOVATION

Verification QR Code

NOTE: This is a computer generated License. To verify the authenticity of this document, Scan the QR Code using QR scanner application.

Appendix VI : Approval Letter from County Commissioner Siaya County

REPUBLIC OF KENYA

OFFICE OF THE PRESIDENT

MINISTRY OF INTERIOR & CO-ORDINATION OF NATIONAL GOVERNMENT

COUNTY COMMISSIONER
SIAYA COUNTY
P O Box 83-40600
SIAYA

E-Mail cc.siaya@yahoo.com
When replying please quote ref. & date

CC/SC/A.31 VOL.IV/92

31ST August, 2022

Deputy County Commissioner
UGUNJA SUB COUNTY

RE: RESEARCH AUTHORIZATION – MISS. YOGO AWINO ROSE

The person referred to above from Mount Kenya University has been authorized by the Director General, National Commission for Science, Technology and Innovation vide letter Ref.no *NACOSTI/P/22/19642/842760* dated 21st August 2022 to carry out research on ***"ASSESSMENT OF FACTORS INFLUENCING THE OCCURRENCE OF TYPHOID",*** for the period ending **21st August 2023**.

Therefore, the purpose of this letter is to ask that you accord her the necessary support as she conducts research in your Sub County.

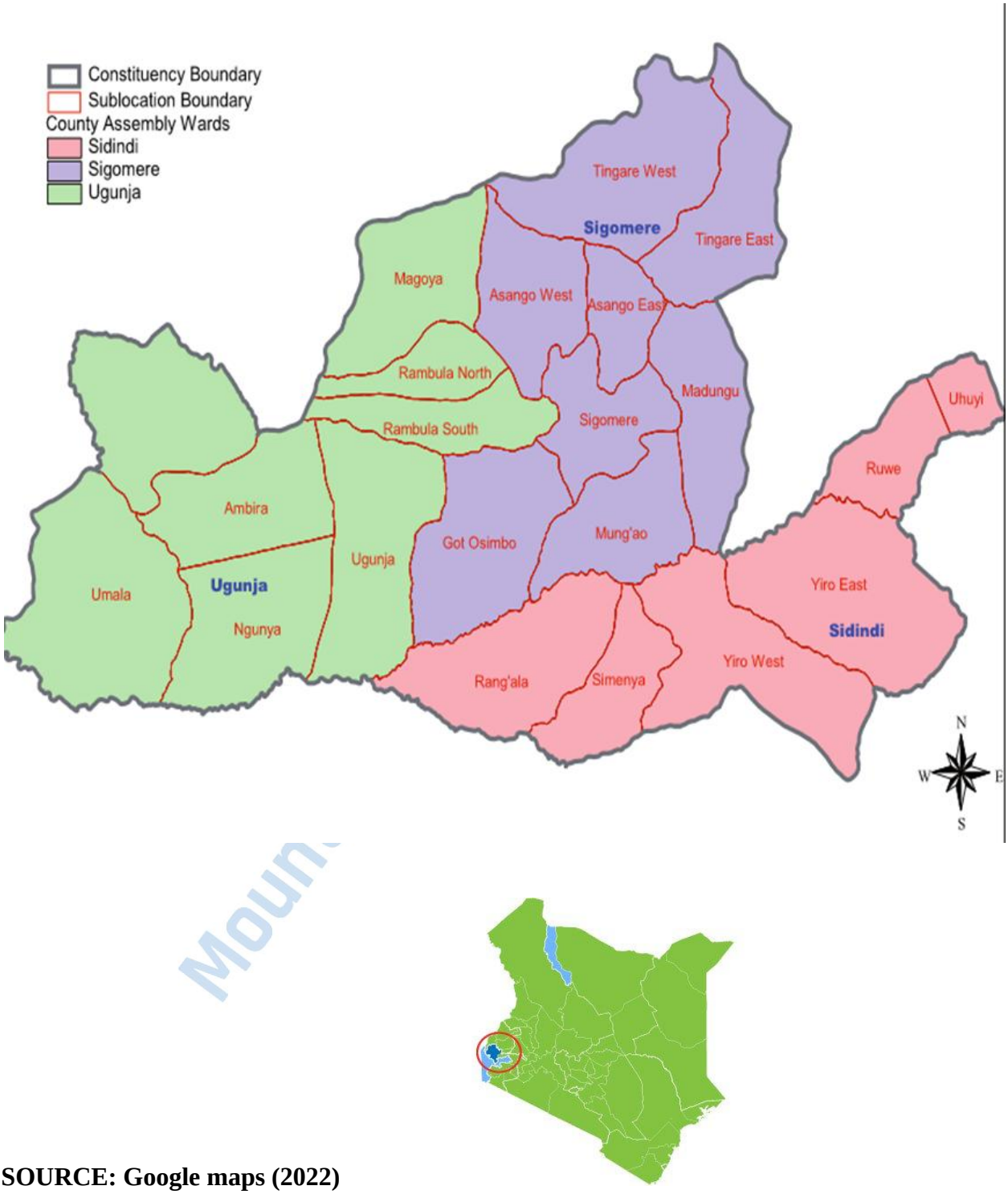
NOTE: Due to the prevailing COVID - 19 situation, she must observe containment protocols as directed by the Ministry of Health.

A. W. MATOFARI
For: COUNTY COMMISSIONER
SIAYA COUNTY

COUNTY COMMISSIONER
SIAYA COUNTY
P. O. Box 83
SIAYA - 40600

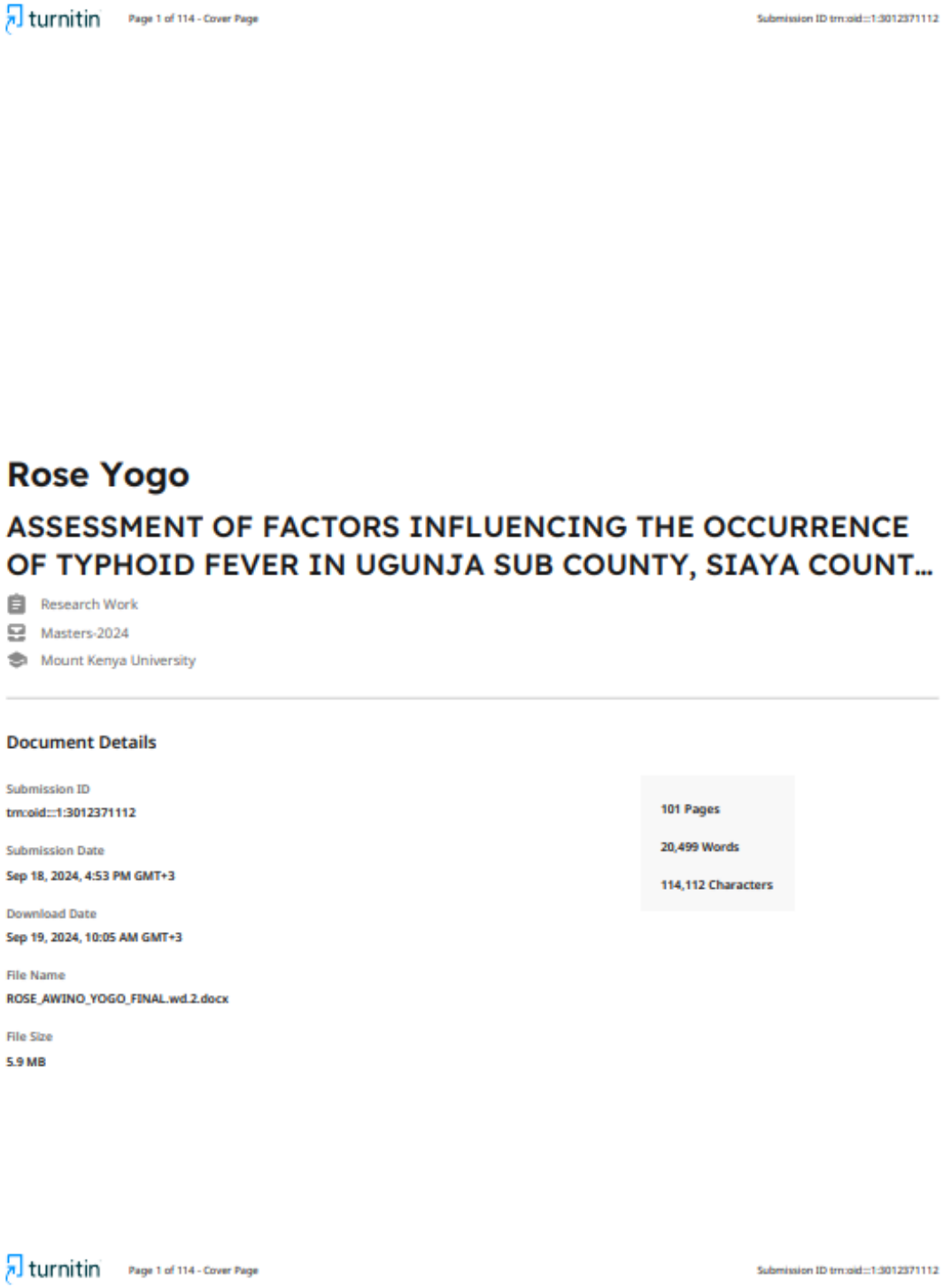
Copy to; Miss Yogo Awino Rose,
Mount Kenya University

Appendix VII : Map Showing the Study Area



SOURCE: Google maps (2022)

Appendix VIII : Similarity Index Report.



20% Overall Similarity

The combined total of all matches, including overlapping sources, for each database.

Exclusions

▸ 1 Excluded Source

Match Groups

- **251** Not Cited or Quoted 17%
  Matches with neither in-text citation nor quotation marks
- **27** Missing Quotations 2%
  Matches that are still very similar to source material
- **10** Missing Citation 1%
  Matches that have quotation marks, but no in-text citation
- **2** Cited and Quoted 0%
  Matches with in-text citation present, but no quotation marks

Top Sources

18% Internet sources
9% Publications
11% Submitted works (Student Papers)

Integrity Flags

1 Integrity Flag for Review

Hidden Text
0 suspect characters on 10 pages
Text is altered to blend into the white background of the document.

Our system's algorithms look deeply at a document for any inconsistencies that would set it apart from a normal submission. If we notice something strange, we flag it for you to review.

A Flag is not necessarily an indicator of a problem. However, we'd recommend you focus your attention there for further review.