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Presented by

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Assessing Students' Knowledge, Attitudes and Practices on Water, Sanitation, Hygiene, and Related Diseases in Selected Schools in Musanze District, Rwanda.

Defended on 02/09/2018 Before the Following Committee:

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DECLARATION

I, **Vincent HABUMUGISHA**, hereby declare that this thesis represents my personal work, realized to the best of my knowledge. I also declare that all information, material and results from other works presented here, have been fully cited and referenced in accordance with the academic rules and ethics.

Signed:  31-7 - 2018

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CERTIFICATION/APPROVAL

This is to certify that this research has been approved and was done under my supervision.

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ABSTRACT

Poor water supply, lack of adequate sanitation, and bad hygiene practices with attendant diseases are killing many people each year in developing countries, including Rwanda, and children under the age of five are the most vulnerable. The research assessed students' hygiene attitudes and practices, sanitation practices, knowledge on related diseases, knowledge on sources of clean water, and knowledge on causes and prevention of selected WASH related diseases.The study also investigated water availability for drinking and sanitation, and sanitation facilities in schools. A total of 1173 students was selected from a population of 2900 students for the survey.Six teachers and six school directors also participated in the survey. Respondents were selected from three rural and three urban schools. Data were collected using questionnaires and analyzed using Statistical Package for the Social Sciences (SPSS). From the results, it was noted that students' attitudes to hygiene in rural and urban schools are the same as they all agree on the necessity to wash hands after visiting the toilet and before eating. The level of concern for hygiene is higher in urban schools than in rural schools and the practice of using latrine for human faeces disposal is not common across both rural and urban schools. Also students' knowledge on diseases related to contact with human faeces in both rural and urban schools is not the same as urban students have more knowledge than rural students while tap water was mentioned to be the major source of clean drinking water for students in rural and urban schools. The students in both rural and urban schools have no knowledge on the causes of Shigellosis and trachoma. However, they have tittle knowledge on causes of Diarrhea, Cholera, Malaria, and typhoid and generally, they have little knowledge on the prevention Shigellosis, Trachoma, Diarrhea, Cholera, Malaria, and typhoid. It was observed that water shortage was a common issue, though water supplied in school was physically clean.All the three rural schools faced water shortage while only one school had this problem in urban center. All schools are supplied through the municipal water system with 66.7%

claiming low supply pressure. All schools visited have pit latrines which are improved sanitation facilities and the toilets were clean. However, in all schools located in rural areas, there were no hand washing facilities and no soap, while in urban schools, hand washing facilities were available, but with no soap. The school authorities are to device programs which will specifically educate students on the importance of washing hands after using the toilets, washing hands and raw food before eating and on the causes and prevention of water, sanitation and hygiene related diseases. Full water supply and sanitation coverage in schools, monitoring of implementation of UNICEF/WHO WASH guidelines in schools and dissemination of WASH related diseases message in health centers, clinics and hospitals after treating WASH diseases related patients is recommended.

RÉSUMÉ

La mauvaise qualité de l'approvisionnement en eau, le manque d'installations sanitaires adéquates et les mauvaises pratiques d'hygiène entraînent la mort de nombreuses personnes chaque année dans les pays en développement, notamment au Rwanda, et les enfants de moins de cinq ans sont les plus vulnérables. La recherche a évalué les attitudes et les pratiques d'hygiène des élèves, les pratiques d'assainissement, les connaissances sur les maladies connexes, les connaissances sur les sources d'eau propre et les connaissances sur les causes et la prévention des maladies liées à l'eau, l'assainissement et l'hygiène. L'étude a également étudié la disponibilité de l'eau pour la boisson et l'assainissement, et les installations d'assainissement dans les écoles. Un total de 1173 étudiants ont été sélectionnés parmi une population de 2900 étudiants pour l'enquête. Six enseignants et six directeurs d'école ont également participé à l'enquête. Les répondants ont été sélectionnés dans trois écoles rurales et trois écoles urbaines. Les données ont été recueillies à l'aide de questionnaires et analysées à l'aide du Paquet statistique pour les sciences sociales (SPSS). À partir des résultats, il a été noté que les attitudes des élèves à l'égard de l'hygiène dans les écoles rurales et urbaines sont les mêmes car ils sont tous d'accord sur la nécessité de se laver les mains après avoir visité les toilettes et avant de manger. Le niveau d'inquiétude pour l'hygiène est plus élevé dans les écoles urbaines que dans les écoles rurales et la pratique consistant à utiliser des latrines pour l'élimination des excréments humains n'est pas courante dans les écoles rurales et urbaines. Les connaissances des élèves sur les maladies liées au contact avec les excréments humains dans les écoles rurales et urbaines ne sont pas les mêmes que celles des élèves des zones rurales, alors que l'eau du robinet était la principale source d'eau potable pour les élèves des zones rurales et urbaines. Les élèves des écoles rurales et urbaines n'ont aucune connaissance des causes de la Shigellose et du trachome. Cependant, ils ont des connaissances sur les causes de la diarrhée, le choléra, le paludisme et la typhoïde et, en général, ils ont peu de connaissances sur la prévention Shigellose, trachome, diarrhée, choléra, paludisme et typhoïde. Il a été observé

que la pénurie d'eau était un problème commun, bien que l'eau fournie à l'école était physiquement propre. Toutes les trois écoles rurales, ont fait face à la pénurie d'eau alors qu'une seule école avait ce problème dans le centre urbain. Toutes les écoles sont approvisionnées par le réseau d'eau municipal et 66,7% déclarent une faible pression d'approvisionnement. Toutes les écoles visitées ont des latrines à fosse qui sont des installations sanitaires améliorées et les toilettes étaient propres. Cependant, dans toutes les écoles situées dans les zones rurales, il n'y avait pas d'installations pour se laver les mains ni de savon, tandis que dans les écoles urbaines, il était possible de se laver les mains, mais sans savon. Les autorités scolaires doivent maitre en place les programmes qui sensibilisent les élèves à l'importance de se laver les mains après avoir utilisé les toilettes, se laver les mains et les aliments crus avant de manger et les causes des maladies liées à l'eau, l'assainissement et l'hygiène.La couverture complète de l'approvisionnement en eau et de l'assainissement dans les écoles, le suivi de la mise en œuvre des directives UNICEF / OMS sur l'eau, l'assainissement et l'hygiène dans les écoles et la diffusion de messages sur les maladies liées à l'eau, l'assainissement et l'hygiène après le traitement des patients souffrant de ces maladies est recommandé.

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LIST OF ABBREVIATIONS

KAP: Knowledge Attitudes and Practices

MDGs: Millennium Development Goals

MIDIMAR: Ministry of Disaster Management and Refugee Affairs

MTU: Michigan Technical University

RBC: Rwanda Biomedical Center

SDGs: Sustainable Development Goals

SPSS: Statistical Package for the Social Sciences

UN: United Nations

UNDP: United Nations Development Programme

UNICEF: The United Nations Children's Fund

WASH: Water, Sanitation and Hygiene

WHO: The World Health Organization

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Chapter 1: Introduction

1.0 Introduction

In the current agenda for Sustainable Development Goals (SDGs), monitoring of water, sanitation and hygiene (WASH) extend beyond the households to cover public spaces like schools (WHO, 2017).A large number of people use WASH services in schools environments, and lack of access to sufficient WASH facilities can negatively impact both school attendance and education achievement of students (WHO, 2017). Eventually, children may avoid attending schools when they know that their schools do not have adequate WASH facilities (WHO, 2017).

The combination of good hygiene practices, basic toilets, and adequate access to clean water are critical for the endurance and development of people, particularly children. In 217, it was noted that around 2.4 billion people did not have access to improved sanitation, and around 663 million did not have access to improved water sources (UNICEF, 2017).

Good hygiene practices, basic toilet, and adequate access to clean water are basic needs and human life is threatened when theses basics are not fully available. WASH related diseases were among the leading causes of death for the children under the age of five (UNICEF, 2017). In 2017, it was reported that over 800 children die daily from preventable diseases caused by poor WASH (UNICEF, 2017).

A good progress in improving access to WASH facilities and services is being made in Rwanda (UNICEF Rwanda, 2017). Rwanda has put in place health improvement initiative through promoting hand washing with soap to reduce incidences and prevalence of WASH related diseases (UNICEF Rwanda, 2017). Nevertheless, in 2017, around 25% of the population did not have adequate access a safe drinking water source; and around 26% of the populations did not have access improved sanitation facilities with rural areas being more affected (UNICEF Rwanda, 2017).

This research was intended to assess knowledge, attitudes and practices on water, sanitation, hygiene, and related diseases in selected schools in Musanze District, in

Rwanda. The research relied on use of questionnaires and field observation as main sources of data. The research findings will be useful in formulating new policies on public health education and full water supply and sanitation coverage interventions that are highly needed to prevent communicable WASH related diseases in Musanze District.

1.1. Problem Statement

Waterborne diseases are global burdens which are negatively impacting countries differently. In 2017, it was reported that annually, around 3.4 million people, particularly children die of water related diseases (WHO, 2017). In low and middle-income countries, around 842,000 annually die as a result of inadequate WASH, representing 58% of total diarrheal deaths (WHO, 2018).

Around 280,000 people are believed to be mainly killed by poor sanitation. Preventable diarrhea remains the main killer. Life losses of about of 361 000 children aged under 5 years each year could be saved through better WASH (WHO, 2018).

The disease and poverty cycle are maintained through open defecation practices. The highest number of deaths of children under the age of five, poverty and malnutrition, and wealth disparities predominate in countries where open defecation is prevalent (WHO, 2018).

Water shortage, poor sanitation and hygiene practices and insufficient knowledge on water, sanitation and hygiene related diseases, coupled with dispersal of faecal contaminants by floods are among the main causes of mounting risks of water related diseases outbreaks such as cholera according to the World Health Organization and Rwandan Biomedical Center. In fact, Rwanda Biomedical Center in 2016 confirmed outbreak of non-bloody diarrhea, typhoid, Shigellosis and cholera cases in Rwanda.

Worldwide, 5% of health loss to disability and 4% of all deaths are due to Diarrhoea disease (WHO, 2017).Inadequate WASH cause gastrointestinal infections which result in around 2.2 million life losses globally each year, mostly children in developing countries (WHO, 2017). The use of clean water in hygiene is the best preventive measure; however, use of unclean water is the main cause of diarrhea. Dysentery and cholera cause severe and life time threatening forms of diarrhea (WHO, 2017). Amongst the poor and particularly in

developing countries, diarrhea remains the major killer.Each year, approximately 4 billion cases of diarrhea are recorded worldwide (WHO, 2017). Daily, over 800 children die globally from preventable diseases caused by poor water, and a lack of sanitation and hygiene (UNICEF, 2017).

In Rwanda cholera outbreak seems to be widespread in some part of the country, especially in areas long Kivu belt. From 2010 to 2015, fifteen outbreaks have been recorded with a total of 285 cases and 3 deaths in 2015 only (RBC, 2015). In 2016, three (3) people died of cholera and another 60 were put in Cholera camp in Kanama sector Rubavu District (http://www.igihe.com, 2016). In 2017 another eight cases were observed in Rubavu District in Rwanda (http://www.igihe.com, 2017).

In the current agenda for Sustainable Development Goals (SDGs), monitoring of water, sanitation and hygiene (WASH) extend beyond the households to cover public spaces like schools (WHO, 2017).A large number of people use WASH services in schools environments, and lack of access to sufficient WASH facilities can negatively impact both school attendance and education achievement of students (WHO, 2017). Eventually, children may avoid attending schools when they know that their schools do not have adequate WASH facilities (WHO, 2017).This research is therefore set out to obtain necessary and relevant information on the status of water, sanitation and hygiene in selected rural and urban schools in Muzanze district. It is expected that the findings will include useful data for planning possible interventions that will lead to improvement in water supply to schools, sanitation services and hygiene practices in general.

1.2Aim and objectives

1.2.1 Aim of the Research

The aim of this research is to assess students' knowledge, attitudes and practices on water, sanitation, hygiene, and related diseases in selected schools in Musanze District.

1.2.2. Objectives of the Research

1) To assess students' hygiene practices (Washing hands after urinating, after defecating, before eating and frequency,washing fruits before consumption and frequency)
2) To assess students' attitudes on hygiene (Feeling of necessity of hand washing after visiting the toilet,Level of concern about hygiene)
3) To assess student's practices towards sanitation (Human waste disposal methods, pollution of environment by open defecation in bushes and water bodies)
4) To assess students' knowledge on diseases related to contact with human faeces
5) To assess students' knowledge on sources of clean water
6) To assess students' knowledge on WASH related diseases (Causes and Prevention)
7) To investigate water availability for drinking and sanitation at schools (field observation, directors and teachers' interview) in terms of quality, quantity and sources.
8) To investigate sanitation facilities at school in terms of
    a. Types of toilets in use(Improved vs unimproved
    b. Hygiene in toilets (Frequency of cleaning, responsibility towards cleaning)
    c. Hand washing facilities (operations and presence of soap)
    d. Refuse collection and disposal site and refuse handling at school
9) To propose WASH intervention policy.

1.3 Research Questions

1) What are students' practices towards water, sanitation and hygiene?
2) What are students' attitudes towards hygiene?
3) What is the students' level of knowledge in relation to water, sanitation and hygiene?
4) What are the quality, quantity and sources of water for drinking and sanitation at school?
5) What are the types of toilets, privacy, hygiene status, operation of hand washing facilities, and how is refuse handling done in the schools?

1.4 Hypotheses

1 Hypothesis 1

a) Null Hypothesis (H_0):Students' attitudes to hygiene in rural and urban schools are the same as they all agree on the necessity to wash hands after visiting the toilet.

b) Alternative Hypothesis (H_1):Students' attitudes to hygiene in rural and urban schools are not the same as they all agree on the necessity to wash hands after visiting the toilet.

2 Hypothesis 2

a) Null Hypothesis (H_0):The level of concern for hygiene is higher in rural schools than in urban schools.

b) Alternative Hypothesis (H_1):The level of concern for hygiene is not higher in rural schools than in urban schools.

3 Hypothesis 3

a) Null Hypothesis (H_0): The practice of using latrine for human faeces disposal is common in both rural and urban schools.

b) Alternative Hypothesis (H_1): The practice of using latrine for human faeces disposal is not common in both rural and urban schools.

4 Hypothesis 4

a) Null Hypothesis (H_0): The students' knowledge on diseases related to contact with human faeces in both rural and urban schools is the same.

b) Alternative Hypothesis (H_1): The students' knowledge on diseases related to contact with human faeces in both rural and urban schools is the same.

5 Hypothesis 5

a) Null Hypothesis (H_0): The major source of clean drinking water for students in rural and public schools is tap water.

b) Alternative Hypothesis (H_1): The major source of clean drinking water for students in rural and public schools is tap water.

6 Hypothesis 6

a) Null Hypothesis (H_0): The students in both rural and urban schools have no knowledge on the causes of Diarrhea.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the causes of Diarrhea.

7 Hypothesis 7

a) Null Hypothesis (H_0):The students in both rural and urban schools have no knowledge on the causes of Shigellosis.

b) Alternative Hypothesis (H_1):The students in both rural and urban schools have knowledge on the causes of Shigellosis**.**

8 Hypothesis 8

a) Null Hypothesis (H_0): The students in both rural and urban schools have no knowledge on the causes of Cholera.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the causes of Cholera.

9 Hypothesis 9

a) Null Hypothesis (H_0): The students in both rural and urban schools have no knowledge on the causes of Trachoma.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the causes of Trachoma.

10 Hypothesis 10

a) Null Hypothesis (H_0): The students in both rural and urban schools have no knowledge on the causes of Typhoid.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the causes of Typhoid.

11 Hypothesis 11

a) The students in both rural and urban schools have no knowledge on the causes of Malaria.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the causes of Malaria.

12 Hypothesis 12

a) Null Hypothesis (H_0): The students in both rural and urban schools have no knowledge on the prevention of WASH related diseases.

b) Alternative Hypothesis (H_1): The students in both rural and urban schools have knowledge on the prevention of WASH related diseases.

1.5 Significance of the study

The research will enable us to find out the level of knowledge, attitudes and practices of students on water, sanitation, hygiene, and related diseases in selected schools in Musanze District.

This is significant as the current understanding of the problems of water, sanitation and hygiene in schools is not adequate. Hence, policies and interventions are not available to address the problems. More importantly, the Sustainable Development Goals agenda, Water Sanitation and Hygiene monitoring are to extend beyond homes to cover and schools (WHO, 2018). This is because water and sanitation services are used by large numbers of people in schools. Some of these users may have particular needs or vulnerabilities (WHO, 2018). Hence the need to identify them and provide services that will enhance the learning environment. In addition, it is clear that in many instances lack of access to adequate water and sanitation facilities can lower attendance and educational achievement in schools (WHO, 2018). Since students may avoid going to schools altogether when they know that the institutions don't have adequate toilets or latrines (WHO, 2018), the findings will encourage the authority to prevent school absenteeism through appropriate policy interventions.

1.6 Scope of the study

This research was limited to assessing knowledge, attitudes and practices of students on Water, Sanitation, Hygiene, and Related Diseases in selected schools in Musanze District. Assessment of knowledge was limited to the level of knowledge on diseases related to contact with human faeces, sources of clean water, causes and prevention of selected water related diseases (cholera, Diarrhea, Shigellosis, typhoid, Trachoma and Malaria).

Assessment of hygiene practices was limited to washing hands after urinating, washing hands after defecating, washing hands before eating and frequency, washing of fruits before consumption and frequency. Attitudes on hygiene were limited to

feeling of necessity of hand washing after visiting the toilet, and level of concern about hygiene.

Assessment of student's practices towards sanitation was limited to human waste (faecal matter) disposal methods and pollution of environment by open defecation in bushes and water bodies.

All other water, sanitation and hygiene related concepts were not covered in this study due to limited time and finances.

Chapter 2: Review of the Literature

2.0 Introduction

Water, basic toilets and hygiene practices are basic needs to sustain life of people. Lack of these basic needs results in health problems and loss of lives worldwide. Despite being a global problem, developing countries suffer more than developed countries due to poverty leading to lack of water supply, hygiene and sanitation infrastructure and facilities.

The percentage of the population using improved drinking-water sources represents the measure of access to safe drinking water (WHO/UNICEF, 2012). Water used for personal hygiene, cooking, drinking, and other domestic purposes is drinking water. Safe drinking water is a safe water meeting microbiological and chemical standards on drinking water quality provided by the WHO Drinking-water Quality Guidelines (4th edition 2011) (WHO/UNICEF ,2012).Safe drinking water access is measured against the proportion of people using improved drinking sources of water. Improved sources of drinking water include rainwater collection; protected spring, protected dug well, borehole, public standpipe, and household connections. Water running in the plot, yard, or dwelling, represent on premises piped drinking water connections(WHO/UNICEF, 2012).

Improved drinking water sources adequately protect water from outside contamination, especially faecal matter, by the nature of its construction. Improved water sources include rainwater collection, protected spring, protected dug well, borehole, public stand pipe, and piped household water connection (WHO/UNICEF, 2012).Sources of unimproved drinking water include tanker truck water, bottled water, vendor-provided water (cart with small tank/drum, tanker truck), surface water (stream, canal, irrigation channel, river, dam, lake and pond,), unprotected spring, and unprotected dug well (WHO/UNICEF, 2012).

The provision of services and facilities for the safe disposal of human faeces and urine refers to sanitation (WHO, 2017).Inadequate sanitation is linked to the global burden of sanitation related diseases and improved sanitation significantly contributes to good health at household and community levels (WHO, 2017).Maintenance of hygiene through waste water and garbage collection refers to sanitation as well (WHO, 2017).

The percentage of people using improved sanitation facilities is the measure of access to sanitation (WHO/UNICEF, 2012).Improved sanitation facilities hygienically prevents human excreta from contacting people. Basic sanitation access is measured against the proportion of population using improved sanitation facilities. Improved sanitation facilities include pit latrines with a slab or covered pit, ventilated improved pit latrines, pour-flush latrines, septic system connections and sewer connections (WHO/UNICEF, 2012).Shared sanitation facilities are acceptable improved sanitation facilities shared between two or among households. Unimproved sanitation facilities do not prevent people from contacting human excreta and include disposal of human feces with other forms of solid waste, open defecation in open spaces, fields, forests, bushes, and water bodies (WHO/UNICEF, 2012).
Hygiene is conditions and practices that maintain good health and preclude the wide spread of diseases (WHO, 2017). Adequate clean water and improved sanitation and safe disposal of medical waste, hand hygiene, sterilization of equipment, and environmental cleaning constitute medical hygiene (WHO, 2017).

According to Stanwell-Smith (n.d), water-related disease is defined as any significant or widespread adverse effects on human health, such as death, disability, illness or disorders, caused directly or indirectly by the condition, or changes in the quantity or quality of any waters. Prior the advent of modern medical care, better water management helped industrialized countries decrease water related diseases (WHO, 2017).Though better water management practices have been promoted, many lives

continue to get lost due to water borne diseases (WHO, 2017).Poor people are dying in developing countries of water borne diseases, and ill-health is the result of bad hygiene practices (WHO, 2017).

Life losses due to water related diseases were preventable. Good health is the engine of development and poverty alleviation (WHO, 2017).Improvement made in water management is the best tool, all people can use to ensure the protection of their lives. Roughly 3.4 million people, particularly children, annually die from water-related diseases worldwide (WHO, 2017).Better sanitation and hygienic conditions and practices can prevent water related diseases. For example, though trachoma keeps being the leading cause of blindness, and accounting for 146 million intense cases worldwide, it is preventable (WHO, 2017). However, Trachoma is still unknown in many places where WASH predominate (WHO, 2017).

According to Michigan Technical University, diseases related to water are categorized as water related insect vectors diseases, water based, water washed, and water borne diseases. Ingesting water contaminated by faecal matter or urine containing pathogenic viruses or bacteria cause water born disease like diarrheal diseases, bacillary dysentery, amoebic dysentery, typhoid, and cholera. (Peter H. Gleick, 2002). These diseases can be prevented through improving water quality.
Inadequate personal hygiene and eye or skin contact with dirty water lead to water washed diseases like tick-borne diseases, lice, trachoma and flea, and scabies. (Gleick, 2002).Increase water access, reliability and full access coupled with good hygienic conditions and practices can prevent all washed water washed diseases (MTU,n.d).

Parasitic organisms hosted by intermediate organism living in dirty water are responsible for water based diseases. These include helminths, schistosomiasis, and dracunculiasis (Peter H. Gleick, 2002).Eating poorly cooked aquatic organisms also result in contacting water based diseases. Decreasing contamination of surface water,

and controlling population of snails can help in controlling water based diseases (MTU,n.d).

Insect vectors like mosquitos breeding in water as dengue, yellow fever, trypanosomiasis, onchocerciasis, malaria, and filariasis are responsible for water related diseases (Gleick, 2002).Using mosquito nets, and destroying breeding sites is the best way to control water related diseases(MTU,n.d).

A study on knowledge, attitude and practices on WASH conducted in different schools in South Africa confirmed the level of knowledge about waterborne diseases to be relatively high. However, knowledge on transmission pathways was found inadequate (Jerry and Jabulani, 2013). According to the same study, majority of respondents had no knowledge of water based diseases causes and prevention. Luckily, it was noted in the study that attitude and practices towards hygiene was high. A disparity in access to hygiene facilities was noted across rural and urban schools (Jerry and Jabulani, 2013). Hand washing facilities were available in urban schools, though with no soap. Schools in rural areas had inadequate water supply and sanitation facilities, had no sanitary bins for girls and had no handwashing facilities. (Jerry and Jabulani, 2013).Privacy was noted to be an issue as some schools in rural areas had toilets with broken doors. Water shortage observed in rural areas might lead to students to consuming unsafe water with possibility of contacting water related diseases. (Jerry and Jabulani, 2013).

At the end of 2015, a gap in achieving millennium development goals on water had been observed between Sub-Saharan African and Northern Africa (UN, 2014). Sub-Saharan Africa, and Northern Africa had differently achieved MDG goals on water despite being the same continent (UN, 2014).The coverage of 92% had been achieved in North Africa, and Northern Africa was on track to meet its target of 94% before 2015 (UN, 2014).

However, 40% of the 783 million people in Sub-Saharan Africa still had not access to improved source of drinking water and the region was on track to meet MDG on water with only16% of water coverage. With that slow pace, it was noted that Sub-Saharan did not achieve the target of 75% which had been set for the region (UN, 2014).

Analysis of data from 35 countries in Sub-Saharan Africa, which represents 84% of the region's population showed a big disparity between the poorest and the richest in both rural and urban areas (UN, 2014).About 90% of the richest in urban areas had access to improved water sources and 60% of them had piped water on premises (UN, 2014). In rural areas, there was no piped water, and less than half of the population used any form of improved water sources in the years 2012 (UN, 2014).

Considering all results, Africa as whole poorly performed towards MDG achievements by 2015.Poor performance towards MDG on sanitation was observed in Africa by 2015 as well (UN, 2014).Though a water coverage of 90% had been achieved in Northern Africa, only 30% coverage had been recorded in Sub- Saharan Africa with only 4% increase from the year 1990(UN, 2014).This is a big issue since lack of basic sanitation lead people to practice unsanitary activities in waste water disposal,solid waste disposal, and open defecation practices all which are associated with severe health issues (UN, 2014) . Open defecation practice alone, is responsible for faecal oral transmission of diseases affecting children primarily (UN, 2014).

Generally in Africa and Sub-Sahara Africa in particular, health complications leading to deaths were recorded though efforts and approaches to sustain and extend WASH services and systems were in place (UN, 2014).The central and Western part of Africa recorded the highest mortality rate of under five years children in all developing regions due to serious water and sanitation issues. The death rate was recorded to be 191 child deaths per 1,000 live births. The prevalence of cholera in rural and urban areas marked the poor state of basic living conditions in the region (UN, 2014).

Rapid population growth coupled with rural-urban migration is the major challenge of WASH systems and services in Africa. The increasing population has driver higher the water demand which later resulted in degradation of water resources in many parts of Africa (UN, 2014).Urban slums are projected to double to around 400 million by 2020, and despite efforts of some countries to expand basic services and improving housing conditions in urban areas, unplanned rapid urban growth had increased the number of unstable settlements in flood prone zones (UN, 2014).

Water access in Africa has been impeded by poverty and economic development. Sub-Saharan Africa is the poorest worldwide (UN, 2014).Poverty in Sub-Saharan Africa has prevented communities to provide adequate WASH services sufficient to foster economic activities and maintain water quality (UN, 2014).

In addition to lack of human capacities, financial and institutional capacities to manage water resources, Africa has economic water scarcity (UN, 2014).Solving water related issues in Africa is being competed funding other public sectors in addition to heavy debt burden in most African countries (UN, 2014).

The Rwandan Ministry of Health through Rwanda Biomedical Centre (RBC) has alerted Rwandans about deadly food and waterborne diseases (RBC, 2017). Deadly food and waterborne diseases outbreaks could occur any moment usually because of poor sanitation; lack of suitable conditions to prepare food lack of safe water, and lack of toilet facilities (RBC, 2017). Rwanda has made tremendous efforts in achieving Millennium Development Goals on Water and Sanitation. According to UNDP report of 2013, 74.5% of Rwandans were using improved sanitation and Rwanda had achieved the targets. However, only 74.2% of Rwandans had access to improved drinking water sources against 82% which had been set as target. Public investment in water sector coupled with localization of water and sanitation services helped

Rwanda achieve impressive progress. Most water and sanitation infrastructure were being managed and distributed by Districts (UNDP Rwanda, 2015).

Rwanda made a notable progress in water and sanitation coverage across the country to achieve MDGs targets on access to basic sanitation and safe drinking water, which was by 2015, to reduce by half the amount of population without access to sustainable basic sanitation and safe water. However, researches on knowledge, attitude and practices on water, sanitation, hygiene and related diseases in schools, and where water related disease outbreak can occur has not yet been done. Proper water and sanitation practices across communities can increase resilience to waterborne disease risks. The introduction of sanitation measures such as safe water piping materials and storage, sanitary sewage disposal, and education on hygienic practices and behaviors in all communities can reduce incidences of water borne diseases (WHO, 2017).

2.1. Water and Sanitation in Rwanda

According to the UNDP report of 2013, Rwanda had maintained a steady increase in access to clean drinking water sources since 2000 and Rwanda was very likely to achieve its 82% target set for 2015 (UNDP Rwanda, 2013). Figure 3.2 shows the improvement in access to clean drinking water in Rwanda from 2000 to 2015.

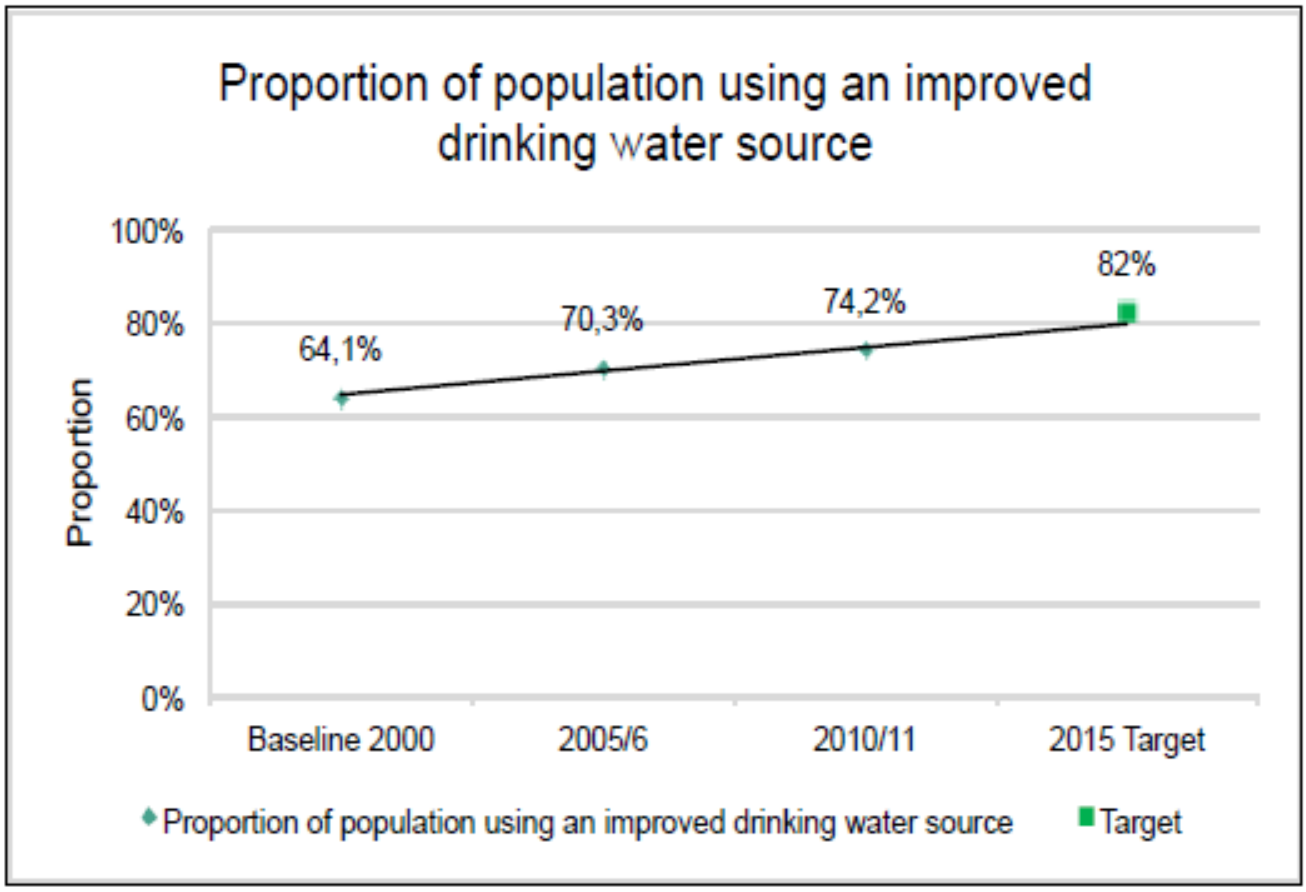


Figure 2.1 Proportion of population using an improved drinking water in Rwanda

Source: Millennium Development Goals Rwanda Final Progress Report: 2013

2.1.1 Access to Safe Drinking Water by Province

Overall, between 2005 and 2011, Rwanda had made progress in water supply coverage. Provincial comparisons as can be seen in Figure 3.3 showed Eastern Province, which is predominantly rural as having made the most gains in access between 2005 and 2011, followed by Western and Northern Provinces which also are largely rural(UNDP Rwanda, 2013).

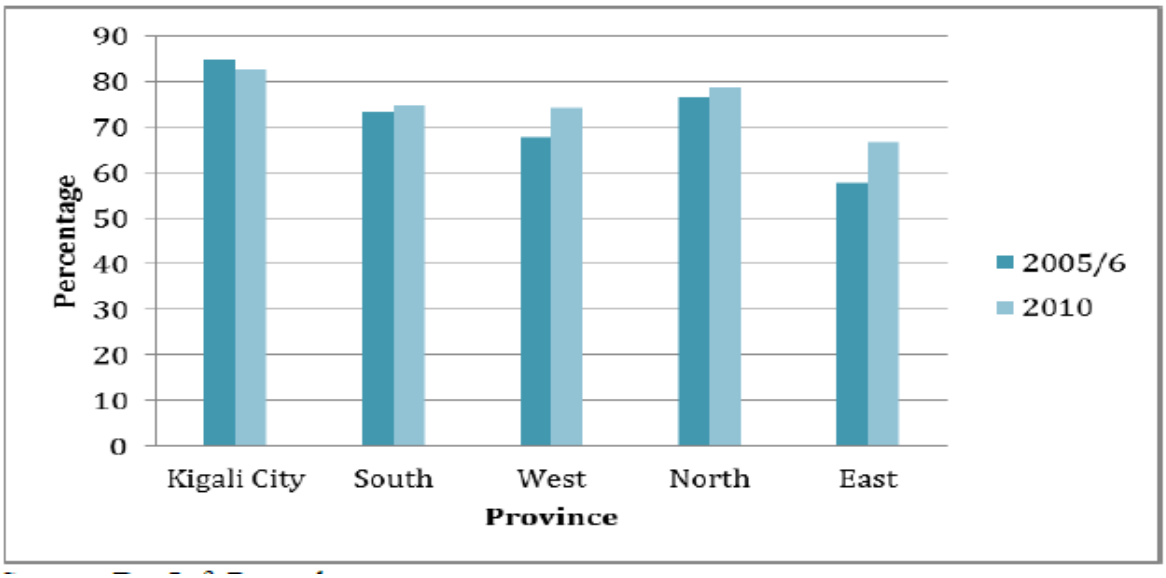


Figure 2.2 Access to Safe Drinking Water by Province(2005-2010)

Source:Millennium Development Goals Rwanda Final Progress Report: 2013

3.1.2 Access to Safe Drinking Water by District

Generally, in 2013 as shown in Figure 3.4 access to safe drinking water by district coverage was between 40% and 92%. Musanze District which is the case study of this research had achieved around 77% of access to safe drinking water (UNDP Rwanda, 2013).

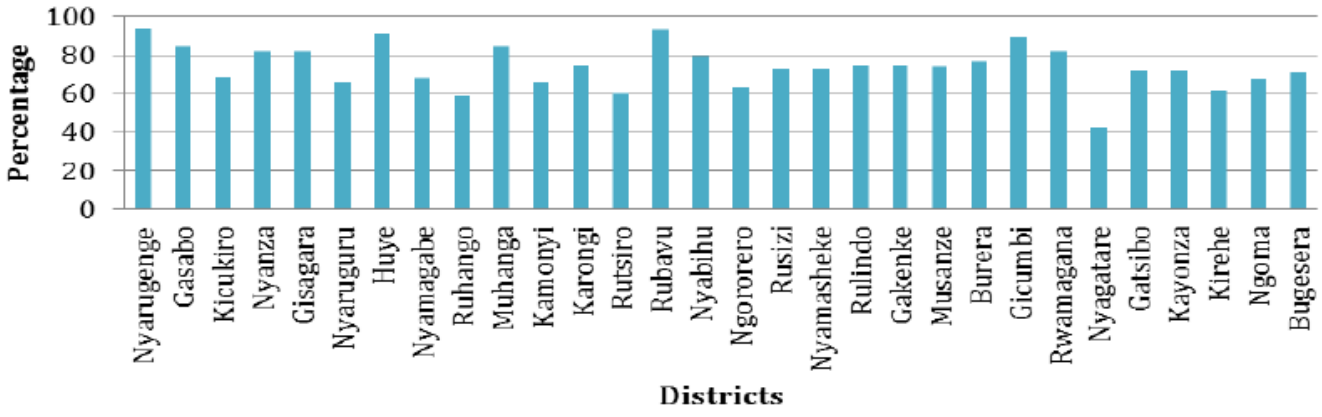


Figure 2.3 Access to Safe Drinking Water by District

Source: Millennium Development Goals Rwanda Final Progress Report: 2013

2.1.3 Proportion of population using an improved sanitation facilities

Overall, Rwanda showed an increase in providing improved sanitation facility and achieved the target of 74.5% by 2015 compared to 51.5% in 2000 as shown in Figure 3.5.

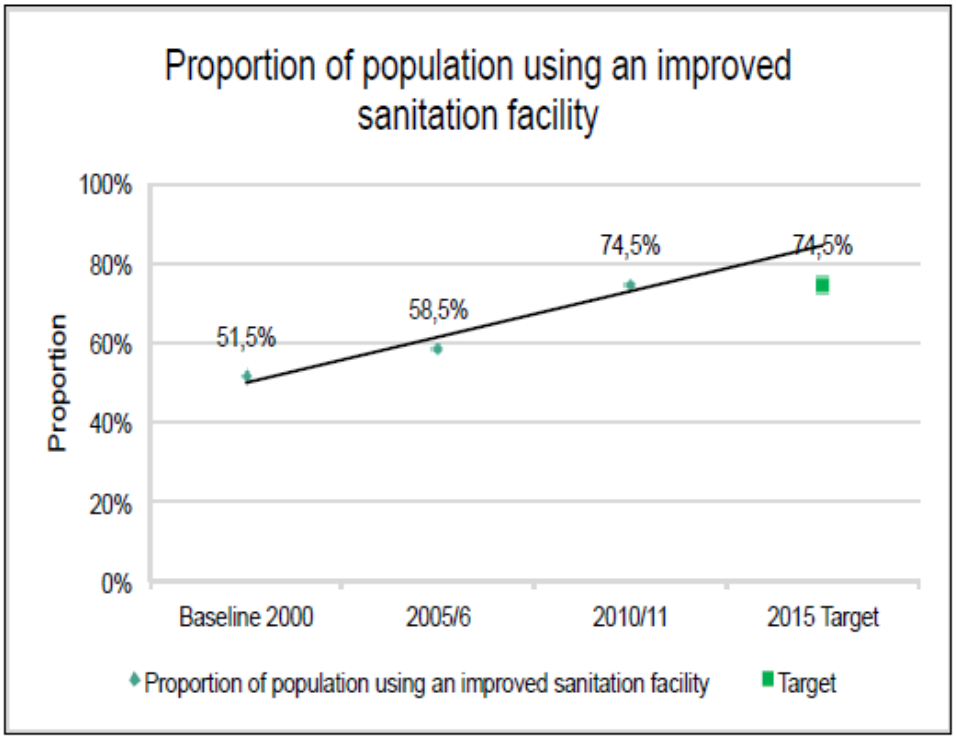


Figure 2.4 Proportion of population using improved sanitation facilities

Source: Millennium Development Goals Rwanda Final Progress Report: 2013

2.1.4 Access to Improved Sanitation Facilities by Province

Overall, Rwanda increased improved sanitation facilities in all 5 provinces between 2005 and 2011. Nothern Province, were Musanze District is located had around 76% of coverage as shown in Figure 3.6.

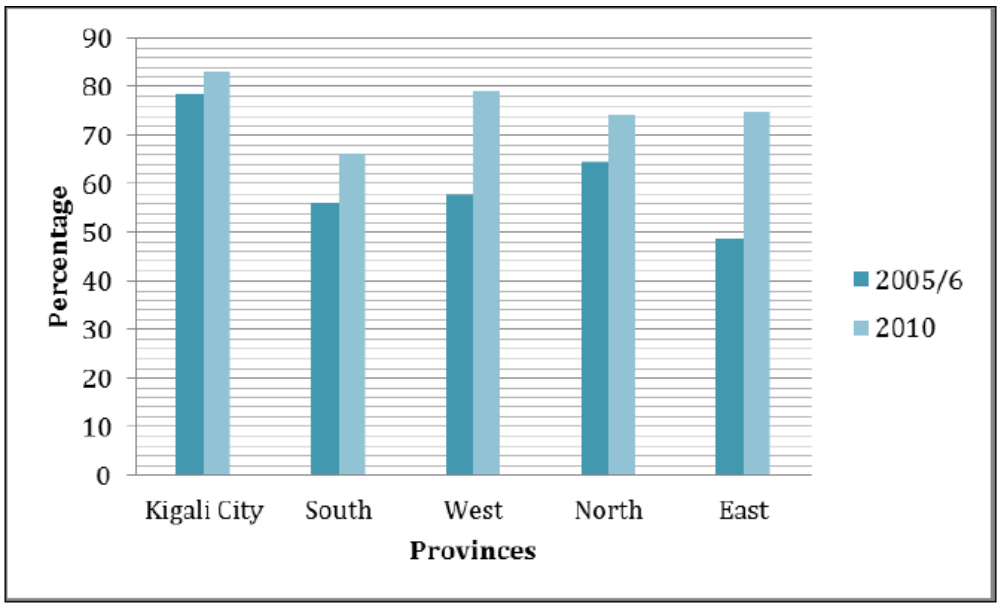


Figure 2.5 Accesses to Improved Sanitation Facilities by Province

Source: Millennium Development Goals Rwanda Final Progress Report: 2013

From 1990 to 2015 Rwanda achieved increase in water and sanitation coverage as showed in both table 3.2 and 3.3.This increases was reflected countrywide including Musanze District.

Table 2.1 Water and Sanitation coverage in Rwanda (1990-2015)

URBAN WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	85%	19%	66%	6%	9%
1995	85%	21%	64%	7%	8%
2000	86%	23%	63%	7%	7%
2005	86%	24%	62%	8%	6%
2010	86%	26%	60%	9%	5%
2015	87%	28%	59%	9%	4%

URBAN SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	61%	25%	11%	3%
1995	61%	25%	12%	2%
2000	60%	25%	13%	2%
2005	60%	24%	14%	2%
2010	59%	24%	16%	1%
2015	59%	24%	16%	1%

RURAL WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	57%	0%	57%	17%	26%
1995	60%	0%	60%	17%	23%
2000	63%	0%	63%	17%	20%
2005	66%	1%	65%	17%	17%
2010	69%	1%	68%	17%	14%
2015	72%	2%	70%	17%	11%

RURAL SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	32%	4%	56%	8%
1995	38%	5%	50%	7%
2000	44%	6%	45%	5%
2005	50%	7%	39%	4%
2010	57%	7%	33%	3%
2015	63%	8%	27%	2%

TOTAL WATER					
Estimated coverage 2015 update					
Year	Total improved	Piped onto premises	Other improved	Other unimproved	Surface water
1990	58%	1%	57%	17%	25%
1995	62%	2%	60%	16%	22%
2000	66%	4%	62%	16%	18%
2005	70%	5%	65%	15%	15%
2010	73%	7%	66%	15%	12%
2015	76%	9%	67%	15%	9%

TOTAL SANITATION				
Estimated coverage 2015 update				
Year	Improved	Shared	Other unimproved	Open defecation
1990	33%	5%	55%	7%
1995	40%	7%	47%	6%
2000	47%	9%	39%	5%
2005	52%	10%	34%	4%
2010	57%	11%	29%	3%
2015	62%	13%	23%	2%

Source: WHO/UNICEF (2015).Joint Monitoring Programme for Water Supply and Sanitation.Estimates on the use of water sources and sanitation facilities.

Table 2.2 Water and sanitation coverage (2018)

SANITATION	%	WATER	%
Proportion of population using improved sanitation facilities (%)	62	Proportion of population using a piped drinking water supply on premises (%)	9
Proportion of population using shared sanitation facilities (%)	13	Proportion of population using another improved drinking water source (%)	67
Proportion of population using other unimproved sanitation facilities (%)	23	Proportion of population using an unimproved drinking water source other than surface water (%)	15
Proportion of population practicing open defecation (%)	2	Proportion of population using a surface water source (%)	9

Sources: https://data.unicef.org/country/rwa/

2.1.5 Inventory of Cholera outbreak, risk factors, and seasonality in Rwanda.

According to Rwanda Biomedical Center, the Cholera outbreak predominated mostly western parts the country. From 2010 through 2015, a total of 285 cases and 3 deaths from fifteen outbreaks were recorded. Particularly, in 2015, nine cases and one death were reported in Musanze district (table 3.4). In 2016, and 2017, Rubavu District Hospital confirmed other 2 cases in Rubavu District. The cholera outbreak map (figure 3.7) shows that Musanze district as one of the five districts with incidents of the outbreak. Figure 3.8 shows seasonality of cholera outbreak in Rwanda from 2010 to 2015. Most of the outbreaks between 2011 and 2015 happened during the rainy season. The risk factors in Table 3.5 associated with cholera outbreak include poor hygiene around the house, use of non-

chlorinated water, lack of a latrine, using of unboiled and untreated water, lack of clean running water, and living in poor hygienic conditions.

Table 2.3 Cholera outbreaks inventory from 2010 --- November 2015

No	Period	Health ccenter	District hospital	District	Number of Cases	Number of deaths	Etiology Identified
1	21/4/2010	Nkombo	Gihundwe	Rusizi	48	0	Not recorded
2	24/10/201	Shyara	Kibogora	Nyamasheke	14	0	Not recorded
3	13/2/2012	Busasamana	Gisenyi	Rubavu	13	0	Vibio
4	29/05/201	Nkamira	Gisenyi	Rubavu	8	0	Vibio
5	10/10/201	Kinunu and	Murunda	Rutsiro	52	0	Vibio
6	29/11/201	Nkombo	Gihundwe	Rusizi	11	0	Vibio
7	16/6/2013	Nkombo	Gihundwe	Risizi	5	0	Vibio
8	20/8/2013	Nkombo	Gihundwe	Rusizi	39	0	Vibio
9	4/10/2013	Bugarama	Mibilizi	Rusizi	8	0	Vibio
10	2/2/2014	Mukoma	Bushenge	Nyamasheke	10	0	Vibio
11	3/4/2014	Mwezi	Bushenge	Nyamasheke	12	0	Vibio
12	4/4/2015	Ruhengeri	Ruhengeri	Musanze	9	1	Vibrio
13	25/7/2015	Mashesha	Mibilizi	Rusizi	1	0	Vibio
14	25/7/2015	Kibingo	Kibogora	Nyamasheke	34	1	Vibio
15	23/10/201	Gihombo,Ki	Kibogora	Nyamasheke	20	1	Vibio
16	July 2016		Gisenyi	Rubavu	60	3	No details
17	July 2017		Gisenyi	Rubavu	8	None	No details

Source: Rwanda Biomedical Center (2015): Cholera outbreak inventory, seasonality and risk factors.

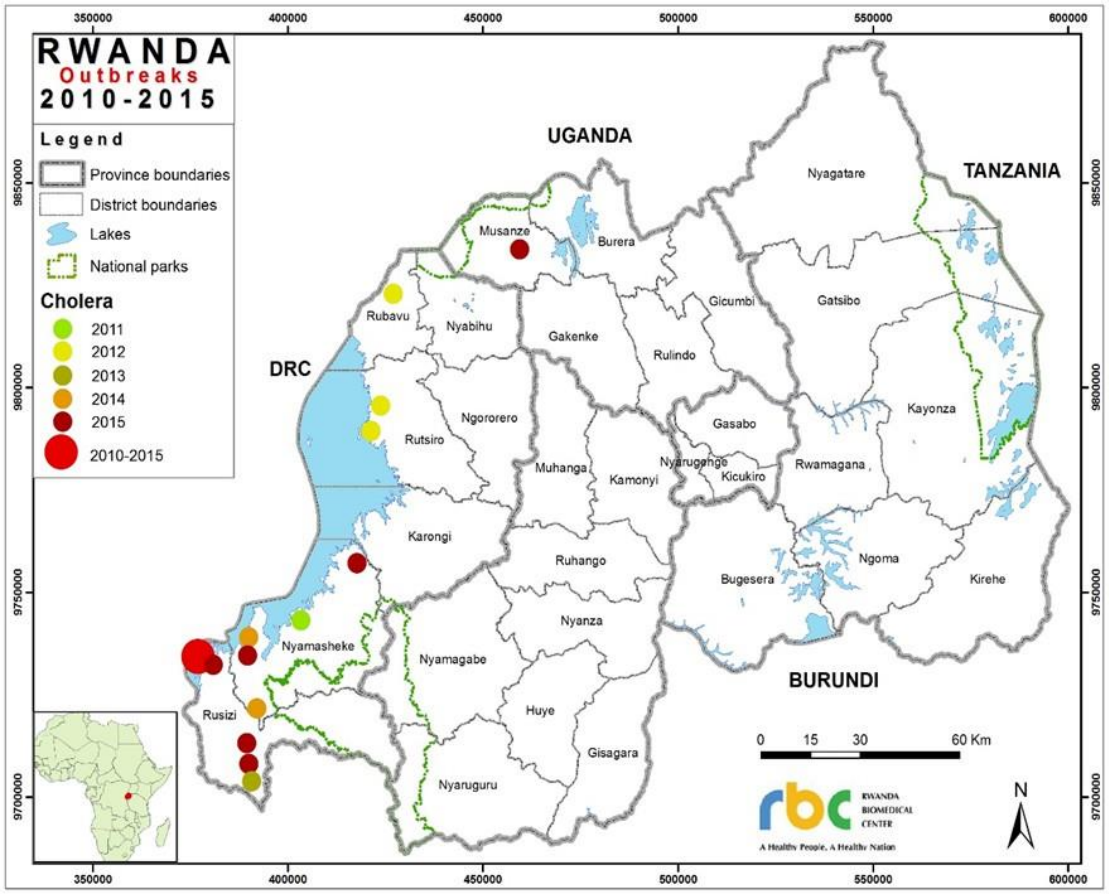


Figure 2.6 Cholera outbreak coverage map

Source: Rwanda Biomedical Center (2015): Cholera outbreak inventory, seasonality and risk factors.

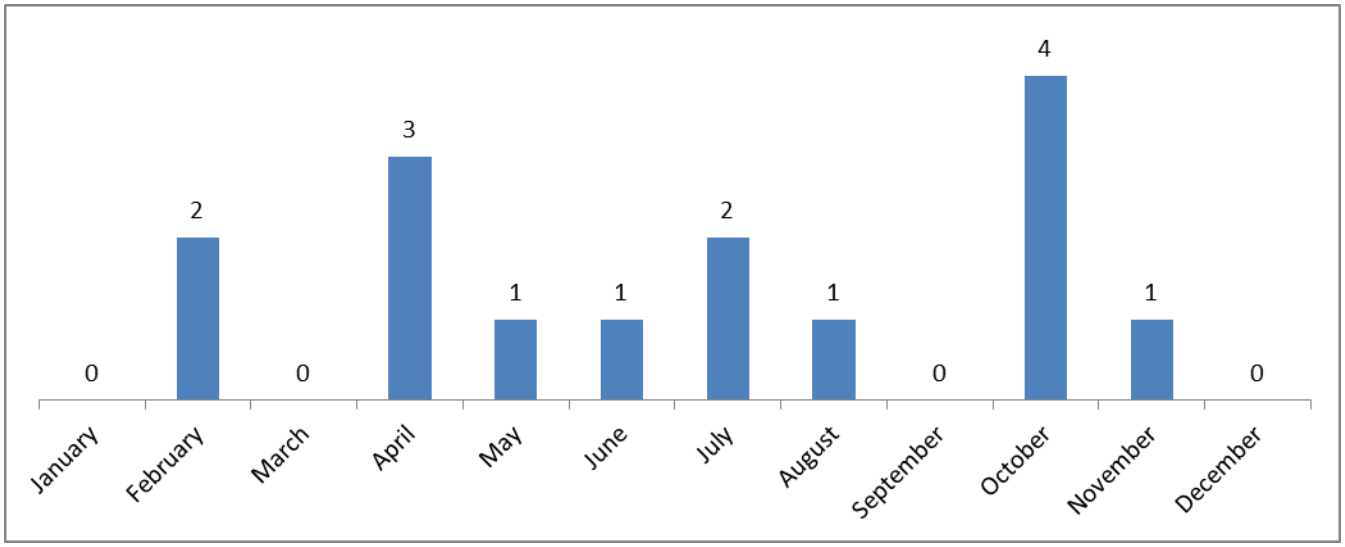


Figure 2.7 Seasonality of cholera outbreak in Rwanda from 2010 to 2015

Source: Rwanda Biomedical Center (2015): Cholera outbreak inventory, seasonality and risk factors.

Table 2.4 Summary of cholera outbreak risk factors

Location and period	Identified risk factors
Risuzi ,Nkombo, 2010	Having used Kivu Lake water as source of drinking water Having an occupation at the Kivu Lake (fisherman) Having been contacted with a case of diarrheal
Nyamasheke, Kagano, Oct 2011	Drink Kivu Lake water due to the broken and damaged water taps
Rutsiro, Kinunu, Oct. 2012	Living in poor hygienic conditions, Lack of clean running water (Use Kivu Lake water) Using of unboiled and untreated water. Lack of latrine (Many Households shared 1 latrines) Substandard latrine that can Kivu Lake during torrential rain.
Rusizi, Nkombo,Dec.2012	Lack of latrine Fishermen use Lake Kivu as latrine Poor hygiene habits Non-functioning water taps

Rusizi, Nkomba,Dec 2012	Use of non-chlorinated water Poor hygiene around the house Inappropriate latrine
Rusizi, Nkombo, Aug 2013	Use of non-chlorinated water Poor hygiene around the house Inappropriate latrine
Rusizi, Nkombo, Sep 2013	Poor hygienic condition of communities Improper pit latrines Using untreated water from lake Kivu for drinking and washing utensils
Nyamasheke, Mwezi, March 2014	All visited households don't have standard pit latrines; Drink untreated/ non boiled water and Lack of the basic measures of hygiene including hand washing before and after using toilets
Rusizi, Gihundwe,Feb.2014	Lack of clean water,(Absence d'eau de Rwiyemezamirimo il avait 2 semaines Drink Lake Kivu water Water is expensive even when available (20RwF a jerrican)
Nyamasheke,Mwezi, April 2014	Lack of latrines Poor hygiene
Musanze, April 2015	Imported Cholera form DRC(Congolese visitors to a Rwandan families)
Nyamasheke, Gihombo, July 2015	Lack of drinking water supply (from March 2015) Lack of latrines and adequate latrines (some don't have ,others have inadequate latrines: no roof, no pit cover,) Use of unboiled and untreated water (Lake kivu and Gaseke river) Lack of washed hands habit Presence of human excrements around the house, pathway and in the
	lake and river. Poor socio-economic condition

Rusizi, Mibilizi, July 2015	• Rusizi District has 18 sectors, 3 of them have been subject of diarrhea cases in the past due to ecological and geographical parameters (wetland and Kivu lake polluted water) • There are 36 adductions of water in Rusizi including 3 for WASAC. Almost all adductions of the district are not maintained adequately which leads to frequent shortage of water in the area • There is insufficiency of clean water in the 4 sectors affected by acute watery diarrhea • Most of people are using polluted water from rivers • In the area where clean water is available, the population prefer to use river water since public tap water is no longer free of charge (WASAC recommended price is 10 RwF per 1 Jerican at
Rusizi . Mururu, March 2015	Poor hygiene Use of unclean water
Nyamasheke,Kinanira, Nov,2015	Lack of clean water, lake Kivu is the only source of water Total lack absence of latrine

Source: Rwanda Biomedical Center (2015): Cholera outbreak inventory, seasonality and risk factors.

Chapter 3: Methodology

3.0 Introduction

This research was conducted in six (6) randomly selected schools in Musanze Dsitrict, Northern Province, Rwanda. Data were collected using questionnaires and analyzed using Statistical Package for the Social Sciences (SPSS).

3.1 Study area

The research was conducted in Musanze District, Rwanda. Rwanda is geographically located in Central Africa between 1°04'and 2°51' south latitude, and between 28°45'and 31°15' East longitude. Rwanda is a land-locked country, bordered by Burundi in the South; Tanzania in the East; Uganda in the North and the Democratic Republic of the Congo in the West. The borders of Rwanda stretched up to 900 kilometers (MIDIMAR, 2015). The country's administrative division comprises of five provinces: Northern Province, Western Province, Southern Province, Eastern Province and the City of Kigali. Rwanda is divided into 30 districts. Musanze District is one of the 30 districts. It is located in Northern Province in the northern part of Rwanda (MIDIMAR, 2015).

The population of Rwanda was 10,515,973, of which 52% are women and 48% men based on the 2012 Census. Table 3.1 shows the distribution of population in the Northern Province of Rwanda while Figure 3.1 shows the administrative map of Rwanda. Since the 2002 Census, the population has increased by 2.4 million, which has represented an average annual growth rate of 2.6%.The population of Rwanda is still largely rural, with 83% living in rural areas (MIDIMAR, 2015).

Table 3. 1 Distribution of population of Northern Province by District, Sex and Density (2012)

Districts	Both sexes	Male	Female	% of female	Population share (% of the total population)	Density (Inhabitants per square km)
Rwanda	**10,515,973**	**5,064,868**	**5,451,105**	**51.8**		**415**
Northern Province	**1,726,370**	**818,456**	**907,914**	**52.6**	**100**	**527**
Rulindo	287,681	135,625	152,056	52.9	16.7	507
Gakenke	338,234	159,366	178,868	52.9	19.7	480
Musanze	**368,267**	**174,399**	**193,868**	**52.6**	**21.4**	**694**
Burera	336,582	160,395	176,187	52.3	19.4	522
Gicumbi	395,606	188,671	206,935	52.3	22.8	477

Source: Rwanda 4th Population and Housing Census, 2012 (NISR)

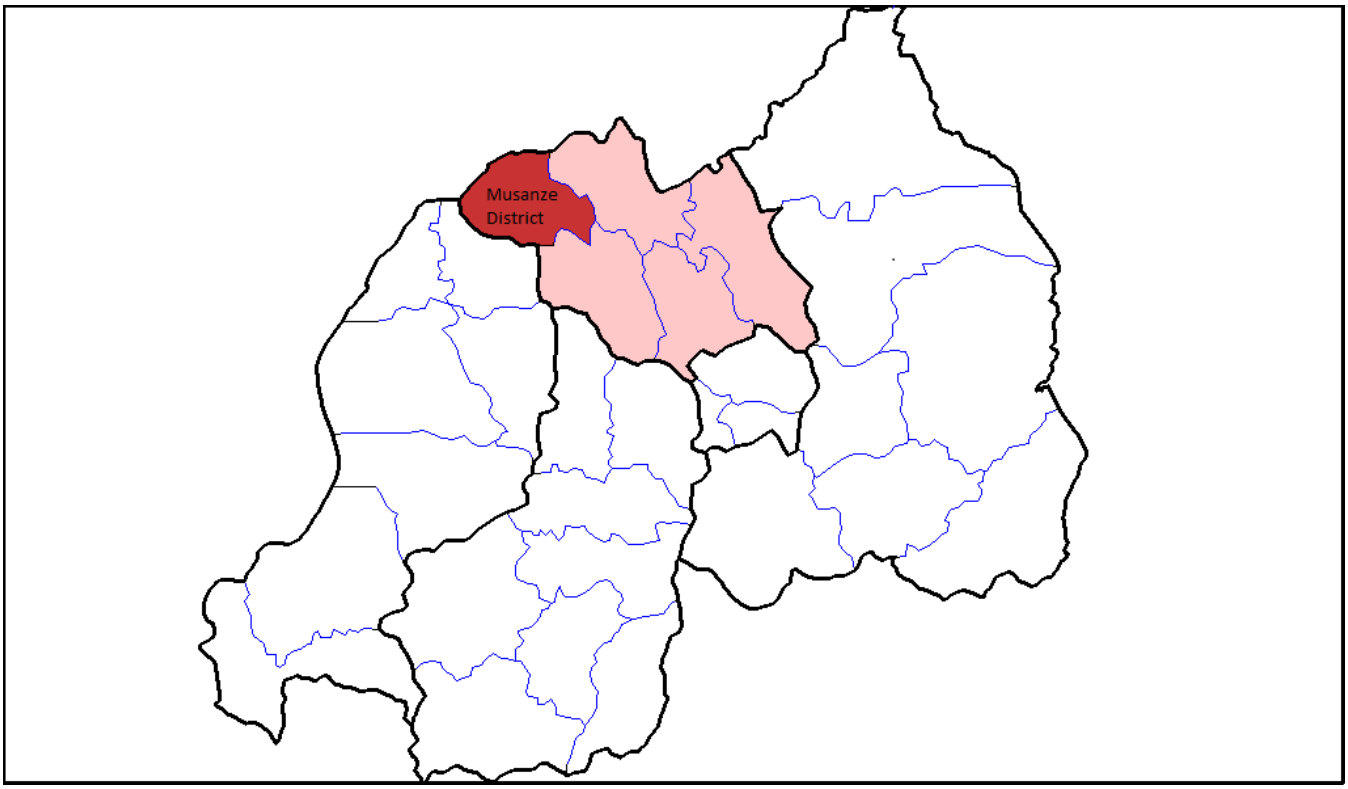


Figure 3. 1 Administrative Map of Rwanda

Source: Steve Rwanda (2007)

3.2 Research design

This research used qualitative primary data. Qualitative research design was used because nominal data on knowledge, attitude and practices are categorical variable which will always be qualitative.

3.3 Population &Target Population

Students in 6 selected school (3 rural and 3 urban) constituted a population. The research targets were students aged between 12 and 15 years.In all the 2900 students in the 6 schools constituted the population. Furthermore, 6 teachers and 6 school directors were selected to participate in survey.

3.3.1 Sample size & Sample Determination

Krejcie and Morgan (1970) table was used to determine sample size as we have finite population size. Sample from each school were selected using Krejcie and Morgan (1970) table and all samples were summed up to 1173 students who participated in this study. Estimation of sample size using Krejcie and Morgan method is commonly employed (Chuan, 2006). Krejcie and Morgan (1970) used the formula below to determine sample size (academia.edu, 2018) from which the table was derived (Chuan, 2006).

$$\mathrm{n} = \frac{X^2 * N * P * (1 - P)}{(ME^2 * (N - 1) + (X^2 * P * (1 - P))}$$

Where

n= Sample size,

X^2=Chi-Square for the specified confidence level at 1 degree of freedom

N=Population size

P=Population proportion

ME=Desired Margin of Error or degree of accuracy (Expressed as proportion at 0.05)

Tables 3.6 and 3.7 show the sampling frame and the sample sizes for all schools respectively.

Table 3.2 Sampling frame for the research

Target Population	Total Population	Sample size	Sampling method
Students aged between 12-15 years	2900	1173	Random sampling
School Directors	6	6	Purposive sampling
Teachers who have been at school at least for two years	6	6	Random sampling
Grand total	**2912**	**1185**	

Table 3.3 School participation, population and corresponding sample size

Name of School	Location of school	Population size	Sample size
Esc.Musanze	Urban	208	136
GS.Muhoza II	Urban	695	248
ESSA Ruhengeri	Urban	140	103
GS.NYANGE	Rural	570	226
GS.KAMPANGA	Rural	912	269
GS.GAKORO	Rural	375	191
Grand Total		**2900**	**1173**

3.4. Data collection Instruments

Data were collected using a questionnaire which was divided into three parts and one additional check list form. The first part of the questionnaire was answered by students, the second part by school directors (or any school official representing the director) and the third part of the questionnaires was answered by selected teachers. Additionally, a check list from was filled in when recoding observations related to water, sanitation and hygiene at each school.

3.5 Data Processing and Analysis

Microsoft Office 2016 was used in data entry and Statistical Package for the Social Sciences (SPSS) was used in Data Analysis.

3.6 Ethical considerations

Names of students, directors and teachers who participated in the research were kept confidential. They were given a full explanation on the purpose of the research showed the introduction letter. Their participation in the research was voluntary, and they responded to questions they wanted or were comfortable to answer.

3.7Data Validity and Reliability

To ensure data validity and reliability, questionnaires were translated in Kinyarwanda to help respondents understand and answer the questions. Before being administered to all respondents, the questionnaire was pre-tested to collect views on questions format, wording or to identify and remove any difficulty related to the way the questionnaire had been prepared.

3.8 Hypothesis Testing

To test hypotheses, Z-test is suitable when results are proportions (LaMorte, 2017; University of Washington, 2018). Two-sample Z-test for the difference between proportions was performed in this study. The formula for calculating Z is here below.

$$z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\bar{p}\bar{q}\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}} \quad \hat{p}_1 = \frac{x_1}{n_1} \qquad \text{and} \qquad \hat{p}_2 = \frac{x_2}{n_2}$$

$$\bar{p} = \frac{x_1 + x_2}{n_1 + n_2} \quad \text{and} \quad \bar{q} = 1 - \bar{p}$$

With

n_1 = size of rural sample (226 + 269 +191) = 686

n_2 = size of urban sample (136 + 248 +103) = 487

x_1 = number of counts/success in rural schools

x_2 = number of counts /Success in the urban school

$\bar{p}$ = weighted estimate for p_1 and p_2

$\hat{P}_1$=the proportion of success in sample 1

$\hat{P}_2$=The proportion of success in sample 2

Chapter 4: Findings

4.0 Introduction

The analysis of data was based on research objectives, research questions and the set of hypotheses. All of the above were reflected in questionnaires which respondents answered.

The analysis was done using a statistical Package for Social Sciences (SPSS, version 25), a package used for logical batched and non-batched statistical analysis. The results of the analysis are summarized in Tables 4.1 to 4.20 and Figures 4.1 – 4.17.

4.1 Sex and schools location

Table 4. 1 Sex and schools location

			Gender		
			Female	Male	Total
Location of school	Rural	Count	383	303	686
		%	55.8%	44.2%	100.0%
	Urban	Count	281	206	487
		%	57.7%	42.3%	100.0%
Total		Count	664	509	1173
		%	56.6%	43.4%	100.0%

4.2 Students' hygiene practices

4.2.2. Washing of hands after urinating

Table 4. 2 Washing hands after urinating

			1.Washing hands after urinating			
			No	No answer	Yes	Total
Location of school	Rural	Count	364	7	315	686
		% within location of school	53.1%	1.0%	45.9%	100.0%
	Urban	Count	225	10	252	487
		% within location of school	46.2%	2.1%	51.7%	100.0%
Total		Count	589	17	567	1173
		% within location of school	50.2%	1.4%	48.3%	100.0%

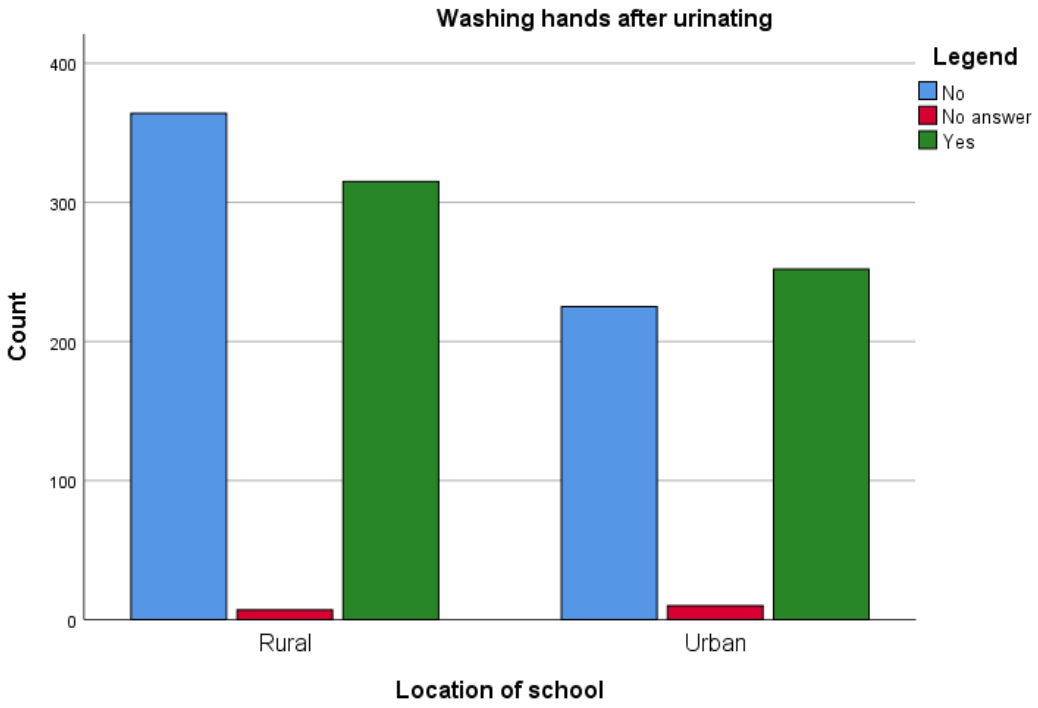


Figure 4. 1Washing hands after urinating

4.2.3. Washing of hands after defecating

Table 4. 3 Washing of hands after defecating

			2.Washing hands after defecating			
			No	No answer	Yes	Total
Location of school	Rural	Count	267	4	415	686
		% within location of school	38.9%	0.6%	60.5%	100.0%
	Urban	Count	166	2	319	487
		% within location of school	34.1%	0.4%	65.5%	100.0%
Total		Count	433	6	734	1173
		% within location of school	36.9%	0.5%	62.6%	100.0%

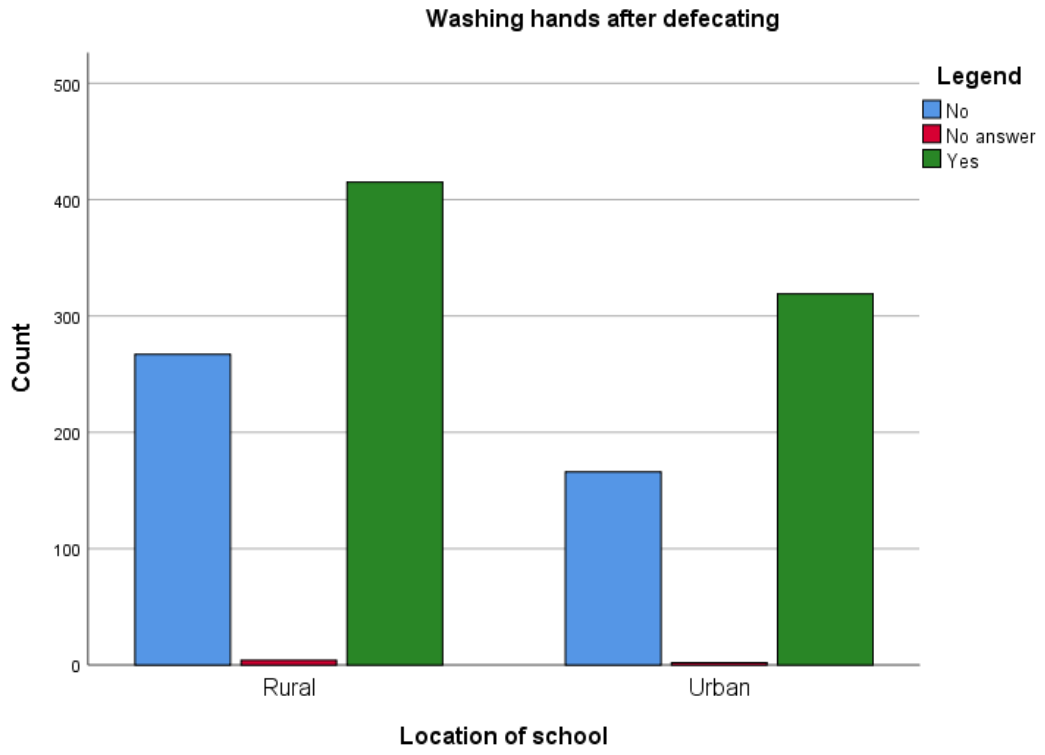


Figure 4. 2 Washing hands after defecating

4.2.4. Washing of hands before eating

Table 4. 4 Washing hands before eating

			Washing hands before eating			
			No	No answer	Yes	Total
Location of school	Rural	Count	58	4	624	686
		% within location of school	8.5%	0.6%	91.0%	100.0%
	Urban	Count	56	1	430	487
		% within location of school	11.5%	0.2%	88.3%	100.0%
Total		Count	114	5	1054	1173
		% within location of school	9.7%	0.4%	89.9%	100.0%

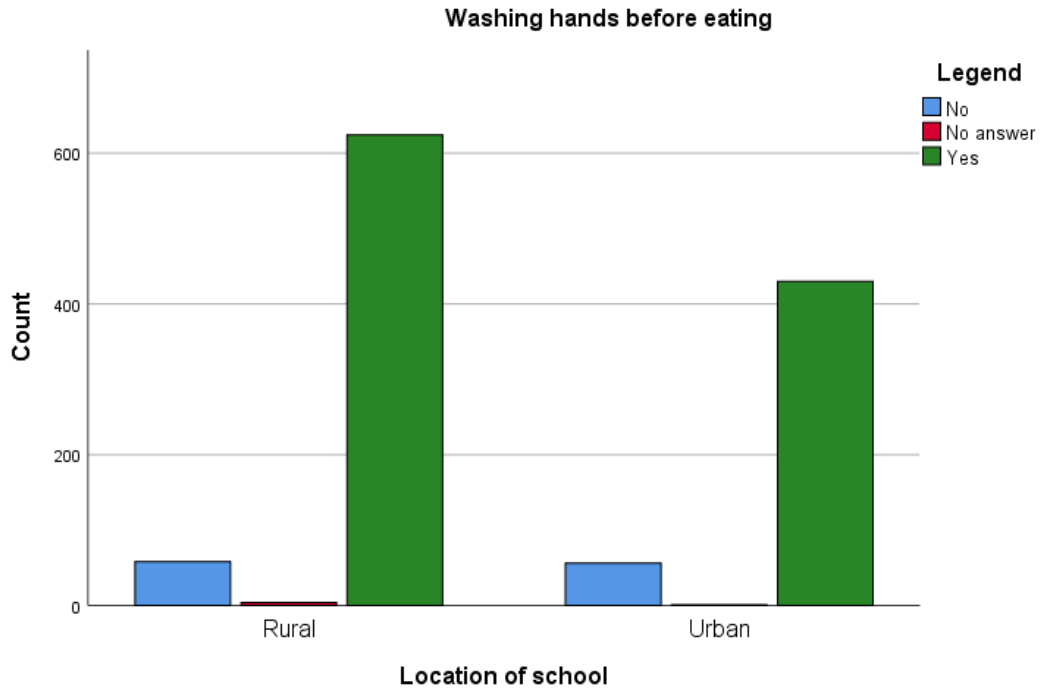


Figure 4. 3Washing hands before eating

4.2.5. Frequency of washing of hands before eating

Table 4. 5 Frequency of washing of hand before eating

			4.Frequency of washing hand before eating			
			Always	No answer	Sometimes	Total
Location of school	Rural	Count	243	8	435	686
		% within Location of school	35.4%	1.2%	63.4%	100.0%
	Urban	Count	196	20	271	487
		% within Location of school	40.2%	4.1%	55.6%	100.0%
Total		Count	439	28	706	1173
		% within Location of school	37.4%	2.4%	60.2%	100.0%

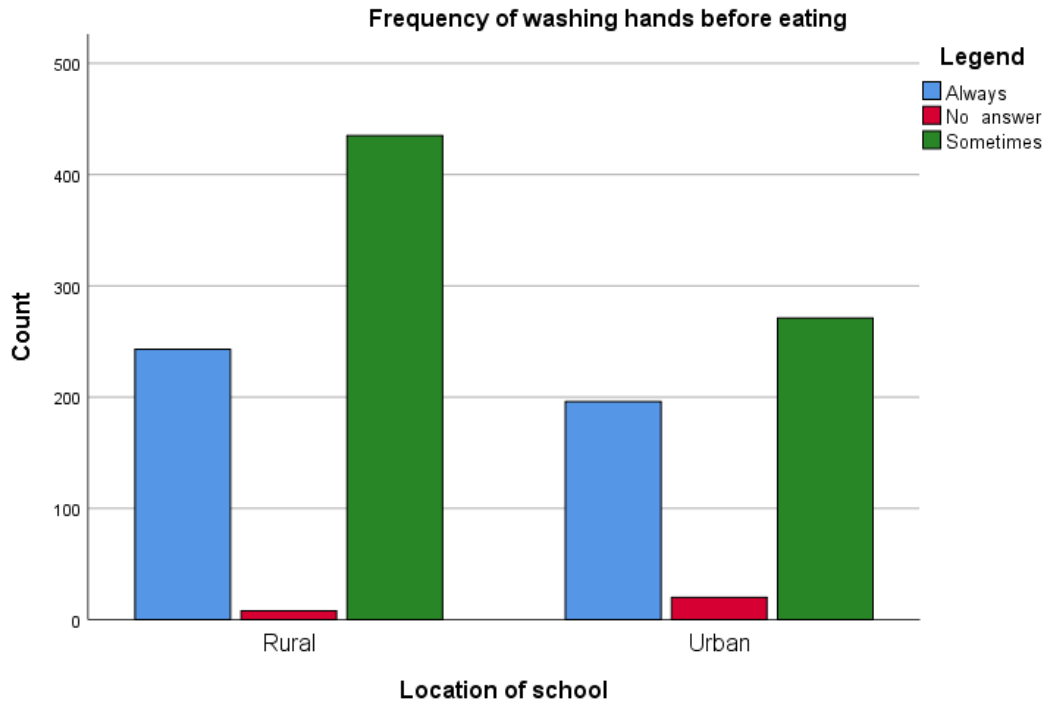


Figure 4.4Frequency of washing hand before eating

4.2.6. Frequency of washing of fruits before consumption

Table 4. 6Frequency of washing fruits before consumption

			5.Frequency of washing fruits before consumption			
			Always	No answer	Sometimes	Total
Location of school	Rural	Count	140	243	303	686
		% within Location of school	20.4%	35.4%	44.2%	100.0%
	Urban	Count	263	42	182	487
		% within Location of school	54.0%	8.6%	37.4%	100.0%
Total		Count	403	285	485	1173
		% within Location of school	34.4%	24.3%	41.3%	100.0%

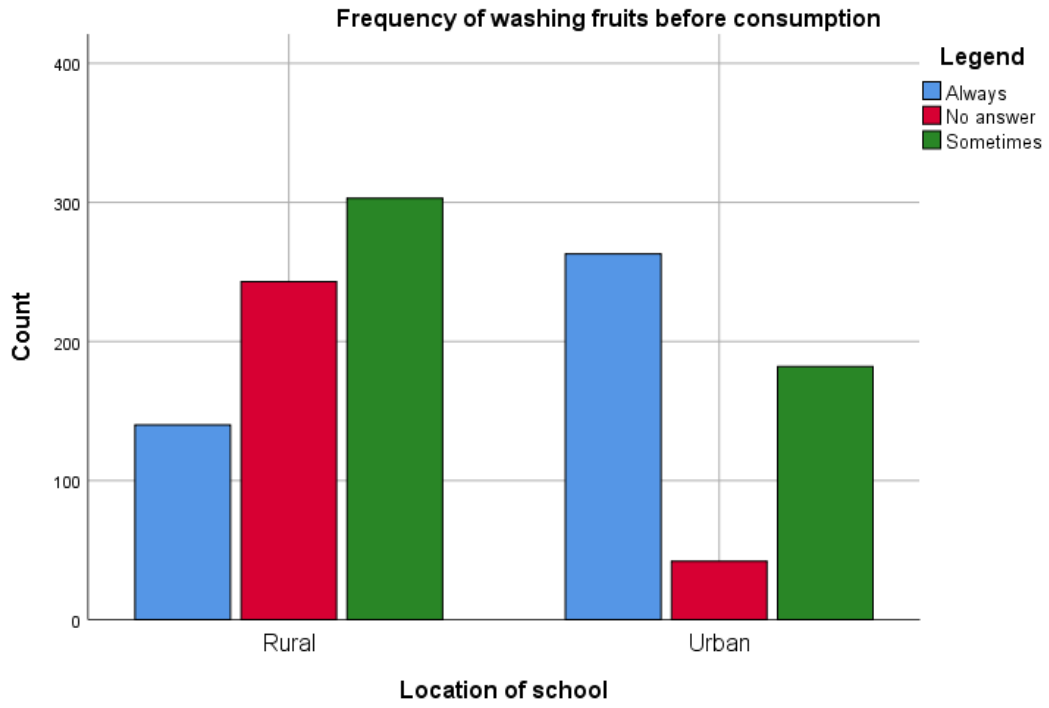


Figure 4. 5 Frequency of washing fruits before consumption

4.3. Students' attitudes on hygiene

4.3.1. Necessity of washing of hands after visiting the toilets

Table 4. 7Necessity of washing hands after visiting the toilets

			6. Necessity of washing hands after visiting the toilets			
			No	No answer	Yes	Total
Location of school	Rural	Count	6	3	677	686
		% within Location of school	0.9%	0.4%	98.7%	100.0%
	Urban	Count	5	0	482	487
		% within Location of school	1.0%	0.0%	99.0%	100.0%
Total		Count	11	3	1159	1173
		% within Location of school	0.9%	0.3%	98.8%	100.0%

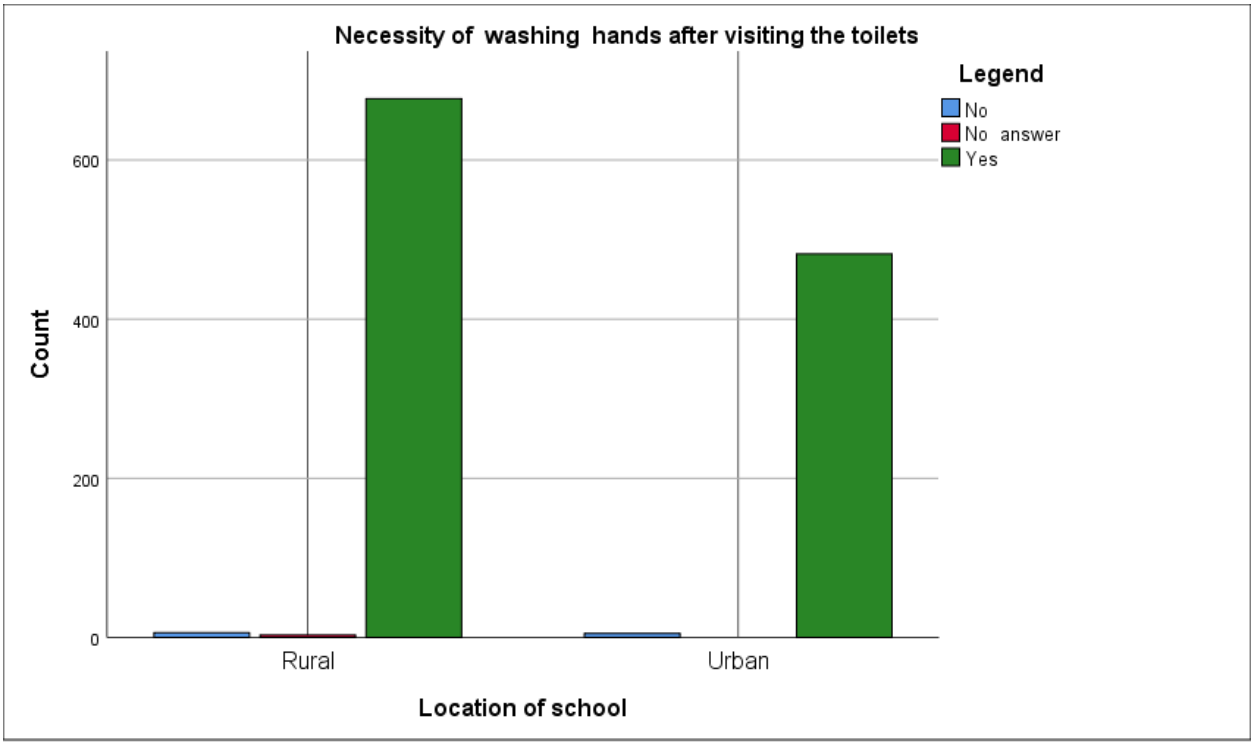


Figure 4. 6 Necessity of washing of hands after visiting the toilets

4.3.2 Level of concern about hygiene

Table 4. 8Level of concern about hygiene

			7.Level of concern about hygiene				
			Always concerned	No answer	Not concerned	Sometimes	Total
Location of school	Rural	Count	7	516	2	4	157	686
		% within Location of school	1.0%	75.2%	0.3%	0.6%	22.9%	100.0%
	Urban	Count	0	398	2	1	86	487
		% within Location of school	0.0%	81.7%	0.4%	0.2%	17.7%	100.0%
Total		Count	7	914	4	5	243	1173
								100.0%

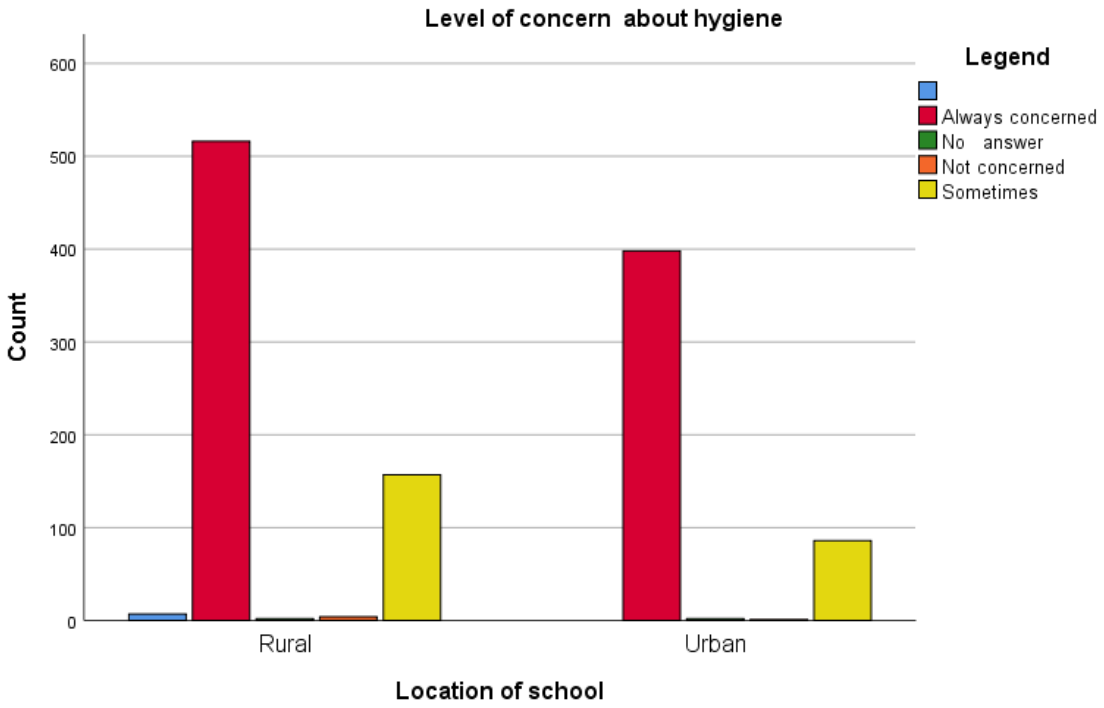


Figure 4. 7 Level of concern about hygiene in schools

4.4. Student's practices towards sanitation

4.4.1. Human faeces disposal

Table 4. 9. Human waste disposal

			8. Human waste disposal						
			Bush toilet	Latrine	Latrine and bush toilet	Latrine, bush toilet and stream	No answer	Stream	Total
Location of school	Rural	Count	9	500	154	17	6	0	686
		% within Location of school	1.3%	72.9%	22.4%	2.5%	0.9%	0.0%	100.0%
	Urban	Count	24	457	1	1	0	4	487
		% within Location of school	4.9%	93.8%	0.2%	0.2%	0.0%	0.8%	100.0%
Total		Count	33	957	155	18	6	4	1173
		% within Location of school	2.8%	81.6%	13.2%	1.5%	0.5%	0.3%	100.0%

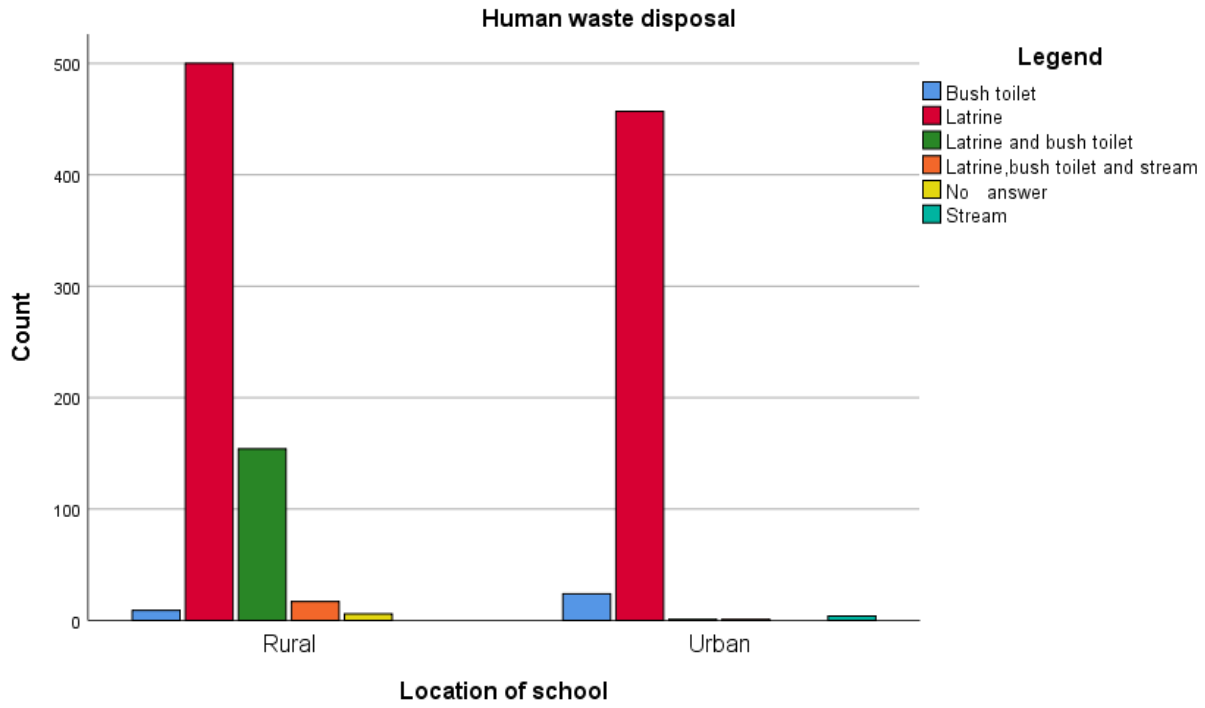


Figure 4. 8 Human waste disposal

4.5 Students' knowledge on diseases related to contact with human faeces.

Table 4. 10 Knowledge on diseases related to contact with human faeces.

			Knowledge on diseases related to contact with human faeces.							
			Cholera	Diarrhea	Dysentery	Malaria	No answer	Shigellosis	Typhoid	Total
Location of school	Rural	Count	417	161	13	0	84	1	10	686
		% within Location of school	60.8%	23.5%	1.9%	0.0%	12.2%	0.1%	1.5%	100.0%
	Urban	Count	251	150	13	3	35	0	35	487
		% within Location of school	51.5%	30.8%	2.7%	0.6%	7.2%	0.0%	7.2%	100.0%
Total		Count	668	311	26	3	119	1	45	1173
		% within Location of school	56.9%	26.5%	2.2%	0.3%	10.1%	0.1%	3.8%	100.0%

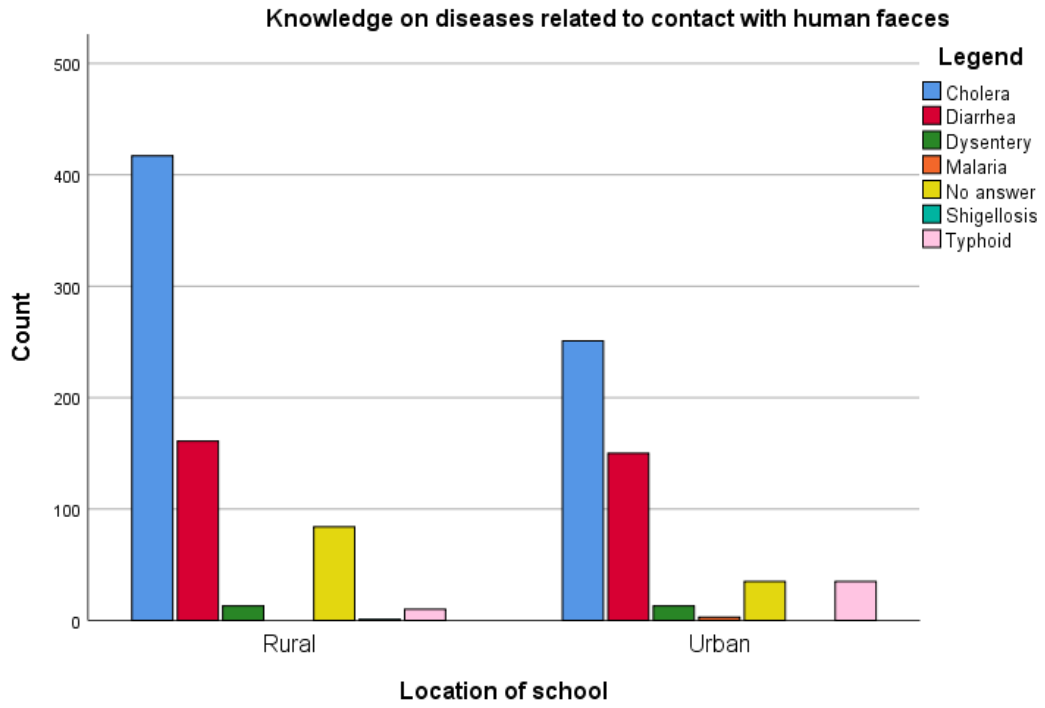


Figure 4. 9 Knowledge on diseases related to contact with human faeces.

4.6 Students' knowledge on sources of clean water

Table 4. 11 Students' knowledge on sources of clean water

			Knowledge on sources of clean water for drinking											
			Boiled water	Bore hole	Lakes	Mineral water	No answer	Rain water	River	Sea	Spring water	Tap water	Water tank	Total
Location of school	Rural	Count	36	23	8	24	71	2	40	0	25	451	6	686
		% within Location of school	5.2%	3.4%	1.2%	3.5%	10.3%	0.3%	5.8%	0.0%	3.6%	65.7%	0.9%	100.0%
	Urban	Count	22	8	3	10	88	5	22	1	31	294	3	487
		% within Location of school	4.5%	1.6%	0.6%	2.1%	18.1%	1.0%	4.5%	0.2%	6.4%	60.4%	0.6%	100.0%
Total		Count	58	31	11	34	159	7	62	1	56	745	9	1173
		% within Location of school	4.9%	2.6%	0.9%	2.9%	13.6%	0.6%	5.3%	0.1%	4.8%	63.5%	0.8%	100.0%

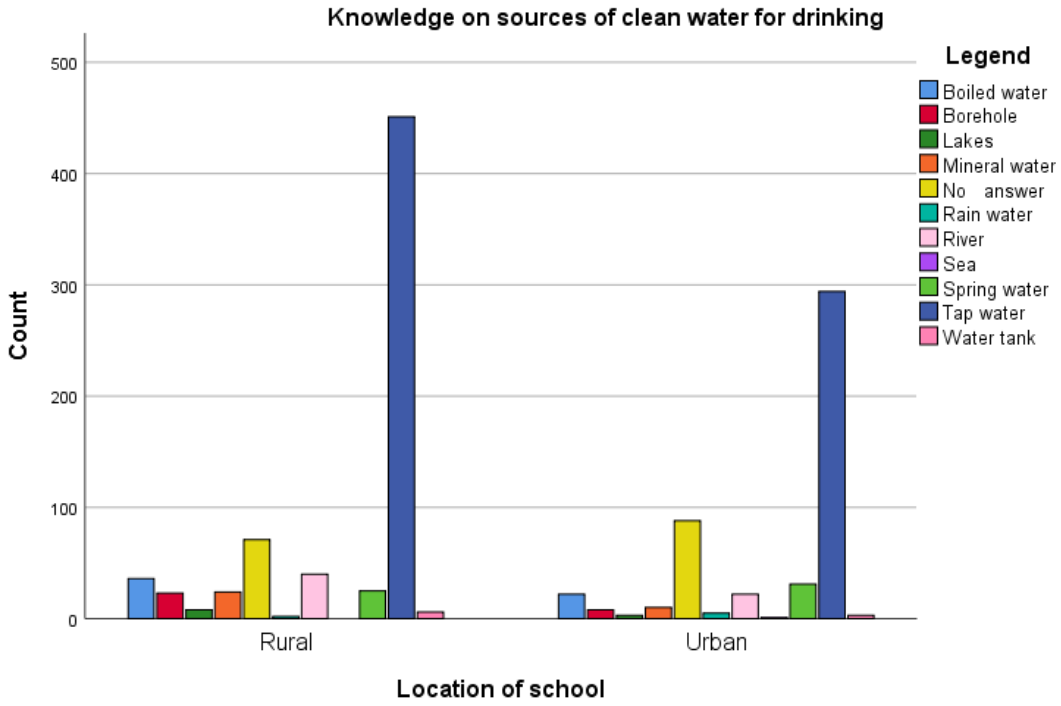


Figure 4. 10Students' knowledge on sources of clean water

4.7 Students' knowledge on causes of selected WASH related diseases

4.7.1. Knowledge on causes of Diarrhea

Table 4. 12Knowledge on causes of Diarrhea

			Knowledge on causes of Diarrhea				
			Amoeba	Drinking dirty water	Irrelevant	Poor sanitation and hygiene	Total
Location of school	Rural	Count	2	53	547	84	686
		% within Location of school	0.3%	7.7%	79.7%	12.2%	100.0%
	Urban	Count	0	80	311	96	487
		% within Location of school	0.0%	16.4%	63.9%	19.7%	100.0%
Total		Count	2	133	858	180	1173
		% within Location of school	0.2%	11.3%	73.1%	15.3%	100.0%

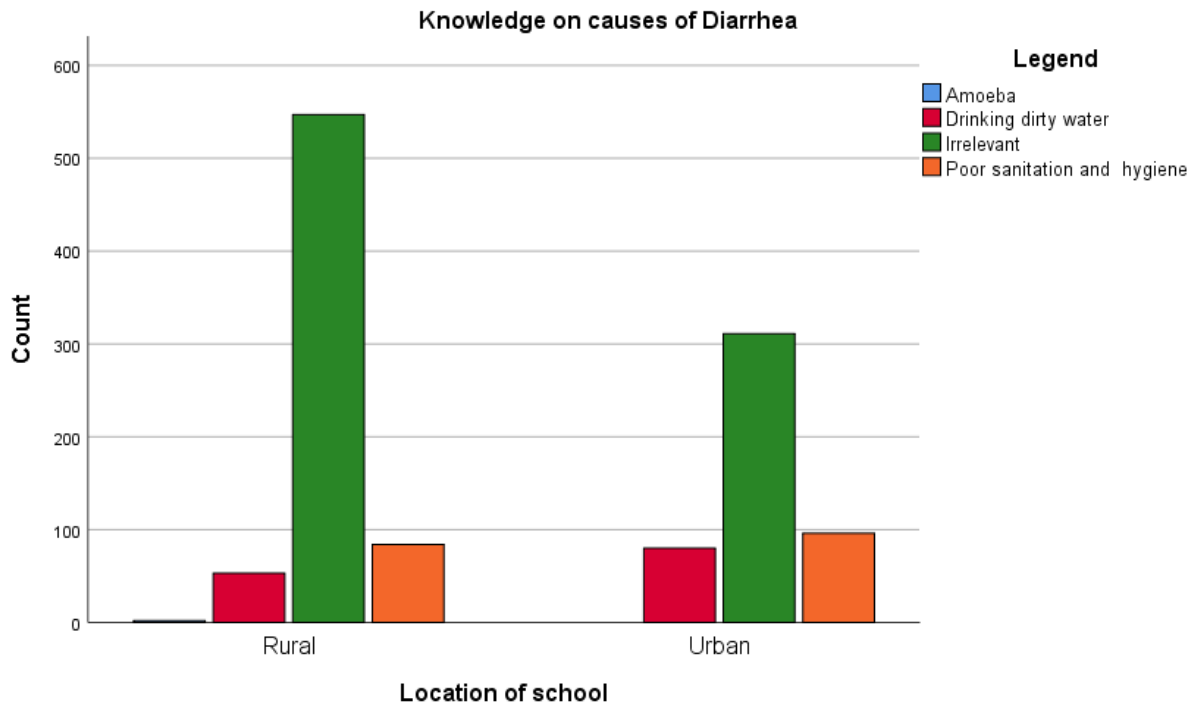


Figure 4. 11 Knowledge on causes of Diarrhea

4.7.2. Knowledge on causes of Shigellosis

Table 4. 13Knowledge on causes of Shigellosis

			Knowledge on causes of Shigellosis				
			Contact with human faeces	Irrelevant	Polluted water	Poor hygiene	Total
Location of school	Rural	Count	1	671	0	14	686
		% within Location of school	0.1%	97.8%	0.0%	2.0%	100.0%
	Urban	Count	1	479	2	5	487
		% within Location of school	0.2%	98.4%	0.4%	1.0%	100.0%
Total		Count	2	1150	2	19	1173
		% within Location of school	0.2%	98.0%	0.2%	1.6%	100.0%

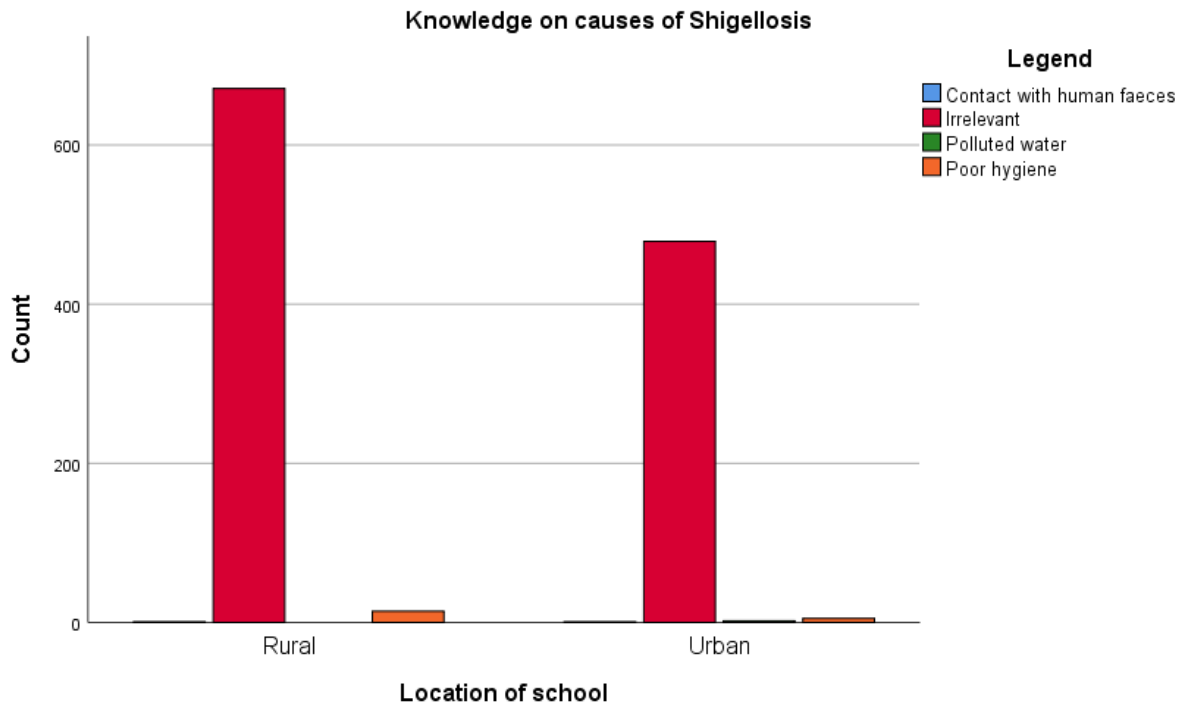


Figure 4. 12Knowledge on causes of Shigellosis

4.7.3 Knowledge on causes of cholera

Table 4. 14 Knowledge on causes of cholera

			Food and water contaminated by human faeces	Irrelevant	Vibrio Cholera	Total
Location of school	Rural	Count	86	553	47	686
		% within Location of school	12.5%	80.6%	6.9%	100.0%
	Urban	Count	42	418	27	487
		% within Location of school	8.6%	85.8%	5.5%	100.0%
Total		Count	128	971	74	1173
		% within Location of school	10.9%	82.8%	6.3%	100.0%

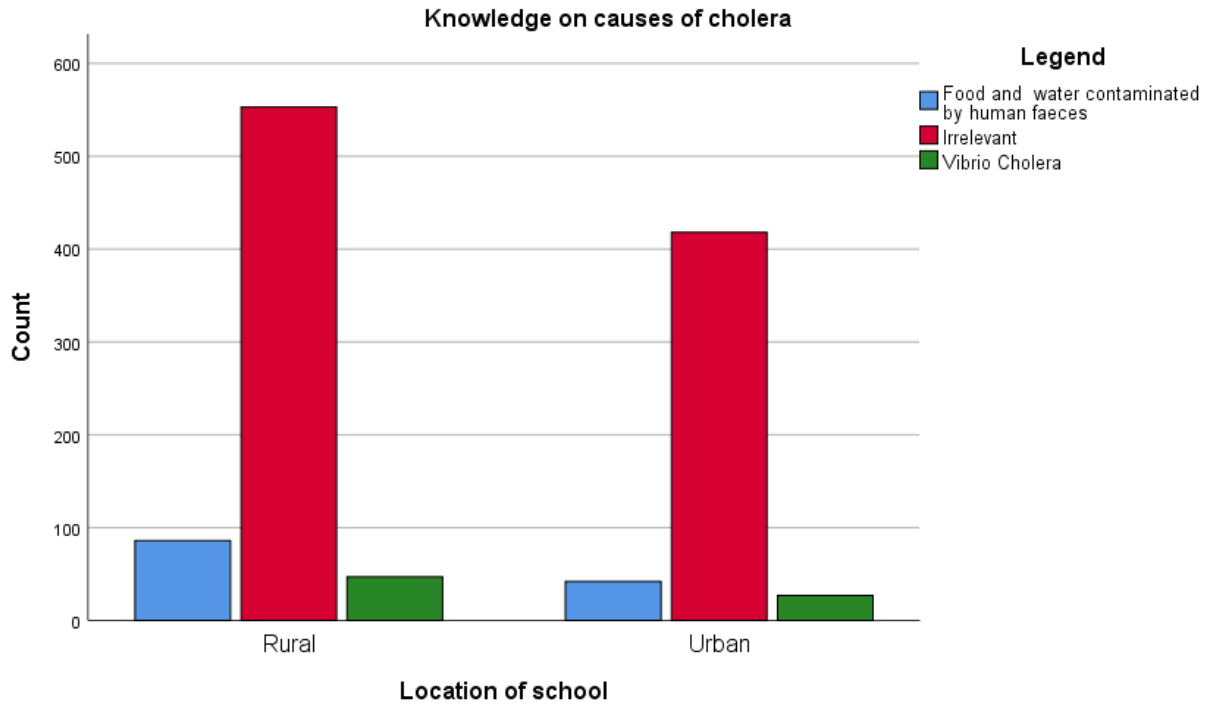


Figure 4. 13Knowledge on causes of cholera

4.7.4 Knowledge on causes of Trachoma

Table 4. 15Knowledge on causes of Trachoma

			Knowledge on causes of Trachoma		
			Irrelevant	Washing face with dirty water	Total
Location of school	Rural	Count	679	7	686
		% within Location of school	99.0%	1.0%	100.0%
	Urban	Count	485	2	487
		% within Location of school	99.6%	0.4%	100.0%
Total		Count	1164	9	1173
		% within Location of school	**99.2%**	**0.8%**	**100.0%**

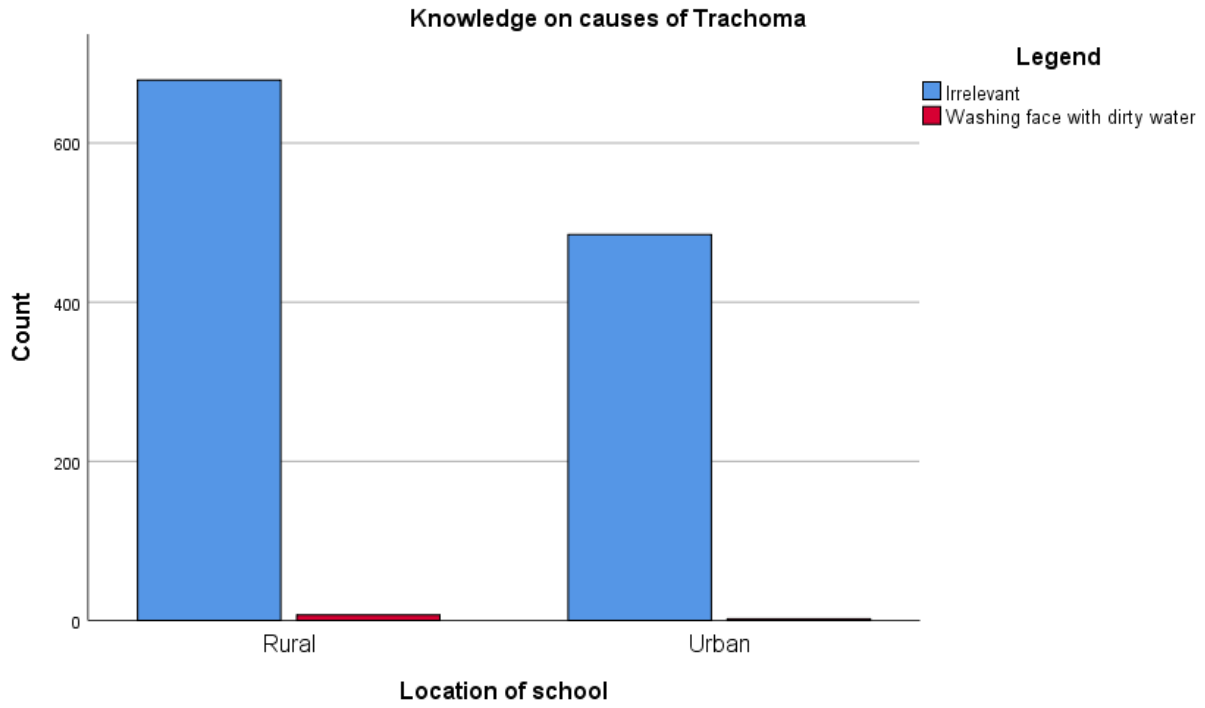


Figure 4. 14 Knowledge on causes of Trachoma

4.7.5 Knowledge on causes of Typhoid

Table 4. 16Knowledge on causes of Typhoid

			Knowledge on causes of Typhoid			
			Eating contaminated food or water	Irrelevant	Salmonella typhi	Total
Location of school	Rural	Count	25	637	24	686
		% within Location of school	3.6%	92.9%	3.5%	100.0%
	Urban	Count	32	435	20	487
		% within Location of school	6.6%	89.3%	4.1%	100.0%
Total		Count	57	1072	44	1173
		% within Location of school	**4.9%**	**91.4%**	**3.8%**	**100.0%**

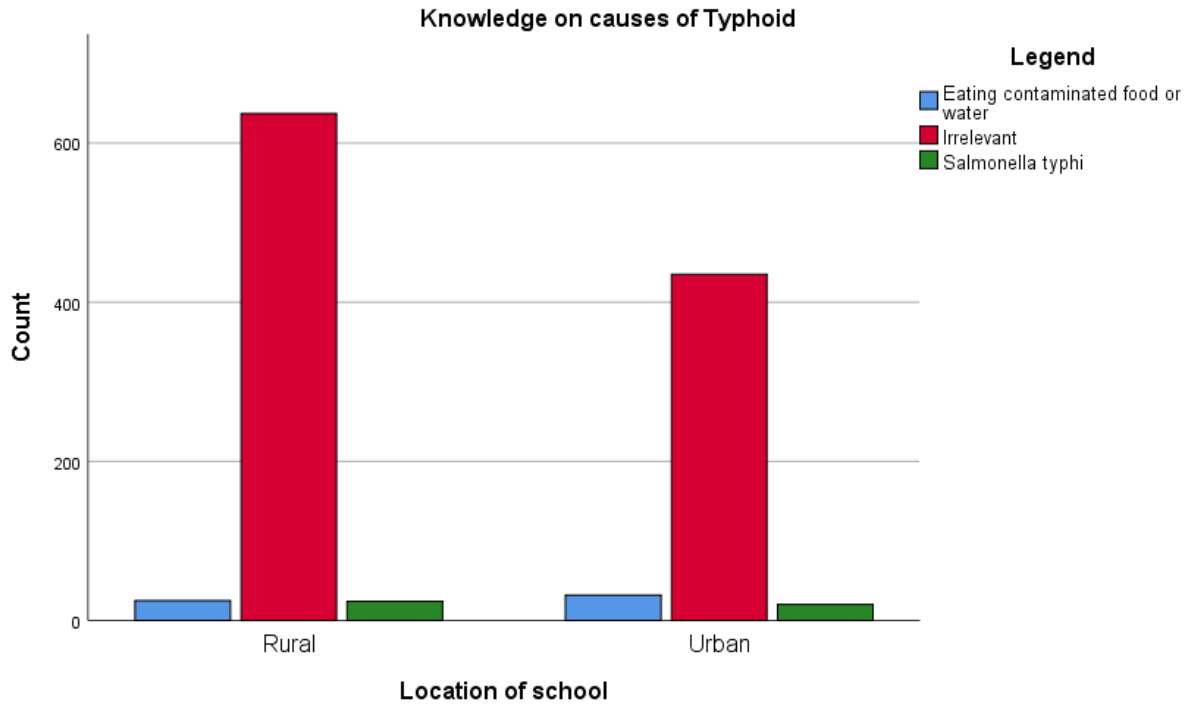


Figure 4. 15Knowledge on causes of Typhoid

4.7.6 Knowledge on causes of Malaria

Table 4. 17Knowledge on causes of Malaria

			Knowledge on causes of Malaria			
			Female Anopheles mosquitoes	Irrelevant	Stagnant water around home	Total
Location of school	Rural	Count	460	224	2	686
		% within Location of school	67.1%	32.7%	0.3%	100.0%
	Urban	Count	225	259	3	487
		% within Location of school	46.2%	53.2%	0.6%	100.0%
Total		Count	685	483	5	1173
		% within Location of school	58.4%	41.2%	0.4%	100.0%

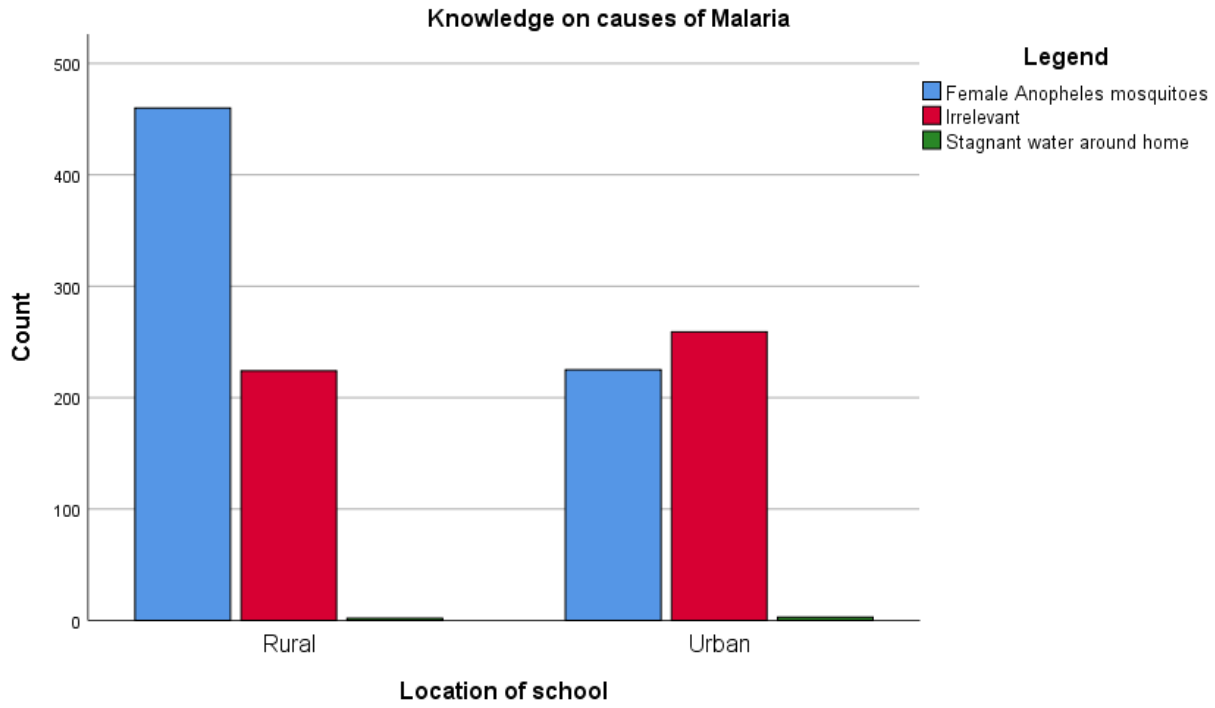


Figure 4. 16Knowledge on causes of Malaria

4.8. Knowledge on prevention of selected WASH related diseases

Table 4. 18Knowledge on prevention of water related diseases

			13.Knowledge on prevention of water related diseases							
			Cholera	Diarrheal diseases	Malaria	No knowledge	Shigellosis	Trachoma	Typhoid	Total
Location of school	Rural	Count	86	224	290	74	2	0	10	686
		% within Location of school	12.5%	32.7%	42.3%	10.8%	0.3%	0.0%	1.5%	100.0%
	Urban	Count	99	216	21	127	2	1	21	487
		% within Location of school	20.3%	44.4%	4.3%	26.1%	0.4%	0.2%	4.3%	100.0%
Total		Count	185	440	311	201	4	1	31	1173
		% within Location of school	15.8%	37.5%	26.5%	17.1%	0.3%	0.1%	2.6%	100.0%

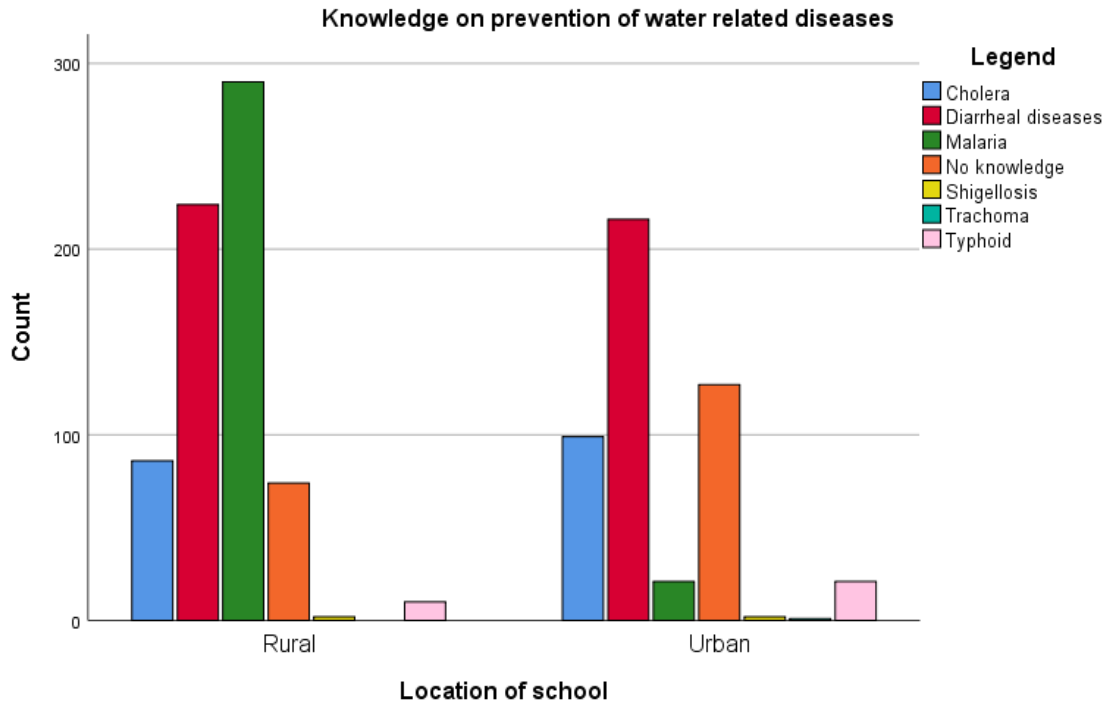


Figure 4. 17Knowledge on prevention of water related diseases

4.9 Water availability for drinking and sanitation in schools

Table 4. 19Water availability for drinking and sanitation at school

Location of school	**Rural**	**Urban**
Water quality	Clean	Clean
Water quantity	100% reported water shortage	33.3% reported water shortage
Source of water supply	Municipal water supply	Municipal water supply
Water pressure	66.6% reported low pressure	66.6% reported low pressure

4.10 Sanitation facilities at schools

Table 4. 20Sanitation facilities at school

Location of school	Rural	Urban
Types of toilet-Improved vs unimproved	Pit latrine	Pit latrine
Hygiene in toilets (Frequency of cleaning, responsibility towards cleaning)	Toilets were clean	Toilets were clean
Hand washing facilities (operations and presence of soap)	No hand washing facilities, no soap	There were hand washing facilities, but no soap
Refuse collection and handling at school	Available	Available

4.11 Results on Hypothesis Testing

4.11.1 Z-Test results on Necessity of washing hands after visiting the toilets

(a)Decision on hypotheses

Ho: students' attitudes to hygiene in rural and urban schools are the same as they all agree on the necessity to wash hands after visiting the toilet.

H_1: students' attitudes to hygiene in rural and urban schools are not the same as they all do not agree on the necessity to wash hands after visiting the toilet.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 677 \hat{p}_1 = \frac{x_1}{n_1} = \frac{677}{686} = 0.986$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{482}{487} = 0.989$

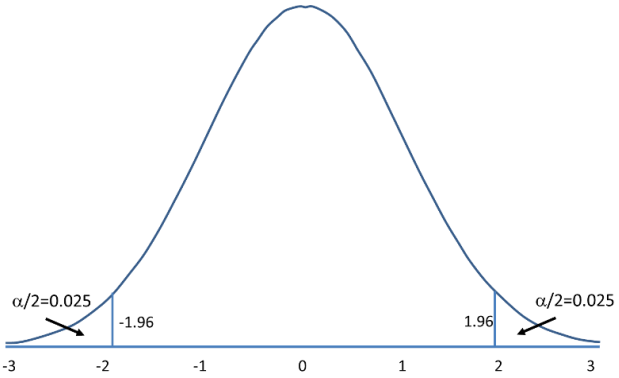
$n_1 = 686$

$x_2 = 482 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{677}{686} + \frac{482}{487} = 0.988$ and $\bar{q} = 1 - \bar{p} = 1 - 0.988 = 0.012$

$n_2 = 487$

$$\text{solve}\left(Z=\frac{0.986-0.989}{\sqrt{0.988(0.012)\left(\frac{1}{686}+\frac{1}{487}\right)}},\right)=-0.464$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z $\leq$ -1.960 or if Z $\geq$ 1.960 (LaMorte, 2017).

Conclusion: We fail to reject H_0. There is enough evidence to support this this claim.

4.11.2 Z-Test results on Level of concern about hygiene

(a)Decision on hypotheses

Ho: The level of concern for hygiene is higher in rural schools than in urban schools.

H_1: The level of concern for hygiene is not higher in rural schools than in urban schools.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 516 \hat{p}_1 = \frac{x_1}{n_1} = \frac{516}{686} = 0.752$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{398}{487} = 0.817$

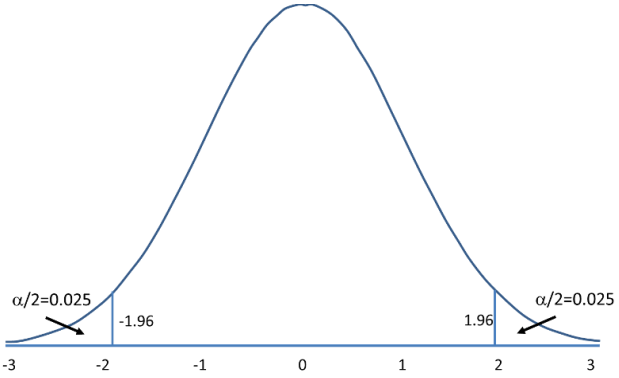
$n_1 = 686$

$x_2 = 398 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{616}{686} + \frac{398}{487} = 0.779$ and $\bar{q} = 1 - \bar{p} = 1 - 0.779 = 0.221$

$n_2 = 487$

$$\text{solve}\left(Z=\frac{0.752-0.817}{\sqrt{0.779(0.221)\left(\frac{1}{686}+\frac{1}{487}\right)}},\right)=-2.643$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z $\leq$ -1.960 or if Z $\geq$ 1.960 (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.3 Z-Test results on Human waste disposal

(a)Decision on hypotheses

Ho: The practice of using latrine for human faeces disposal is common in both rural and urban schools.

H_1: The practice of using latrine for human faeces disposal is not common in both rural and urban schools.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 500\hat{p}_1 = \frac{x_1}{n_1} = \frac{500}{686} = 0.728$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{457}{487} = 0.938$

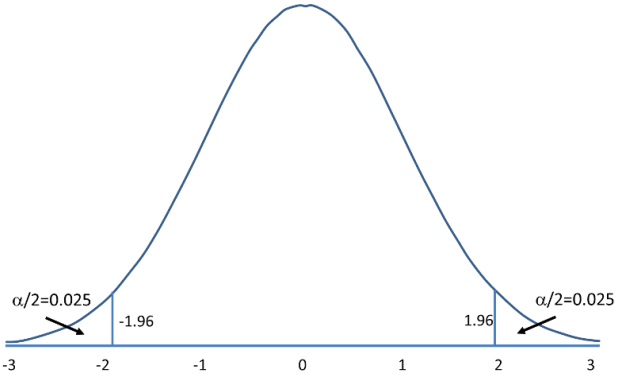
$n_1 = 686$

$x_2 = 457 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{500}{686} + \frac{457}{487} = 0.815$ and $\bar{q} = 1 - \bar{p} = 1 - 0.815 = 0.185$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.728 - 0.938}{\sqrt{0.815(0.185)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = -9.12$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z $\leq$ -1.960 or if Z $\geq$ 1.960 (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.4 Z-Test results on Knowledge on diseases related to contact with human faeces.

(a)Decision on hypotheses

Ho: The students' knowledge on diseases related to contact with human faeces in both rural and urban schools is the same.

H_1: The students' knowledge on diseases related to contact with human faeces in both rural and urban schools is not the same.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 602 \hat{p}_1 = \frac{x_1}{n_1} = \frac{602}{686} = 0.877$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{452}{487} = 0.928$

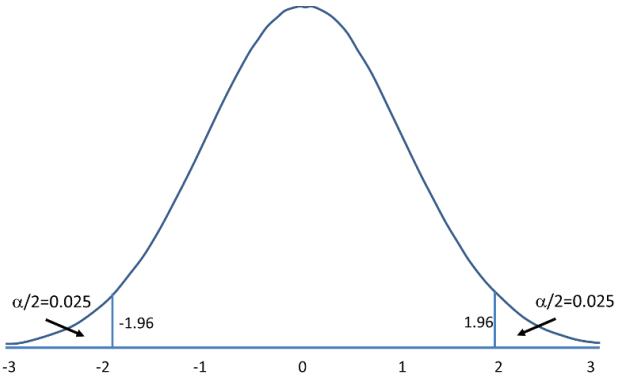
$n_1 = 686$

$x_2 = 452 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{602}{686} + \frac{452}{487} = 0.898$ and $\bar{q} = 1 - \bar{p} = 1 - 0.898 = 0.102$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.877 - 0.928}{\sqrt{0.898(0.102)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = -2.843$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with $\alpha = 0.05$

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.5 Z-Test results on Knowledge on sources of clean water for drinking

(a)Decision on hypotheses

Ho: The major source of clean drinking water for students in rural and urban schools is tap water.

H_1: The major source of clean drinking water for students in rural and urban schools is tap water.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 451 \hat{p}_1 = \frac{x_1}{n_1} = \frac{451}{686} = 0.657$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{294}{487} = 0.603$

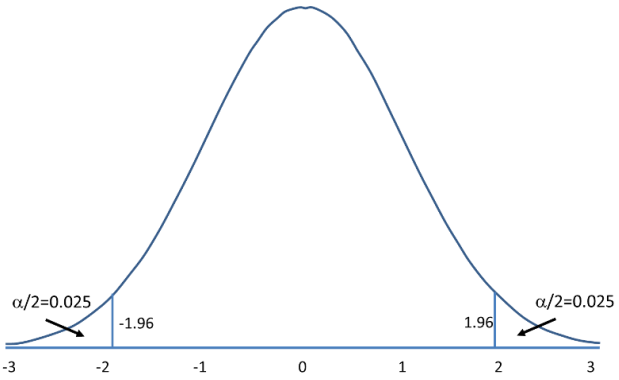
$n_1 = 686$

$x_2 = 294 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{451}{686} + \frac{294}{487} = 0.635$ and $\bar{q} = 1 - \bar{p} = 1 - 0.635 = 0.365$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.657 - 0.603}{\sqrt{0.635(0.365)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = 1.892$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with $\alpha = 0.05$

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: We fail reject H_0. There is enough evidence to support this claim.

4.11.6 Z-Test results on Knowledge on causes of Diarrhea

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Diarrhea.

H_1: The students in both rural and urban schools have knowledge on the causes of Diarrhea.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 139 \hat{p}_1 = \frac{x_1}{n_1} = \frac{139}{686} = 0.202$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{176}{487} = 0.361$

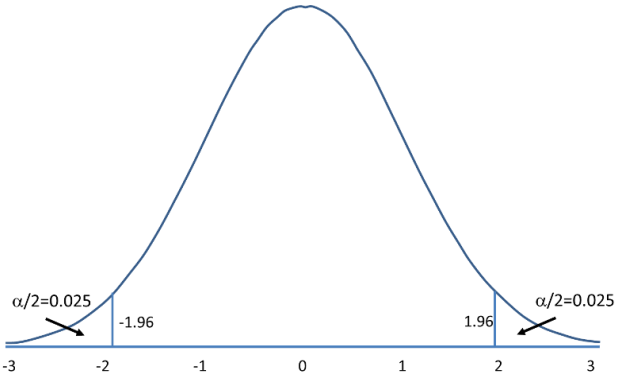
$n_1 = 686$

$x_2 = 176 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{139}{686} + \frac{176}{487} = 0.268$ and $\bar{q} = 1 - \bar{p} = 1 - 0.268 = 0.732$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.202 - 0.361}{\sqrt{0.268(0.732)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = -6.052$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z ≤ -1.960 or if Z ≥ 1.960 (LaMorte, 2017).

Conclusion: We reject H_0. There is enough evidence to reject this claim.

4.11.7 Test results on Knowledge on causes of Shigellosis

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Shigellosis.

H_1: The students in both rural and urban schools have knowledge on the causes of Shigellosis**.**

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 15 \hat{p}_1 = \frac{x_1}{n_1} = \frac{15}{686} = 0.021$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{8}{487} = 0.016$

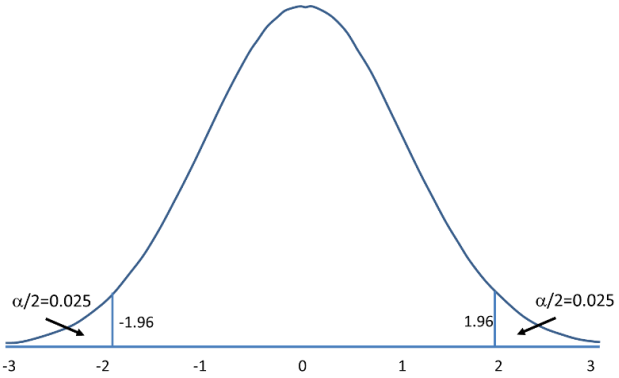
$n_1 = 686$

$x_2 = 8 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{15}{686} + \frac{8}{487} = 0.019$ and $\bar{q} = 1 - \bar{p} = 1 - 0.019 = 0.981$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.021 - 0.016}{\sqrt{0.019(0.981)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = 0.618$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z $\leq$ -1.960 or if Z $\geq$ 1.960 (LaMorte, 2017).

Conclusion: We fail to reject H_0. There is enough evidence to support this claim.

4.11.8 Z-Test results on Knowledge on causes of Cholera

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Cholera.

H_1: The students in both rural and urban schools have knowledge on the causes of Cholera.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 133 \hat{p}_1 = \frac{x_1}{n_1} = \frac{133}{686} = 0.193$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{69}{487} = 0.141$

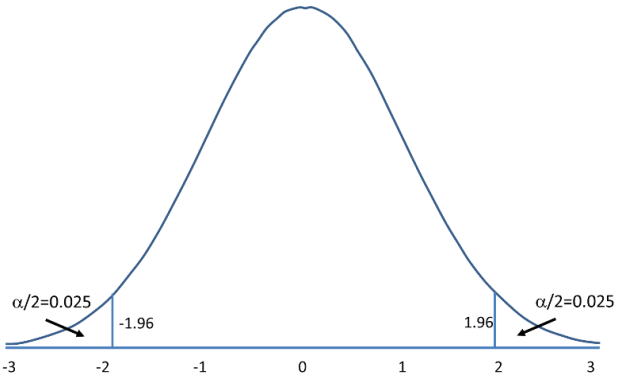
$n_1 = 686$

$x_2 = 69 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{133}{686} + \frac{69}{487} = 0.172$ and $\bar{q} = 1 - \bar{p} = 1 - 0.172 = 0.828$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.193 - 0.141}{\sqrt{0.172(0.828)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = 2.325$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.9. Z-Test results on Knowledge on causes of Trachoma

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Trachoma.

H_1: The students in both rural and urban schools have knowledge on the causes of Trachoma.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 7\hat{p}_1 = \frac{x_1}{n_1} = \frac{7}{686} = 0.010$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{2}{487} = 0.004$

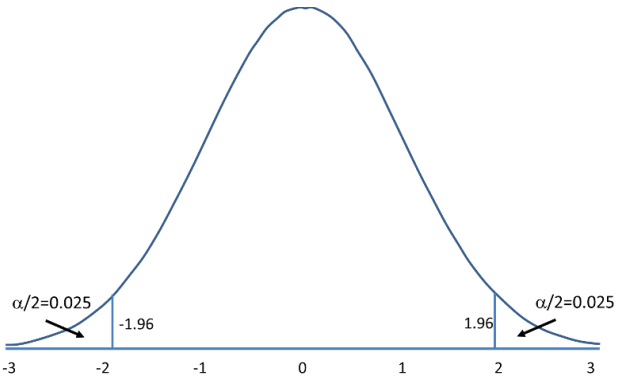
$n_1 = 686$

$x_2 = 2\bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{7}{686} + \frac{2}{487} = 0.007$ and $\bar{q} = 1 - \bar{p} = 1 - 0.007 = 0.993$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.01 - 0.004}{\sqrt{0.007(0.993)\left(\frac{1}{686} + \frac{1}{487}\right)}},\right) = 1.214$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: We fail to reject H_0. There is enough evidence to support this claim.

4.11.10Z-Test results on Knowledge on causes of Typhoid

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Typhoid.

H_1: The students in both rural and urban schools have knowledge on the causes of Typhoid.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 49 \hat{p}_1 = \frac{x_1}{n_1} = \frac{49}{686} = 0.071$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{52}{487} = 0.106$

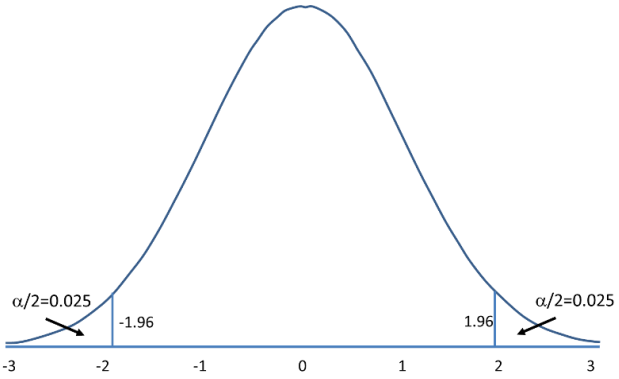
$n_1 = 686$

$x_2 = 52 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{49}{686} + \frac{52}{487} = 0.086$ and $\bar{q} = 1 - \bar{p} = 1 - 0.086 = 0.914$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.071 - 0.106}{\sqrt{0.086(0.914)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = -2.106$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if Z $\leq$ -1.960 or if Z $\geq$ 1.960 (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.11Z-Test results on Knowledge on causes of Malaria

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the causes of Malaria.

H_1: The students in both rural and urban schools have knowledge on the causes of Malaria.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 462 \hat{p}_1 = \frac{x_1}{n_1} = \frac{462}{686} = 0.673$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{228}{487} = 0.468$

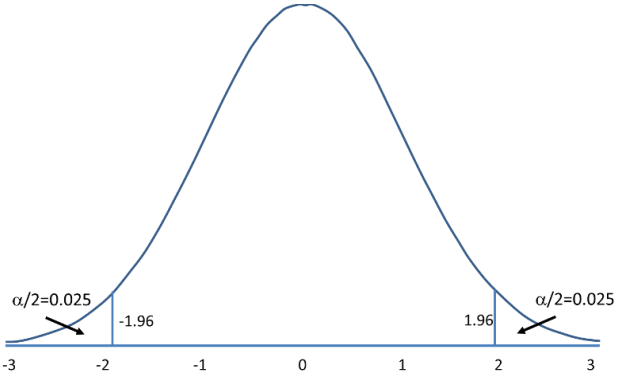
$n_1 = 686$

$x_2 = 228 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{462}{686} + \frac{228}{487} = 0.588$ and $\bar{q} = 1 - \bar{p} = 1 - 0.588 = 0.412$

$n_2 = 487$

$$\text{solve}\left(Z = \frac{0.673 - 0.468}{\sqrt{0.588(0.412)\left(\frac{1}{686} + \frac{1}{487}\right)}}, \right) = 7.029$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

4.11.12 Z-Test results on Knowledge on prevention of WASH related diseases

(a)Decision on hypotheses

Ho: The students in both rural and urban schools have no knowledge on the prevention of WASH related diseases.

H_1: The students in both rural and urban schools have knowledge on the prevention of WASH related diseases.

(b) Decision on significance level (α). Here we consider α of 0.05

(c) Computation of the test statistic

$x_1 = 612 \hat{p}_1 = \frac{x_1}{n_1} = \frac{612}{686} = 0.892$ and $\hat{p}_2 = \frac{x_2}{n_2} = \frac{360}{487} = 0.739$

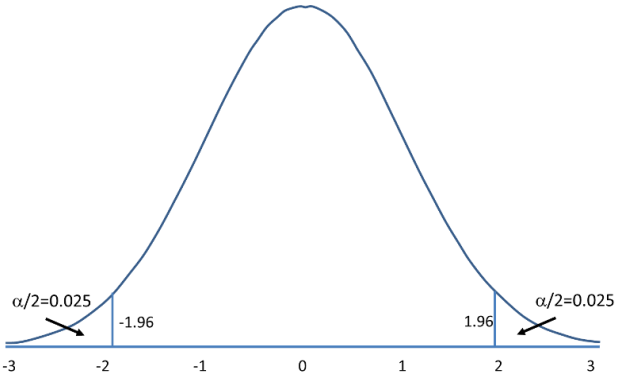
$n_1 = 686$

$x_2 = 360 \bar{p} = \frac{x_1}{n_1} + \frac{x_2}{n_2} = \frac{462}{686} + \frac{228}{487} = 0.828$ and $\bar{q} = 1 - \bar{p} = 1 - 0.828 = 0.172$

$n_2 = 487$

$$\text{solve}\left(Z=\frac{0.892-0.739}{\sqrt{0.828(0.172)\left(\frac{1}{686}+\frac{1}{487}\right)}},\right)=6.842$$

(d)The decision rule



Rejection Region for Two-Tailed Z Test (H_1: $\mu \neq \mu_0$) with α =0.05

The decision rule is: Reject H_0 if $Z \leq -1.960$ or if $Z \geq 1.960$ (LaMorte, 2017).

Conclusion: we reject H_0. There is enough evidence to reject this claim.

Chapter 5: Discussion

5.0 Introduction

This chapter discusses the results highlighted in chapter 4. All results in table, figures and hypotheses testing are fully discussed herein.

5.1 Analysis of results

5.1.1 Sex and schools location

The respondents were of both sexes. Male and female respondents accounted for 43.4% and 56.6% respectively across the entire population in both rural and urban areas. Females were few (55.8%) in rural areas compared to urban areas (57.7%) The schools in the rural areas had a greater number of students (58.4%) compared to urban areas (41.7%) as shown in Table 4.1

5.1.2.Students' hygiene practices

Hygiene is multi-dimensions and can constitute much behavior, including menstrual hygiene, food hygiene, and hand washing, (WHO, 2018). In this survey, hygienic practices were limited to washing hands after urinating, hand washing after defecating, hand washing before eating, and washing of fruits before consumption.Poor hygiene practices and inadequate sanitary conditions play major roles in the increased burden of communicable diseases within developing countries(Alyssa et al., 2010).

5.1.2.1Washing of hands after urinating

The U.S. Centers for Disease Control and Prevention recommends washing hands after use of toilets. After urinating, washing hands reduces contamination from pathogenic microorganisms which might be present on hands, fingers and nail surfaces (the Open University, 2018). Results from the study shown in Table 4.2 and Figure 4.1 show that overall, only 48.3% of the students wash their hands after urinating with 45.9% in rural and 51.7% in urban areas.

5.1.2.2 Washing of hands after defecating

Daily activities make dirty hands and it is therefore paramount to wash hands as most often as possible. In our normal activities our hands frequently get dirty (the Open University, 2018). In our daily activities there are chances that pathogenic microbes stick to our hands (the Open University, 2018). The faeco-oral route is a way to transmission of many communicable diseases (the Open University, 2018).Therefore; hand hygiene plays a major in breaking the transmission of diseases, particularly after defecating (the Open University, 2018). From the research finding shown in Table 4.3 and Figure 4.2, it was observed that overall 62.6% of the students wash their hands after defecating with 60.5% in rural and 65.5% in urban areas.

5.1.2.3 Washing of hands before eating

Hand washing before eating food or feeding children is highly recommended to avoid direct ingestion of pathogenic microorganisms susceptible to cause communicable diseases

like diarrhea.Not washing hands with soap, and running clean water result in spreading many diseases and unhealthy conditions according to the U.S. Department of Health & Human Services. The results in Table 4.4 and Figure 4.3 showed that overall,89.9% of the students surveyed wash their hands before eating with 91.0% in rural and 88.3% in urban areas.

5.1.2.4 Frequency of washing of hands before eating

The hand washing is one of the best ways to protect ourselves from getting sick. Washing of hands is easy, and it's one of the most effective ways to prevent the spread of germs. The hand washing should be done always before eating as clean hands can stop germs from spreading from one person to another according to U.S. Department of Health & Human Services. Considering results shown in Table 4.5 and Figure 4.4, it is noted that only 37.4% of the students always wash their hands before eating while 60.2% do it sometimes.

5.1.2.5 Frequency of washing of fruits before consumption

Though hand hygiene is paramount, washing of fruits before consumption is of utmost importance as well.Washing of fruits and vegetables before consumptionhelps to remove exterior bacteria. It is recommended to rinse all produce under running tap water, however, filling the sink with water and let produce get soaked thereis not recommended(Barbara, 2007).

Biological, chemical or physical food safety hazards are major caused of food borne diseases. (University of New Hampshire Cooperative Extension, (n.d).Biological food safety hazards included bacteria, molds and parasites, and viruses found on raw food that is not carefully prepared or washed (University of New Hampshire Cooperative Extension, (n.d).Looking the results in Table 4.6 and Figure 4.5 for the study area, overall, only 34.4% of the students always wash fruits before consumption with 20.4% in rural and 54.0% in urban areas.

5.1.3 Students' attitudes on hygiene

5.1.3.1Necessity of washing of hands after visiting the toilets

Washing hands after visiting the toilets is necessary to remove viruses and bacteria which might have contacted hands when handling faeces or urine. Each time after using the toilet, it is recommended to wash hands with soap and clean water. A proper hand washing before preparing food and eating reduces the chance of contacting diarrheal diseases. In absence of water, an alcohol-based gel hand sanitizer can be used (Lindsay, 2018). Based on findings from this study as shown in Table 4.7 and Figure 4.6 overall, 98.8% of the students considered it necessary to wash hands after visiting the toilets with 98.7% in rural and 99.0% in urban areas.

5.1.3.2 Level of concern about hygiene

Hygiene should be everyone's concern to reduce the possibilities of contacting hygiene related diseases. Considering the results of the study as shown in Table 4.8 and Figure 4.7, overall, only 77.9% of the students always showed some concern about hygiene with 75.2% in rural and 81.7% in urban areas. About 20.7% sometimes feel concerned about hygiene while only a negligible felt no concern at all about hygiene.

5.1.4 Student's practices towards sanitation

Proper human faeces disposal is a safe way to preventing sanitation related diseases. Therefore, improved sanitation facilities should be used since they separate people from contact with faeces.

5.1. 4.1. Human faeces disposal

It was observed that students in rural and urban areas use both improved and unimproved sanitation. They dispose their human waste in latrines, and practice open defecation in the bushes and streams. The results of the survey as shown in Table 4.9 and Figure 4.8 indicated that overall, students use only latrine for human waste disposal at 81.6%.In rural areas 72.9% use only latrines and 93.8% in urban areas. However, about 17.9% combine

latrine with other unimproved sanitation like open defecation in streams and in nearby bushes.

Health of children in developing countries is seriously being threatened by open defecation practices (UNICEF India, 2018).Open defecation practice is the major reason of diarrheal diseases killing many children under-five in the developing world like in India(UNICEF India, 2018). Snakes bites, and danger of physical attacks for women may result in open defecation practices (UNICEF India). Poor sanitation also hampers national development as people live shorter lives, produce less, save and invest less, and family poverty preclude children from being sent to school (UNICEF India, 2018).Since polio transmits through faecal-oral route, polio infection is prevalent in communities where open defecation is practiced.

5.1.5. Students' knowledge on diseases related to contact with human faeces.

Contact with human faeces is a health risk. One gram of faeces contains: 10,000,000 viruses, 1,000,000 bacteria, and 1,000 parasite cysts (UNICEF India, 2018). In both rural and urban settings, students mentioned different diseases they know are caused by contact with human faeces. Across the school settings, 56.9% mentioned Cholera, 26.5% mentioned Diarrhea, 2.2 % mentioned Dysentery, 0.3% mentioned Malaria, 0.1% mentioned Shigellosis, and 3.8% mentioned Typhoid and 10.1% had no idea. Cholera and Diarrhea were the most mentioned diseases in both rural and urban areas, while Shigellosis and Malaria were the least stated as shown in Table 4.10 and Figure 4.9.

The bacterium Vibrio cholera is the cause of cholera. Eating food or drinking water which was contaminated by faeces pf cholera infected person is the main infection pathway to Cholera. (WHO, 2017).Ingesting bacteria, virus, and parasites living water contaminated by human and faecal matter from latrines, septic tanks and municipal sewages result in diarrhea (WHO, 2017).Shigella bacteria which are found in faeces and are spread through poor hygiene cause Dysentery (Health Service Executive, 2017, and WHO, 2017). Plasmodium parasites cause malaria and spread when people are bitten by malaria infected anopheles mosquito (WHO, 2017).

Contacting Shigella bacteria present in faeces of infected people cause Shigellosis.The majority of infections result from Shigella Bacteria following faeco-oral transmission pathway from one person to another (Minnesota Department of Health, 2017).Salmonella typhi is the cause of Typhoid. Fecal-oral route from infected to healthy people is the pathway to get infected with Salmonela typhi. Eating food or drinking water contaminated by urine or feces of infected people is most the common source of infection (David, 2017). In short, Cholera, Diarrhea, Dysentery, Shigellosis, and Typhoid are diseases connected to contact with human feces. However, Malaria is water related disease which is not related to human feces.

5.1.6 Students' knowledge on sources of clean water

The study found that students in both rural and urban areas have ideas about different sources of clean water for drinking. Table 4.11 and Figure 4.10 show the results of the survey on sources of water. Overall, about 6.3% of respondents mentioned unimproved sources of clean water while 81.1% mentioned improved sources of clean water. In rural areas, 7% mentioned unimproved sources of clean water while in urban areas 5.3% mentioned the same.Boiled water, borehole, mineral water, rain water, protected spring, tank water and tap water are improved sources of clean water because through active intervention or by nature of their construction are protected from outside contamination, especially faecal matter (WHO, 2018). However, other surface waters like lakes, river, and sea water are unimproved sources of clean water vulnerable external contamination by faecal matter.

5.1.7 Students' knowledge on causes of selected WASH related diseases

Knowledge on causes of water, sanitation and hygiene related diseases are paramount and centerpiece for adequate prevention. The assessment of knowledge was limited to the following selected diseases only: Cholera, Diarrhea, Malaria, Shigellosis, Trachoma, and Typhoid.

5. 1.7.1 Knowledge on causes of Diarrhea

The majority of respondents have no knowledge on causes of diarrhea both in rural and urban areas. About 0.2% mentioned that amoeba is the cause of diarrhea. About 11.3% mentioned drinking of dirty water, 15.3% mentioned poor sanitation and hygiene while 73.1% do not know the causes of diarrhea. Amoeba and drinking of dirty water were mostly stated in both rural and urban schools as shown in Table 4.12 and Figure 4.11.Diarrhea is a symptom of infection caused by a host of parasitic, bacterial, and viral living in water contaminated by human and animal faecal matter from latrines, septic tank and municipal sewage (WHO, 2017). Therefore, drinking dirty water polluted by human feces, poor hygiene and sanitation result in diarrhea. Amoeba also causes diarrhea (Battikhi, 2004).

5.1.7.2 Knowledge on causes of Shigellosis

The results of the survey as shown in Table 4.13 and Figure 4.12 showed that the bulk of respondents (98%) had no idea on the causes of shigellosis. About 0.2% mentioned it is caused by contact with human feces, 0.2% responded that it is caused by polluted water and 1.6% mentioned poor hygiene.Shigellosis is caused by Shigella Bacteria present in faeces of the infected person. Most of the infections result from Shigella Bacteria passes which pass through faecal-orl route (Minnesota Department of Health, 2017). Therefore, contact with human feces, water pollution by human feces, and poor disposal of human feces can result in shigellosis.

5.1.7.3 Knowledge on causes of cholera

The bacterium Vibrio cholera is the cause of Cholera. Eating food or drinking water infected by feces of a person infected by cholera is the major transmission pathway (WHO, 2017). In the survey results shown in Table 4.14 and Figure 4.13 the students mentioned food and water contaminated by human feces (10.9%), and vibrio cholera (6.3%) to becauses of cholera. However,82.8% did not know what causes cholera.

5.1.7.4 Knowledge on causes of Trachoma

Trachoma is an infection of the eyes and repeated re-infections may result in blindness. It is caused by washing of the face with dirty water according to the World Health

Organization (WHO, 2017). The results of the survey showed in Table 4.15 and Figure 4.14 shows that generally, students have little knowledge on the causes of trachoma. Only 0.8% responded that it is caused by washing of the face with dirty water, while 99.2% did not know the cause.

5.1.7.5 Knowledge on causes of Typhoid

Salmonella typhus is the cause of Typhoid. People are infected with Salmonella typhi through fecal-oral route from infected individuals to healthy ones. Contacting urine or feces of infected people is the major source of contamination (David, 2017). The survey results shown in Table 4.16 and Figure 4.15 indicate that most students had no knowledge of causes of typhoid. The eating contaminated food or water (4.9%) and Salmonella typhus (3.8%) were mentioned to be causes of typhoid.

5.1.7.6 Knowledge on causes of Malaria

Plasmodium parasites cause Malaria. Malaria spreads when people are bitten by malaria infected anopheles mosquito (WHO, 2017). Through availability of stagnant water, the larval stage of mosquitoes develops (WHO, 2017). The survey results in Table 4.17 and Figure 4.16 show that 58.4% of the students and 0.4% of the student stated that female anopheles mosquitoes and stagnant water around home were the causes of Malaria, while 41.2% did not know the causes of Malaria.

5.1.8 Knowledge on prevention of selected water related diseases

Having knowledge in prevention of WASH related diseases is a key to a better health. The survey results presented in Table 4.18 and Figure 4.17 show that about 15.8% of respondents mentioned drinking clean water as a way to prevent Cholera. About 37.5% mentioned washing of hands with soap and maintaining food hygiene will prevent diarrheal diseases. About 26.5% stated draining stagnant water, using bed nets, and clearing bushes around homes as a way of preventing Malaria. About 0.3% said they can prevent Shigellosis through washing hands with soap and prevention of contact with human feces, while only 0.1% said they can avoid swimming in dirty water to prevent

Trachoma, and about 2.6% said cleaning raw vegetables, fruits and use clean water is the way to prevent Typhoid. However, about 17.1% do not have knowledge to prevent any of the stated diseases.

5.1.9 Water availability for drinking and sanitation in schools

In the six schools where this research was conducted, water shortage was a common issue, though water supplied in those schools was physically clean. As shown in Table 4.19 all the schools in the rural areas, have water shortage problem while only 33.3% reported water shortage in urban areas. Both rural and urban schools are supplied through the municipal water supply system. However, low pressure of flow of water across all schools was reported at the rate of 66.6%.Water shortage is a major obstacle to public health and development (Faissal Tarrass, 2011). The shortage of water lead to poor sanitation practice and conditions, and the transmission of diseases such as, diarrhoea, polio, dysentery, hepatitis A, cholera, and typhoid.

Poor sanitation is estimated to cause 280 000 diarrhoeal deaths annually (WHO, 2018). Inadequate sanitation and is a major factor in many neglected tropical diseases, including intestinal worms, and trachoma and schistosomiasis (WHO, 2018).Malnutrition is linked to inadequate sanitation. Currently, the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) estimate that 1.1 billion people lack access to adequate water supply and 2.6 billion people lack adequate sanitation. As a result, an estimated 1.6 million deaths every year is recorded from inadequate water sanitation and poor hygiene.

4.1.10 Sanitation facilities at schools

Hygienic sanitation facilities are crucial for public health. All schools visited have pit latrines which are improved sanitation facilities and toilets were clean. However, in all schools located in rural areas, there were no hand washing facilities and no soap, while in urban schools, hand washing facilities were available, but with no soap. The summary of the situation based on physical visit to the schools and observations made is shown in Table 4.20.

Hygiene is a multi-dimension and comprises much behavior, including hand washing, food hygiene and menstrual hygiene (WHO, 2018). Hand washing with soap and clean water is a top priority in all settings, and also as a suitable indicator for national and global monitoring of WASH (WHO, 2018). Hand washing is paramount for good health. According to Curtis and Cairncross (2003) it was found that washing hands with soap can reduce the risk of diarrhea by 42% to 47 % (World Bank, 2005). The same research indicated that hand washing is also important in the prevention of intense respiratory infections (World Bank, 2005).

5.1.11 Results on Hypothesis Testing

In our research, results were reported as proportions. To test hypotheses, Z-test is suitable when results are proportions (LaMorte, 2017).); University of Washington, 2018). Two-sample Z-test for the difference between proportions was performed in this study.

5.1.11.1 Z-Test results on Necessity of washing hands after visiting the toilets

We failed to reject the hypothesis stating that students' attitudes to hygiene in rural and urban schools are the same as they all agree on the necessity to wash hands after visiting the toilet.The above hypothesis testing results are similar to the study conducted in South Africa, where it was noted that in terms of practices, most of the respondents from both rural and urban schools reported that they practiced hand washing, especially before eating and after visiting the toilet (Jerry and Jabulani, 2013).

5.1.11.2 Z-Test results on Level of concern about hygiene

We rejected the hypothesis stating that the level of concern for hygiene is higher in rural schools than in urban schools.The results on hypothesis testing are in line with the results found by Jerry and Jabulani. In a survey on WASH conducted in South African and reported by Jerry and Jabulani (2013), a chi-square test for independence (with Yates Continuity Correction) indicated a significant association between the concern about the hygiene and location of schools and that urban schools were more concerned about hygiene.

5.1.11.3 Z-Test results on Human waste disposal

We rejected the hypothesis stating the practice of using latrine for human faeces disposal is common in both rural and urban schools.Hypothesis testing results above matches research findings conducted in India to assess latrine use in low-income countries. From the field study in rural India, it was found that overall, latrine use was poor and the leading reported reason for non-use of latrines was a preference for open defecation (Sinha, 2017). In another study on School Sanitation in underserved urban areas in India, It was noted that access to improved sanitation is higher in urban areas than in rural (Hanna et al.2015).

5.1.11.4 Z-Test results on Knowledge on diseases related to contact with human faeces

We rejected the hypothesis stating that the students' knowledge on diseases related to contact with human faeces in both rural and urban schools is the same.The above hypothesis testing results are in line with results found in a study conducted by Jerry and Jabulani in 2013 in South Africa, where it was noted that the level of hygiene knowledge for urban schools was high (71.70 ± 2.04%) in comparison with rural schools (28.30 ± 2.04%), with the respondents saying that they acknowledged the importance of washing hands after visiting the toilet. They did so mostly to remove germs and bacteria while on the other hand preventing diseases. In urban areas, they also knew the transmission route for waterborne diseases was through drinking water that is contaminated with fecal matter.

5.1.11.5 Z-Test results on Knowledge on sources of clean water for drinking

We failed to reject the hypothesis stating that the major source of clean drinking water for students in rural and urban schools is tap water.The results above on hypothesis testing are similar to what was found in South Africa. According to Jerry and Jabulani (2013), in their research on Knowledge, Attitude and Practices (KAP) Survey on Water, Sanitation and Hygiene in Selected Schools in Vhembe District, Limpopo, South Africa, it was noted that municipal water was found to be the most popular source of clean water followed by borehole and bottled water respectively in both rural and urban schools. Also in a KAP

baseline survey on water, sanitation and hygiene in eight regions of Ethiopia, it was observed that public taps/standpipes are the major types of improved water sources used by 23% of households, followed by protected wells (13%) and protected springs (11%) (UNICF Ethiopia, 2017).

4.1.11.6 Z-Test results on Knowledge on causes of Diarrhea

We rejected the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Diarrhea.The results above on hypothesis testing are similar to what was found in South Africa. According to Jerry and Jabulani (2013), in their research on Knowledge, Attitude and Practices (KAP) Survey on Water, Sanitation and Hygiene in Selected Schools in, South Africa, it was found that about 13% of students in rural and urban schools claimed to know the causes diarrhea.

5.1.11.7 Test results on Knowledge on causes of Shigellosis

We failed to reject the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Shigellosis.The results above on hypothesis testing are different from what was found in Iran. In a study on knowledge, attitude, and practice regarding food, and waterborne outbreak after a massive diarrhea outbreak in Yazd Province, Iran, in summer of 2013, it was found that only 64% of the participants had high knowledge and good practice regarding food and waterborne outbreaks and 43% of them had a positive attitude(Zahra et al. 2013).

5.1.11.8 Z-Test results on Knowledge on causes of Cholera

We rejected the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Cholera.The results above on hypothesis testing are similar to what Jabulani and Jerry found in South Africa.According to Jerry and Jabulani (2013), conducted their research on KAP on WASH in Selected schools in Vhembe District, Limpopo, South Africa. Apparently 62.5 ± 2.55 % of the respondents from urban schools knew about cholera in comparison to 35.5 ± 2.55% of respondents from rural areas.

5.1.11.9. Z-Test results on Knowledge on causes of Trachoma

We failed to reject the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Trachoma.The results above on hypothesis testing are different from what was found in Kenya. In a study on knowledge, practices and perceptions of trachoma and its control among communities of Narok County, Kenya, it was observed that majority of the community members had knowledge of trachoma and its transmission (Njomo, et al. 2016).

5.1.11.10 Z-Test results on Knowledge on causes of Typhoid

We rejected the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Typhoid.The results above on hypothesis testing are similar to what was found in South Africa. According to Jerry and Jabulani (2013), in their research on Knowledge, Attitude and Practices (KAP) Survey on Water, Sanitation and Hygiene in selected schools, in South Africa, it was found that about 3% of students in rural and urban schools knew the causes on typhoid.

5.1.11.11 Z-Test results on Knowledge on causes of Malaria

We rejected the hypothesis stating that the students in both rural and urban schools have no knowledge on the causes of Malaria.The results above on hypothesis testing are similar to what was found in Cameroun and in Nigeria. In a study on status of malaria-related knowledge in school-going children in Cameroon, It was revealed that students were aware of what malaria is and the ways in which malaria can be transmitted (Valerie, et al. n.d.). In another study conducted in coastal community in Calabar, Nigeria, it was found that most adolescents (77.5%) were aware that the vector transmits the malaria parasite through biting. Fewer respondents would prevent malaria attacks by clearing the vegetation in the peri-domestic environment (13.5%), filling up potholes (16.9%), opening up drainage (11%), using insecticide-treated nets (25.7%) or using antimalarial drugs (11.2%) (Ndifreke , Abraham and Aniekan, 2010).

5.1.11.12 Z-Test results on Knowledge on prevention of WASH related diseases

We rejected the hypothesis stating that the students in both rural and urban schools have no knowledge on the prevention of WASH related diseases.The results above on hypothesis testing are similar to what was found South Africa. According to Jerry and Jabulani (2013) in their research on Knowledge, Attitude and Practices (KAP) Survey on water, sanitation and hygiene in Selected Schools in Vhembe District, Limpopo, South Africa. It was found that that knowledge about water related diseases and its prevention was actually poor in the studied area of rural and urban areas, with 78.40 ± 1.71% of the respondents admitting that they had no idea on what was meant by water related diseases. Majority of those who knew about the prevention of water diseases mentioned that to avoid water based infections such as bilharzia one has to avoid swimming in dirty water. Also,the respondents mentioned that water from a stream must be boiled and cooled before drinking to avoid getting ill due to waterborne diseases.

Chapter 6: Conclusion

6. 0 Introduction

The research assessed students' knowledge, attitudes and practices on water, sanitation, hygiene and related diseases in selected schools in Musanze District. The research was designed to examine how young people are considered in actualizing Sustainable Development Goal 6 by ensuring access to water and sanitation for all.

6.1 Conclusion

From the research findings, it was noted that students' attitudes to hygiene in rural and urban schools are the same as they all agree on the necessity to wash hands after visiting the toilet. The level of concern for hygiene is higher in urban schools than in rural schools and the practice of using latrine for human faeces disposal is not common across both rural and urban schools.

Also students' knowledge on diseases related to contact with human faeces in both rural and urban schools is not the same as urban students have more knowledge than rural students while tap water was mentioned to be the major source of clean drinking water for students in rural and public. The students in both rural and urban schools have no knowledge on the causes of Shigellosis and trachoma. However, they have some knowledge on causes of Diarrhea, Cholera, Malaria, and typhoid and generally, they have some knowledge on the prevention Shigellosis, Trachoma, Diarrhea, Cholera, Malaria, and typhoid.

Schools do not have enough water of good quality from improved sources for drinking and sanitation. This is because in all rural areas, they face water shortage while only 33.3% reported water shortage in urban areas. Both rural and urban schools are supplied by municipal water supply. However, low pressure of water across all schools was reported at the rate of 66.6%. All schools visited have pit latrines which are improved sanitation facilities and toilets were clean. However, in all schools located in rural areas, there were no hand washing facilities near latrines and no soap, while in urban areas, hand washing facilities were available, but with no soap and their no water in some hand washing

facilities. As conclusion, schools have improved toilets, with privacy, good hygiene, facilities, and decent refuse handling options but with no fully operating hand washing facilities. However, water shortage, lack of, or insufficiency of hand washing facilities and soap might be the reason the bulk of students do not wash hands after urinating and defecating. In addition, water shortage, lack of, or insufficiency of hand washing facilities and soap might be the reason the bulk of students do not wash hands after urinating and defecating. In addition, since the majority of students do not have enough knowledge on diseases related to contact with human feaces, and the causes and prevention of some frequent wash related diseases, this might be the reason, they still practice open defecation in bushes and water bodies, and do not wash hands after defecating and urinating.

Since it was noted that students' hygiene practices, on water, sanitation, and hygiene, can endanger their health, with insufficiency of knowledge on diseases related to contact with human faeces, knowledge on sources of clean water, knowledge on causes and prevention of selected WASH related diseases, despite their high level of good attitudes and concern towards hygiene, surveyed students aged between the age of 12 and 15 years old cannot fully help their younger siblings under five years old who are reported to be vulnerable to water, sanitation and hygiene related diseases according to World Health Organization and UNICEF.

6.2. Recommendations

6.2.1. Policy on public health education in schools.

There is a need to provide public health education to children in schools. The education should focus on decent sanitation and hygiene practices, decent use of sanitation facilities, and provision of knowledge on causes and prevention of water, sanitation, and hygiene related diseases. Public health education will increase students' attitudes on hygiene and reshape their sanitation and hygiene practices.

In schools where the research was conducted, students need to be specifically informed on the importance of washing hands after urinating and after defecating since both in rural and urban areas only 48.3% wash hands after urinating while only 62.6% wash hand after

defecating. Information needs to be spread on importance on washing hands before eating since only 37.4% always wash hands before eating. Students also need to be educated on danger of eating uncleaned raw fruits since only 37.4% always wash fruits before consumptions.

There is a need to raise level of concern about hygiene since only 77.9% reported to be always concerned about hygiene. Students in both rural and urban schools needs to be informed more of the importance of using latrine to end open defecation practices as only 72.9% were reported to use latrine in rural areas against 93.8% in urban areas. Students both in rural and urban schools need to be taught of disease related to contact with human feces since 10.1% of them had not knowledge while 0.3% of them reported Malaria to be a disease related to contact with human feces. Students need to be informed of improved sources of clean water since about 6.3% still consider relying on unimproved sources of water for drinking while it was noted that about 13.6% have no idea about improved sources of clean water.

Students need to be taught about causes of water related disease since about 73.1%, 98% , 82.8%,99.2% , 91.4%, and 41.2% do not know the causes of Diarrhea, shigellosis, cholera, trachoma, typhoid, and malaria respectively. Knowledge on prevention of these stated diseases need also to be shared since about 17.1% have no knowledge on prevention of the above diseases.

6.2.2. Policy on provision of full water supply and sanitation coverage in public places.

Public places like schools need enough water with consistent supply. Full availability of hand washing facilities with soap is also needed. Availability of water, coupled with fully operating hand washing facilities will help students increase hygiene and reduce chances of contacting communicable water, sanitation and hygiene related diseases in their schools environments.

Regarding water availability in schools where this research was conducted, there is a need to increase water quantities. Water quality needs to be checked on regular basis too, especially, harvested rainwater stored in tanks for many days. Hand washing facilities with

soap in rural and urban schools need to be fully provided and number of both number of latrines and hand washing facilities has to be proportional to the number of students each schools has.

Policy on public health education in schools and other communities coupled with policy on provision of full water supply and sanitation coverage in public places will help Rwanda achieve Sustainable Development Goal six (SDG6) set to ensure availability and sustainable management of water and sanitation for all. The above policies can be implemented by both the Government of Rwanda and all other stakeholders like Non-governmental Organizations operating in Musanze District in the areas of water sanitation and hygiene.

6.2.3. Policy on monitoring of implementation on UNICEF/WHO WASH guidelines in schools.

Regular monitoring on WASH in schools in highly recommended tracking progress on compliance with UNICEF/WHO WASH guidelines in schools.

6.2.4. Policy on dissemination of WASH related diseases message in health centers, clinics and hospitals.

Medical practitioners should disseminate a message on causes and prevention of WASH related diseases after treating patients suffering from WASH related Diseases. This practice can increase awareness on causes and prevention of WASH related diseases.

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APPENDICES

(I) Appendix A: Questionnaires

PART 1: STUDENTS' QUESTIONNAIRE

Knowledge, attitude and practice (KAP) on water use, sanitation and hygiene for students.

Location of school- Rural ☐ Urban ☐

Name of school…….....

Gender……Female..☐……male…☐……

Age……...

You are kindly requested to make a cross or even to tick in the corresponding box provided and fill on the provided space. You can choose more than one if possible

1**.** Do you wash your hands after urinating?

Yes	
No	

2. Do you wash your hands after defecating?

Yes	
No	

3. Do you wash your hands before eating?

Yes	
No	

4. Do you wash your hands after eating?

Yes	
No	

5. If yes, how often do you wash your hands?

always	

sometimes	

6. Do you wash fruits before consumption/eating them?

Yes	
No	

7. Do you think it's really necessary for one to wash his/her hands after visiting the toilets?

Yes	
No	

8**.** Name any disease caused by pollution from/contact with human faeces

……

9. Do you have any idea as to what causes the following diseases?

Diseases	**Causes**
Diarrhea	
Shigellosis	
Cholera	
Trachoma	
Typhoid,	
Malaria	

10. Do you have any knowledge about the prevention of the waterborne diseases above.

Yes	
No	

11. if yes, explain e.g., washing your hands with soap or the use of latrines etc.

……

……

12. Name some forms (types) of disposal of human waste that you normally use.

Would you say human waste can be disposed of in the river or some people defecate in the river?

Latrine	
Bush toilets	
River	

13. How often do you use them?

Not often	
Sometimes	
Always	

14. Do you know of any source(s) of clean water?

Yes	
No	

If yes, (specify)……

Knowledge: Sanitation and Hygiene

You are kindly requested to make a cross or even to tick in the corresponding box provided and fill on the provided space. You can choose more than one if possible

1. Are you concerned about hygiene?

Yes	
No	

2. If yes, how concerned are you about hygiene?

Always concerned	
Sometimes	
Not concerned	

3. Do you ever wash your hands?

Yes	

No	

4. How often do you wash your hands?

Always	
sometimes	

5. If yes, when do you wash them?

First thing in the morning	
Before eating	
After visiting the toilet	

6. Do you think it's really necessary for one to wash his/her hands after visiting the toilet?

Yes	
No	

7. Do you wash fruits before consumption?

Yes	
No	

8. If yes, how often do you wash them?

Always	
sometimes	

9. Name any disease caused by pollution from human faeces.

……

10. Do you have any idea as to what causes the following diseases?

Cholera	
Diarrhea	
Shigellosis	

Malaria	
Trachoma	
typhoid	

11. Do have any knowledge about the prevention of the waterborne diseases above.

Yes	
No	

12. If yes, explain e.g., washing your hands with soap or the use of latrines etc.

……

13. Can you differentiate between waterborne and water based diseases?

Yes	
No	

14. Name some forms (types) of disposal of human waste that you normally use.

Latrine	
Bush toilets	
River	

15. How often do you use them?

Not often	
Sometimes	
Always	

16. Do you know of any source(s) of clean water?

Yes	
No	

If yes, (specify)……

17. Do you normally get information on hygienic and sanitation practices?

Yes	
No	

18. If yes where do you it?

Radio	
Television	
News papers	
Posters	
Booklets	

THANK YOU FOR YOUR COOPERATION!!!

PART 2: SCHOOL DIRECTOR'S QUESTIONNAIRE

This should be filled by the school principal

You are kindly requested to make a cross or even to tick in the corresponding box provided and fill on the provided space. You can choose more than one if possible

School Name :…….

School location:

Rural	
Urban	

Water availability at school

1. Do your school have clean water supply?

Yes	
No	

2. What is the water source in your school?

Municipal	
Borehole	
Hand dug wells	
Rivers/ lakes/ dams	

3. Do you normally experience water shortages and low pressure?

	Water shortage	Low pressure
Yes		
No		

4. If yes, for how long is the shortage?

Less than 3 hours a day	
More than 3 hours a day	

Other, (specify)…….

5. Has there been any case of water-borne diseases around the school environment?

Yes	
No	

6. Are you satisfied with the current water supply service in your school?

Yes	
No	

7. What makes you say so?

……

……

Sanitation facilities

8. Do you have hand washing facilities in your school?

Yes	
No	

9. Do you have toilets in you school?

Yes	
No	

10. What type of toilets are they?

Pit latrines	
Flushing toilets	
Open defecation in fields	

Bucket system	

11. Are you happy with the status of the toilets in your school?

Yes	
No	

12. In a week, how many times are the toilets cleaned in your school?

Every day	
After two days	
Not cleaned at all	

13. Who is responsible for cleaning toilets in your school?

No one	
Learners	
School cleaners	

14. Does the school have refuse collection and disposal site?

Yes	
No	

15. What is the estimate cost of refuse collection and disposal per month?
    Estimated amount is …….
16. Who pays for this service?

The school alone	
Parents of students contribute	

17. Who is engaged in refuse collection and disposal?

Students	
School workers	

18. How frequent is refuse collected and removed from your school

Once a week,	
Twice a week,	
Three times a week	
Every two weeks	
Processed at school	

19. How much water (cubic meters) does the school receive from water supply system to use (average per month)?
    Estimate amount in cubic meters…….
20. What do you suggest would be improved in relation to water supply, water use at school, refuse collection at school?

……
……..

<u>THANK IN ADVANCE FOR YOUR CO-OPERATION!!</u>

PART 3: TEACHER'S QUESTIONNAIRE

This questionnaire is to be filled in by a teacher who has been teaching in this school for at least two years.

Location of school- Rural ☐ Urban ☐

Name of school…….....

Gender……Female…☐……male…☐……

Age……...

Your highest qualification……

For how many years have you been teaching at this school?.....

You are kindly requested to make a cross or even to tick in the corresponding box provided and fill on the provided space. You can choose more than one if possible

Q.1 When teaching, do you tell your students about water, sanitation, hygiene, and related diseases?

Yes	
No	

Q2. Does this school have enough and clean water for to use?

Yes	
No	

Q3.What is the water source in your school?

Municipal	
Borehole	
Hand dug wells	
Rivers/ lakes/ dams	

Q4. Have you ever hear students in this school complaining about water quantity (Water Shortage) and quality over the past 2 years?

Yes	
No	

If yes,
How often did you hear about the issue?

Once	
Twice	
Three times	

Four times	
Five times	
Over than five times	
I do not remember	

Sanitation facilities

Q5. Do you have hand washing facilities in your school?

Yes	
No	

Q6. Do you have toilets in you school?

Yes	
No	

Q7. What type of toilets are they?

Pit latrines	
Flushing toilets Chemical toilets: Bucket system?	

Q8. Are you happy with the status of the toilets in your school?

Yes	
No	

Q9. In a week, how many times are the toilets cleaned in your school?

Every day	
After two days	
Not cleaned at all	

Q10. Who is responsible for cleaning toilets in your school?

No one	
Students	
School cleaners	

Q11.Do you think student should have be given information and knowledge on water, sanitation, hygiene, and related diseases?

YES	
NO	

Q12.Has any water related disease occurred in this area over the past two years?

YES	
NO	

THANK IN ADVANCE FOR YOUR CO-OPERATION!!

PART 4: THE CHECKLIST FORM: FIELD OBSERVATIONS AT SCHOOLS

The checklist form: Field observations at schools

Name of school……..

Location of school……

You are kindly requested to make a cross or even to tick in the corresponding box provided and fill on the provided space. You can choose more than one if possible

Section A: Water supply

1. **Sources of water**

Municipal	
Borehole	
Rain water harvesting tanks	

Other, (specify)…….

2. **State the quality (physical appearance) of water at the schools**

Clear	
Dirty	
Brown	

3. **Water availability**

Yes	
No	

Section B: Sanitation facilities

4. **Do they have toilets**

Yes	
No	

5. **Do they have sanitary bins (pads) for girls**

Yes	
No	

6. **Is soap available in hand washing areas?**

Yes	
No	

7. **Number of water taps**

One	
Two	
Three	
More than five	

Other, (specify)……

8. **The general outlook of hand washing areas**

Clean	
Dirty	
Weeds	
Grass	

9. **Type of sanitary structure**

Well constructed with bricks	
Mortar	

10. Are the toilets clean?

Yes	
No	

11. Does the sitting of toilets provide privacy?

Yes	
No	

12. The distance between toilets and hand washing areas

Within 3 meters	
About 5 meters	
About 10 meters	

Other, (specify)……

(ii) Appendix B: Table for determination of sample size (Krejcie and Morgan table)

TABLE FOR DETERMINING SAMPLE SIZE FROM A GIVEN POPULATION

N	S	N	S	N	S	N	S	N	S
10	10	100	80	280	162	800	260	2800	338
15	14	110	86	290	165	850	265	3000	341
20	19	120	92	300	169	900	269	3500	246
25	24	130	97	320	175	950	274	4000	351
30	28	140	103	340	181	1000	278	4500	351
35	32	150	108	360	186	1100	285	5000	357
40	36	160	113	380	181	1200	291	6000	361
45	40	180	118	400	196	1300	297	7000	364
50	44	190	123	420	201	1400	302	8000	367
55	48	200	127	440	205	1500	306	9000	368
60	52	210	132	460	210	1600	310	10000	373
65	56	220	136	480	214	1700	313	15000	375
70	59	230	140	500	217	1800	317	20000	377
75	63	240	144	550	225	1900	320	30000	379
80	66	250	148	600	234	2000	322	40000	380
85	70	260	152	650	242	2200	327	50000	381
90	73	270	155	700	248	2400	331	75000	382
95	76	270	159	750	256	2600	335	100000	384

Note: "N" is population size
"S" is sample size.

Krejcie, Robert V., Morgan, Daryle W., "Determining Sample Size for Research Activities", Educational and Psychological Measurement, 1970.