PREVALENCE AND RISK FACTORS FOR HELICOBACTER *PYLORI* INFECTION IN CHILDREN AGED 3-60 MONTHS ATTENDING A PRIVATE AND A PUBLIC HOSPITAL CLINIC IN KENYA (GERTRUDE'S CHILDREN'S HOSPITAL AND GITHOGORO CLINIC): A COMPARATIVE STUDY

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1. Gertrude's Children's Hospital
2. The University of Nairobi

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An application for funding of this research project was submitted to Gertrude's Children's Hospital and they funded the HpSA tests.

DECLARATION

I certify that this dissertation is my original work and has not been presented for a degree in any other university.

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This dissertation has been submitted with our approval as supervisors.

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DEDICATION

I dedicate this dissertation to my husband Ombongi Alex for his unwavering support and to my children Nissi, Samara, Tunu and Jesse for motivating me.

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This study would not have come to fruition without the efforts of many.

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ABBREVIATIONS

Ag	Antigen
ELISA	Enzyme linked immunosorbent assay
GCH	Gertrude's Children's Hospital
H. pylori	*Helicobacter pylori*
HpSA	*H pylori* stool antigen
MALT	Mucosa-associated lymphoid tissue
PCR	Polymerase chain reaction
PUD	Peptic ulcer disease
PPI	Proton pump inhibitor
SES	Socioeconomic status
Spp	Species
SPSS	Statistical Package for the Social Sciences
UBT	Urea breath test
WHO	World Health Organization

ABSTRACT

Introduction: *Helicobacter pylori* is a common bacterial infection globally with the highest infection rates occurring in developing countries. Acquisition occurs in early childhood and the prevalence tends to increase with age. The local burden of disease among children is largely unknown due to few studies. *H. pylori* infection Higher prevalence rates have been linked to low socioeconomic status, overcrowding, poor sanitation and low education levels.

Objective: Our study objective was to determine the prevalence and risk factors for *Helicobacter pylori* infection among children aged 3 months to 5 years attending immunization clinics at private hospital (Gertrude's Children's Hospital) and an affiliated public institution (Githogoro clinic).

Methodology: A cross-sectional study of 212 children (106 from each group) was carried out. A structured questionnaire was used to obtain sociodemographic characteristics of the children attending the immunization clinics. *H. pylori* infection was assessed using a stool antigen test. Statistical analysis was done using SPSS version 22 and data presented using descriptive statistics. Chi-square test was used to determine the association between *H pylori* infection and risk factors. Multivariate analysis was done using logistic regression.

Results: The participants' mean age was 29months with a male to female ratio of almost 1:1.The *H.pylori* feco-prevalence was 45% with those at Githogoro having a 2 fold higher risk of the infection (OR 2.137(95% C.I 0.863-5.296).

Multivariate regression analysis indicated that the water source for domestic use and number of people sharing a room were statistically significant risk factors for *H. pylori* infection.

Conclusion: There is a high prevalence of *H. pylori* among children in this study as reported in other studies in developing nations.

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CHAPTER ONE

1.1 Introduction

It is estimated that about half of the world's population is infected with *Helicobacter pylori*[1]. The prevalence varies by age, ethnicity, nation, and socioeconomic conditions[2]. By country, the *H. pylori* prevalence ranges between 20%- 70% with the lowest prevalence in parts of Western Europe and North America and the highest prevalence in Eastern Europe, Asia and developing countries[3]. According to Frenck et.al, the prevalence tends to be higher in some ethnicities like the Hispanics(62%) and non Hispanic blacks at 53% even though the United States (U.S.), prevalence is low[4]. The prevalence of infection in the West has been declining but it is still high in developing nations with the bulk of the global burden in these poorer nations [5]. This can be explained by the risk factors for *H. pylori* such as low socioeconomic status (SES), crowded living, poor sanitation, large family size and unclean water. This is a common theme in many households in the developing world and the major underlying factor is poverty[6]. *H. pylori* infection has also been attributed to low education levels.

Age at acquisition of infection also differs between industrialized and developing countries. *H. pylori* infection is thought to be acquired in childhood with up to 70% of children in the developing world being infected by 15years of age. In the U.S., the prevalence among children 10 year old children is 10%. In a review by Frenck et. al, the infection occurs at a younger age in developing countries as compared to western nations. In these low to middle income countries prevalence of more than 50% by the age of 5 years has been reported[4]. A study done in Gambia using the urea breath test reported a prevalence greater than 75% in year two of life[7]. In contrast, studies done in western countries show much lower prevalence rates-6% in Finland [8], 11% in Scotland[9], 13% in Germany[10] and 23% in Italy[11].

In the West, *H. pylori* prevalence has been demonstrated to increase with age. This may be attributed to a cohort effect whereby adults acquired the infection within their childhood years when it was more common in their regions than it is currently[12]. *H. pylori* acquisition rate is reportedly low (0.3-0.5% per patient per year) in high income countries [13].

1.2 Socioeconomic impact of *H. pylori* infection

Peptic ulcer disease (PUD) is a chronic disorder characterized by a relapsing remitting course whose complications include life threatening bleeding or perforation. Some of the direct costs include doctor's consultations, tests, medications and hospital admissions. Low work productivity, absenteeism and poor quality of life are some of the attributable indirect costs. Eradication of *H. pylori* aids in reducing these costs.

H. pylori infection is an underlying predisposition to gastric malignancies in the latter years of life. Cancer of the stomach ranks fourth in types of malignancy globally and second as a cause of mortality from cancer, contributing to 10.4% of the cancer deaths[14]. The World Health Organization (WHO) classified *Helicobacter pylori* as a group I carcinogen for gastric cancer[15]. Various studies have used simulation models to demonstrate how cost effective eradication therapy is when compared to surveillance in cancer prevention especially in high risk populations[16]. These studies show that prevention of gastric malignancy by *H. pylori* eradication is a prudent public health approach. Screening children for the disease may be a good preventive strategy but it is expensive in third world countries and there are no clear guidelines on when to test children and the recommended tests to use.

1.3 Problem Statement

Helicobacter pylori infection occurs in 50% of the global population[5]. The prevalence is higher in low to middle income nations like Kenya and once infected it tends to persist for life. It causes chronic gastritis, peptic ulcers, dyspepsia and in 1% of persons infection may predispose to development of certain gastric tumors. Kalebi et al.,2007[41] found *H. pylori* to be a significant cause of gastritis amongst adult patients who underwent biopsy. The actual estimates of gastroduodenal pathology following *H. pylori* infection in Kenya is unknown and requires further study. These sequelae are expensive to manage, have high morbidity and are a challenge to our strained resources (limited funds allocated to healthcare, few trained gastroenterologists, limited treatment options especially for cancer). The indications for testing and treatment in children are also not well tailored to our local set-up. Previous local studies have reported a prevalence of 73% (Kimang'a et al., 2010[17]), 45.6% (Langat et al., 2000[18]) and 93.7% (Nabwera et al., 2000[19]). Low socioeconomic status, poor sanitation and low education level are risk factors for infection. This study aims to compare two different populations and evaluate these risk factors.

1.4 Justification

Helicobacter pylori is a common bacterial infection across the world[1]. The incidence and prevalence of the infection is highest in low to middle income countries. Kenya is a developing country where poverty and other conditions that favor the infection are rampant. Few studies have been done locally on the infection especially in children. Most of the local available data is from studies in adults. Acquisition of the infection is known to occur in early childhood years [7] therefore this study aims to determine the *H. pylori* prevalence in children below 5 years and compare the sociodemographic characteristics between a low socioeconomic group and a middle level to high income group.

Most epidemiological studies use serology for testing participants and this may not give accurate information on *H pylori* prevalence as the titers may depict a past infection. The stool antigen test that I will use has high sensitivity [20, 21] and is non invasive hence suitable for testing children. It has been used among children in other studies reliably[22]. It is fast and easy to use. The findings of this study would be useful in highlighting the local *H. pylori* burden in children. Prevalence also varies from one geographical area to another even within one country hence the reason to compare two populations. *H. pylori* transmission is postulated to be gastro-oral, oro-oral and faeco-oral. Differences between the two populations captured in the study would help inform public health interventions to be used in reducing disease burden. This study would advocate for pediatric gastroenterology follow up of children who test positive for *H. pylori* while encouraging health care workers to test young children in whom the infection is suspected. Kimang'a A N et al., 2010[17] and Lwai-Lume et al., 2005[40] found resistance of isolated *H. pylori* strains to metronidazole (a common antimicrobial used routinely for treatment of assumed enteric infections). Rising antibiotic resistance globally, high disease burden as well as constrained resources may limit use of antibiotics for all patients who test positive for *H. pylori.* Development of local clinical practice guidelines would be a more practical approach to *H. pylori* management in children.

1.5 Hypotheses

Null hypothesis: There is no difference between the prevalence of *H pylori* infection in children receiving immunization at Githogoro from that of children at Gertrude's Hospital.Alternate hypothesis: There is a higher prevalence of *H pylori* infection in children at Githogoro than that of children attending Gertrude's Hospital.

1.6 Research Questions

1. What is the prevalence of *H. pylori* infection in children aged 3-60 months in the immunization clinic at Gertrude's Children's Hospital and in Githogoro clinic?
2. Is there a difference in the risk factors for *H. pylori* infection in children aged 3-60 months attending Gertrude's Children's Hospital and Githogoro clinic?

1.7Objectives

1.7.1Broad Objective

To determine the prevalence and risk factors of *H pylori* infection in children aged 3-60 months attending Gertrude's Children's Hospital and Githogoro clinic

1.7.2 Specific Objectives

1. To determine the prevalence of *H pylori* infection among children 3-60 months at Gertrude's Hospital and Githogoro clinic using stool antigen test (HpSA Biomeridian science).

2. To compare the difference in risk factors for *H pylori* infection in children aged 3-60 months attending the immunization clinics at Gertrude's Hospital and Githogoro clinic.

CHAPTER TWO

LITERATURE REVIEW

2.1. History of aetiological agent.

In 1983 Drs. Robin Warren and Barry Marshall reported a curved bacterium in gastric biopsy specimens and named it *Campylobacter pyloridis*[24].They noted that infection caused gastric and duodenal ulceration[25]. In 1989 it was renamed *Helicobacter pylori.* It is the main human pathogen in the Genus *Helicobacter* and man is the only natural reservoir. The Genus *Helicobacter* belongs to a subdivision of *Proteobacteria,* Order *Campylobacterales*, Family *Helicobacteraceae*. The Genus *Helicobacter* consists of over 20 species (spp.). *Helicobacter* spp can be divided into two major lineages: gastric spp, of which H. pylori is a member, and non gastric spp. Both groups demonstrate high organ specificity[26].

2.2. Microbiology

H pylori is a gram-negative bacillus that has a smooth surface and sheathed flagella with terminal bulbs. Although spiral shaped it may look like a rod while cocci are seen on culture or after therapy with antibiotics[27]. Cocci cannot be cultured and are thought to be dead cells[28]. This urease producing bacterium is slow growing. It is adapted to inhabiting the gastric mucous layer. Its fastidious nature necessitates use of enriched media for isolation from clinical specimens. Optimal growth takes 4-6days at 37^0C in humidified microaerophilic conditions with 10% carbon dioxide . It is oxidase and catalase positive[29].

2.3. Transmission

H. pylori transmission routes are not well known[23]. However, spread from one person to another appears to be the most likely mode of transmission among family members [30, 31, 32]. Thus the postulated transmission routes are faeco-oral, gastro-oral and oro-oral. Premastication of food for infants has been associated with increased of *H pylori* in this age group and supports oro-oral transmission. The chewing of food by mothers before feeding their babies occurs commonly in Africa and South East Asia[33].Culture of *H. pylori* from vomitus points to gastro-oral transmission as a possibility. Other possible routes include water-borne transmission[34]. A Peruvian study by Klein et. al, showed that children whose households used municipal water supply had a higher infection risk in comparison with those who used well water for drinking[35].

2.4. Pathogenesis

Virulence factors

2.4.1. Urease enzyme enables the organism to split urea to release nitrogen thus increasing the gastric pH. This enables the organism to survive in the hostile acidic gastric antrum. Urease also provides nitrogen for protein synthesis by the bacterium.

2.4.1.1. Vacuolating cytotoxin (VacA)

The VacA protein induces vacuolation in eukaryotic cells. Insertion into the membrane of endosomal vesicles changes anion composition in the endosomes leading to osmotic swelling which may alter mucosal barrier permeability and specific immune suppression. It also induces apoptosis.

2.4.1.2. Cytotoxin-associated antigen (CagA)

Some *H. pylori* strains induce inflammation attributable to the CagA gene. The CagA gene is located in the Cag pathogenicity island (PAI), a 40kb genome segment that codes for 30 genes.

CagA PAI genes encode a secretory complex that transports a protein, cag across both bacterial membranes and injects it into host cells. Once inside gastric enterocytes Cag induces pro-inflammatory cytokine production such as interleukin-8. CagA positive strains induce expression of a DNA editing enzyme that causes accumulation of mutations in tumor suppressor p53. However, strains lacking CagA PAI can still cause gastroduodenal disease. This shows that other factors such as environmental factors and host immunity have a role in causation of cancer and gastritis[36].

2.5 Clinical features

Incubation period lasts a few days then patients get gastritis which may present as abdominal pain, nausea and/or vomiting, malodorous breath and flatulence. Infected children may have some of these symptoms. The clinical features of gastritis relapse and remit, therefore it is possible to detect *H pylori* infection in individuals who have histological evidence of gastritis but no signs or symptoms[36].

The outcome of *H. pylori* infection is an interplay between host genotype, strain virulence and the environment. Most infections are asymptomatic despite presence of chronic active gastritis and the stomach looks normal on endoscopy. Chronic gastritis in some infected individuals may lead to dyspepsia, peptic ulcers and gastric tumors.

2.5.1 Gastric Cancer.

Antral gastritis from chronic infection is associated with a higher risk of gastric adenocarcinoma. *H. pylori* also predisposes to gastric MALT (mucosal associated lymphoid tissue) lymphoma and eradication treatment results in resolution[29].

2.5.2 Extragastric manifestations

Studies have linked *H. pylori* infection to various cardiac, neurologic and dermatologic manifestations but these are unproven. Infection has also been reported to be associated with sideropenic anemia, short stature and diarrhea[37].

2.6 Epidemiology

There is a higher *H. pylori* prevalence in low income countries than in developed nations. Age, gender, ethnicity, geographical region and SES all determine incidence and prevalence of the infection. Prevalence also varies between urban and rural populations. This may be accounted for by the socioeconomic variations in different populations[38]. In a study of antibiotic susceptibility, Kimang'a et al., (2010) reported 73% prevalence of *H pylori* in children in Nairobi[17.] Histology and rapid urease tesst were used for diagnosis of *H pylori* in this study. Nabwera et al., found a 93.7% prevalence among children aged 3-15 years by UBT in Trans Nzoia[19]. Langat and colleagues found a prevalence of 45.6% in children below 3 years in Nairobi health facilities by stool antigen test[18].

2.7. Risk Factors

Low socioeconomic status, bed sharing by children in crowded living conditions, poor sanitation, unclean water and low parental education level are some of the factors that pose a risk for *H. pylori* infection . Public health measures like improving sanitation, provision of potable water for domestic use, and eliminating poverty as well as overcrowding would help prevent *H. pylori* infection[13]

2.8. Diagnosis

Definitive tests for *H. pylori* infection depend on isolating the organism in gastric mucosal biopsy specimens. Initial screening is by non invasive tests.

2.8.1. Non invasive tests

2.8.1.1. Serology

Latex agglutination and enzyme linked immunosorbent assay (ELISA) are antibody based *H. pylori* tests. They are not a good screening test, cannot exclude infection or test for cure in patients treated with antibiotics due to antibody persistence [36].

2.8.1.2. Urea breath test (UBT)

This test is based on urease produced by *H. pylori* that splits urea into carbon dioxide and ammonia in the stomach. Its sensitivity is 90-96% and specificity is 99% [29].

2.8.1.3. Stool antigen tests

These detect the antigens of *H. pylori* in stool. These are highly sensitive (90-100%) and specific (92- 95%) [21].

2.8.1.4. Polymerase chain reaction (PCR)

There are DNA probes for detecting *H. pylori* in dental plaque, gastric juice and stool. PCR has a 95-100% sensitivity and 95-99% specificity but is expensive and unavailable in most developing countries[36].

2.8.2. Invasive tests

2.8.2.1. Endoscopy should not be done on patients who have been on antibiotics or proton pump inhibitors (PPI) for 1 month prior to the test. Biopsy specimens are taken from the mucosa of the gastric antrum, duodenal ulcer(s) or other areas of potential colonization and subjected to culture,

histology and urease detection. Histology samples may be stained by acridine orange, silver impregnation, Giemsa, or Gram's stain for *H pylori*. [29]

2.8.2.2 Biopsy urease test

A biopsy specimen is placed in urea (10% deionised water) solution with phenol red (pH indicator) that detects alkalinity as a result of ammonia production. It has sensitivity of 85- 95% and specificity of 80-90% and is quick and easy to perform[29].

2.8.2.3. Culture

Brain-heart infusion enriched Columbia blood agar or Skirrows media can be used incubated in high humidity for 3-4 days. Antimicrobial resistance testing can be done on culture isolates and the data used for epidemiology studies[29].

2.9. Treatment

Treatment is indicated in peptic ulcer disease, gastric cancer, dyspepsia unremitting with conventional treatment and those with iron deficiency anemia assuming that celiac disease has been excluded.

At least two antibiotics are combined with an acid lowering agent for *H. pylori* eradication (triple therapy) [3]

CHAPTER THREE

STUDY DESIGN AND METHODOLOGY

3.1 Study Design

This was a cross-sectional descriptive study to establish the prevalence of *H. pylori* and differences in sociodemographic characteristics among children attending the well baby clinic at Gertrude's Children's Hospital in comparison with those at the Githogoro outreach clinic, Gertrude's, Nairobi, Kenya. A closed ended questionnaire was used to obtain information on socioeconomic status and living conditions. Stool samples of the eligible children were collected for *H. pylori* antigen testing.

3.2 Study Site

Gertrude's Children's Hospital is a private hospital in Kenya, located at Muthaiga in Nairobi County. It caters for all medical requirements of children in Nairobi and surrounding environs, as well as those from East and Central Africa. The outpatient department consists of casualty at Muthaiga and outpatient satellite clinics located at Nairobi West, Donholm, Lavington, Pangani, Embakasi, Komarock, Rongai, Thika and Mombasa. Collectively, the outpatient serves about 800-1000 patients per day. It has a bed capacity of 97 beds and admits patients from age 0-21years.The main hospital at Muthaiga serves 40 children at the well baby clinic daily. The Hospital has outreach clinics at Githogoro and Mathare. Githogoro is an informal settlement, a few kilometers from Gertrude's Children's hospital located next to the Runda suburb within Westlands constituency in Nairobi, Kenya. Githogoro slum inhabits 20,000 residents of whom 2700 are children.

3.3 Study Population

The study populations were children aged 3-60 months seen at the well-baby clinic for immunization from June 2015 to October 2015 at Muthaiga and Githogoro outreach clinic.

Inclusion criteria

1. Children aged 3 months - 5 years.
2. Children whose parents consented to the study.
3. Children whose stool specimens were availed for testing as the stool was a requirement for *H.pylori* antigen detection. Those children who did not have a stool sample were contacted and asked to bring a sample at the next immunization clinic visit.

Exclusion criteria

1. Children whose parents declined to participate in the study.
2. Children who were on antibiotics or PPIs 4 weeks prior to the study.

3.4 Sample Size Determination

Formula by Fleiss (1980) for difference in two proportions:

$$\boldsymbol{n = \frac{\left[Z_{\propto/2}\sqrt{(r+1)p(1-p)} + Z_{\beta}\sqrt{rp_1(1-p_1) + p_2(1-p_2)}\right]^2}{r(p_1 - p_2)^2}}$$

$$\boldsymbol{p = \frac{p_1 + rp_2}{r+1} = \frac{0.45 + 1(0.65)}{1+1} = 0.55}$$

$$\boldsymbol{n = \frac{\left[1.96\sqrt{(1+1)0.55(1-0.55)} + 0.84\sqrt{0.45(1-0.45) + 0.65(1-0.65)}\right]^2}{(0.45 - 0.65)^2} = 106}$$

n- sample size with a ratio (r) of 1 in each population

For a 95% CI, $Z_{\alpha} = 1.96$, $Z_{\beta} = 0.84$ ($\alpha = 0.05$ and $\beta = 0.20$)

p1 = 45% , p2 = 65%

For this study, the level of confidence of 95% was used and an error margin of ±5% considered as acceptable. A previous study by Langat et al., (2006) reported a prevalence of 45%, which was used for the population1 in the study. Assuming a higher prevalence in the lower SES group, a proportion of 65% was hypothesized with an aim of detecting a 20% difference between the 2 groups with a statistical power of 80%,

Thus;

A sample size of n = 212 (106 from each group) was used to achieve the required sufficient precision for the estimated prevalence of *H. pylori* in children.

3.5 Sampling Method.

Purposive sampling was used. The sampling frame included children aged 3-60 months visiting Muthaiga or Githogoro for immunization whose parents consent to participate in the study. The first patient was picked at random and eligible patients recruited until the desired sample size of 212 is achieved. Eligibility for participating in the study was based on age, consent and no use of PPI or antibiotics 1month prior to date of data collection.

3.6 Participant Recruitment and Consenting Procedure

Parents bringing their children (within the age group of interest) for immunization were approached and asked to participate in the study. After explaining the study, those who consented answered the questions listed in the questionnaire (Appendix 2) and a stool sample taken for testing. Those children without a stool sample on the date of questionnaire administration were asked to avail a stool sample for testing at a later date. Those children who tested positive were booked for the next pediatric gastroenterology clinic for follow up and further management. The

management and follow up of those who tested positive was left to the discretion of the pediatric gastroenterologist at the gastroenterology clinic. According to the World gastroenterology organization, not all children who test positive for *H. pylori* need triple therapy[5]. Those who test negative were reassured and thanked for their participation in the study.

3.7Data Collection Instruments

A questionnaire (Appendix 2) was used to collect sociodemographic data as well as information on SES, sanitation and living conditions.

The result of the stool antigen test was noted as positive or negative at the end of the questionnaire.

3.7.1Stool Collection and Testing with Rapid strip HpSA (Meridian Bioscience Europe)

Fresh formed stool about 100mg will be collected into polypots.1ml of sample diluent was then be transferred into a test tube. Using a wooden applicator, a stool sample portion of 5mm in size was added to the diluent and shaken gently to suspend it in the diluent. After waiting for 3 minutes 500 microlitres of supernatant was transferred to another test tube with a pipette. The reaction strip was then dipped in the second test tube and the result read in 5minutes.

3.7.1.1. Principle of the test

The test strip is pre-coated with monoclonal antibodies against the CagA antigen of *H. Pylori* that is highly immunogenic. During testing the sample reacts with the colored conjugate (anti-CagA monoclonal antibodies-red polystyrene microspheres) which has been pre-dried on the test strip. The sample mixture moves upward on the membrane by capillary action. As the sample flows through the test membrane the colored particles migrate. In a positive result the specific antibodies present on the membrane will capture the colored conjugate (test region). The mixture continues

to move across the membrane to the immobilized antibody in the control band region. As a procedural control and internal control for the reagents, a colored band always appears regardless of the presence or absence of *H pylori* antigen in a sample.

3.7.1.2. Interpretation of results

If only one green band was seen in the control band area this would be interpreted to be negative, meaning that the sample does not contain *H pylori* antigen.

A positive result is one where there's a red band in the test area and a green band in the control area, meaning that the sample contains the *H pylori* antigen.

An invalid result is characterized by absence of colored control band regardless of a band on the test region. This requires repeating the test after verifying reagent stability and reviewing the procedure.

3.8 Variables

Dependent

H. pylori infection

Independent

1. SES
2. Living conditions
3. Sanitation
4. Source of drinking water
5. Age and sex of child

Confounders

Undocumented antibiotic use 1month prior to testing may give rise to a false negative result. Children who have been on antibiotics were excluded from the study.

Overuse of hospital facilities in the affluent group.

3.9 Quality assurance procedures

Only fresh stool samples were tested and they had to reach the laboratory within 2hours of collection. Any samples that had been stored at 4^0C was tested within 72hours of reaching the laboratory or stored at -20^0C until tested. All stool samples were discarded after 1week.

The fecal antigen test was carried out as stipulated by the manufacturer's instructions. The Meridian Bioscience rapid strip HpSA kit had an inbuilt quality control. All laboratory procedures were done according to the standard operating procedures. The Gertrude's laboratory carries out inter-laboratory controls.

3.10 Ethical Consideration

Ethical approval was obtained from the Kenyatta National Hospital/University of Nairobi Ethics Review Committee as well as the Ethics Committee at Gertrude's Children's Hospital, the area of study. Participation was on voluntary basis and assent for recruited children were sought through a signed informed consent form. The consent form was translated to Kiswahili for parents who do not understand English.

3.11 Data Management and Statistical Analysis Plans.

Qualitative and quantitative data was obtained using a questionnaire (APPENDIX 2).The data was coded and keyed into Microsoft Excel, which acted as the database. Data was imported into SPSS version 22 for analysis. Descriptive statistics of frequencies, respective proportions and means

with corresponding standard deviations, medians and respective inter-quartile ranges were used after assessing the normality of the particular continuous variable such as age, size of nuclear family, number of rooms. Chi square statistics was used to was to assess for differences in prevalence of *H. pylori* in children aged 3-60 months by either socio-economic status or sanitation which are categorical variables. Univariate analysis was done using logistic regression analysis to assess for factors significantly association *H pylori* in children aged 3-60 months; with significant factors included into a multivariable logistic regression model. Crude and adjusted Odds Ratios (OR), respective 95% confidence intervals and p values were reported for each of the covariates fitted in the model. Tables, histograms and pie charts and tables were used to display the analysis results. All analysis was done using SPSS version 22 and hypotheses was evaluated at the 5% level ($p < 0.05$).

CHAPTER FOUR

RESULTS

4.1 Introduction

The findings of the study are presented in this chapter. The main objective of the study was to determine the prevalence and risk factors of *H. pylori* infection in children aged 3-60 months attending immunization clinics at Gertrude's Children's Hospital and Githogoro clinic.

4.2 Patient Demographics

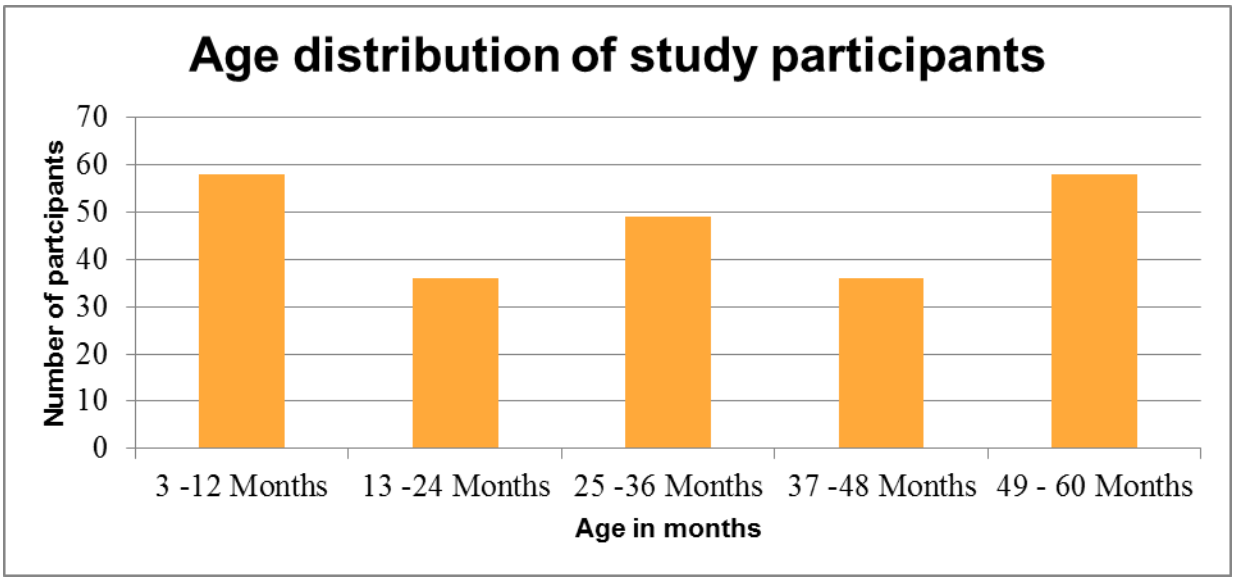
Two hundred and twelve (212) children at Gertrude's Hospital, Muthaiga and Githogoro clinic (also run by Gertrude's Hospital) were enrolled into the study. The mean age of the study participants was 29months ± SD 18.196. The largest proportion of children in this study were between the age of 3months to 12 months 54(27.4%) .

Table 1: Children Characteristics

The characteristics of the children is as shown by the table below.

	Frequency n (%)			
	Gertrude (N=106)	**Githogoro (N=106)**	**Total**	**p-value**
Age (Months)				
03-12	26 (48.1)	28 (51.9)	54 (100)	0.753
13-24	23 (47.9)	25 (52.1)	48 (100)	0.743
25-36	19 (51.4)	18 (48.6)	37 (100)	0.856
37-48	25 (64.1)	14 (35.9)	39 (100)	0.051
49-60	13 (38.2)	21 (61.8)	34 (100)	0.102
Gender				
Male	49 (45.4)	59 (54.6)	108 (100)	0.169
Female	57 (54.8)	47 (45.2)	104 (100)	
Guardian Level of Education				
Secondary and below	20 (18.0)	91 (82.0)	111 (100)	<0.001
Tertiary	86 (85.1)	15 (14.9)	101 (100)	

Figure 1 Graph showing number of participants per age group



The gender distribution of the study population consisted of one hundred and eight (108) males and one hundred and four (104) females respectively (figure 2).

Figure 2 showing the gender distribution of study participants

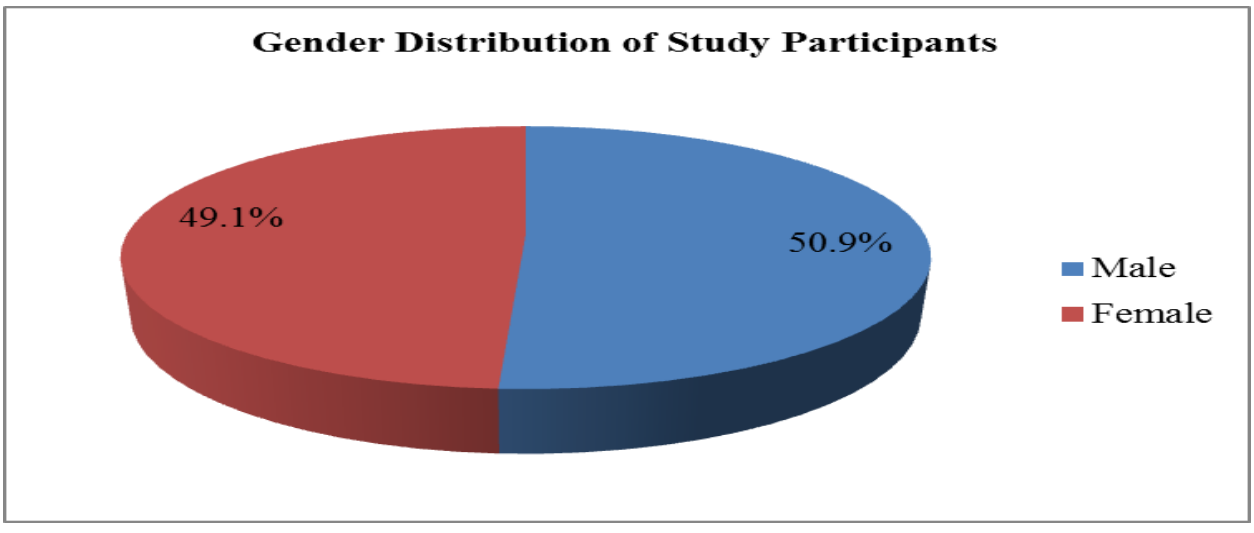


Table 2: Social Economic Status

The social economic status of the participants is as shown by the table below.

	Frequency n (%)			
	Gertrude (N=106)	**Githogoro (N=106)**	**Total**	**p-value**
People per room				
≤2	86 (54.8)	71 (45.2)	157 (100)	0.019
>2	20 (36.4)	35 (63.6)	55 (100)	
Toilet type				
Flush toilet	81 (56.3)	63 (43.8)	144 (100)	0.008
Private latrine	20 (50.0)	20 (50.0)	40 (100)	1.000
Public latrine	5 (17.9)	23 (82.1)	28 (100)	<0.001
Source of water				
Private tap	62 (80.5)	15 (19.5)	77 (100)	<0.001
Public tap	24 (38.7)	38 (61.3)	62 (100)	0.035
Borehole/Well/Other	20 (27.4)	53 (72.6)	73 (100)	<0.001

4.3 Prevalence of *H. pylori* Infection

This section presents the prevalence of *H. pylori* infection among children 3-60 months at Gertrude's Hospital and Githogoro clinic using stool antigen test (HpSA Biomeridian science).

Table 3: Distribution of H. pylori Status by Site

	Frequency n (%)			
	Gertrude (N=106)	**Githogoro (N=106)**	**Total**	**p-value**
Positive	28 (26.4)	67 (63.2)	95 (44.8)	<0.001
Negative	78 (73.6)	39 (36.8)	117 (55.2)	

The number of children whose fecal samples were positive for *H.`pylori* were 95 in total with 64% of these residing in Githogoro and approximately 26% living in areas around Muthaiga as shown below:

The age distribution of children who tested positive for the *H. pylori* infection at Gertrude's Hospital and Githogoro clinic using stool antigen test is as shown by the table below.

	Frequency n (%)			
	Positive (N=95)	**Negative (N=117)**	**Total**	**p-value**
Age (Months)				
03-12	24 (25.3)	30 (25.6)	54 (25.5)	0.950
13-24	29 (30.5)	19 (16.2)	48 (22.6)	0.013
25-36	16 (16.8)	21 (17.9)	37 (17.5)	0.833
37-48	15 (15.8)	24 (20.5)	39 (18.4)	0.377
49-60	11 (11.6)	23 (19.7)	34 (16)	0.083
Gender				
Male	53 (55.8)	55 (47.0)	108 (50.9)	0.203
Female	42 (44.2)	62 (53.0)	104 (49.1)	

4.4 Risk Factors for *H. pylori* Infection

This section presents the results of the risk factors for *H. pylori* infection in children aged 3-60 months attending the immunization clinics at Gertrude's Hospital and Githogoro clinic

Table 4: Risk Factors

	Frequency n (%)				
	Positive (N=95)	**Negative (N=117)**	**Total**	**OR (95% CI)**	**p-value**
Guardian Level of Education					
Secondary and below	69 (72.6)	42 (35.9)	111 (52.4)	4.7 (2.6-8.5)	<0.001
Tertiary	26 (27.4)	75 (64.1)	101 (47.6)		
Study site					
Muthaiga	28 (29.5)	78 (66.7)	106 (50.0)	0.2 (0.1-0.4)	<0.001
Githogoro	67 (70.5)	39 (33.3)	106 (50.0)		
People per room					
≤2	63 (66.3)	94 (80.3)	157 (74.1)	0.5 (0.3-0.9)	0.021
>2	32 (33.7)	23 (19.7)	55 (25.9)		
Toilet type					
Flush toilet	61 (64.2)	83 (70.9)	144 (67.9)	0.7 (0.4-1.3)	0.297
Private latrine	21 (22.1)	19 (16.2)	40 (18.9)	1.5 (0.8-3.0)	0.278
Public latrine	13 (13.7)	15 (12.8)	28 (13.2)	1.1 (0.5-2.4)	0.853
Source of water					
Private tap	9 (9.5)	68 (58.1)	77 (36.3)	0.1 (0.1-0.2)	<0.001
Public tap	41 (43.2)	21 (17.9)	62 (29.2)	3.5 (1.9-6.5)	<0.001
Borehole/Well/Other	45 (47.4)	28 (23.9)	73 (34.4)	2.9 (1.6-5.2)	<0.001
Age (Months)					
03-12	24 (25.3)	30 (25.6)	54 (25.5)	1.0 (0.5-1.9)	0.950
13-24	29 (30.5)	19 (16.2)	48 (22.6)	2.3 (1.2-4.4)	0.013
25-36	16 (16.8)	21 (17.9)	37 (17.5)	0.9 (0.4-1.8)	0.833
37-48	15 (15.8)	24 (20.5)	39 (18.4)	0.7 (0.3-1.4)	0.377
49-60	11 (11.6)	23 (19.7)	34 (16.0)	0.5 (0.2-1.1)	0.083

Children whose guardians had attained secondary education and lower had a 5 fold increased risk of infection with *H. pylori* (OR 4.7(95% C.I 2.6-8.5) in comparison to the children of college educated guardians. The type of toilet used in the household and number of people sharing a room were not statistically significant as risk factors for *Helicobacter pylori* infection in this study. Children aged 13months to 36months had the largest percentage of fecal *H. pylori* positivity in this study. However age was not deemed to be statistically significant as a risk factor for the infection on univariate analysis.

The results for the logistic regression for the risk factors is as shown by the table below.

	B	**S.E.**	**Wald**	**Sig.**	**OR**	**95% C.I. for OR**	
						Lower	**Upper**
Education							
Secondary and below	0.745	0.468	2.532	0.112	2.106	0.842	5.269
Tertiary (Ref)							
Study site							
Muthaiga (Ref)	0.760	0.463	2.692	0.101	2.137	0.863	5.296
Githogoro							
People/room	0.747	0.332	5.079	0.024	2.111	1.102	4.043
Water source			29.672	0.000			
Private tap	-2.011	0.488	16.982	0.000	0.134	0.051	0.348
Public tap/Water vendor	0.947	0.470	4.056	0.044	2.577	1.026	6.475
Borehole/Well/Other (Ref)							
Age of child			6.022	0.197			
03-12 months	0.924	0.564	2.685	0.101	2.519	0.834	7.608
13-24 months	1.385	0.587	5.564	0.018	3.995	1.264	12.630
25-36 months	1.053	0.613	2.947	0.086	2.865	0.861	9.527
37-48 months	0.724	0.598	1.467	0.226	2.064	0.639	6.666
49-60 months (Ref)							
Type of toilet			12.630	0.002			
Flush toilet (Ref)							
Private latrine	-1.048	0.520	4.057	0.044	0.351	0.126	0.972
Public latrine	-2.287	0.647	12.507	0.010	0.102	0.029	0.361
Constant	-2.436	0.817	8.887	0.003	0.087		

CHAPTER FIVE

DISCUSSION

5.0 Introduction

The purpose of this study was to determine the prevalence and risk factors of *H pylori* infection in children aged 3-60 months attending Gertrude's Children's Hospital and Githogoro. This study was a cross sectional hospital based prospective study carried out at a private hospital in an urban setting within Nairobi, Kenya-Gertrude's Children's Hospital and the hospital's outreach clinic in a nearby informal settlement area-Githogoro clinic. A questionnaire was used to obtain parental sociodemographic characteristics, income level and housing/hygiene conditions. Stool samples from the children recruited into the study were then obtained and tested using an immunochromatographic assay for *Helicobacter pylori* antigen. The study recruited asymptomatic healthy children attending the immunization clinic.

5.1 Prevalence of *H.Pylori* Among The Study Participants

The overall prevalence of *Helicobacter pylori* infection was 44.6% (95/212) and the prevalence increased with age as has been shown in other studies.[18,43,45] Children aged between 3-12 months had the lowest prevalence rate at 34% while those aged 49-60 months had the highest prevalence of 56.9%. The prevalence in this study is similar to the prevalence of 45.6% reported by Langat among children less than 3years in Nairobi[18]. There was a higher prevalence of *H. pylori* infection in children at Githogoro clinic as compared to those at Gertrude's Children's Hospital(64% versus 26%) and on univariate analysis by chi square this was found to be statistically significant at a p-value of 0.001(OR2.250(1.638-3.091).

H. pylori is thought to be acquired in early childhood and prevalence increases with age. Nabwera and colleagues reported a prevalence of 93.7% among school going children aged 3-15 years by urea breath test in Trans Nzoia county and hypothesized that the infection may be occurring before the age of 3years.[19] Langat's study recruited healthy children below 3years and also tested their mothers for *H. pylori* antibodies in their blood and was done in various clinics throughout Nairobi County.

Majority of the local studies on *H. pylori* have been done in symptomatic adults or older children. Kimangá and colleagues reported a *H. pylori* prevalence of 73.3% in the biopsy specimens of children with dyspeptic symptoms at Aga Khan Hospital in Nairobi[17]. Aitila et. al,2017 found a prevalence of 24.3% among children aged 1-15years with abdominal complaints at a Mbarara hospital in Uganda.[42] Another Ugandan population based study by Hestvik recorded a *H. pylori* prevalence of 44.3% among healthy children aged 0-12years and in this study, the prevalence rose with age. A population based study by Aguemon et. al, in Benin found a prevalence of 68.2% among children aged 2-5years and the prevalence rose with age to 78.6% among children aged 6-10years. [43] In this Beninese population the detection of the infection was done by ELISA on serum. Akwu et. al, found a *H. pylori* prevalence of 14.1% by stool antigen testing in a rural population of children aged 5-16years in Ghana.[44]

A retrospective medical records survey of children with dyspeptic symptoms who had undergone endoscopy found a prevalence of 24.7% among adolescents aged 15-19 years in Brazil.[46]

The prevalence of *H. pylori* varies from one geographical location to another and these differences may be due to socioeconomic disparities, environmental conditions, hygiene practices, cultural habits such as premastication of food given to young children. The differences may also be

attributed to the laboratory methods and samples used as the sensitivities of fecal *H. pylori* antigen kits, urea breath test and serum *H. pylori* antibody tests differ.

5.2 Risk Factors of *Helicobacter Pylori* Infection among Children Aged 3 Months To 60 Months

Various risk factors have been postulated to have an association with *H. pylori* infection in other studies and these include the use of unsafe water for domestic use , overcrowding , toilet sharing and poor social economic status. The prevalence of *H. pylori* was twice as high among children visiting Githogoro immunization clinic compared to those attending clinics at Gertrude's Hospital, Muthaiga. This difference may be due to a larger number of people per household in Githogoro as compared to Muthaiga residences. This study showed that the risk for infection increased by 2 fold when there were more than 2people sharing a room(p-value of 0.04,OR 2.111). The fecal oral transmission of this bacterial infection is favoured by cross infection in crowded living situations.[32] According to this study *H. pylori* infection increased with age and was highest among toddlers aged 13months to 36months and lowest in infancy (3to 12 months). The higher positivity rate among toddlers may be attributed to hygiene and sanitation around their food preparation as well as cultural practices by the guardians. Water source was a significant risk factor the infection. Those who used a private tap were protected from the infection while those sharing a public tap had a 3fold higher risk for the infection when compared to those using borehole water. A Peruvian study by Klein et.al, showed increased risk of *H. pylori* among preschoolers who use municipal water.[35] This study also found that those who used latrines were more protected from the infection(p-value 0.044,OR 0.351(95% C.I.0.126-0.972) as compared to those who had a flush toilet in their households. This may be due to contamination by fomites or poor handwashing

though this was not explored in the study. Most studies show that lack of sanitary facilities is a significant risk factor for *H. pylori* infection.[43,44,45] However, none have compared the use of flush toilets to latrines as a risk factor for *H. pylori*.

5.3 Conclusion

This study affirms that the *H. pylori* prevalence is high in Nairobi facilities as 44.6% of the preschoolers tested at Gertrude's Hospital and Githogoro clinic were infected with *H. pylori*. The prevalence was highest among toddlers aged 13-24months. Overcrowding and source of water for domestic use were associated with a higher risk of infection.

5.4 Recommendation

Health education on *H.pylori* infection among mothers visiting immunization clinics could help increase awareness in the community and possibly reduce transmission of the infection.

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APPENDICES

APPENDIX 1: CONSENT FORM FOR PARTICIPATION IN THE STUDY

STUDY TITLE:PREVALENCE AND RISK FACTORS FOR *HELICOBACTER PYLORI* INFECTION IN CHILDREN AGED 3-60 MONTHS ATTENDING GERTRUDE'S CHILDREN'S HOSPITAL AND GITHOGORO CLINIC

NAME OF RESEARCHER: DR EVELYN MACHOGU

I am a postgraduate student at the University of Nairobi Institute of Tropical and Infectious Diseases pursuing a Master in Science degree in tropical and infectious diseases.

As part of fulfillment for the above degree I am to conduct a study on the prevalence and risk factors for *H. pylori* infection in children aged 3-60months attending the immunization clinics at Gertrude's Hospital and Githogoro clinic. *Helicobacter pylori* is a common bacterial infection that affects children in Kenya and other parts of Africa. It causes gastritis, peptic ulcers and stomach cancer in a few individuals.

Your participation in this study will help me determine the number of children who are infected with *H. Pylori*. It will also help us identify factors that are associated with the infection. The results of this study will help create awareness among health workers in this facility and beyond about the infection. The study will help mothers understand the importance of good hygiene and sanitation in prevention of the infection. A stool sample from your child will be required for testing.

Kindly understand the following:-

i. Participation is entirely voluntary.

ii. Confidentiality will be maintained.

iii. Refusal of any participation in the study will not attract any penalties. Your child will continue to receive immunization and growth monitoring.

iv. No risk will be incurred while participating in this study. Any child found to have a parasitic infection on stool microscopy shall be referred for treatment. However those who test positive for *H. pylori* will be booked for the next pediatric gastroenterology clinic for further management and

follow up based on the results availed to the doctor. There is no monetary compensation for participating in this study. Should the child have recurrent abdominal pain, bloating, poor feeding or persistent vomiting in future, please consult the pediatrician.

In case of any concerns during the study you may contact me or my supervisors on 0726-282776 or KNH research and ethics committee P.O box 20273-00202 Nairobi, telephone number 020-2726300 Ext 44355 or Gertrude's Children's Hospital P.O. Box 42325-00100, Nairobi, phone number 0722898948.

I……../parent/guardian of ……..have fully understood the purpose of this study and consent to my/his/her participation.

IDHINI YA KUSHIRIKISHWA KATIKA UTAFITI

MAAMBUKIZI NA HATARI ZA *HELICOBACTER PYLORI* KATIKA WATOTO WENYE UMRI WA MIEZI 3-60 WANAOTIBIWA KATIKA HOSPITALI YA GERTRUDE NA KLINIKI YA GITHOGORO

JINA LA MTAFITI: DR EVELYN MACHOGU

Mimi ni mwanafunzi wa Uzamili katika Chuo Kikuu cha Nairobi Taasisi ya Magonjwa ya Kuambukiza ninayesomea shahada ya Sayansi katika magonjwa ya kitropiki na magonjwa ya kuambukiza.

Ili kuhitimu shahada hii,ninafanya utafiti juu ya maambukizi na hatari za maambukizi ya *H. pylori* kwa watoto wenye umri wa miezi 3-60 wanaohudhuria kliniki ya chanjo katika Hospitali ya Gertrude na kliniki ya Githogoro. *Helicobacter pylori* ni maambukizi ya bakteria ambayo huathiri watoto katika nchi ya Kenya na sehemu nyingine za Afrika. Viini hivi husababisha vidonda vya tumbo na saratani ya tumbo kwa baadhi ya watu wanaougua.

Ushiriki wako katika utafiti huu utanisaidia kuamua idadi ya watoto ambao wameambukizwa *H.pylori*. Itakuwa pia kutusaidia kutambua mambo yanayohusishwa na maambukizi. Matokeo ya utafiti huu yatanisaidia kujenga kuelewa miongoni mwa wafanyakazi wa afya katika kituo hiki na zaidi juu ya maambukizi. Utafiti huu utawasaidia akina mama kuelewa umuhimu wa usafi na usafi wa mazingira katika kuzuia maambukizi. Sampuli ya kinyesi cha mtoto wako itakuwa inahitajika kwa ajili ya kupima.

Tafadhali elewa yafuatayo: -

i. Ushiriki ni kwa hiari.

ii.Nitaitunza siri yako.

iii. Kukataa kushiriki katika utafiti hautavutia adhabu yoyote. Mtoto wako ataendelea kupokea chanjo na ushauri juu ya kukua kwake.

iv. Hakuna hatari inayotarajiwa kwa kushiriki katika utafiti huu. Mtoto yeyote atakayepatikana na maambukizi ya vimelea kwenye kinyesi atashauriwa akatibiwe. Hata hivyo, wale walioonekana na virusi vya *H. pylori* wataelekezwa kumwona daktari wa watoto. Hakuna fidia ya fedha kwa ajili ya kushiriki katika utafiti huu. Mtoto yeyote atakayekuwa na maumivu ya tumbo, kutapika,kutokula chakula vizuri au kiungulia katika siku/miezi/miaka ijayo anahimizwa kumwona daktari wa watoto.

Katika kesi ya matatizo yoyote wakati wa utafiti unaweza kuwasiliana na mimi au wasimamizi wangu kwenye simu 0726-282776 au kamati ya utafiti na maadili KNH S.L.P. 20273-00202 Nairobi, nambari ya simu 020-2726300 ext 44355 au Hospitali ya Gertrude, S.L.P 42325-00100, Nairobi, nambari ya simu 0722898948.

Mimi ..... / mzazi / mlezi wa ..... nimeelewa kikamilifu lengo la somo hili na ninakubali ushiriki wa mtoto wangu.

APPENDIX 2

QUESTIONNAIRE

PREVALENCE AND RISK FACTORS FOR ***HELICOBACTER PYLORI*** INFECTION IN CHILDREN 3 MONTHS- 5 YEARS ATTENDING GERTRUDE'S CHILDREN'S HOSPITAL AND GITHOGORO.

Interview no Date of interview _____

Age of the child _____ _____

Sex _____ Residence_____ Study site ……...

1. What level of formal education have you achieved?

    a) None

    b) Primary

    c) Secondary

    d) Tertiary

2. How many people are currently living in your household including yourself? .....

3. What is the size of your nuclear family? ……

4. Please describe the home where you live:

    a) It is owned or being bought by you (or someone in the household)

    b) It is rented for money

    c) It is occupied without payment of money or rent

    d) Other. Specify……..

5. How many rooms does your house have? ……..

6. What is the main roofing material of your house?

    a) Tiles e) grass/ leaves

    b) Concrete f) grass & mud

c) Iron sheets g) Other. Specify…….

d) Asbestos

7. What is the main walling material of your house?

a) Concrete d) grass/leaves

b) Iron sheets e) grass & mud

c) Timber f) paper

g) Other. Specify ……

8. What type of toilet does your household use?

a) Flush toilet d) No toilet (bush)

b) Private latrine e) Other. Specify…….

c) Public latrine

9. What energy source does your household use for cooking?

a) Electricity e) Charcoal

b) Solar power f) Firewood

c) Gas g) Crop residues

d) Paraffin/kerosene h) Other. Specify……

10. What lighting source does your household use?

a) Electricity e) Wick lamp

b) Solar power f) Candles

c) Hurricane lamp g) Firewood

d) Pressure lamp h) other. Specify

11. Does your household own the following? (Circle all that apply)

a) Radio/cassette (music system) d) Bicycle

b) Iron box e) Vehicle

c) Telephone (mobile) f) TV

12. What is the guardian's occupation?

a) Self employed c) Student

b) Employed d) housewife

13. What is your total monthly family income?

a) < KSh. 4,999

b) KSh 5,000 – 19,999

c) KSh 20,000 – 49,999

d) KSh 50,000 – 99,999

e) >100,000

14. What is the source of water for your domestic use?

a) Private tap d) Water vendor

b) Public tap e) Well

c) Borehole f) Other. Specify ……

15. Did you exclusively breastfeed?

a) Yes b) No

16. If yes for how long?

a) <6months

b) 6months

c) Other. Specify……..

17. How do you sterilize your child's feeding bottles or utensils?

……

18. Has the child been on antibiotics in the past 1 month?

☐ Yes ☐ No

19. Has anyone in your family been diagnosed with ulcers?

a.) Yes b.) No

20. Has anyone in your family been diagnosed with gastric cancer?

a.) Yes b.) No

21.*H. pylori Ag* result: a.) positive

b.) negative

DODOSO

MAAMBUKIZI NA HATARI ZA ***HELICOBACTER PYLORI*** KATIKA WATOTO WA MIEZI 3- 60 WANAOHUDHURIA HOSPITALI YA GERTRUDE NA KLINIKI YA GITHOGORO .

Nambari ya mahojiano _____ Tarehe ya mahojiano _____

Umri wa mtoto _____

Jinsia _____ Makazi _____

1. Una kiwango gani cha elimu?
a) Hakuna
b) shule ya msingi
c) shule ya upili
d) Elimu ya juu
2. Watu wangapi sasa wanaishi kwako ikiwa ni pamoja na wewe mwenyewe? .....
3. Familia yako nyuklia ina watu wangapi? .....
4 . Tafadhali eleza nyumba unamoishi :
   a) Ni inayomilikiwa au kununuliwa na wewe (au mtu katika kaya)
   b) Ni kukodi kwa ajili ya fedha
   c) Ni bila malipo ya fedha au kodi
   d) Nyingine. Bayana .....
5. Nyumba yako ina vyumba vingapi? .....
6. Paa ya nyumba yako imetengenezwa kwa vifaa vipi?
   a) matofali
   b) saruji
   c) mabati
   d) Asbestos
   e) nyasi / majani
   f) nyasi & tope
   g) Nyingine. Bayana .....
7. Kuta za nyumba yako zimetengezwa na kifaa kipi?
   a) Saruji
   b) Mabati
   c) Mbao
   d) nyasi / majani
   e) nyasi & tope
   f) karatasi
   g) Nyingine. Bayana .....
8. Nyumba yako kina aina gani ya choo?
   a) flush toilet
   b) choo cha kibinafsi
   c) choo cha umma
   d) hakuna choo (kichaka)
   e) nyingine. Bayana .....
9. Mnatumia nishati ipi kupikia ?
   a) Umeme
   b) Nishati ya jua
   c) Gesi
   d) Mafuta ya taa
   e) Makaa
   f) Kuni
   g) Mabaki ya mazao
   h) Nyingine. Bayana .....
10. Mnatumia kifaa kipi kuwapa mwangaza kwenye nyumba yako ?
   a) Umeme
   b) Nishati ya jua
   c) Hurricane lamp
   d) Pressure lamp
   e) Taa
   f) Mishumaa
   g) Kuni
   h) Nyingine. bayana

11. Je, kaya yako ina vitu vifuatavyo ? (Circle zote zinazotumika)

a) Redio
b) Pasi
c) Simu ya mkononi
d) Baiskeli
e) Gari la kibinafsi
f) Televisheni

12. Kazi ya mlezi ni nini?

a) kazi ya kujiajiri
b) kazi ya ajira
c) mwanafunzi
d) mama wa nyumbani

13. Jumla ya mapato ya familia yenu kila mwezi ni:

a) < shilingi 4999
b) Shilingi 5,000 - 19,999
c) Shilingi 20,000 - 49,999
d) Shilingi 50,000 - 99,999
e) > 100,000

14. Maji ya matumizi nyumbani yanatoka wapi?

a) Bomba la kibinafsi
b) Bomba la umma
c) Kisima
d) muuzaji wa maji
e) Naam
f) Nyingine. Bayana .....

15. Je, ulinyonyesha mtoto?

a) Ndiyo
b) La

16. Kama ndiyo kwa muda gani?

a) < miezi 6
b) miezi 6
c) Nyingine. Bayana .....

17. Jinsi gani unasafisha vyombo vya kulisha mtoto wako?

.....

18. Mtoto wako ametumia antibiotic (dawa) katika mwezi mmoja uliyopita?

a.) Ndiyo
b.)Hapana

19. Je, kuna jamaa amewahi kupatikana na vidonda vya tumboni?

a.) Ndiyo
b.) La

20. Kuna jamaa amewahi kupatikana na saratani ya tumbo?

a.) Ndiyo
b.) La

21. Matokeo ya utafiti wa kinyesi dhidi ya *H. Pylori*:a) Ndiyo
b) La