UNIVERSITY OF RWANDA

"ASSESSMENT OF *HELICOBACTER PYLORI* INFECTION USING STOOL ANTIGEN TESTING: A CROSS-SECTIONAL STUDY AT UNIVERSITY TEACHING HOSPITAL OF BUTARE (CHUB) "

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Nicolas RUBAMBANA

"ASSESSMENT OF *HELICOBACTER PYLORI* INFECTION USING STOOL ANTIGEN TESTING: A CROSS-SECTIONAL STUDY AT UNIVERSITY TEACHING HOSPITAL OF BUTARE (CHUB) "

By

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DECLARATION OF INDEPENDENT WORK

I, Nicolas RUBAMBANA, hereby declare that this research project submitted to the University of Rwanda, Rwanda for the degree of Masters of Science in Biotechnology is my own original work and has not been submitted before to any institution by myself or any other person in fulfillment to the award of any degree or any other Qualification.

Nicolas RUBAMBANA

SUPERVISORS'APPROVAL

This research proposal has been submitted for evaluation and examination with our approval as University Supervisors.

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DEDICATION

To my Family and Friends for your support during this academic pathway.

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"*Thank you for your unwavering support*".

ABREVIATIONS AND ACRONYMS

CHUB: University teaching Hospital of Butare

Helicobacter Pylori: *Helicobacter Pylori*

OR: Odds Ratio

CIs: Confidence intervals

SATs: Stool antigen Tests

SDG: Sustainable Development Goals

MALT: Mucosa-Associated Lymphoid Tissue

PUD: Peptic Ulcer Diseases

AST: Antimicrobial Susceptibility Testing

STT: Standard Triple Therapy

PPI: Proton Pump Inhibitor

WHO: World Health Organization

NISR: National Institute of Statistics of Rwanda

IBM SPSS: International Business Machine, Statistical Package for Social Sciences Software

B: regression coefficient

S.E: Standard Error

Cag PAI: Cytotoxin-associated gene pathogenicity island

CagA: Cytotoxin-associated protein gene A

T4SS: Type IV Secretion System

VacA: Vacuolating cytotoxin A

Df: Degrees of Freedom

Sig: Significance

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ABSTRACT

Background:

Helicobacter pylori is a common bacterium linked to stomach cancer and peptic ulcer disease. Despite its therapeutic importance, nothing is known about its prevalence in Rwanda. Finding the baseline prevalence of *Helicobacter Pylori* in CHUB patients was the aim of this investigation. It also examined the distribution of infection across demographic groups to inform future research.

Methods:

Participants in a cross-sectional study included people who used various CHUB health services. H. pylori was detected in stool samples using a fast antigen assay. The demographic data collected included age, sex, and housing location. To find independent predictors ($p < 0.05$) and ascertain descriptive prevalence, logistic regression was employed.

Results:

Out of 1373 participants, 300 (21.8%) tested positive for *Helicobacter Pylori*. Females had a slightly higher overall H. pylori positive rate (22.4%) than males (21.0%). The Eastern Province had the highest regional frequency (29.2%), while the highest infection rate (30.0%) was observed in the 15–24 age group. Urban dwellers were slightly more positive (23.0%) than their rural counterparts (20.9%). There was no significant association between infection and sex, province, and residence ($p > 0.05$). Only the 25-44 age group had significantly higher odds of infection (OR = 2.10, $p = 0.028$) compared to children under 5. The model's constant was significant ($p = 0.004$), reflecting a baseline risk of infection at reference levels.

Conclusion:

The findings demonstrate moderate prevalence of *Helicobacter Pylori* is in the general population attending CHUB, with slight differences by age and residency. These findings emphasize the need for a better understanding of the ongoing prevalence of sickness in public health.

Recommendation:

These findings highlight the significance of conducting a nationwide survey using the same test to provide a more complete picture of the current situation in Rwanda. Such data could serve as a benchmark for future investigations on test efficacy in contrast to histology, culture-based, and molecular approaches, potentially improving Helicobacter pylori diagnostic accuracy and directing treatment strategies in Rwanda.

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CHAPTER ONE: INTRODUCTION

1.1. Background to the study

Helicobacter pylori is a gram negative bacteria(Sun, Liu, Yang, Cao, & Han, 2025). It is typically acquired during childhood and, if left untreated, lasts a lifetime (Hawkey et al., 2022).Nearly 50 % of people on the planet are afflicted (Yuan et al., 2022; Zamani et al., 2018) but prevalence varies according to geographical location , sanitization norms and economic standing, with the most prevalence in developing countries (de Martel, Georges, Bray, Ferlay, & Clifford, 2020; Meliț et al., 2022; Yan et al., 2022).Peptic ulcers, gastric cancer, and gastric mucosa-associated lymphoid tissue lymphoma are among the severe gastroduodenal illnesses that can develop from *Helicobacter pylori* infections (Malfertheiner et al., 2023),(I. HE, 2014). It has been found to be associated to additional diseases including the ischemic heart disease, type 2 diabetes mellitus, anemia, adverse metabolic traits in obese individuals, and insulin resistance mentioned among many others (C.-X. Chen et al., 2017; J. Liu, Wang, & Shi, 2015).

There is a nowadays recorded rise of *Helicobacter Pylori* resistance to antibiotics posing challenges to clinical therapeutic practices with limited data about incidence, distribution and its clinical pattern (Savoldi, Carrara, Graham, Conti, & Tacconelli, 2018; Talebi Bezmin Abadi, 2018) .Early and accurate detection and identification of drivers of infection are key to implementing a targeted treatment , management and prevention of potential complications that may lead to cancers (M. Liu et al., 2022; Talebi Bezmin Abadi, 2018).

1.2. Problem Statement

Helicobacter pylori remains a major global health concern, classified as class I carcinogen infecting about 44% of the world's population, or nearly half of humanity(Alexander et al., 2021; Hooi et al., 2017). The disparity in prevalence is striking: industrialized countries have relatively low rates (20–40%), which is a sign of strong public health systems and improved living standards(Lu, Yu, Li, Yu, & Xu, 2018). The situation is far worse in low-income countries , where infection rates typically reach 70–90% due to inadequate sanitation, overcrowding, and limited access to treatment(Malfertheiner et al., 2023; Shafiq, Zafar, & Shafiq, 2024). Sub-Saharan Africa has one of the highest burdens, with prevalence rates frequently exceeding 70% and in some places approaching 90% (Y.-C. e. a. Chen, 2024).With a high and persistent incidence of 60–80% that disproportionately affects both rural and urban regions, Rwanda is not an exception(Ishimwe, Tuyishime, Uwamahoro, Nzeyimana, & Migabo, 2024; Nizeyimana, Rugwizangoga, Manirakiza, & Laga, 2021; Shikama et al., 2022).

Despite efforts since its discovery in the nineteenth century to manage the infection across various settings, concerns regarding increase in prevalence , rising antibiotic resistance, declining eradication rates, and low retesting rates persist (H. Yang & Hu, 2021). In Rwanda, a high prevalence of *Helicobacter Pylori* infection (75%) was recorded (Jaka & Smith, 2024) and results from gastric biopsies indicated the risk of infection and its effects across all ages and both sexes (Nizeyimana et al., 2021). Rwanda, like in other low resourced settings, the gastric biopsy analyses and susceptibility based treatment are not fully initiated at all levels. While susceptibility guided treatment is highly recommended ,in the country ,the investigation of the diagnostic accuracy of both invasive and noninvasive approaches has not yet been done to better support early detection, lowering the risk of stomach cancer, treatment failures, and prolonged patient suffering (Fallone et al., 2016),(Park et al., 2016). The histological and urease based testing has estimated the Highest prevalence(Jaka & Smith, 2024) .

Stool fast antigen testing, the most popular technique has been used in managing dyspepsia and assessing the *Helicobacter pylori* burden (Saha et al., 2016), but shows far lower detection rates, according to routine hospital statistics(KARASANYI, Ogendi, & Murekatete, 2025; Uwihanganye Jean Leodegard1 & 2025; Yadufashije, Uwitonze, Manizabayo, & Habyarimana, 2019) compared to the histological and urease based testing (Jaka & Smith, 2024) .

This disparity increases the risk of underdiagnoses in everyday practice, even though the stool test's diagnostic accuracy has never been fully assessed at the tertiary level. In the absence of such a baseline evaluation, Rwanda lacks the data required to evaluate the validity of this strategy, which could compromise national diagnostic efforts and prolong undetected infection.

The current study aims to determine the prevalence of *Helicobacter pylori* infection at the University Teaching Hospital of Butare (CHUB) and look into the main contributing factors using stool antigen testing. The findings are intended to serve as a baseline reference for future, more in-depth research on H. pylori in Rwanda, supporting targeted prevention initiatives and evidence-based management regimens.

1.3. Justification of the study

Evaluation of *Helicobacter Pylori* prevalence and risk variables in patients with dyspepsia utilizing the non-invasive stool antigen Test (SATs) is critical in improving *H.Pylori* management strategies ,(Imamura et al., 2024) and will help providing the basic data to further related study approaches and sound interventions aimed at improved clinical decision making for better patients outcomes (Cano-Contreras et al., 2018), and available resources allocations in this eradication pathways (Hsu et al., 2025).

Considering the highest *Helicobacter Pylori* prevalence recently documented in the similar University teaching hospital in Kigali city 75% (Nizeyimana et al., 2021) , other research perspective using the Stool antigen test in dyspeptic patients at CHUB would be more informative to next steps for comparative diagnostic accuracy and therapeutic results in local context (Malfertheiner et al., 2023).

1.4. General objective

The aim of this study is to assess the prevalence of *Helicobacter Pylori* infection and its relationship to demographic characteristics and geographic location among patients tested at CHUB using the stool antigen diagnostic test.

1.5. Specific Objectives

- To estimate the total prevalence of *Helicobacter Pylori* infection based on stool antigen test results.
- To assess the distribution of *Helicobacter Pylori* infection by sex, age, and residential patterns.
- To investigate the relationship between *Helicobacter Pylori* infection and demographic characteristics.

1.6. Research questions

The present study seeks to answer the below stated research questions as aligned with objectives:

1. What is the overall prevalence of *Helicobacter Pylori* among all patients tested at CHUB using Rapid Stool Antigen Test?
2. How does the prevalence differ by gender, age group, residency status, and geographic location?

3. Are there any statistically significant relationships between *Helicobacter Pylori* positive and socio-demographic characteristics?

1.6. Study Justification

The importance of quick, non-invasive stool antigen testing for prompt *Helicobacter pylori* infection detection and treatment is demonstrated by this study. It gives clinicians crucial information to help them with targeted diagnosis and treatment by identifying prevalence and related risk factors. Additionally, the results will help guide public health initiatives and future studies on better ways to diagnose and treat illnesses. The findings also support national health policies that deal with gastrointestinal disorders. It supports everyone's health and well-being, which is in line with Sustainable Development Goals (SDG 3) (Nation, 2015) .

CHAPTER TWO: LITERATURE REVIEW

2.1. Introduction

The Gram-negative, spiral-shaped, flagellated bacillus *H. pylori* is microaerophilic organism that colonizes the human stomach mucosa and causes gastric adenocarcinoma, peptic ulcers, chronic gastritis, and mucosa-associated lymphoid tissue (MALT) (Floch, Mégraud, & Lehours, 2017; Hassan et al., 2020; Yuan et al., 2022). This infection is now considered by the World Health Organization as class 1 carcinogen that causes peptic ulcer disease and stomach cancer (Alexander et al., 2021). It affects over 50% of the world population, (Hooi et al., 2017) and its infection has existed from millennia on this planet everywhere the human has existed and has exhibited the vertical transmission and genetic variability(Maixner et al., 2019) .

2.2. Routes of transmission

The most prevalent route of H. pylori transmission appears to be fecal-oral (Mladenova & Durazzo, 2018) ; although the oral-oral circuit is significant, the evidence does not support its universality (Kato et al., 2019). The gastric-oral route is generally used in youngsters and individuals who are prone to vomiting(Stefano, Marco, et al., 2018). Meanwhile, anal-oral and genital-oral pathways are still conceivable. Person-to-person and foodborne infections are the most common modes of H. pylori transmission, but animal-to-human and occupational exposure is associated with significant environmental and occupational constraints (Duan et al., 2023).

While the exact mode of transmission of *Helicobacter Pylori* is unknown, the level of contamination is heavily influenced by familial and environmental factors, with inadequate hygiene and sanitation having a significant impact (Stefano, Marco, et al., 2018).

2.3. Risk factors of H. Pylori

The complex risk factors for Helicobacter pylori infection vary by region(Lu et al., 2018), poor sanitation and hygiene, such as using traditional pit latrines or not having a toilet, significantly raises the risk, especially when combined with claustrophobic living conditions and inadequate hand hygiene(Lu et al., 2018; Malfertheiner et al., 2023; Shafiq et al., 2024). The usage of contaminated water sources, such as untreated or tank-stored water, is another important problem(Boehnke et al., 2018). Low socioeconomic status, which includes unemployment, poverty, and inadequate education, makes vulnerability even worse, particularly in rural or farming regions where healthcare facilities may be lacking(Elshair et al., 2022; Kotilea, Bontems, & Touati, 2019; Prodan, Pintilie, Ionete, & Ciocirlan, 2024; Shafiq et al., 2024).

High birth order, common sleeping arrangements, and big family sizes all contribute to person-to-person transmission within families(Go, 2002; Salih, 2009). Additionally, dietary and lifestyle behaviors such as smoking, drinking alcohol, and consuming raw or spicy foods have been linked to higher infection rates(S. He et al., 2024). Host-related factors, including genetic predisposition (e.g.blood group O) and early childhood exposure, affect individual vulnerability(Chakrani, Robinson, & Taye, 2018; Shafiq et al., 2024; Sostres et al., 2015). Furthermore, due to specific living arrangements or food preparation techniques, certain ethnic and cultural habits may raise risk(Habbash et al., 2022; Łaszewicz et al., 2014). Importantly, inadequate access to healthcare services delays diagnosis, reduces awareness, and prevents appropriate treatment, all of which lengthen the infection cycle(Zandian et al., 2023).

2.4. Clinical manifestations

Many *Helicobacter pylori* infections are asymptomatic, particularly in youngsters and in the early stages of infection(Mladenova, 2021). About 20% of people who have an H. pylori infection will develop a clinical illness linked to *H. pylori*(Graham, 2014).

Epigastric pain or discomfort, sometimes described as burning or gnawing, is the most common symptom(Moayyedi et al., 2017). Patients may also have early feelings of satiety, frequent burp, and bloating after eating little portions. Nausea may develop, sometimes with vomiting, especially during flare-ups. In chronic situations, inexplicable appetite and weight loss may occur(Shiotani, Lu, Dore, & Graham, 2017).

For other people, the infection manifests as functional dyspepsia, or persistent upper stomach pain without an ulcer(Rodríguez-García & Carmona-Sánchez, 2016). More serious side effects include gastritis, peptic ulcer disease (duodenal or stomach ulcers), and upper gastrointestinal hemorrhage(R. Li, Wang, Ma, & Chen, 2023). A history of infection is a known risk factor for stomach adenocarcinoma and mucosa-associated lymphoid tissue (MALT) lymphoma(Stefano, Marco, et al., 2018) .Symptoms in children, such as irritability, stunted growth, or recurrent stomach ache, are often nonspecific(Assa et al., 2022).

2.5. Pathophysiology of *Helicobacter Pylori*

A complex interaction between host, environmental, and bacterial virulence variables mediates this pathogenesis and disease consequences(C.-Y. Kao, Sheu, & Wu, 2016). The pathogen's entrance, via a variety of pathways, initiates the pathogenesis of Helicobacter pylori(Sharndama & Mba, 2022). For H. pylori colonization and pathology, four phases are essential: surviving in a 1-2 stomach acidic p^H; moving toward epithelial cells via flagella-mediated motility; adhesins binding to host receptors; and releasing toxins that injure tissue(C.-Y. Kao et al., 2016; C. Y. Kao et al., 2012; X. Yang et al., 2014).

The bacteria attachment on the mucosa surface of the stomach mostly takes advantage of the host immune system (Díaz, Valenzuela Valderrama, Bravo, & Quest, 2018; Rossez et al., 2014). The tissue damage in the host is followed by the manifestation of symptoms. Peptic Ulcer Diseases (PUD) and malignancies are among the consequences that arise from an infection when treatment is not administered properly(Feldman, Friedman, & Brandt, 2020).

The two primary elements of H. pylori's pathogenic foundation at the molecular level are as follows:One element of H. pylori that is strain-specific is the cytotoxin-associated gene pathogenicity island (Cag PAI) (Jang, Hansen, Su, Solnick, & Cha, 2022). Cytotoxin-associated protein gene A (CagA), the type IV secretion system (T4SS) island terminal gene product, is encoded by this gene locus. This T4SS has a syringe -like structure which injects bacterial effector protein into the host Gastric epithelial cells.

The vacuolating cytotoxin (VacA) locus, which encodes a secreted toxin, is an *H. pylori* locus, the second element linked to an elevated risk of stomach cancer. The VacA protein causes tissue damage leading to cell death, cytotoxicity, and intracellular vacuole formation in vitro(Chmiela, Walczak, & Rudnicka, 2018).

For improved mobility in vivo, H. pylori may transform into a spherical shape even during antibiotic treatment or extended in vitro cultivation. To live in unfavorable environmental circumstances such inadequate nutrition, dryness, oxygen deprivation, and antibiotic exposure, *H. pylori* can transform from a spiral to a coccoid form which may impact the detection using rapid tests (Sharndama & Mba, 2022) .

2.6. Diagnosis of *Helicobacter Pylori*

Treating a variety of gastroduodenal disorders effectively requires an accurate diagnosis of *H. pylori* infection. Peptic ulcers and stomach cancer are among the consequences that might be avoided with an accurate diagnosis and efficient treatment (Pichon et al., 2020; Umar, Tang, Marshall, Tay, & Wang, 2025).

Of the diagnostic methods available, the non-invasive stool antigen test (SAT), Urea Breath Test, Serology Ig G antibody detection and PCR stool based technique. The invasive methods are gastric Histology , Rapid Urease test , Culture and PCR, each with distinguishing advantages and limitations(Elbehiry et al., 2023).One test is usually sufficient for the diagnosis in a clinical context (Sabbagh et al., 2019). Noninvasive methods use peripheral samples, such as blood, breath, and stool specimens, to detect antibodies, bacterial antigen, and urease activity. While urea breath tests and fecal antigen tests are the most widely used noninvasive tests in clinical settings for the identification of *H. pylori* infection and during follow-up following eradication antibiotic therapy, blood samples are employed for screening and epidemiological research (Stefano, Rosalia, et al., 2018; Suerbaum & Michetti, 2002).

Invasive tests are based on endoscopic biopsy of the gastroduodenal section for histology, culture, rapid urease test, and molecular methods(Bordin, Voynovan, Andreev, & Maev, 2021; Nevoa et al., 2017; Saniee, Shahreza, & Siavoshi, 2016). The clinical environment, local availability, cost, and use of drugs (such as PPIs, bismuth, or antibiotics) that lower the density of H. pylori and hence lower the accuracy of tests for active infection all influence the test selection(Sharara, 2021). The pretest probability of the illness also influences the test selection(Uotani & Graham, 2015).

It has been demonstrated that monoclonal antibody based stool Antigen commercial kits for qualitative enzyme immunoassay can identify *H. pylori* protein antigens at concentrations of nanograms per milliliter of stool(Suerbaum & Michetti, 2002; Sugano et al., 2015).These types of kits offers a specificity and sensitivity similar to those of the Urea Breath Tests (Talley, 2017). With sensitivity and specificity above 90%, the Stool Antigen Test (SAT) is a widely used non-invasive diagnostic technique that is inexpensive and quick to perform. Its price and ease of use make it particularly helpful in primary care and other low-resource settings (Raguza, Granato, & Kawakami, 2005; Vilaichone, Quach, Yamaoka, Sugano, & Mahachai, 2018). Its use for both initial diagnosis and follow- up after treatment ratifies its place within routine diagnostic work up(Korkmaz, Kesli, Karabagli, & Terzi, 2013).

2.7. Treatment of *Helicobacter Pylori*

According to the best recommendation of treatment for Helicobacter pylori, unless there is proof that the infection has been healed in the past, all patients with present or past peptic ulcer disease should be tested for *H. pylori* infection(RANDEL, 2018). Tests should also be performed on patients who have a history of endoscopic excision of early gastric cancer or low-grade gastric mucosa-associated lymphoid tissue lymphoma(Aslan, Akın, Babacan, & Özdemir, 2019). It is not advised to test people with gastroesophageal reflux disease unless they have a history of dyspepsia or peptic ulcer disease(Katz et al., 2022).

Prior to administering antibiotics for an H. pylori infection, the 2022 Maastricht VI recommendations recommend susceptibility testing (Mestrovic et al., 2020) .This involves obtaining a culture from the stomach mucosa after endoscopic biopsy and evaluating drug sensitivity using agar dilution, disc diffusion, or an Epsililometer (E- test) (Ma, Li, Liao, Cai, & Zhang, 2022).

Because single treatments are typically ineffective, several antibiotic regimens are needed to eradicate *Helicobacter Pylori*. Amoxicillin, clarithromycin, and a proton pump inhibitor, known as the standard triple therapy (STT), were once quite effective (Fallone et al., 2016). However, developing antibiotic resistance and other difficulties such as poor adherence, genetic differences, obesity, smoking, and reinfection have reduced its effectiveness. Proton pump inhibitors are vital for lowering stomach acid and promoting tissue repair. The average duration of treatment is 14 days(Chey, Leontiadis, Howden, & Moss, 2017).

When an infected patient has a 14-day triple medication and then either re-infects or experiences *Helicobacter Pylori*-related side effects, this is known as antibiotic resistance (Shiotani et al., 2017). The overuse of metronidazole, which is primarily used in countries to treat a variety of gastrointestinal disorders, is the primary known cause of resistance (J. Chen et al., 2022).

The 14-day quadruple therapy, which consists of administering metronidazole, bismuth, tetracycline, and proton pump inhibitor (PPI), is one of the most often used first-line antibiotic (Malfertheiner et al., 2017),and is superior to the (STT) (B.-Z. Li et al., 2015). For 14 days, concurrent therapy consists of three antibiotics: amoxicillin, tetracycline, PPI, and metronidazole or Tinidazole (Fallone et al., 2016). Treatment for a patient with gastroesophageal reflux disease should be administered with the understanding that symptoms are unlikely to improve if testing reveals an *H. pylori* infection(Dore, Pes, Bassotti, & Usai-Satta, 2016).

Notwithstanding, the *Helicobacter pylori* treatment options, the question of potential changes in the native gastric microbiome and their effects on human health has been brought up by rising employment rates and the misuse of needless antibiotic therapies for the prevention or treatment of disease(Gomez-Ramirez et al., 2021).

While early detection is key to initiating a comprehensive treatment and follow up, the identification of risk factors would help preventing the *H pylori* infection, therefore reducing its prevalence among population attending CHUB.

CHAPTER THREE: MATERIALS AND METHODS

1.1.Study area and design

This cross sectional study on assessment of *Helicobacter pylori* Infection Using Stool Antigen testing was undertaken at the University Teaching Hospital of Butare (CHUB), in the parasitology unit between April and June 2025. It relied on rapid stool antigen readings and analysis of demographic data.

1.2.Population and inclusion criteria

Everyone who attended CHUB and had *Helicobacter pylori* stool antigen testing during the study period, regardless of age, was included in the study regardless of gender or place of residence.

1.3. Sample size

The total number of participants in this cross-sectional survey was 1,371. Because the study made use of pre-existing data from all participants who had *Helicobacter pylori* stool antigen testing at CHUB during the study period, a formal sample size calculation was not required. Incorporating all available information ensured sufficient statistical power for interpretable descriptive and comparative studies, providing a solid foundation for accurately predicting prevalence and examining associated factors.

1.4.Data collection

The data were gathered over a three-month period from CHUB's laboratory registers and patient medical records. To systematically gather pertinent data, we developed a structured tool which included information on age, sex, residence and test results (positive or negative), The age categories was adapted to the 2025 WHO, age classification as follow (Children (0-14 years), Youth (15-24 years), Young adults (25-44 years), Middle age (45-59 years), Elderly age (60-74 years), and Senior age (75+ years)(Dyussenbayev, 2017). In order to study about the burden in early children, we included another category of Children of < 5 year).

Residence areas (Urban or rural) were determined using the National Institute of Statistics of Rwanda (NISR); Fifth Rwanda Population and Housing Census, District Profiles (NISR, 2023).Records were checked for completeness and point out any unclear or missing information to guarantee quality. All information was anonymized and treated with confidentiality during the process.

1.5.Data analysis

The data was entered and analyzed using SPSS version 25. Descriptive statistics were used to describe demographic data and estimate the prevalence of *Helicobacter pylori* infection under frequency and percentages. To determine variables like age, sex, and province, and residency status that were independently associated with infection, binary logistic regression analysis was employed. A p-value of less than 0.05 was considered statistically significant, and the results were displayed as odds ratios (ORs) with 95% confidence intervals (CIs).

1.6.Data dissemination

For widespread accessibility, the research findings will be disseminated via medical networks and the University of Rwanda. The CHUB hospital personnel will be informed of the results in order to facilitate the diagnosis and treatment of H. pylori. The results will be published in peer-reviewed journal and presented at scientific conferences. To help in policy planning, public health authorities will receive brief summaries. This method guarantees both clinical and academic impact.

1.7.Ethical consideration

This study followed ethical principles to ensure the safety, privacy, and rights of participants. Before beginning the collection, the ethical approval was secured from CHUB add reference number. All data was coded and anonymized in compliance with biosafety and ethical research standards to protect patient privacy.

CHAPTER FOUR : PRESENTATION OF FINDINGS

4.1. Prevalence of *Helicobacter Pylori* infection at CHUB

Out of a total number of 1373 stool samples analysed, 300 representing 21.8% tested positive for H. Pyroli as presented in the (figure 1).

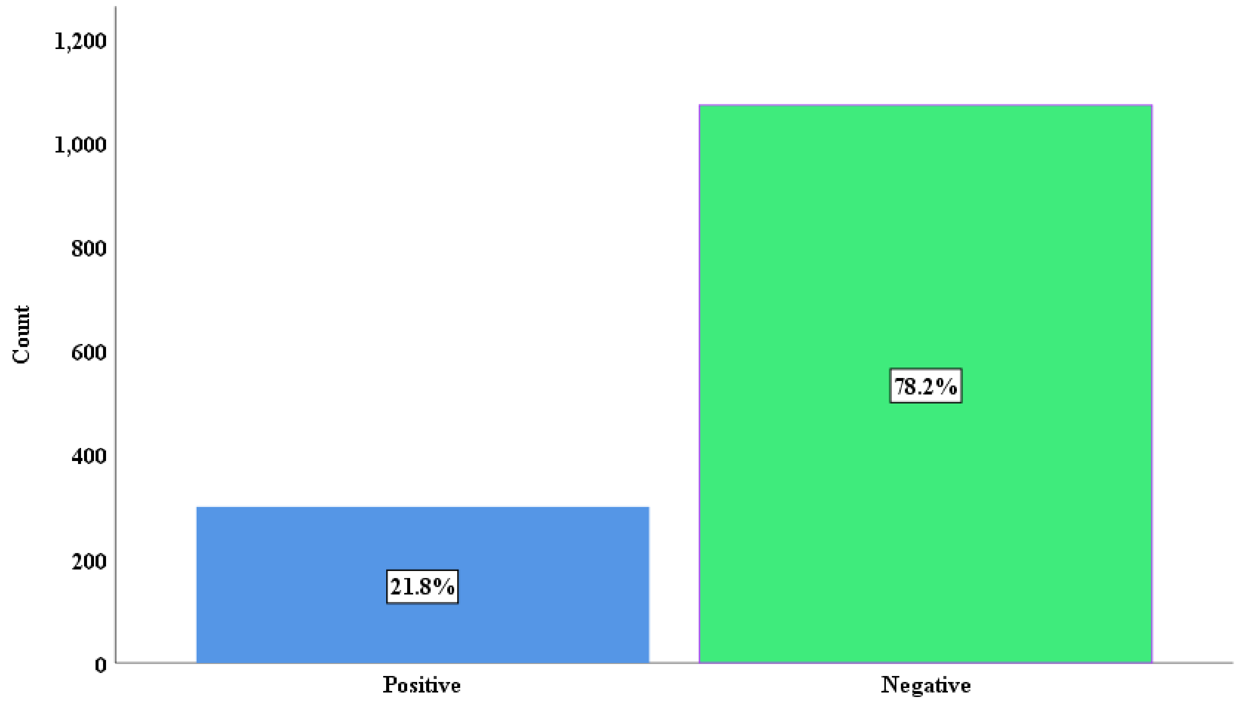

Figure 1. The overall prevalence of Helicobacter pylori at CHUB

4.2. Frequency of *Helicobacter Pylori* by sex, age and residential patterns

The total H. pylori infection positive rate was somewhat higher in females (22.4%) than in males (21.0%). The 15–24 age group had the highest positivity rate (30.0%), followed by the 5–14 and 45–59 age groups, per age-specific analysis. With a positivity rate of 29.2%, the Eastern Province had the highest of any province; rates in the other regions ranged from 19.5% to 21.9%. Compared to those in rural areas (20.9%), the positive percentage among urban participants was marginally higher at 23.0%. The results are summarized in the (table 1).

Table 1.Distribution of *Helicobacter Pylori* by sex, age and residential patterns

	SAT Test results			
Variables	**H .pylori Positive (n)**	**H .pylori Negative (n)**	**Total (n)**	**Positivity rate (%)**
Sex				
Male	112	422	534	21.0%
Female	188	651	839	22.4%
Age Category (Years)				
< 5	3	20	23	13.04%
5-14	24	90	114	21.1%
15-24	64	149	213	30.0%
25-44	84	351	**435**	19.3%
45-59	61	218	279	21.9%
60-74	50	179	229	21.8%
≥75	14	66	80	17.5%
Province				
South	249	890	1139	21.9%
West	23	95	118	19.5%
Kigali City	9	36	45	20.0%
North	5	18	23	21.7%
East	14	34	48	29.2%
Residence				
Rural	162	612	774	20.9%
Urban	138	461	599	23.0%

4.3. Assessment of the association of *Helicobacter Pylori* and Demographic factors

A binary logistic regression analysis was conducted to assess the association between Helicobacter pylori infection and a few selected demographic parameters. The model considered age group, sex, province, and resident status. Sex and infection did not significantly correlate (p = 0.600; OR = 0.930; 95% CI: 0.710–1.218). Most age categories showed no significant association, except for those aged 15–24 years, who had significantly greater chances of infection (p = 0.028; OR = 2.099; 95% CI: 1.082–4.072) than those under 5 years. There was no significant correlation between infection and province (p = 0.728) or residence type (rural vs. urban; p = 0.344). At reference levels, the statistically significant constant (p = 0.004) showed a baseline risk.

Table 2.Association of *Helicobacter Pylori* Positivity and demographic factors

Variables	**B**	**S.E.**	**Wald**	**df**	**Sig.**	**OR**	**95% C.I.for EXP(B)**	
							Lower	**Upper**
Sex (Male vs Female)	-0.072	0.138	0.275	1	0.6	0.93	0.71	1.218
Age category vs < 5 (Years)			11.719	6	0.069			
5–14	-0.319	0.688	0.215	1	0.643	0.727	0.189	2.802
15–24	0.239	0.375	0.405	1	0.525	1.269	0.609	2.647
25–44	0.742	0.338	4.816	1	0.028	2.099	1.082	4.072
45–59	0.121	0.319	0.144	1	0.704	1.129	0.604	2.109
60–74	0.264	0.329	0.643	1	0.423	1.301	0.683	2.478
≥75	0.255	0.336	0.578	1	0.447	1.291	0.668	2.494
Province vs South			2.044	4	0.728			
West	-0.106	0.344	0.094	1	0.759	0.9	0.459	1.765
Kigali	-0.36	0.403	0.797	1	0.372	0.698	0.317	1.537
North	-0.419	0.5	0.703	1	0.402	0.658	0.247	1.751
East	-0.41	0.602	0.463	1	0.496	0.664	0.204	2.161
Residence (Urban vs Rural)	-0.131	0.138	0.894	1	0.344	0.878	0.669	1.15
Constant	-1.315	0.455	8.346	1	0.004	0.269		

CHAP FIVE: DISCUSSION ,CONCLUSION AND RECOMMEDATIONS

5.1. Discussion

5.1.1. Prevalence of *Helicobacter Pylori*

Stool antigen testing revealed that 21.8% of the participants assessed in this study had a *Helicobacter pylori* infection. This study suggests a moderate frequency of H. pylori in the general community, with nearly one in five individuals testing positive for the infection. According to the WHO Rwanda Country Cooperation Strategy 2021–2024, this finding supports the organization's focus on bolstering health information systems to enhance disease surveillance and trend monitoring(WHO).

This frequency is low when compared to the overall prevalence of 70% across Africa(Yuan et al., 2022), lower than the prevalence of 77.5% previously reported in CHUK in the study conducted from 2016-2018 (Nizeyimana et al., 2021) ; and 78.8% found at CHUB from 2014-2019 , and the prevalence reported in Tanzania at Temeke Regional Referral Hospital in Dar -Es Salaam, Tanzania (43.77%) (Kibira & Tungu, 2025) However, it is slightly higher than the prevalence reported at Kigeme District Hospital's 19% (KARASANYI et al., 2025) and low in 45.7% and 46% found in Nemba and Butaro Hospitals respectively (Uwihanganye Jean Leodegard1 & 2025; Yadufashije et al., 2019) .

Again, this prevalence was found to be low in comparison to 37% that was found by Ishimwe et .Al 2024 in Muhoza Health center (Ishimwe et al., 2024) ,36.8% in Eastern Democratic Republic of Congo (Tibasima et al., 2025) and 30.4% feco -prevalence found by Seid et. Al, 2018 in Ethiopia (Seid & Demsiss, 2018).

This inconsistency in *H pylori* detection rates seen with stool rapid antigen (SAT) tests, and other available diagnostic approaches may be attributed to various clinical factors not yet investigated in this study: Partial or inappropriate therapy can suppress bacterial load or induce antigen shedding suppression, resulting in false-negative SAT results(Graham & Dore, 2016) .The coccoid or dormant form of *H. pylori*, which may persist post-treatment, further diminishes antigen shedding and evades detection (Ierardi et al., 2020). These findings may also have been impacted by the fact of testing too soon after therapy, or while patients still use PPIs or antibiotics, which is known to greatly reduce SAT sensitivity(Graham, Lee, & Wu, 2014) .This creates significant risk of underdiagnoses among symptomatic patients, potentially delaying treatment, increasing disease progression, and hindering eradication efforts at the community level(Shah et al., 2023; Umar et al., 2025). These observed discrepancy between the high prevalence from invasive methods and the lower detection rates from stool rapid antigen testing was observed in other studies suggesting a multifactorial aspect of the prevalence (Masoero et al., 2000; Qi et al., 2024), underscoring the urgent need for a throughout tertiary-level investigation of SAT performance, tailored testing protocols, and improved post-treatment testing practices to accurately identify infection and guide effective *H. pylori* control .

The results of this study mainly represent the prevalence of Helicobacter pylori infection in patients seeking hospital-based care because it was carried out among patients who were admitted to the University Teaching Hospital of Butare. The true burden of H. pylori infection in the general population, where asymptomatic carriers and those with poor access to healthcare may go undetected, may not be adequately captured by such a hospital-based sampling strategy(Hooi et al., 2017). Therefore, if many community cases are not represented in the hospital population, the prevalence found in this study may be lower or higher due to the selective recruitment of symptomatic and severely affected individuals(Walker, Karemera, Ngabonziza, & Kyamanywa, 2014). In order to give a more realistic picture of the prevalence of H. pylori in the general population, this limitation emphasizes the necessity of future community-based epidemiological investigations that include both symptomatic and asymptomatic individuals.

Despite the stool antigen test's well-established theoretical foundation, its diagnostic limits should be taken into account, especially in light of Rwanda. Recent usage of proton pump inhibitors, antibiotics, or bismuth-containing drugs all of which are widely available in Rwanda without a prescription may lower the test's accuracy(Talebi Bezmin Abadi, 2018). Additionally, there is little local validation evidence to support the sensitivity and specificity of commercial kits in Rwandan communities, and their performance may differ and has not been compared to other gold standard to confirm the presence of the infection (Vazirzadeh et al., 2020). Another significant drawback is that stool antigen testing does not reveal information on antibiotic susceptibility, which is crucial given the rise in metronidazole and clarithromycin resistance in Africa. This is in contrast to stomach biopsy culture or PCR.

Despite these limitations, stool antigen testing was selected for this study because it is non-invasive, cost-effective, and feasible for routine use in resource-limited settings. Other diagnostic approaches such as urea breath tests, although highly accurate, remain unavailable in most

Rwandan hospitals, while invasive endoscopic biopsy methods are impractical for large-scale epidemiological studies(Sharara et al., 2025). Thus, the stool antigen test represents a practical compromise between diagnostic accuracy and feasibility in the Rwandan context.

5.1.2. Distribution of *Helicobacter pylori* at CHUB

In terms of demographic factors, the findings of our study suggest that women had a little greater rate of *H. pylori* positivity than men, 22.4% vs 21.0% although the difference was not statistically significant. This discovery is similar to the observation made in Muhoza Health Center and rural areas in Sub-Saharan Africa(Awuku et al., 2017; Ishimwe et al., 2024). This sex difference is however in contrast with the one found by Ibrahim. A et.Al ,2017 where male had a great prevalence than Female(Ibrahim, Morais, Ferro, Lunet, & Peleteiro, 2017) .

The greatest *H. pylori* infection rate (30.0%) observed in the 15–24 age range may be due to childhood infections, when the bacterium is often asymptomatic. The findings are in accordance with those found among Secondary School Adolescents in Port Harcourt Metropolis, Nigeria(IRABOR, 2025), highlighting the importance of early detection strategies, as undiagnosed infections from childhood can silently progress toward symptomatic disease in later years which is in contrast to Kampala International Hospital's data, which showed the lowest rate in the same age range individuals (12.2%)(Shaban Ssewankambo*, 2024).

The same lower prevalence was reported in Iran, where a similar age group demonstrated a lower frequency of 24% in the youngest cohort when compared to older age groups (Maleki, Mohammadpour, Zarrinpour, Khabazi, & Mohammadpour, 2019) ,suggesting increased vulnerability or exposure in adolescent(Yuan et al., 2022) .The elevated prevalence observed in the Eastern Province 29.2% may reflect regional variations in environmental or socioeconomic factors (Shafiq et al., 2024). The assumption of factor related to access to improved sources of drinking water may have further verification as the Eastern Province is not the one having the lowest access rate(NISR, 2023). Surprisingly, the high prevalence among urban dwellers 23.0% compared to their rural counterparts 20.9% may reflect lifestyle or sanitation-related elements specific to urban living mainly related to socioeconomic aspects in Urban community (Braga et al., 2007; Mikhail, Abd El Maksoud Mohamed, Shaker, El Desouky, & Shalaby, 2023). The similar finding was also observed in Jordan ,Vietnam and Nepal(Altamimi et al., 2020; Hoang, Bengtsson, Phung, Sörberg, & Granström, 2005; Obaidat & Roess, 2019) .The lack of link with province or place of residence may imply that the population under research is exposed to the same dangers or has equal access to healthcare (Mnichil, Nibret, Hailegebriel, Demelash, & Mekonnen, 2024; Shafiq et al., 2024).

By identifying specific at-risk groups, health programs can be tailored to address the unique needs of these populations, thereby improving the effectiveness of *H. pylori* control strategies and it is crucial to implement preventive measures that consider these lifestyle factors. Additionally, integrating *H. pylori* screening into routine health check-ups for this age group could facilitate early detection and treatment, reducing the risk of complications.

5.1.3. Association of Demographic factors on *Helicobacter Pylori*

The findings from the binary logistic regression indicate that, of all demographic variables analyzed, **age** particularly the 25–44-year category was the sole element that had a significant correlation with *H. pylori* positive. This observation may be true since this is the period of time when the illness reaches its height with inflammation patterns (Araújo et al., 2022; Kouitcheu Mabeku, Noundjeu Ngamga, & Leundji, 2018). In addition, this age category falls under "Prime working-age adults"; those who typically enter or establish themselves in the workforce between the ages of 25 and 44(Paccagnella, 2017). This phase may increase vulnerability to H. pylori infection due to increased occupational exposure, stress, irregular eating patterns, and mobility (Huerta-Franco et al., 2013; Paccagnella, 2017; Song et al., 2025).

This cohort was almost twice as likely as children under the age of five to become infected. The prevalence of *Helicobacter pylori* in this dataset may be age-dependent rather than significantly influenced by gender or geography, as other variables such as sex, province, and type of habitation did not show a statistically significant link to infection. These results emphasize the importance of targeting teenage, adolescents **and young adults** for preventive or early diagnostic strategies(Saito, Nishikawa, Masuzawa, Tsubokura, & Mizuno, 2021).

5.2. Conclusion

Stool antigen testing revealed that the study population had a significant prevalence of H. pylori infection. Infection rates varied by age group, with one group (25-44) exhibiting a statistically significant correlation. However, there were no notable variations by residence, province, or sex. This implies that exposure to infection risk factors may be uniform across demographic groups. Overall, *Helicobacter pylori* positivity was not significantly impacted by demographic factors.

5.3. Recommendations

There is a need to conduct a national-wide study using the *Helicobacter pylori* stool antigen testing to be able to generalize these findings at National level. This baseline data can be used to support subsequent of efficacy comparison studies involving this rapid test, histology, culture-based, and molecular diagnostics, which will improve diagnostic precision and inform treatment plans.

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APPENDICES

1. Approval

COLLEGE OF SCIENCE AND TECHNOLOGY

UNIVERSITY of RWANDA

SCHOOL OF SCIENCE

Date: 15th July 2025.

Dear Sir/Madam,

TO WHOM IT MAY CONCERN

I the Undersigned, Prof, Antoine NSABIMANA hereby confirm that the research proposal entitled ""**Prevalence and Risk Factors Associated with *H. Pylori* Infection Among Dyspeptic Patients at CHUB: A Retrospective Review of Rapid Diagnostic Test Results and Clinical Records"** for Mr. **Nicolas RUBAMBANA** with (Reg.No: **222021035**), has been approved by the Department of biology.

The study involves data collection from participants and/or departments within CHUB, Additionally, we request your support in **facilitating the data collection process** once ethical clearance is granted and therefore, He will submit his protocol to your committee for ethical review and approval at the institutional level.

Sincerely,

Prof Antoine NSABIMANA
Program coordinator of MSc in Biotechnology
(CMHS, CAFF, CVAS and CST)
Hosted By CST
University of Rwanda

Cc: **Prof Leon Mutesa**.
PI of the Project

PO BOX 3900 Kigali-Rwanda www.ur.ac.rw

2. Ethical clearance

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CHUB

CLINICAL EDUCATION AND RESEARCH DIVISION
DIRECTORATE: RESEARCH -ETHICS COMMITTEE **RESEARCH**

Huye,22th, July,2025

RUBAMBANA NICOLAS
Approval Notice: No: REC/CHUB/089/2025
Email: nrubambana@gmail.com

Reference is made to your letter requesting ethical clearance for **"Prevalence and Risk Factors Associated with H. Pylori Infection Among Dyspeptic Patients at CHUB: A Retrospective Review of Rapid Diagnostic Test Results and Clinical Records"** Having reviewed your application and been satisfied with your protocol, your study is hereby granted ethical clearance and should be conducted within University Teaching Hospital of Butare. Please note that approval of the protocol and consent form is valid for one year starting on the issue date and shall be renewed on request. You are responsible for fulfilling the following requirements:

- Changes, amendments and addenda to the protocol or consent form must be submitted to the committee for review and approval before activation of the changes
- Only approved consent forms are to be used in the enrollment of participants
- All consent forms signed by subjects should be retained on file.
- The committee may conduct audits of all study records. Consent documentation may be part of such audits
- A continuing review application must be submitted to the committee in a timely fashion and before the expiry of this approval
- Failure to submit a continuing review application result in termination of the study
- Notify the committee once the study is finished
- Identification of participants must be kept confidential for the duration of the study

Sincerely

RESEARCH ETHICS COMMITTEE (CHUBREC)
UNIVERSITY TEACHING HOSPITAL
OF BUTARE

Dr. HABIMANA Emmanuel
Chairperson of Ethics Committee/CHUB

Cc: - Director General

- Head of Clinical Education and Research Division
- Head of Clinical Service Division
- Director of DTS
- Head of Pathology Department

"Assessment of Helicobacter pylori Infection using Stool Antigen Testing: A Cross-sectional Study at University Teaching Hospital of Butare (CHUB) "

by Nicolas Rubambana

Submission date: 30-Jul-2025 09:30PM (UTC+0300)
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