Case-controlled Study

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Risk factors of *Helicobacter pylori* infection in Bukavu, Democratic Republic of the Congo: a case–control study

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Background: *Helicobacter pylori* (*H. pylori*) is the common etiology of gastric tumors. This study aimed to evaluate the risk factors associated with *H. pylori* infection in the eastern part of the Democratic Republic of the Congo (DR Congo), where these tumors seem to be more frequent than in its western part.

Patients and Methods: Between January and December 2021, the authors conducted a multicenter case–control study in three hospitals in Bukavu City involving 90 individuals with dyspeptic complaints. Risk factors for *H. pylori* infection were assessed in a participant interview and *H. pylori* status from stool antigen detection.

Results: Among the risk factors assessed, only history of *H. pylori* in the family and the habit of adding salt to already-seasoned food were found positively associated with the risk of *H. pylori* infection (adjusted odds ratio: 7, 95 CI: 2.742–17.867; $P<0.0001$ and 2.911, 95% CI: 1.010–8.526; $P=0.048$, respectively). On the other hand, low-temperature food storage seems to be protective with a negative association (adjusted odds ratio: 0.044, 95% CI: 0.009–0.206; $P=0.0001$).

Conclusion: This study demonstrated again the importance of lifestyle-related factors on the risk of acquisition of *H. pylori*. These findings call for preventive interventions for this group of individuals.

Keywords: *Helicobacter pylori*, risk factors, DR of the Congo

Introduction

Helicobacter pylori (*H. pylori*) is a spiral, motile, and microaerophilic Gram-negative bacterium 3–4-μm long. This bacterium particularly colonizes the gastric mucosa and was first isolated in 1982 from gastric biopsies by two Australian researchers: J. Robin Warren and Barry J. Marshall[1,2].

Transmission is essentially human-to-human within the family (parent–child or sibling), and the infection is acquired during childhood by oral or fecal-oral contamination due to unfavorable hygiene and promiscuity conditions[3].

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HIGHLIGHTS

- *Helicobacter pylori* infection remains a public health concern in the DR Congo.
- A family history of *H. pylori* infection influence positively the presence of this infection.
- The addition of salt to already-seasoned foods influences positively the *H. pylori* infection.
- Low-temperature food storage seems to protect against *H. pylori* infection.

H. pylori infection is the most common chronic bacterial infection worldwide and the leading cause of gastric cancer[4]. In many studies, risk factors reported include low economic status, low education, crowded housing, poor access to safe water, and young age[5]. These factors, which are frequent in developing countries, explain the high prevalence of this disease. Indeed, while the rate of *H. pylori* infection decreases in developed countries due to improved living conditions, developing countries still suffer from this disease with a high prevalence that can reach 80 or even 90%[6,7].

Since 1997, the European Consensus Conferences of Maastricht allowed standardization of clinical practices for *H. pylori* infection worldwide[7]. Unfortunately, the management of this infection is confronted nowadays by the antibiotic resistance of the bacteria. This latter result leads to treatment failure and favors the evolution of the disease toward complications such as peptic ulcer, Mucosa-Associated Lymphoid Tissue lymphoma, gastric atrophy, and even gastric adenocarcinoma[8]. The diagnosis and management of these complications remain very expensive for developing countries, where, unfortunately, the infection is the most frequent. That is why identification and better control of risk factors seem to be the most effective measures in the fight against this disease.

In the DRC and especially in South Kivu Province, studies on *H. pylori* infection are rare. In 1991, a prospective series in a rural region of South Kivu showed a 90% prevalence in symptomatic patients according to histological and bacteriological analysis[9]. Between 2001 and 2011, a multicenter study analyzing precancerous and cancerous gastric lesions noted a higher frequency of cancer in the eastern provinces (including South Kivu Province) of the DRC than elsewhere in the country[10]. Thus, the prevalence and, especially, the consequences of this infection could be more frequent in our region. Hence the importance of research in identifying its predisposing factors in our environment.

This study aims to prevent *H. pylori* infection in Bukavu City by determining its risk factors.

Patients and methods

Study framework

This was a multicenter case–control study conducted from January to December 2021 in the three main hospitals of Bukavu City, South Kivu Province, in Democratic Republic of the Congo. This work has been reported in line with the STROCSS criteria[11].

Study population

In total, 90 patients of both sexes who consulted at these three hospitals with dyspeptic symptoms were enrolled in this study. Recruitment was continuous throughout the study period to achieve a 1 : 1 ratio of cases to controls (one infected for one uninfected). At the end of the recruitment period, we had a total of 50 cases and 45 controls. We, therefore, decided to eliminate the last five patients recruited from the case group to achieve the set proportions (45 cases to 45 controls). A case was defined as a patient with a positive antigenic test. In the same period, we also enrolled controls among dyspeptic patients with negative tests using the same method. We have excluded from this study any participant, case, or control with unclear results. The majority of cases were recruited at the Hopital Général de Panzi (44.4%), while two-thirds of control patients came from the Hopital Général de Bukavu (66.7%).

Sample collection and H. pylori infection status

The *H. pylori* infections were diagnosed based on the combined stool analysis antigen test. For this purpose, 50 mg of solid stools (or two drops of liquid stool) were transferred to a tube containing an extraction buffer. The tube was then shaken and left to settle for at least 2 min. Two drops of the extracted specimen were then transferred to the test device, and results were read after 10 min, according to the manufacturer's instructions.

Data collection

Epidemiological data from questionnaires included sociodemographic data (age, sex, marital status, occupation, educational level, and socioeconomic level), socioeconomic factors (socioeconomic status, household population, source of drinking water), and factors influencing the onset of the disease (history of *H. pylori* infection, dietary, and eating behavior, family factors, alcohol, and tobacco consumption).

Statistical analysis

All data were computerized, and statistical analysis was performed using Epi-info 7.1 software. χ^2 and *t*-tests were used for categorical and continuous data, respectively. The strength of association between variables was assessed by simple logistic regression to estimate the adjusted odds ratio and 95% CI. *P* less than 0.05 was considered statistically significant.

Ethical considerations

The participants were aware of the purpose and methodology of this study and voluntarily agreed to answer our questions. Written informed consent was obtained from each participant, and the ethical committee of each hospital approved the study. The confidentiality of the collected data was scrupulously respected.

Results

Table 1 shows the characteristics of the 90 participants. Patients under 50 years of age were the most represented in both groups, at 77.7 and 97.7% in cases and controls, respectively. The male sex remained the most represented in both groups with 55.6 and 53.4% of patients, respectively ($P=0.832$). However, cases appear to be older than controls (37.4 ± 18 vs. 29.1 ± 10 years) ($P=0.0082$). According to the socioeconomic data, neither the level of education nor the economic level seemed to influence the *H. pylori* infection status. Concerning family history, *H. pylori* infection in a first-degree relative and the presence of gastric cancer in the family were associated with *H. pylori*-positive infection. Other factors, such as the presence of dyspeptic symptoms in the family or the history of gastric surgery, did not show a statistically significant difference.

Table 1

Characteristics of study participants and *H. pylori* positivity.

	Cases [*n* (%)]	Control [*n* (%)]	*P* value
Age group (years)			
< 50	35 (77.7)	44 (97.7)	
> 50	10 (22.2)	1 (2.2)	0.01
Sex			
Female	20 (44.4)	21 (46.6)	
Male	25 (55.6)	24 (53.4)	0.832
Education			
Primary or lesser	7 (15.5)	4 (8.8)	0.51
Secondary or above	38 (84.4)	41 (91.1)	
Socioeconomic level			
Low	17 (37.8)	12 (26.7)	0.143
Medium	12 (26.7)	21 (46.6)	
High	16 (35.6)	12 (26.7)	
Family history			
Family history of *H. pylori* infection	35 (77.8)	15 (33.3)	< 0.0001
Family history of dyspepsia	20 (44.4)	12 (26.7)	0.078
Family history of gastric cancer	7 (15.6)	1 (2.2)	0.026
Family history of gastric surgery	2 (4.4)	1 (2.2)	0.557

This table shows the principal characteristics of the study population. Family history of *H. pylori* infection and family history of gastric cancer seem to influence the *H. pylori* infection.
H. pylori, *Helicobacter pylori*.

According to lifestyle, no factors related to life in promiscuity (i.e. household crowding, community toilets, community meals, etc.); access to drinking water, alcohol consumption, or smoking seem to be associated with the presence of *H. pylori* infection (Table 2).

However, concerning the dietary habits, preserving food by smoking was a risk factor for developing *H. pylori* infection, as well as the addition of salt at the table. On the other hand, some factors, such as the cold storage of food seem protective.

The logistic analysis (Table 3) using factors with statistical significance in univariate analysis showed that family history of *H. pylori* infection [odds ratio (OR): 7; 95% CI: 2.742–17.867; $P<0.0001$] and addition of salt at the table (OR: 2.911, 95% CI: 1.010–8.526; $P=0.048$) were positively associated with *H. pylori* infection. In contrast, low-temperature storage food seems to be a protective factor (OR: 0.044, 95% CI: 0.009–0.206; $P=0.0001$). However, factors such as family history of gastric cancer or smoking and food preservation seem to show an association but are not statistically significant ($P=0.055$, respectively).

Table 2

Lifestyle and dietary/eating habits are associated risk factors for *H. pylori* infection.

	Cases [*n* (%)]	Controls [*n* (%)]	*P* value
Lifestyle			
Household crowding (mean ± SD)	7.8 ± 3 (2–21)	6.8 ± 3 (3–12)	0.117
Drinking water from public water distribution system	31 (68.9)	36 (80)	0.226
Drinking water from wells	6 (13.3)	2 (4.4)	0.138
Community toilets	7 (15.5)	6 (13.3)	0.764
Community meals	40 (88.9)	36 (80)	0.244
Frequent alcohol driking	17 (37.8)	15 (33.3)	0.824
Smoking	4 (8.9)	3 (6.6)	0.693
Method of food preservation			
Refrigeration	22 (48.8)	43 (88.8)	< 0.001
Smoking	7 (15.5)	1 (2.2)	0.026
Salting	5 (11.1)	1 (2.2)	0.091
Fruit and vegetable consumption			
Low fruit consumption	18 (40)	12 (26.7)	0.179
Low vegetable consumption	11 (24.4)	5 (19.94)	0.098
Salt consumption			
Adding salt at the table	14 (31.1)	6 (13.3)	0.042
Low salt diet	16 (35.5)	15 (33.3)	0.824

This table shows lifestyle and eating habits that may influence the *H. pylori* infection. Food smoking storage and adding salt on the table to already-seasoned food are associated with the risk of *H. pylori* Infection. Refrigeration food storage seems to have a protective effect.
H. pylori, *Helicobacter pylori*.

Discussion

The present study aimed to evaluate the risk factors associated with the acquisition of *H. pylori* infection in the eastern part of the DR of the Congo. Several studies have been conducted on risk factors for *H. pylori* infection, but some findings are still controversial. Generally, the infection is frequent among people with low socioeconomic and hygiene state. Our study appears to show the importance of lifestyle factors in the transmission of this infection.

H. pylori infection usually occurs in childhood, and the prevalence is higher in the young adult population[12]. In our study, the participants in both groups were predominantly young, which is largely related to the current age pyramid of African countries. As in several other studies, sex seemed not to be associated with *H. pylori* infection[7,13–15].

Low socioeconomic status is generally recognized as a risk factor for *H. pylori*-related gastritis[5,12]. However, many authors from developing countries whose studies involved adult participants did not find the influence of socioeconomic level[7,14]. This was also found in our study, where neither the level of education ($P=0.533$) nor a low economic level ($P=0.143$) seemed to influence the presence of this bacterium. The explanation provided is that people with high living standards in developing countries have mostly been subjected to bad living conditions during their childhood, which is the common transmission period of the disease[16].

The risk of *H. pylori* transmission between family members or cohabiting individuals is suggested by the presence of the same strain in people living together[15]. This is mainly related to oral or fecal transmission. In our study, factors suggesting family contamination were also assessed. Our study showed that the presence of *H. pylori* infection in the family increases the risk of acquiring the infection by seven times. Several other studies have reported an increased risk of intrafamilial *H. pylori* infection, and this is obvious in the available literature[17,18].

Some behaviors, such as promiscuity (assessed by household size), unsafe drinking water, use of shared toilets, and consuming food in community, did not influence the presence of *H. pylori* although these factors are known to promote the risk of infection[5,16]. This may be explained by the small sample size of our study population but also by the fact that the current socioeconomic status of individuals does not necessarily reflect the status during childhood, the usual period of contamination.

Studies on the association between *H. pylori* and smoking or alcohol consumption are participant of contradictions in the literature. Even though one study recently incriminated smoking as a risk factor for *H. pylori* eradication treatment failure[19], most studies have not found the influence of smoking on susceptibility to infection[20–23]. However, in one study, Wu *et al.*[24] curiously found that smoking was a risk factor in males but protective in females. Moreover, a Turkish study has incriminated regular smoking as a risk factor for *H. pylori* infection[25]. Our study reported no statistically significant effect of smoking and alcohol

Table 3

Risk factors for *H. pylori* infection as evaluated by a multivariate analysis.

	Adjusted OR	95% CI	*P*
Age > 50 years	1.75	0.746–4.106	0.198
Family history of H. *pylori* infection	7.00	2.742–17.867	< 0.0001
Family history of gastric cancer	8.10	0.953–68.877	0.055
Cold storage of food	0.044	0.009–0.206	0.0001
Preservation of food by smoking	8.10	0.953–68.877	0.055
Adding salt at the table	2.911	1.010–8.526	0.048

This table shows a logistic regression of factors influencing the *H. pylori* infection in univariate analysis. The family history of *H. pylori* infection and the adding salt on the table keep their positive association. Cold storage food shows a protective effect.
H. pylori, *Helicobacter pylori*; OR, odds ratio.

consumption on *H. pylori* infection. In the same way, tobacco consumption also did not influence the presence of *H. pylori*. It is known that alcohol has antimicrobial activity and stimulates gastric acid secretion, which could interfere with the growth of the bacterium[26]. Some other studies have also found no association between alcohol consumption and *H. pylori* infection[27,28].

The role of salt consumption in the susceptibility to developing *H. pylori* infection is not well studied. However, some studies have suggested an increase in gastric disease associated with *H. pylori* infection in the population with high sodium chloride consumption[29,30]. Our study showed that *H. pylori* infection was higher among individuals with the habit of adding salt at the table to already-seasoned food. In this group, the risk of acquiring the infection is majored (ORa: 2.911, 95% CI: 1.010–8.526; $P=0.048$).

The relationship between *H. pylori* infection and cold storage is little discussed in the literature. The present study revealed that low-temperature storage of food seems to be protective. Although *H. pylori* have demonstrated resistance to low-temperature conditions[31], this latter could retain several substances that interfere with the growth of this bacterium. These include vitamins that act as natural antioxidants[32]. But also, the preservation of food by cold could discourage other, more harmful forms of storage (such as preservation by salt), which is positively associated with the risk of developing an *H. pylori* infection. Finally, the widespread use of refrigerators in Western countries in the recent past may partly explain the continuing decline in the incidence of gastric cancer[33]

In conclusion, this study is the only one so far carried out in our setting that has investigated the susceptibility factors of *H. pylori* infection in the DRC, where the prevalence of gastric tumors is highest. Our study has found that classically favoring factors such as a low socioeconomic level and some unfavorable living conditions, although recognized in the literature as risk factors, did not influence the presence of *H. pylori* infection. However, the history of *H. pylori* infection in the family and some dietary behaviors seem to be positively or negatively associated with the risk of *H. pylori* infection.

The limitation of this study is its small sample size, which does not allow generalize the results. Finally, the difficulty of objectively quantifying some parameters, such as the quantity of salt consumed, should be taken into account when considering our findings.

Ethical approval

020/2021/UOB/FM/EC/MKS.

Consent

Yes.

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None.

Authors' contributions

Y.C.B. drafted the manuscript and assisted in data analysis. A.M.B. drafted the manuscript and assisted in sample collection. D.K.M. reviewed the manuscript. T.A.S. conceived and designed the study, analyzed the data, and reviewed the manuscript. All authors read and approved the final manuscript.

Conflicts of interest disclosure

None.

Provenance and peer review

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