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Risk factors associated with *Helicobacter pylori* infection among patients attending private clinics in Borama district, Somaliland

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ABSTRACT

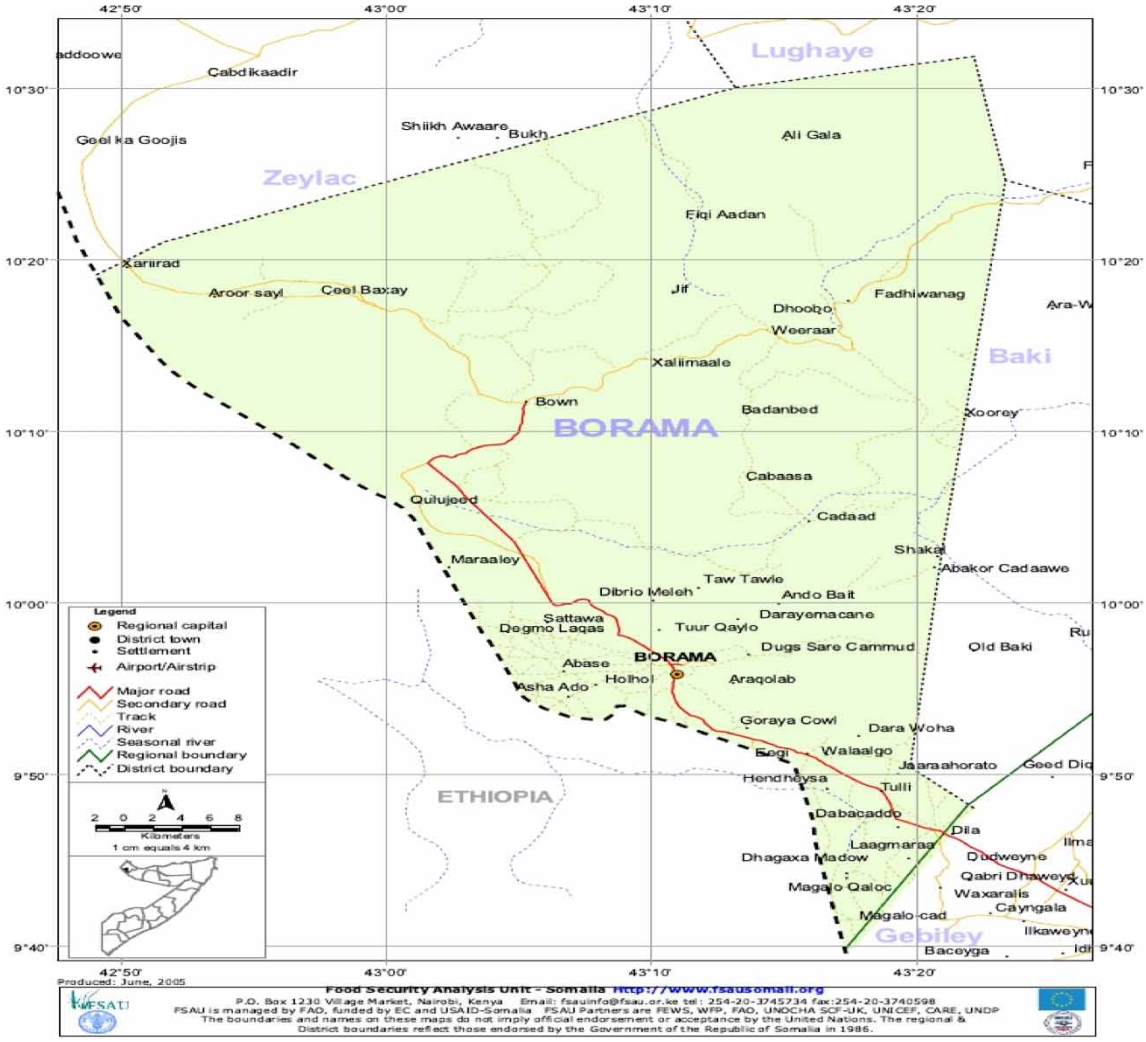
Risk factors associated with *Helicobacter pylori* infection among patients attending private clinics in Borama district, Somaliland, are studied. We specifically investigated the association among the use of non-steroidal anti-inflammatory drugs, the users' socioeconomic status, and the household hygiene practice of people with *H. pylori* infection attending the Borama private clinic. *Helicobacter pylorus* (*H. pylori*) is a Gram-negative spiral-shaped bacterium that infects gastric-type epithelium, and it is probably the most common bacterial agent in humans after *Streptococcus mutans*, which causes dental caries. *H. pylori* infection is now recognized as a worldwide problem and it is the most common cause of chronic gastritis and is strongly linked to peptic ulcer disease and gastric cancer. The prevalence of *H. pylori* infection is high in less-developed Asian countries like India, Bangladesh, Pakistan, and Thailand, and is acquired at an earlier age than in the more developed Asian countries like Japan and China. *H. pylori* infection is a global public health problem, affecting over 50% of the population worldwide.

Key words: anti-inflammatory drugs, gastric-type epithelium, *Helicobacter pylori* infection, hygiene practices, stomach inflammation and ulcers

HIGHLIGHTS

- There are risks associated with non-steroidal anti-inflammatory drugs and association with the occurrence of *Helicobacter pylori* infection.
- The risks are common to patients attending private clinics.
- It is due to the most common bacterial agents.
- Study in patients attending private clinics in Borama district, Somaliland.
- The researchers recommend that the study be done on a larger scale in order to cover more areas.

GRAPHICAL ABSTRACT



INTRODUCTION

Risk management is vital for daily living and human survival. In January 2022, some studies were conducted to investigate the use of wastewater-based epidemiology (WBE) so as to estimate heavy metal exposure in Sungai Petani (Ruzi *et al.* 2024). In the course of the research in Malaysia, atomic absorption spectroscopy was used to detect copper. Atomic absorption spectroscopy was used to detect copper (Cu), nickel (Ni), zinc (Zn), iron (Fe), and cadmium(Cd) in wastewater from eight sewage treatment facilities in Sungai Petani. The results of WBE estimation showed that Fe, Ni, and Zn had the highest estimated per population exposure levels, while Cd had the lowest. This was compared to a similar study conducted in Penang, Malaysia, which found that all metals except Cu were had higher concentrations in Sungai Petani, even though it is a non-industrial district, which emphasized the importance of addressing heavy metal contamination in Sungai Petani and to implement effective risk management and prevention strategies. WBE has expanded as a tool for collecting COVID-19 surveillance data, but there is limited information on the feasibility of this form of surveillance within decentralized wastewater systems (e.g., septic systems). A study was also conducted in 2020 (Tanvir Pasha (2024). The study assessed SARS-CoV-2 RNA concentrations in wastewater samples from a septic system servicing a mobile home park (66 households) and from two pumping stations serving a similarly sized (71 households) and a larger (1,000 households) neighborhood within a nearby sewershed over 35 weeks. The results suggested that sampling from decentralized wastewater infrastructure can be used for continuous monitoring of SARS-CoV-2 infections, which can invariably be highly vital in risk control and management. Fecal–oral and oral–oral

are the most commonly known routes for transmission of *H. pylori*, therefore contaminated water plays an important role in transmission of *H. pylori* to humans. Please refer to the study by Atipo-Ibara *et al.* (2023). Fecal–oral transmission of *H. pylori* occurs through several channels such as feeding contaminations, poor hygiene, and close and direct contact. It could result in gastric cancer, peptic ulcers, gastrointestinal diseases, and malnutrition, which could create severe and serious economic impacts (Keita 2022). *Helicobacter pylorus* (*H. pylori*) is a Gram-negative spiral-shaped bacterium that infects gastric-type epithelium, and it is probably the most common bacterial agent in humans after *Streptococcus mutans*, which causes dental caries (Francisco & Ramesh 2017). It affects over 50% of the population worldwide (Eshraghian 2014). Prevalence of *H. pylori* infection is high in less developed Asian countries like India, Bangladesh, Pakistan, and Thailand, and is acquired at an earlier age than in more developed Asian countries like Japan and China (Mishra 2008). In sub-Saharan countries, specifically Ethiopia, the prevalence of *H. pylori* infections is 52.2% and it is recognized as a major cause of gastrointestinal diseases (Addisu *et al.* 2019). The prevalence of *H. pylori* in Somaliland is 60% (Ahmed 2018). In Borama town, *H. pylori* infection is a health problem mostly seen in both public and private hospitals. Although *H. pylori* infection is mostly found in Borama town, the exact factors associated with this increase are not clearly known and remain undocumented.

H. pylori has various definitions. According to (Goodwin 1987), *H. pylori* is defined as organisms that are spiral, microaerophilic, gram-negative bacteria that demonstrate bluntly rounded ends in gastric biopsy specimens. *H. pylori* is a small (0.5–1.0 μm in width and 2.5 to 5.0 μm in length), spiral-shaped, highly motile, gram-negative rod with 4–6 unipolar sheathed flagella that causes *H. pylori* c infection. It can also be defined as a highly heterogeneous bacterium with a large genomic diversity, in addition, humans may sometimes harbor multiple strains, and *H. pylori* can change genotypically and phenotypically during colonization in a single host (Suerbaum & Josenhans 2007). In this study, *H. pylori* is defined as a bacterium that causes stomach inflammation and ulcers in the stomach and duodenum detectable through a laboratory test of stool called a stool polymerase chain reaction (PCR) test.

Risk factors associated with *H. pylori* infections have been studied by different authors. These risk factors are characterized as household hygiene practices, socioeconomic status and socio-demographic factors (Maria *et al.* 2002). Maria (2002) studied risk factors associated with *H. pylori* infections as environmental factors, sociocultural factors and socioeconomic status. Furthermore, the factors such as crowded living conditions, smoking, and the use of non-steroidal anti-inflammatory drugs (NSAIDs) can also be studied (Segal *et al.* 2001). This study includes risk factors associated with *H. pylori* infections, including NSAIDs, socioeconomic status, and household hygiene practices.

NSAIDs are drugs that are used to reduce pain and fever. This study will focus on the NSAIDs such as Ibuprofen, Aspirin, and Diclofenac.

Socioeconomic status has a variety of definitions. Elizabeth (2014) defined socioeconomic status as a measure of one's combined economic and social status. It can also be viewed as a combined measure of society's economic and social position relative to others, based on income, education, and gender (Saifullah & Tariq 2011). Socioeconomic status is defined as a measure of the economic and social status of mothers; it can be seen as level of education, income and gender (Kibua 2014). In this study, socioeconomic status is classified based on income, education, and gender.

Household hygiene practices are a hygiene promotion that encourages people to replace their unsafe hygiene practices with simple, safe alternatives; the elements of household hygiene practices are seen as food hygiene and safety, water supply and toilet availability (Abdallah & Burnham 2004). In this study, household hygiene practices are maintaining all levels of house sanitation. Household hygiene practices will be defined as food hygiene and safety, water supply, hand wash practice, and toilet availability and usage.

Socioeconomic status and *H. pylori* infection

This aspect of socioeconomic status is classified based on income, education, and gender. Levels of education are an ordered set of categories, intended to group educational programs in relation to gradations of learning experiences and the knowledge, skills and competencies which each program is designed to impart. Income is the flow of cash or cash equivalents received from work (wage or salary), capital (interest or profit), or land(rent) (William 2000). Gender is not something we are born with and not something we have, but something we do.

The link between socioeconomic status and *H. pylori* infection has been investigated in various places. A study by Zhang *et al.* (2017) in China on socioeconomic status factors that increase the risk of *H. pylori* infection in China found that there were associations between income level and *H. pylori* infection. Another study by Midhet *et al.* (2010) in Uganda on Socioeconomic Status related risk factors of *H. pylori* infection found that there is a strong association between *H. pylori* infection

and adults' level of education and gender. A study conducted by Lori *et al.* (2008) in Russia suggested that in the study about socioeconomic status is a factor influencing the acquisition and prevalence of *H. pylori* infection. Another study by Nahar *et al.* (1995) on socioeconomic status in Bangladesh showed that poor socioeconomic conditions, such as low income, and the use of a stove for heating or cooking caused a high prevalence of *H. pylori* infection. Furthermore, a study conducted by Tedla (1992) in Ethiopia showed that socioeconomic factors, such as low-income levels can contribute to H. pylori infections. Thus, socioeconomic status is related to the *H. pylori* infection among patients attending private clinics. However, these studies were all conducted outside Somaliland. As such, they cannot be applied fully without empirical justification.

Household hygiene practices and *H. pylori* infections

This study focuses on household hygiene practices such as food hygiene and safety, water supply and toilet availability. Food hygiene and safety is the careful hygienic preparation and storage of complementary foods which is crucial to prevent contamination (Aching 2014). Water supply is the provision of water by public utilities, commercial organizations, community endeavors or individuals, usually via a system of pumps and pipes. Irrigation is covered separately by WHO (2013). Toilets are sanitation facilities at the user interface that allow safe and convenient urination and defecation.

The association between household hygiene practices and *H. pylori* infections has been investigated in various places. A study by Will *et al.* (2003) in Nigeria on food hygiene and safety and *H. pylori*: evidence of a positive association from a large prospective cohort study, found that food hygiene and safety increased, the rate of *H. pylori* infection increased for both men and women. Another study by Merrill *(*2014) in South Sudan on the impact of water supply on the risk of *H. pylori* infection in middle-aged women found that water supply was also significantly associated with *H. pylori* infection. Another study done by Keith *et al.* (2016) in Egypt on toilet availability and risk of *H. pylori* infection found that toilet availability is associated with *H. pylori* infection.

A study conducted by Brown (2000) in Ethiopia found that elucidation of the paramount role played by household hygiene backed by domestic water quality in the transmission of bacterial pathogens is of great importance as a prophylactic move, both in developed and developing countries. Another study conducted by Abangwa *et al.* (2017) in Cameroon showed a low level of education, promiscuity, lack of basic services, swimming in rivers, the consumption of contaminated water and focally contaminated fruit and vegetables, improper food handling, lack of refrigeration, the poor quality and low quantity of food available, child malnutrition, poor house hygiene practices, contaminated food before and after cooking, and the lack of access to drinking water affect the incidence and prevalence of *H. pylori* infection. A study conducted by Neto *et al.* (2010) from Brazil shows that poor sanitation conditions may also constitute important risk factors for *H. pylori* infection. Household hygiene practices relate directly to the *H. pylori* infection among patients attending private clinics. However these studies were all conducted outside Somaliland, so they cannot be applied wholesale without empirical justification.

A study by Zhang *et al.* (2017) in China on socioeconomic status factors that increase the risk of *H. pylori* infection in China found that there were associations between household size and *H. pylori* infection.

METHOD

The methodology includes the research design, location of study, sampling techniques, sample size, research instruments, data collection procedures, and data analysis techniques. Here, the sample size was determined from which the samplings were taken from the research study location. Validity was determined from the ratings $\mathrm{CVI} = n_{3/4}/N$, where the items were rated 3 or 4 by both judges, and N is the total items in the instrument. This method has advantages with regard to ease of computation, focus on agreement of relevance, and provision of both item and scale information (Table 1).

Validity was determined from items rated 3 and 4 by both judges as $\mathrm{CVI} = n_{3/4}/N$, where $n_{3/4}$ is items rated relevant and very relevant by both judges, and N is the total number of items: $\mathrm{CVI} = 29/34 = 0.85$. A valid index of 0.85 was reported. This was an accepted measure because it was higher than the 0.70 value recommended in social science research.

The scores from parts of the tests are correlated. The researcher administered a single instrument to a non-probability through a stratified sampling method of 30 *H. pylori*-infected patients in Gabiley town and then correlated using a correlation formula. The reliability with high correlation indicates that a respondent would perform equally well (or as poorly) on both halves of the test. Split half-reliability uses one set of questions divided into two equivalent sets. The two tests are given to one group of respondents who sit the test at the same time. The instrument was administered to a non-probability sample through a stratified sampling of 30 *H. pylori*-infected patients in Gabiley town once by dividing the questions into half (odd and even

Table 1 | Content validity

		Judge 2				
		1	2	3	4	Total
Judge 1	1	0	0	0	2	2
	2	0	0	1	0	1
	3	0	0	1	1	2
	4	1	1	9	18	29
Total		1	1	11	21	34

Note: Shaded regions in 3 and 4 indicate items that were rated quite relevant and very relevant by both judges.

or up and down) and then correlated using the Spearman Brown formula $\Gamma = 2\,r/1 + r$. The scores on the responses of each respondent were taken to provide a single score for each respondent on the instrument.

Then, reliability was calculated as

$$\Gamma = 2\,r/1 + r\,1- = 2(0.827)/1 + 0.827 = 0.90$$

where r is the reliability of half of the test. Hence a reliability index of 0.90 was reported. This means that out of any ten equations in the questionnaire, at least seven of the respondents understood the same way. This is acceptable reliability because it was higher than the 0.70 value recommended by social science research. Hence the research instrument is able to produce constant responses at one time. It is most commonly used for multiple-choice tests you can theoretically use it for any type of test – even tests with essay questions. Then the results from the two instruments were correlated to yield a coefficient of stability of at least 0.70.

The chi-square test was ideally applied to determine if there were significant differences in categorical proportions as

$$\chi^2 = \sum \frac{(f_0 - f_e)^2}{f_e}, \text{ with df} = (R-1)(C-1)$$

where is f_0 observed frequency; f_e is the expected frequencies; R is the number of rows and C is the number of columns in the data set.

Coefficient (C) statistic as contingency coefficient (C) was preferred over other measures of the strength of association because it is the way to calculate the strength of an association in tables which have more than 2×2 rows and columns.

$$C = \sqrt{\frac{x^2}{n + x^2}}$$

Data were analyzed at 95% level of confidence, 0.05 level of significance and 5% margin of error. 95% level of confidence means that findings arrived at had 95% chance of being true, 0.05 level of significance means that the maximum probability of accepting a null hypothesis if it was true was 5 in every 100, and 5% margin of error indicates that the maximum expected difference between true population and the sample of any parameter cannot exceed ± 5. These levels were selected because they are conventional measures commonly used in social science research.

FINDINGS AND RESULTS

This section presents findings and results of the study on the risk factors associated with *H. pylori* infection among patients attending private clinics, in Borama District, Somaliland. The study investigated three specific objectives: the relationship between uses of NSAIDs, socioeconomic status and household hygiene practices and *H. pylori* infection among patients attending private clinics in Borama district, Somaliland. Ibuprofen, Aspirin, and Diclofenac are the elements of NSAIDs. Socioeconomic status is defined as income, education, and gender. Household hygiene practices were defined as: food hygiene and safety, water supply and toilet availability. Using a correlation cross-sectional survey research design, data were collected from 152 *H. pylori*-infected patients in Borama private clinics, which gives a response-return rate of 100%.

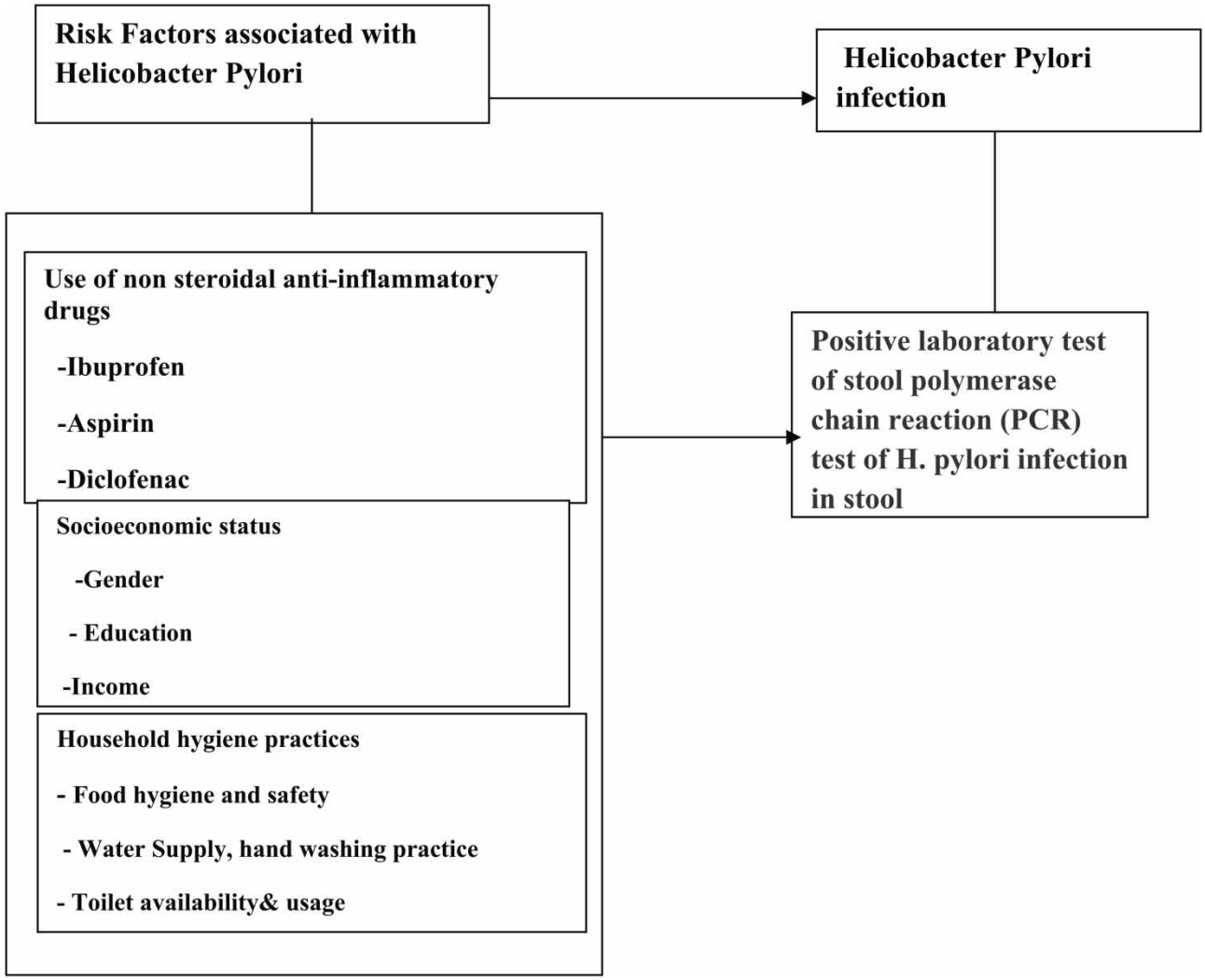


Figure 1 | Conceptual framework of the risk factors and *Helicobacter pylori* infection.

The study collected data on the background information of the respondents, NSAIDs that were used, socioeconomic status and household hygiene practices (Figure 1).

The study sought to establish the general characteristics of the respondents such as gender, and residence, marital status, age and level of education. Preliminary investigation on the data was also done to eliminate errors that could have occurred during coding and transformation. Then the dataset had the absence of outliers and met normality tests, and descriptive statistics on the demographic information of respondents were presented.

Figure 2 shows the distribution of respondents by gender. It indicates that 53.9% of the respondents were females, while 46.1% of the respondents were males. This shows that *H. pylori* infection is significantly more common in females than in males in the study population.

Figure 3 shows the distribution of respondents by location. It shows that most (34.2%) of *H. pylori*-infected patients were located in Sheikh Osman, while 25% reside in Sh. Ahmed Salam area and 20.4% Come from Sh. Ali and Sh. Makahil, respectively. These show that data were collected from all regions of the district and this makes the data representative.

Figure 4 shows the distribution of respondents by marital status. It shows that the majority (50%) of the respondents were married, and 27.6, 9.2, 7.9, and 5.3% were single, separated, widowed, and divorced, respectively.

Figure 5 shows the distribution of respondents by age. It showed that 38.1% of the respondents were aged 30–40 years, 25% were aged <30 years,17.8% were aged >60 years, and 11.2% were aged 41–50 years. Meanwhile only 7.9% of the respondents were aged 51–60 years. This indicates that most of the respondents were aged between 30–40 years.

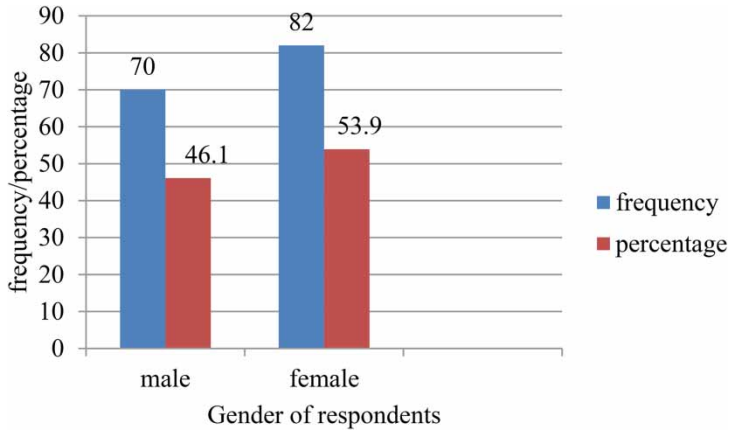


Figure 2 | Gender of the respondents.

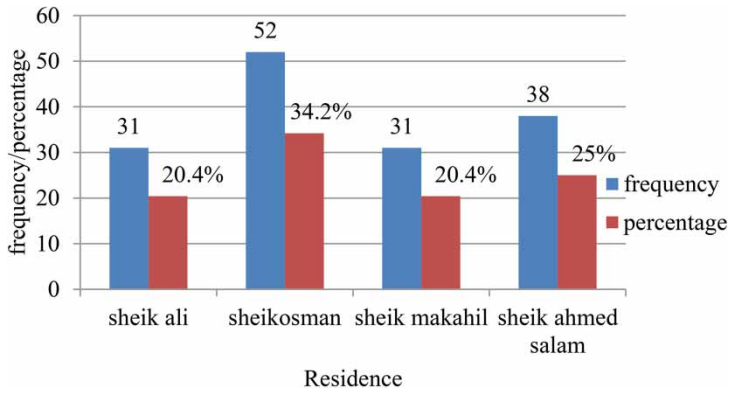


Figure 3 | Distribution of the respondents by their area of residence.

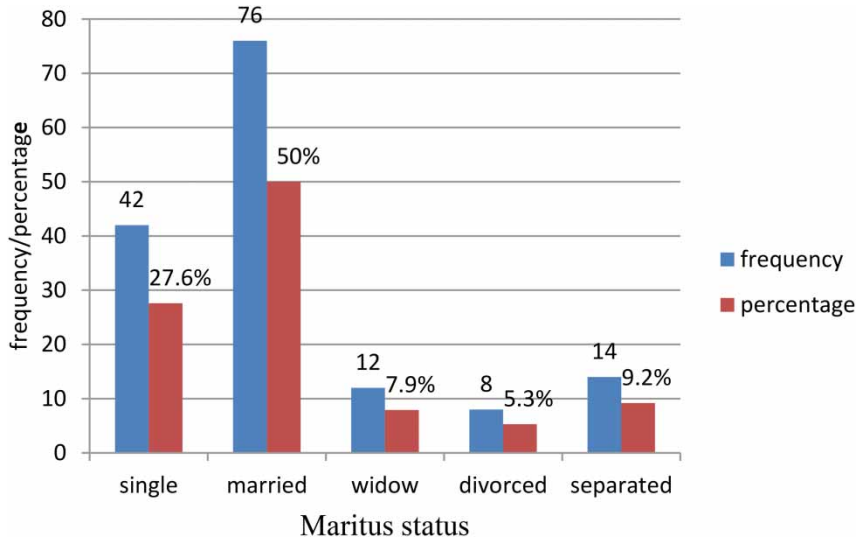


Figure 4 | Marital status of the respondents.

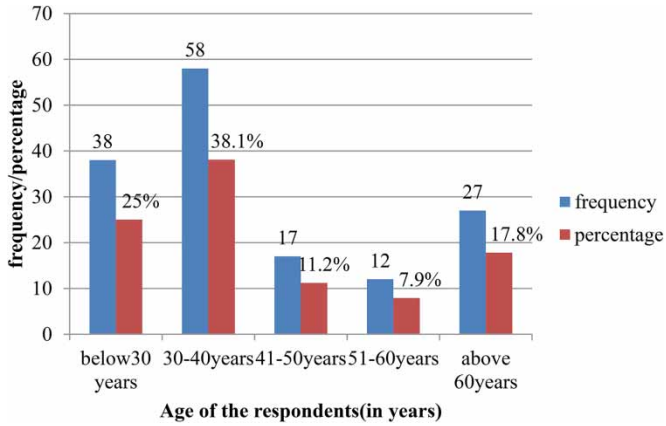


Figure 5 | Age of the respondents.

Figure 6 shows the distribution of respondents by their level of education. Results on the education level of the respondents showed that 30.9% of the patients had not attained any formal education, 28.3% had attained university level, and 23.7% had secondary education. Only a minority of the study population (3.4%) had attended primary education.

H. pylori infection and associated risk factors

Here, the risk factors associated with *H. pylori* infection among patients attending private clinics in Borama District, Somaliland were determined.

The use of NSAIDs and *H. pylori* infection

Table 3 shows the status of the usage of NSAIDs among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland. It shows that most (47.4%) of the respondents always used NSAIDs, while 22.4% of respondents had not used NSAIDs. Data in the last row show the diagnosis of *H. pylori* infection among patients in Borama District. It shows that most (57.9%) patients are diagnosed by laboratory tests, whereas 42.1% are diagnosed by clinical symptoms (Table 2). Thus, the status of usage of NSAIDs among *H. pylori*-infected patients attending private clinics in Borama District Somaliland was generally high. On comparing with the diagnosis from laboratory tests, most (30.3%) of the patients with always-used NSAID status had diagnosis by laboratory test, while only 7.9% of patients with not-used NSAID status had diagnosis by laboratory test. Along the clinical symptoms column, most (17.1%) of the patients with always-used NSAID status had been diagnosed with clinical symptoms, while only 10.5% of patients with sometimes-used NSAID status had been diagnosed with clinical symptoms.

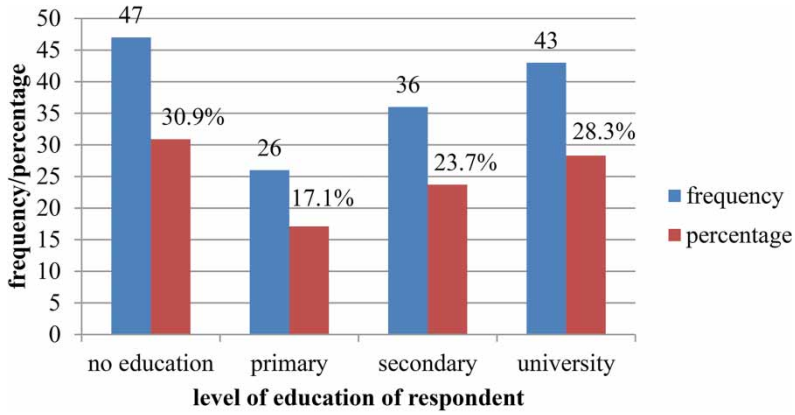


Figure 6 | Level of education of the respondents.

Table 2 | Variables score, rate, and weight

Variable	Scores	Level	Code	Analysis
Uuse of non-steroidal anti-inflammatory drugs	77– 11	Not used	1	Chi-square test of independence
	12–16	Sometimes used	2	
	17–23	Always used	3	
	7–10	Low	1	
Socioeconomic status	11–14	Medium	2	Chi-square test of independence
	15–20	High	3	
	14–26	Poor	1	
Household hygiene practice	27–40	Good	2	Chi-square test of independence
Helicobacter pylori infection	1–2	Clinic symptoms	1	Chi-square test of independence
		Lab test	2	

Table 3 | Using non-steroidal anti-inflammatory drugs with *Helicobacter pylori* infection

			***Helicobacter pylori* infection**		
			Clinical symptoms	**Lab test**	**Total**
Use NSAIDs	not used	Count	22	12	34
		% with NSAIDs	64.7%	35.3%	100.0%
		% with HBPI	34.4%	13.6%	22.4%
		% of Total	14.5%	7.9%	22.4%
	sometimes used	Count	16	30	46
		% with NSAIDs	34.8%	65.2%	100.0%
		% with HBPI	25.0%	34.1%	30.3%
		% of Total	10.5%	19.7%	30.3%
	always used	Count	26	46	72
		% with NSAIDs	36.1%	63.9%	100.0%
		% withHBPI	40.6%	52.3%	47.4%
		% of Total	17.1%	30.3%	47.4%
Total		Count	64	88	152
		% with NSAIDs	42.1%	57.9%	100.0%
		% with HBPI	100.0%	100.0%	100.0%
		% of Total	42.1%	57.9%	100.0%

Note: NSAIDs, non-steroidal anti-inflammatory drugs; HBPI, *Helicobacter pylori* infection.

These results could be associated with the constant use of NSAIDs due to the occurrence of *H. pylori* infection among patients who attended private clinics in Borama District, Somaliland. The data in Table 3 were subjected to a chi-square test of goodness-of-fit to establish whether there were significant differences between the proportions reported, and to test the null hypothesis that the use of NSAIDs is not associated with the occurrence of *H. pylori* infection among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland.

H_{o1}: Use of NSAIDs is not associated with the occurrence of *H. pylori* infection among *H. pylori*-infected patients attending Borama Private Clinics in Borama District, Somaliland**.** The results of the chi-square analysis are summarized in Table 4.

Table 4 shows the results of chi-square test of the status of uses of NSAIDs among *H.pylori*-infected patients attending private clinics in Borama District, Somaliland. It shows that $\chi^2_{(2,N=152)} = 9.197$, $p = 0.010$. Further $\chi^2_0 = 9.197 > \chi^2_c = 5.99$ which led to the rejection of the null hypothesis. This means that there were more respondents who rated always using NSAIDs than those who rated not using NSAIDs. The hypothesis that use of NSAIDs was not associated with the occurrence of *H. pylori* infection was, therefore, rejected. The finding suggested by the data in Table 4 was, therefore, upheld. The study, therefore, established that the *H. pylori*-infected patients who attended private clinics were generally always using NSAIDs when they were first diagnosed with *H. pylori* infection.

Table 4 | Summary χ^2 test for using non-steroidal anti-inflammatory drugs

Variables	N	Df		χ^2	PC
Uses NSAIDs	152	2	9.197	0.010	0.239

Note: $\chi^2_{(2,.05)} = 5.99$.

The contingency coefficient ($C = 0.239$) indicates an association of 0.239 which means that 23.9% of the variance in the occurrence of *H. pylori* infection is dependent use of NSAIDs. Therefore, up to 23.9% of the changes from always using NSAIDs to not using NSAIDs can prevent the occurrence of *H. pylori* infection in the Borama district of Somaliland.

Socioeconomic status and *H. pylori* infection

Table 5 shows the socioeconomic status among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland. It shows that most (46.1%) of the respondents indicated that they had moderate socioeconomic status, while 25.7% of respondents indicated that they had low socioeconomic status. Data on the last row show the status of diagnosis among patients in Borama District. It shows that most (57.9%) of patients had been diagnosed with laboratory tests, while (42.1%) of patients were diagnosed with clinical symptoms Thus, the socioeconomic status among *H. pylori*-infected patients attending private clinics in Borama District Somaliland was generally moderate.

On cross comparison along the diagnosis laboratory test column, most (28.3%) patients with moderate socioeconomic status had diagnosis laboratory tests, while only 13.3% of patients with high socioeconomic status had diagnosis laboratory tests. The Clinical symptoms column shows most (17.8%) patients with moderate socioeconomic status were diagnosed with clinical symptoms, while only 9.9% of patients with low socioeconomic status had been diagnosed with clinical symptoms. While the figures do not suggest a clear-cut relationship, they tend to suggest that there is a positive association between socioeconomic status and *H. pylori* infection. The data in Table 5 were tested using the chi-square test of independence to establish if there were significant differences between the proportions reported, and to test the null hypothesis that socioeconomic status is not associated with the occurrence of *H. pylori* infection among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland.

H_{01}: Socioeconomic status is not associated with the occurrence of *H. pylori* infection among patients attending private Clinics in Borama District, Somaliland.

The results of the chi-square analysis are summarized in Table 6.

Table 5 | Socioeconomic status with *Helicobacter pylori* infection

			Helicobacter pylori infection		
			Clinical symptoms	Lab test	Total
SES	low	Count	15	24	39
		% with SES	38.5%	61.5%	100.0%
		% with HBPI	23.4%	27.3%	25.7%
		% of Total	9.9%	15.8%	25.7%
	medium	Count	27	43	70
		% with SES	38.6%	61.4%	100.0%
		% with HBPI	42.2%	48.9%	46.1%
		% of Total	17.8%	28.3%	46.1%
	high	Count	22	21	43
		% with SES	51.2%	48.8%	100.0%
		% with SES	34.4%	23.9%	28.3%
		% of Total	14.5%	13.8%	28.3%
Total		Count	64	88	152
		% with SES	42.1%	57.9%	100.0%
		% with HBPI	100.0%	100.0%	100.0%
		% of Total	42.1%	57.9%	100.0%

Note: SES, socioeconomic status; HBPI, *Helicobacter pylori* Infection.

Table 6 | The result of chi-square analysis

Variables	N	dfχ^2	P
SES 152	2	2.018	0.365

Note: $\chi^2_{(2,.05)} = 5.99$.

Table 5 shows the results of the chi-square test of the socioeconomic status among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland. It shows that $\chi^2_{(2,N=152)} = 2, 018, p = 0.365$. Further $\chi^2_0 = 2.018 < \chi^2_c = 5.99$ which led to accepting the null hypothesis.

The hypothesis that socioeconomic status is not associated with the occurrence of *H. pylori* infection was, therefore, accepted. The finding suggested by the data in Table 5 was, therefore, upheld. The study established that *H. pylori*-infected patients who are attending private clinics generally have moderate socioeconomic status when they are first diagnosed with *H. pylori* infection.

Households Hygiene Practice and *H. pylori* infection

Table 7 shows the status of household hygiene practices against *H. pylori* infection. By examining the last column, Table 7 shows 50.7% of the patients had poor household hygiene practices and 49.3% had good household hygiene practices. Hence, *H. pylori*-infected patients attending private clinics in Borama District are generally poor. This could promote cases of *H. pylori* infections. The last row presents the same information as in Tables 3 and 5. Most patients (57.9%) had diagnosis laboratory tests, while 42.1% had clinical symptoms. The combination of poor household hygiene practices and *H. pylori* infections are more related.

Further, an examination of Table 7 shows that of those with a diagnosis laboratory test, 33.6% had poor household hygiene practices, and 24.3% had good household hygiene practices. But among those with clinical symptoms, 25% had good household hygiene practices and just 17.1% had poor household practices. This could indicate the association between household hygiene practice and the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. The data in Table 8 were subjected to a chi-square test of goodness-of-fit to establish if there were significant differences between the proportions reported, and to test the null hypothesis that household hygiene practice is not associated with the occurrence of *H. pylori* infection among those attending private clinics in Borama District, Somaliland.

H_{01}: Household Hygiene Practice is not associated with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. The results of the chi-square analysis are summarized in Table 8.

Table 7 | Household hygiene practice and *Helicobacter pylori* infection

			***Helicobacter pylori* infection**		
			Clinical finding	**Lab test**	**Total**
HHP	poor	Count	26	51	77
		% with HHP	33.8%	66.2%	100.0%
		% within HBPI	40.6%	58.0%	50.7%
		% of Total	17.1%	33.6%	50.7%
	good	Count	38	37	75
		% with HHP	50.7%	49.3%	100.0%
		% with HBPI	59.4%	42.0%	49.3%
		% of Total	25.0%	24.3%	49.3%
Total		Count	64	88	152
		% with HHP	42.1%	57.9%	100.0%
		% with HBPI	100.0%	100.0%	100.0%
		% of Total	42.1%	57.9%	100.0%

Note: HHP, household hygiene practice; HBPI, *Helicobacter pylori* infection.

Table 8 | Summary of χ^2 test on household hygiene practice

Variables	N	df	χ^2	p	c
HHP	152	1	4.452	0.035	0.169

Table 8 shows the results of the chi-square test of the status of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. It shows that $\chi^2_{(1,N=152)} = 4.452$, $p = 0.035$. Furthermore, $\chi^2_0 = 4.452 > \chi^2_C = 3.84$ which led to rejection of the null hypothesis. This means that there were more respondents who rated poor household hygiene practices than those who rated good household hygiene practices. The hypothesis that household hygiene practice is not associated with the occurrence of *H. pylori* infection was, therefore, rejected.

The contingency coefficient (C = 0.169) indicates an association of 0.233 which means that 16.9% of the variance in occurrence of *H. pylori* infection is dependent on moderate household hygiene practice. Therefore, up to 16.9% of the changes from moderate household hygiene practice to good household hygiene practice can prevent the occurrence of *H. pylori* infection in Borama District, Somaliland.

Summary

The association between the use of NSAIDs and the occurrence of *H. pylori* infection among patients attending private clinics in Borama district, Somaliland was determined. It was found that most (47.4%) respondents had always used NSAIDs, while 22.4% of the respondents indicated that they had not used NSAIDs. This indicates that the use of NSAIDs among patients with *H. pylori* infection attending Borama private clinics was generally high. This position was upheld by the chi-square test. The study established that patients who used NSAIDs were more likely to develop *H. pylori* infection than those who did not use them. The document analysis indicates that 52% of the respondents always used NSAIDs, 40% of the respondents sometimes used NSAIDs, and 8% of the respondents did not use NSAIDs.

Also, the correlation between socioeconomic status and the occurrence of *H. pylori* infection among patients at a private clinic in Borama District was determined. Socioeconomic status can be defined based on their levels of income, education, and gender. The study noted that 46.1% of the respondents indicated that they belonged to moderate socioeconomic status, while 25.7% of respondents indicated that their socioeconomic status was low. Thus, the socioeconomic status among *H. pylori*-infected patients attending private clinics in Borama District, Somaliland was generally moderate. The study established that socioeconomic status was moderate and it is not one of the factors associated with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. The document analysis indicates that 7% of the patients had good socioeconomic status, 30% of patients had poor socioeconomic status, and 63% had moderate socioeconomic status.

Finally, the correlation between household hygiene practices and *H. pylori* infection among patients attending private clinics in Borama District, Somaliland was also determined. Here, the household hygiene practices were defined based on food hygiene and safety, water supply, and toilet availability. It was shown that most (50.7%) of the patients had poor household hygiene practices and 49.3% had good household hygiene practices. The study established that the status of household hygiene practice was poor and it is one of the factors associated with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. Document analysis indicates that 60% of the respondents had poor household hygiene practices and 40% of the respondents had good household hygiene practices.

DISCUSSION

The results of the study are as follows :

- The use of NSAIDs has a significant association with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland.
- Socioeconomic status does not have a significant association with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland.
- Household hygiene practices have a significant association with the occurrence of *H. pylori* infection among patients attending private clinics in the Borama District.

CONCLUSION

The use of NSAIDs has a significant association with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. Socioeconomic status does not have a significant association with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District, Somaliland. Second, the study established that socioeconomic status is not significantly associated with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District Somaliland. The finding of this study does not agree with previous similar studies. One such study by Midhet *et al.* (2010) in Uganda showed that there was a strong association between *H. pylori* infection and the patients' level of education and gender, indicating their socioeconomic status. Another study done by Zhang *et al.* (2017) in China on socioeconomic status factors found that there was an association between income level and *H. pylori* infection. Lori *et al.* (2008) in Russia suggested in a study that socioeconomic status remains a factor influencing the acquisition and prevalence of *H. pylori* infection. Nahar *et al.* (1995) in Bangladesh showed that poor socioeconomic conditions, such as low income, and the use of a stove for heating or cooking result in high prevalence of *H. pylori* infection. Furthermore, a study conducted by Tedla (1992) in Ethiopia showed that socioeconomic factors such as low-income levels can contribute to *H. pylori* infections. Thus, the results of other studies are different from the findings of this study. Household hygiene practices are significantly associated with the occurrence of *H. pylori* infection among patients attending private clinics in Borama District.

The risk factors associated with *H. pylori* infection among patients attending private clinics in Borama District, Somaliland were investigated. The study mainly focused on the use of NSAIDs, socioeconomic status, and household hygiene practices. Based on the findings and above-mentioned discussion, the study concludes that the use of NSAIDs as well as improper practice of household hygiene is significantly associated with the infection, whereas the socioeconomic status is not associated with the infection.

LIMITATION

The availability of precious time and resources has greatly slowed further study and subsequent proceedings with regard to the research activities. Also, other factors associated with the occurrence of *H. pylori* infection could be studied. It is, therefore, recommended that other forms of research criteria apart from risk factors could also be studied. These could include but are not limited to factors such as family history, practices like smoking, and a host of other bacterial factors.

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ETHICAL CONSIDERATIONS

Each participant was notified of the intentions of the study. The consent of each respondent was obtained. It was ensured that any information provided was confidential and should not be without the permission of the client.

DATA AVAILABILITY STATEMENT

All relevant data are included in the paper or its Supplementary Information.

CONFLICT OF INTEREST

The authors declare there is no conflict.

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