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Prevalence and Factors Associated with Dyslipidemia among Patients with Helicobacter Pylori Infection Attending Fort Portal Regional Referral Hospital in Uganda: A Crossectional Study

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Abstract

Background: *Cardiovascular disease is the number one cause of death worldwide while dyslipidemia is key modifiable risk factor of atherosclerotic cardiovascular disease accounting for 4 million deaths annually worldwide. Few studies assessing the relationship between H. pylori and dyslipidemia show changes in serum levels of lipids. The aim of this study was to determine the prevalence and factors associated with dyslipidemia among patients with H. pylori infection.*

Methods: *A cross-sectional study was performed between September to December 2022 at Fort Portal regional referral hospital, Uganda on 380 H. pylori infected patients. A validated questionnaire and 5-mL blood specimens were used to obtain data. Correlation analyses, chisquare tests, t-tests, and logistic regression were used to detect correlations and associations, with adjusted odds ratios and p values considered significant at values ≤0.05.*

Results: *According to the individual lipid profile parameters in this study, decreased HDL-C (24.21%) was the most common dyslipidemia form, followed by elevated LDL-C (16.58%), elevated triglycerides (13.42%), and elevated total cholesterol (11.32%). The prevalence of dyslipidemia among patients with H. pylori infection was 41.58% at Fort Portal Regional Referral Hospital. In this study, religion and education level were independently associated with dyslipidemia, that is, Muslims had a 5-fold increased risk compared to Pentecostal believers aOR 4.97 (95% CI 1.57-15.73, p 0.006), while primary education level conferred a tripled risk compared to tertiary level education aOR 3.21 (95% CI 1.17-8.78, p= 0.023).*

Conclusion: *The high prevalence of dyslipidemia among H. pylori patients merits that countrywide awareness programs on dyslipidemia should be carried out, and that patients with H. pylori infection, overweight people, and hypertensive patients should have routine screening for dyslipidemia as they could potentially benefit from lipid-reducing regimens.*

Keywords: H Pylori, Dyslipidemia, Prevalence, Risk Factors, LDL C, HDL C, Total Cholesterol, Triglycerides, Cardiovascular Disease

Abbreviations

SAT: Stool Antigen Test
WHO: World Health Organization
LDL: Low-density Lipoprotein
HDL: High-density Lipoprotein
TC: Total Cholesterol
TG: Triglycerides
FPRRH: Fort Portal Regional Referral Hospital Referral Hospital
AOR: Adjusted Odds Ratio
CI: Confidence Interval

1. Background

Dyslipidemia is a key cardiovascular risk factor that takes includes a group of metabolic disorders of cholesterol and triglycerides affecting cardiovascular system, producing pathologies such as vascular coronary disease and atherosclerosis [1,2]. Dyslipidemia is described as any or a combination of the following: low high-density Lipoprotein cholesterol (HDL-c) <40mg/dL in men and <50mg/Dl in women, elevated low-density lipoprotein cholesterol ((LDL-c) (>130md/dL)), elevated total cholesterol (>200 mg/dL), and elevated triglycerides TG (>150mg/dL) [3]. H. pylori virulence factors attract immunologically active cells, which release cytokines, tumor necrosis factor (TNF), and interferons (IFNs) that can function outside of H. pylori's native environment. In the acute phase, CRP causes endothelial cells to produce more intercellular adhesion molecule 1 (ICAM-1) and monocyte chemo-attractive protein-1 (MCP-1), both of which are involved in atherogenesis. Several cytokines' plasma concentrations increase. To date, 35 cytokines have been identified, the majority of which exhibit pro-inflammatory and antiinflammatory properties. Elevated levels of IL-1, IL-6, IL-8, IL-10, and IL-17 have been isolated in human stomach mucosa. Increased tissue and plasma levels of ILs could accelerate their pathogenic action [4].

In one study, Helicobacter pylori significantly raised mean total cholesterol, triglyceride, LDL-C, ApoB lipoprotein, and Lp (a) levels, as well as total Cholesterol/HDL ratio and LDL-C/HDL-C ratio in a study conducted in Turkey [5]. In a study conducted in Japan, it was discovered that H. pylori infection has a considerable impact on the serum lipid profile of healthy persons [6]. According to a study conducted in Korea, people with persistent H. pylori infection have a higher chance of having high LDL-C, low HDL, and high cholesterol levels. It was also suggested that eliminating H. pylori will lower LDL-C and total cholesterol while increasing HDL-C [7]. The prevalence of H pylori infection in Uganda varies according to different geographic locations. In Uganda, a study of patients with gastrointestinal ulcer disease at Bwera Hospital in Kasese discovered that the prevalence of H. pylori infection was 29.6% [8]. In a study of 176 patients with gastrointestinal ulcer disease conducted at Mbarara Regional Referral Hospital, the prevalence of H. pylori infection was found to be 75.6 percent, with H. pylori significantly increasing gastric ulcer, gastritis, gastric cancer, esophageal cancer, and duodenal ulcers [9]. In 2019 the World Health Organization, reported that cardiovascular disease was the first cause of death worldwide with its main risk factor being atherosclerotic vascular disease [10]. Dyslipidemia is key modifiable risk factor of atherosclerotic cardiovascular disease accounting for 4 million deaths annually worldwide [11]. A study done in Tanzania and Uganda in 2019 reported that dyslipidemia affects a third of the study population and 32–45% of rural adults are affected by low high-density lipoprotein cholesterol [12]. Furthermore, Asiki et al observed in 2015 that low HDL-C had a high prevalence in southwestern Uganda as well as high total cholesterol; but none of these studies assessed relationship between H. pylori and hyperlipidemia. Globally, half of people in the world are affected by H. pylori and 80% of people in developing countries are infected [13]. Evidence from previous studies shows an association H. pylori infection and change in serum levels of lipids, with an increasing trend towards dyslipidemia [5]. All the studies that have assessed hyperlipidemias in Uganda have not reported about the association with H. pylori yet the burden of H. pylori and hyperlipidemias has been reported to be high [11,12].

2. Methods

2.1 Study Design, Study Area, and Study Participants

We conducted a hospital-based cross-sectional descriptive and analytical study at Fort Portal Regional Referral Hospital. The study was conducted in the Medical Outpatient department of FPRRH. The Department runs daily from Monday to Friday and receives an average of 150 patients of which 40% are diagnosed with peptic ulcer disease according to the outpatient department record (unpublished FPRRH record). It is run by Specialists, Residents, Intern Doctors and Clinical Officers. The laboratory of FPRRH is well equipped and staffed to carry out different investigations including H pylori stool antigen testing and lipid profile determination. We targeted all adult patients with confirmed H. pylori infection attending the outpatient department at Fort Portal Regional Referral Hospital after applying the study criteria.

2.2 Study Inclusion and Exclusion Criteria

We included adult patients with positive stool test for H pylori aged 18 years old and above attending the Outpatient Department of FPRRH. A participant was considered positive only after a test done on the day of contact at the clinic visit. Participant with positive H. pylori test who did not consent to be part of the study, participant with chronic diseases like diabetic and HIV, Patients on statin therapy, and propranolol users were excluded from this study.

2.2 Sample Size Determination

The sample size was determined using Daniel's formula (2009) with the prevalence of dyslipidemia estimated at 50%, as no existing data on prevalence in East Africa Community countries was found, thus, a total of 380 adult patients were included in this study.

2.3 Study Procedures

A consecutive sampling procedure was employed in this study until the sample size was obtained. Pretested questionnaires and standardized laboratory report forms for urine protein were utilized as primary data collection tools. The diagnosis of dyslipidemia was done through laboratory investigation based on the WHO defined dyslipidemia as the presence of any of the following: TG 150-400 mg/dl (1.7-4.5 mmol/l), TC >200 mg/dl (>5.2 mmol/l), LDL-C >135 mg/dl (>3.5 mmol/l), HDL-C <35 mg/dl (<0.9 mmol/l in men) or <40 mg/dl (<1.0 mmol/l in women). In this study the diagnosis of dyslipidemia considered any value that was above for LDL, TG and TC or below for HDL; than the given values. Adult patients with positive H. pylori from the outpatient department of FPRRH, were informed about the study, a written consent was sought and demographic data obtained. A detailed history was taken to check for the history of peptic ulcer disease, hypertension

or other cardiovascular diseases and diabetes mellitus and use of beta blockers or statin. Patients were counseled about having physical examination, in order to check for other components of metabolic syndrome like waist circumference; blood pressure and body mass index. The blood sample was withdrawn from the patient's vein using aseptic technique and taken to the biochemistry laboratory by the research assistant for immediate processing and analysis of the specimen. The sample was collected by the principal investigator and labeled with the patient`s serial number for confidentiality and easy follow up of the result. Data obtained by the predetermined questionnaire and by using the Cronbach's Coefficient alpha of more than 0.8 was considered that the items of the questionnaire were reproducible and consistent. The specimens were collected while ensuring sterile conditions so that reliability is ensured.

2.4 H. pylori testing

The World Gastroenterology Organization (WGO) global guidelines by Hunt et al. indicated that serology is less accurate than SAT in areas with low prevalence of H. pylori infection, where a negative test result is more valuable [14]. Stool antigen test (SAT): SAT is a type of EIA, and is used for diagnosis and to assess the response to treatment of a H. pylori infection. The different SATs evaluated have shown both varying sensitivities (48.9–100%) and specificities (87–94.4%). While SATs using monoclonal antibodies are superior to SATs using polyclonal antibodies in both pre- and post-treatment conditions, SATs are comparable to UBTs in pre-treatment but inferior in post-treatment [14].

2.5 Lipid Profile Determination

The blood samples collected (2-4 mL) in dry tubes used on the same day to measure lipid parameters. The samples collected will be centrifuged and then serums will be decanted. Total cholesterol, HDL cholesterol and triglycerides measured using enzymatic colorimetric assay on Mindray R BS-120 automaton (Guangdong, China). The different types of dyslipidemia will be classified according to criteria defined in the National Cholesterol Education Program Adult Treatment Panel III [15]. 10% (38 of participant samples were also retested at Kampala International University Teaching Hospital laboratory for quality control assessment.

3. Data Analysis

Data was coded and entered into a database created using Microsoft Excel, cleaned and edited.

Dataset was then imported into STATA 14.2 (Statacorp, Lakeway Drive, USA Texas) for analysis. Prevalence of dyslipidemia among patients with H pylori infection attending OPD at Fort Portal Regional Referral Hospital was computed and presented in a pie chart. Dyslipidemia was considered with the presence of any abnormality in a participant's lipid profile, however, multiple anomalies in one participant's sample were considered as 1 in the numerator. The lipid profile pattern of these patients was computed and summarized in a table. Factors associated with dyslipidemia were analyzed by both bivariate and multivariate logistic regression analysis. Variables that were biologically plausible and those with p-value ≤ 0.2 at bivariate were considered for multivariate analysis. The variables in the final multivariate model were significant when p-value ≤ 0.05. The measure of association was reported using crude odds ratio (cOR) at bivariate analysis and adjusted odds ratio (aOR) at multivariate analysis with their corresponding 95% CI and p-value.

4. Results

4.1 Characteristics of Study Participants

Majority of the participants were at least 40 years old (65.53), female (80.26%), Batoro (62.37%), Catholics (48.95%), had primary education level (54.74%), unemployed (90.26%), married (76.84%), stayed in urban dwellings (50.79%), had normal blood pressure (46.58%), and had a normal BMI (52.11%). 10.79% of the study participants were known to have hypertension, while no participant had HIV, diabetes mellitus, or peptic ulcer disease (Table 1).

Characteristic	Frequency (N=380)	Percentage (%)
Age Category (years)		
<40 years	131	34.47
40+ years	249	65.53
Gender		
Male	75	19.74
Female	305	80.26
Tribe		
Mutoro	237	62.37
Mukiga	93	24.47
Others	50	13.16
Religion		
Anglican	117	30.79
Catholic	186	48.95
Pentecostal	58	15.26

Muslim	19	5.00
Level of Education		
None	104	27.37
Primary	208	54.74
Secondary	42	11.05
Tertiary	26	6.84
Occupation		
Unemployed	343	90.26
Employed	37	9.74
Marital status		
Not married	88	23.16
Married	292	76.84
Residence		
Rural	187	49.21
Urban	193	50.79
Physical exercise		
Yes	12	3.16
No	368	96.84
Known Hypertension patient		
Yes	41	10.79
No	339	89.21
Blood pressure class		
Normal	177	46.58
Elevated	57	15.00
Obese		
Stage I HTN	106	27.89
Stage II HTN	40	10.53
BMI category (Kg/m2)		
Underweight (<18.5)	1	0.26
Normal weight (18.5-24.9)	198	52.11
Overweight (25.0-29.9)	147	38.68
Obese (≥30.0)	34	8.95

Table 1: General Characteristics of Study Participants

4.2 Prevalence of Dyslipidemia

Dyslipidemia in this study was defined by any presence of either elevated Low-density lipoproteins (LDL-C), elevated Triglycerides, elevated total cholesterol, or decreased High density lipoproteins (HDL-C), singly or in concert, and as shown in the figure below, the presence of dyslipidemia was 41.58% at Fort Portal Regional Referral Hospital (Figure 1).

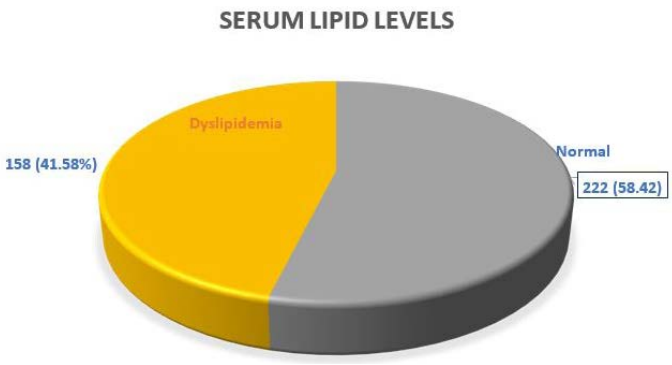

Figure 1: Prevalence of Dyslipidemia

4.3 Lipid Profile Patterns of Study Participants

The mean LDL-C level was 2.684 mmol/l, mean HDL-C level was 1.085 mmol/l, mean serum triglyceride level was 1.616 mmol/l, and the mean total serum cholesterol level was 4.439 mmol/l. Based on the individual lipid profile parameters, the commonest dyslipidemia was decreased HDLC (24.21%), followed by elevated LDL-C (16.58%), elevated triglycerides (13.42%), and least was elevated total cholesterol (11.32%). By gender, there was no clear difference in HDL-C levels, however, males had higher dyslipidemia levels for dyslipidemia in general and also for LDL-C, serum triglycerides, and total cholesterol levels (Table 2). By number of abnormal lipid profile parameters, 86(22.63%) had only one abnormal lipid profile parameter, 53(13.95%) had two abnormalities, and 19(5.00%) had three lipid profile abnormalities. Except for presence of two abnormal lipid profile parameters in which females had a higher proportion than males (14.38% versus 12.16%), males had higher proportions of lipid profile abnormalities for one parameter (24.32% vs 22.22%) and three anomalies (6.76% vs 4.58%) compared to females (Table 3).

Parameter	Number (N=380)	Male (n=75)	Female(n=305)
Dyslipidemia			
Yes	158 (41.58)	33 (44.00)	125 (40.98)
No	222 (58.42)	42 (56.00)	180 (59.02)
Highdensity Lipoproteins			
Reduced	92(24.21)	18(24.00)	74(24.26)
Normal	288(75.79)	57(76.00)	231(75.74)
Low-density Lipoproteins			
Elevated	63(16.58)	16(21.33)	47(15.41)
Normal	317(83.42)	69(78.67)	258(84.59)
Serum triglycerides			
Elevated	51(13.42)	11(14.67)	40(13.11)
Normal	329(86.57)	64(85.33)	265(86.89)
Total Cholesterol			
Elevated	43(11.31)	9(12.00)	34(11.15)
Normal	337(88.68)	66(88.00)	271(88.85)

Table 2: Dyslipidemia Profile of Study Participants

Gender	Normal n (%)	One anomaly n (%)	2 anomalies n (%)	3 anomalies n (%)	Total n (%)
Male	42(56.76)	18(24.32)	9(12.16)	5(6.76)	75(100)
Female	180(58.42)	68(22.22)	44(14.38)	14(4.58)	305(100)
Total	222(58.42)	86(22.63)	53(13.95)	19(5.00)	380(100)

Table 3: Number of Lipid Profile Anomalies by Gender

4.4 Factors Associated with Dyslipidemia

At bivariate analysis, age category, religion, level of education, marital status, participant's residence, participants known to have hypertension and blood pressure classes of stage I hypertension and stage II hypertension were significant at bivariate analysis and thus included in the multivariate model (Table 4 and Table 5). At multivariate analysis stage, only religion and education level were independently associated with dyslipidemia, that is, Muslims had a 5-fold increased risk compared to Pentecostal believers aOR 4.97 (95% CI 1.57-15.73, p 0.006), while primary education level conferred a tripled risk compared to tertiary level education aOR 3.21 (95% CI 1.17-8.78, p= 0.023) (Table 6).

Characteristic Frequency (N=380), n (%)		Normal lipid profile, n (%)	Dyslipidemia, n (%)	COR (95%CI)	Bivariate pValue
Age Category (years)					
<40 years	131 (34.47)	85 (64.89)	46 (35.11)	Ref	
40+ years	249 (65.53)	137 (55.02)	112 (44.98)	1.51 (0.98-2.34)	0.064
Gender					
Male	75 (19.74)	42 (56.00)	33 (44.00)	1.13 (0.68-1.88)	0.635
Female	305 (80.26)	180 (59.02)	125 (40.98)	Ref	

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Tribe					
Mutoro	237 (62.37)	136 (57.38)	101 (42.62)	1.18 (0.72-1.92)	0.517
Mukiga	93 (24.47)	57 (61.29)	36 (38.71)	Ref	
Others	50 (13.16)	29 (58.00)	21 (42.00)	1.15 (0.57-2.31)	0.702
Religion					
Anglican	117 (30.79)	63 (53.85)	54 (46.15)	1.90 (0.98-3.70)	0.057
Catholic	186 (48.95)	112 (60.22)	74 (39.78)	1.47 (0.78-2.75)	0.231
Pentecostal	58 (15.26)	40 (68.97)	18 (31.03)	Ref	
Muslim	19 (5.00)	47 (61.04)	30 (38.96)	3.81 (1.29-11.3)	0.016
Level of Education					
None	104 (27.37)	58 (55.77)	46 (44.23)	2.64 (0.98-7.12)	0.055
Primary	208 (54.74)	113 (54.33)	95 (45.67)	2.80 (1.08-7.26)	0.034
Secondary	42 (11.05)	31 (73.81)	11 (26.19)	1.18 (0.38-3.71)	0.773
Tertiary	26 (6.84)	20 (76.92)	6 (23.08)	Ref	
Occupation					
Unemployed	343 (90.26)	200 (58.31)	143 (41.69)	1.05 (0.53-2.09)	0.893
Employed	37 (9.74)	22 (59.46)	15 (40.54)	Ref	
Marital status					
Not married	88 (23.16)	44 (50.00)	44 (50.00)	Ref	
Married	292 (76.84)	178 (60.96)	114 (39.04)	0.64 (0.40-1.03)	0.069
Residence					
Rural	187 (49.21)	103 (55.08)	84 (44.92)	Ref	
Urban	193 (50.79)	119 (61.66)	74 (38.34)	0.76 (0.51-1.15)	0.194

Table 4: Bivariate Analysis of Sociodemographic Characteristics

Normal lipid (N=380), n (%) profile, n (%)			**Dyslipidemia, n (%)**	**COR (95%CI)**	**Bivariate pValue**
Characteristic		**Frequency**			
Known Hypertension patient					
Yes	41 (10.79)	18 (43.90)	23 (56.10)	1.93 (1.00-3.71)	0.049
No	339 (89.21)	204 (60.18)	135 (39.82)	Ref	
Blood pressure class					
Normal	177 (46.58)	110 (62.15)	67 (37.85)	Ref	
Elevated	57 (15.00)	36 (63.16)	21 (36.84)	0.96 (0.52-1.78)	0.891
Stage I HTN	106 (27.89)	57 (53.77)	49 (46.23)	1.41 (0.87-2.30)	0.166
Stage II HTN	40 (10.53)	19 (47.50)	21 (52.50)	1.81 (0.91-3.62)	0.091
BMI category (Kg/m²)					
Underweight	(<18.5)	1 (0.26)	1 (100.00))	0 (0.00)	1.00
Normal weight	(18.5-24.9)	198 (52.11)	119 (60.10	79 (39.90)	Ref
Overweight (25.0-29.9)	147 (38.68)	84 (57.14)	63 (42.86)	1.13 (0.73-1.74)	0.581
Obese (≥30.0)	34 (8.95)	18 (52.94)	16 (47.06)	1.34 (0.64-2.78)	0.434

Table 5: Bivariate Analysis of Medical Factors

Characteristic	Dyslipidemia, n (%)	COR (95%CI)	Bivariate pValue	AOR (95%CI)	Multivariate pValue
Age Category (years)					
<40 years	46 (35.11)	Ref			
40+ years	112 (44.98)	1.51 (0.98-2.34)	0.064	1.23 (0.77- 1.96)	0.385
Religion					
Anglican	54 (46.15)	1.90 (0.98-3.70)	0.057	1.96 (0.97- 3.93)	0.059
Catholic	74 (39.78)	1.47 (0.78-2.75)	0.231	1.40 (0.73- 2.66)	0.313
Pentecostal	18 (31.03)	Ref			
Muslim	30 (38.96)	3.81 (1.29-11.28)	0.016	4.97 (1.5715.73)	0.006
Level of Education					
None	46 (44.23)	2.64 (0.98-7.12)	0.055	2.89 (0.99-8.40)	0.052
Primary	95 (45.67)	2.80 (1.08-7.26)	0.034	3.21 (1.17-8.78)	0.023
Secondary	11 (26.19)	1.18 (0.38-.71)	0.773	1.30 (0.40-4.30)	0.663
Tertiary	6 (23.08)	Ref			
Marital status					
Not married	44 (50.00)	Ref			
Married	114 (39.04)	0.64 (0.40-1.03)	0.069	0.88 (0.52- 1.49)	0.630
Residence					
Rural	84 (44.92)	Ref			
Urban	74 (38.34)	0.76 (0.51-1.15)	0.194	0.92 (0.59- 1.43)	0.710
Known Hypertension patient					
Yes	23 (56.10)	1.93 (1.00-3.71)	0.049	2.50 (0.5810.79)	0.219
No	135 (39.82)	Ref			
Blood pressure class					
Normal	67 (37.85)	Ref			
Elevated	21 (36.84)	0.96 (0.52-1.78)	0.891	0.95 (0.50- 1.81)	0.881
Stage I HTN	49 (46.23)	1.41 (0.87-2.30)	0.166	1.41 (0.84- 2.36)	0.188
Stage II HTN	21 (52.50)	1.81 (0.91-3.62)	0.091	0.69 (0.16-3.02)	0.620

Table 6: Multivariate Analysis of Study Variables

5. Discussion

Dyslipidemia in this study was defined by any presence of either elevated Low-density lipoproteins (LDL-C), elevated Triglycerides, elevated total cholesterol (TC), or decreased High density lipoproteins (HDL-C), singly or in concert, and the prevalence of dyslipidemia was 41.58% at Fort Portal Regional Referral Hospital among patients with H. pylori infection. This prevalence was significantly lower compared to two studies in Ethiopia among H. pylori patients that showed prevalences of 71.8% and 87.2% in two different areas, and also lower than the reported prevalence of 60.4% from Iran [16-18]. The differences might be due to variations in lifestyle, dietary patterns, and sample size differences. Based on the individual lipid profile parameters, the commonest dyslipidemia was decreased HDLC (24.21%), followed by elevated LDL-C (16.58%), elevated triglycerides (13.42%), and least was elevated total cholesterol (11.32%). These values are much less than the overall figures of lipid abnormalities in the general Sub-Saharan Africa populations, that is, 25.5% elevated total cholesterol, 37.4% decreased HDL-C, 28.6% raised LDL-C, and 17.0% elevated triglycerides, similar to a study in Ethiopia though having lower prevalence, in which decreased HDL-C (45.3%) and elevated LDL-C (35.0%) were the commonest abnormal profiles in H pylori infected patients [16,19]. The commonest abnormal lipid profile variables however differed from a study in Iran with increased LDL-C (32%), increased total cholesterol (28.9%), increased triglycerides (11.4%) and decreased HDL-C (8.7%) being the distribution of lipid derangements, however their study included diabetic participants and those with renal disease which all met exclusion in our study [18]. Another Ethiopian study also showed varied distribution of lipid profile parameters with increased triglycerides (53.1%), decreased HDL-C (41.7%), increased total cholesterol (35.2%), and increased LDL-C (26.8%) being the distribution of anomalies, however this difference could be explained by study population differences in diet and activity patterns based on study settings [17].

The invasion of the stomach by H. pylori can cause disturbances that may affect certain biochemical parameters, such as lipid profiles in the patient's body. The possible

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mechanisms underlying these conditions include chronic low-grade activation of the coagulation cascade, acceleration of atherosclerosis, and antigenic mimicry between H. pylori and host epitopes, which may result in autoimmune disorders and lipid metabolism abnormalities, also, H. pylori infection may cause appetite-related disorders and significant changes in body weight and the dysregulated absorption of nutrients and the inflammatory response system resulting from H. pylori infection may also contribute directly to changes in serum lipids [20,21].

Primary education level participants, uneducated participants, and Muslim faith participants had a statistically significant increased risk for dyslipidemia. This finding of increased risk with lower or no education status is reciprocated by the two Ethiopian studies among H. pylori patients that showed that lower education status or no education attainment had more risk for dyslipidemia compared to tertiary education attainment [16,18]. A study in the United States of America showed that lower education was associated with poor health outcomes dues to poor access to services, poor diet, and higher likelihood for sedentary lifestyles, however, the Uganda demographic health survey showed contrast with obesity being more common in populations who attained secondary education or more [22,23]. Muslims (aOR 4.97, 95% CI 1.57-15.73, p=0.006) had increased risk of having dyslipidemia compared to Pentecostal believers. This finding is similar to a study among South-Asians living in America which demonstrated that Islam-affiliated participants had significantly increased risk for lower HDL-C, higher LDL-C, and higher serum triglyceride levels compared to participants without any religious affiliation [24]. Muslim faith does not encourage alcohol intake yet studies have shown that moderate alcohol intake raises the serum levels of HDL-C, additionally, Muslims had a higher likelihood of having sedentary lifestyle and poor dietary habits when compared with other faiths [24].

6. Study Strengths and Limitations

This study's strengths included its focus on a relatively large sample size of patients diagnosed with H. pylori infection without being on any treatment, thus the findings were less likely to be influenced by pharmacological therapy. Because the study relied on primary data, the data's reliability is also good. The study employed a validated tool, enabling comparability due to the instrument's excellent reliability, validity, and sensitivity. As constraints, only one institution had been included, no previous studies on this subject in Uganda were available for comparison, in addition to the potential of recall and social desirability bias among study participants.

7. Conclusion and Recommendations

In this study, the prevalence of dyslipidemia was 41.58% at Fort Portal Regional Referral Hospital among patients with H. pylori infection and based on the individual lipid profile parameters, the commonest anomalies included decreased HDL-C (24.21%), followed by elevated LDL-C (16.58%), elevated triglycerides (13.42%), and the least was elevated total cholesterol (11.32%). Lower education attainment, no education, and Islamic faith were independently associated with increased dyslipidemia risk. We recommend that country-wide awareness programs on dyslipidemia should be carried out, including community health education and promotion outreaches with emphasis on prevention, and early detection of dyslipidemia, and religions implicated with dyslipidemia ought to be studied more in this regard to identify the specific practices that may be increasing the risk for dyslipidemia. Additionally, patients with H. pylori infection who are overweight and/or hypertensive should have routine screening for dyslipidemia as they could potentially benefit from lipid-reducing regimens by health workers, and trainings and conferences for health workers directly dealing with these patients to encourage assessment for dyslipidemia to promote guidelines development.

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Author's Contributions

FKB, EO, JA and CLA conceptualized and designed the study, including ethical guidance and approval. EO and FKB actively contributed in data analysis and presentation. FKB, EO, JA, CLA, GBN and WD contributed to drafting and review of the manuscript. All authors read and approved the manuscript.

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Data availability

Data available from the corresponding author upon reasonable requests.

Declarations

Ethical approval and consent to participate

This study was approved by the research ethics committee of Kampala International University, Western Campus (KIU-REC) with an approval number of **KIU-2022-132.** All participants provided written informed consent. We followed the ethical standards for the regulation of research in humans in accordance with the Declaration of Helsinki.

Consent for Publication

Not applicable.

Competing Interests

The authors declare no competing interests.

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