

*Full Length Research Paper*

# Prevalence and associated factors of *Helicobacter pylori* Infection among HIV positive adults on Anti-retroviral Therapy

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Human immunodeficiency virus (HIV) and *Helicobacter pylori* (*H. pylori*) infections are worldwide healthcare burdens. This study aimed to assess the prevalence and associated factors of *H. pylori* infection among HIV patients at Southern-Ethiopia. A Hospital based cross-sectional study was conducted at Hawassa University comprehensive specialized hospital on 390 HIV infected adults on antiretroviral therapy from September to November 2017. All vital data were collected by designed questionnaires and stool samples were collected using appropriate sample cap for *H. pylori* stool antigen diagnosis. The overall prevalence of *H. pylori* infection of HIV infected patients was 17.9%. About 42.6% of the participants had a history of dyspepsia and of them, 4.3% were positive for *H. pylori* infection. In addition, 48.9% of patients were using either aqua tablet (67 mg-Trocloresene sodium) or water filters for drinking water, of them 11.5% were positive for *H. pylori* infection. Having a history of dyspepsia: the adjusted odds ratio [AOR (95% CI): 4.8 (1.6–14.7)], and age  $\leq 30$  years [AOR (95% CI): 3.7(1.6–8.8)] were associated factors of *H. pylori* infection. Moreover, the association of *H. pylori* infection  $\leq 30$  years old and history of dyspepsia indicates the need of further large-scale and cohort type studies to determine the other possible associated factors for the infection.

**Key words:** *Helicobacter Pylori*, HIV, stool antigen test, South-Ethiopia.

## INTRODUCTION

*Helicobacter pylori* is a gram negative bacteria, spiral, flagellated bacillus that naturally colonizes humans' stomach. It lives extra-cellular spaces, mucous layer.

Then this infection induces a host response that results in mucosal damage and a chronic active gastritis (Ostrow et al., 2010). *H. pylori* infection is associated with peptic

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ulcer, gastric cancer, and lymphomas in human (Marshall et al., 2008). The infection has also been associated firmly with the development of gastric neoplasia, including gastric adenocarcinomas and gastric mucosa-associated lymphoid tissue lymphomas (Versalovic, 2003). In addition, the prevalence of *H. pylori* infection among People Living with Human immunodeficiency virus (HIV) varies from 10 to 76% depending on the period, geographical area and diverse in population (Nkuize et al., 2010; Fialho et al., 2011). Even if antiretroviral treatment (ART) had brought improvements including increased the life expectancy in HIV infected individuals, however, *H. pylori* infections are seen more frequent in ART patients compared to those did not receive ART (Palella et al., 1998). The gastro-intestinal tract (GIT) plays an important role in the patho-physiology of HIV/ Acquired Immuno-deficiency syndrome (AIDS) (Khamri et al., 2010). Further, *H. pylori* colonizes the gastric and duodenal mucosae and then it induces a specific local in addition with systemic immune response. The CD4+ T cells, dendritic cells, regulatory T cells and Th17 cells components also play a role in HIV pathogenesis (Khamri et al., 2010; Mitchell et al., 2007). Few studies were done on the assessment of problem in Ethiopia and these studies were mainly based on serological tests and *that* has its own drawbacks difficulties in distinguishing between current and past infections, including with its low specificity.

Therefore, this study aimed to assess the prevalence and associated factors of *H. pylori* infection among HIV-infected adults in Hawassa University Compressive Specialized Hospital (HUCSH) by using stool antigen test.

## MATERIALS AND METHODS

### Study area and study population

This institution based cross sectional study was conducted at Hawassa University comprehensive specialized Hospital, Southern Nations Nationalities and Peoples Region (SNNPR) from September to November 2017. The Hospital was established in November 2005 and it provides teaching and health services. Nowadays, the hospital has over 400 beds and providing health services for patients including practical training for students. About 7125 HIV positive patients were attending the Hospital during the study period. All HIV-positive adults on ART age greater than or equal to 18 years old were eligible in the study. However, patients who were receiving anti-*H. Pylori* treatment within two weeks, and who were receiving anti-*H. Pylori* agents currently were excluded from the study.

### Ethics clearance and consent to participate

The study was approved by the Institutional Review Board of Hawassa University, College of Medicine and Health Sciences. All the study participants were well versed about the protocol of the study, the involvement was voluntary and written informed consent was obtained from the study participant before data collection.

### Sample size and technique

The sample size was calculated based on single population proportion formula and 64.2% prevalence of *H. Pylori* infection among peoples living with HIV in Addis Ababa, Ethiopia (Teka et al., 2015).

Based on the above-mentioned, formula, including with 10% non-response rate, the final sample size was calculated to be 390. To select participants from the study population, daily patients flow was assessed for a week in the ART clinic. Thus, the trend showed that the average weekly HIV patients flow was about 73. Lastly, every fifth HIV-infected patients were selected by systematic sampling method.

### Data collection and assessment

Socio-demographic data and other relevant medical related information of the study subjects were collected by trained nurses using pre-tested and designed questionnaires. About two gram of stool sample was collected from each patients using sterile stool containers with a spatula in it. Instruction was given for each patient to avoid contamination of sample from the toilet, and covering immediately to avoid sample drying. Sample containers were properly labeled with unique number that was analogous with the patient's identity number found on the questionnaire. In addition, *H. pylori* stool antigen test was performed at Hawassa University Comprehensive Specialized Hospital Laboratory by *H. pylori* stool antigen test kit (CTK H.PYLORI, USA) according to the manufacturer instruction. Moreover, the test kit Sensitivity and specificity was 94.4 and 97.8%, respectively. Further, laboratory performance was strictly managed by following standard operating procedure from sample collection to result releasing.

### Statistical analysis

All questionnaires were checked and entered into Epi Data version 3.1 and then exported to Statistical Package for Social Sciences (SPSS) version 20 for statistical analysis. Besides, categorical variables were summarized as frequencies and percentages, while mean values and standard deviations were tabulated for quantitative continuous variables. Chi-square was used for categorical variables. Bivariate analyses were conducted primarily to check the study groups differences in the distribution of categorical variables. Further, to control the possible effect of confounding variables, those variables having a P-value of less than 0.2 were entered in to multivariate logistic regression model. Finally, alpha level was set at 0.05 for statistical significance at 95% of confidence interval (CI).

## RESULTS

### Socio demographic characteristics of study participants

Among the 390 participants, 247 (63.3%) were females and the mean age of the study participant was  $37 \pm 9.7$  with the range of 18 to 62 years old. About 19 (4.9%) of the respondents were aged below 24 years old, while 75 (19.2%) and 90 (23.1%) were aged in between 30-34 and 35-39 years, respectively. In addition, 368 (92.8%), 48(12.3%), 170 (43.6%) and 72 (44.1%) of the study subjects were urban inhabitants, had no formal education,

**Table 1.** Socio-demographic characteristics of HIV positive adults at Hawassa Comprehensive Specialized Hospital.

Variable	Frequency	%	Variable	Frequency	%
<b>Sex</b>			<b>Residence</b>		
Male	143	36.7	Urban	362	92.8
Female	247	63.3	Rural	28	7.2
<b>Age group</b>			<b>Education</b>		
18-24 years	19	4.9	Illiterate	48	12.3
25-29Years	57	14.6	Primary	170	43.6
30-34 years	75	19.2	Secondary	119	30.5
35-39 Years	90	23.1	Technical/Vocational	23	5.9
40-44 years	69	17.7	≥Universities	30	7.7
45-49 years	38	9.7	<b>Source of drinking water</b>		
50-54 years	30	7.7	Tap water	381	97.7
≥ 55 years	12	3.1	Well	4	1.0
<b>Marital status</b>			Spring	5	1.3
Single	35	9.0	<b>Household Waste disposal</b>		
Married	216	55.4	Open field	246	63.1
Divorced	59	15.1	Specified place	144	36.9
Separated	33	8.5			
Widowed	47	12.0			

primary level of education, and greater or equal to secondary education, respectively. About 35 (9.0%) were non-married and 216 (55.4%) were married, whereas 59 (15.1%) were divorced, 33 (8.5%) were separated and 47 (12.1%) were widowed (Table 1).

**Behavioral characteristics of study participants**

Participants who had a habit of continuously hand washing before meal, after defecation and before food preparation were 375 (96.2%), 363 (93.3%), and 368 (94.4%), respectively. About 35 (9.0%) and 9 (2.3%) of the study participant ever drank alcohol and ever smoked cigarette. Besides, 191 (48.9%) were using either aqua tablet (67 mg-Trocloresene sodium) or water filter to treat and purify water for drinking (Table 2).

**Clinical characteristics and the prevalence of *H. pylori* infection**

Patients on TDF/3TC/EFV of ART regimen were 192 (49.2%) followed by AZT/3TC/EFV: 75 (19.2%). The majority, 169 (43.3%) of the patients had been received ART for greater than or equal to five years. In addition, Participants with the previous history of opportunistic infection were 262 (67.2%) and about 43 (11%) of the participants had CD4+cells count less than or equal to 200 cells/μl. One hundred sixty six 166 (42.6%) of the participants had a history of dyspepsia. Moreover, the overall prevalence of *H. pylori* infection in the study

participants was 70 (17.9%) and females had high prevalence rate 46 (11.8%) compared to males 24 (6.2%). The mean age of *H. pylori* infected participants was significantly higher (39.8±7.7 years) when compared to *H. pylori* negatives (36.4±8.8 years), p=0.003 and 31 (7.9%) *H. pylori* infection was observed in age group in between 31-40 years old. Among dyspeptic patients, 17 (4.3%) were positive for *H. pylori* infection. Furthermore, 191(48.9%) were using either aqua tablet (67 mg-Trocloresene sodium) treatment or water filters for drinking water and 45 (11.5%) of them were positive for *H. pylori* infection (Table 3).

**Factors associated with *H. pylori* infection**

In bivariate analysis: family size greater than or equal to six households had the crude odds ratio [COR (95% CI): 1.7 (1.0–2.9); p = 0.038] and age ≤30 years [COR (95% CI): 3.7(1.7-8.3); p = 0.001] were associated with *H. pylori* infection. In addition, having a history of dyspepsia [COR (95% CI): 2.7 (1.5-4.9); p = 0.001], being unmarried [COR (95% CI): 10.7(1.3–87); p = 0.03] and having a previous history of *H. pylori* infection [COR (95% CI):2.0(1.2-3.5); p = 0.012] were also associated with *H. pylori* infection (Table 4).

However, multivariate analysis was adjusted for possible confounding factors, only having a history of dyspepsia: the adjusted odds ratio [AOR (95% CI): 4.8 (1.6–14.7); p = 0.005], and age less than or equal to 300.005], and age less than or equal to 30 years [AOR (95% CI): 3.7(1.6–8.8); p = 0.003] were the associated

**Table 2.** Characteristics of HIV positive adults at Hawassa comprehensive specialized hospital.

Variable	Frequency	Percentage
<b>Hand washing before eating</b>		
Always	375	96.2
Sometimes	15	3.8
<b>Hand washing after defecation</b>		
Always	363	93.1
Sometimes	23	5.9
No	4	1.0
<b>Hand washing before food preparation</b>		
Always	368	94.4
Sometimes	22	5.6
<b>Hand washing after cleaning</b>		
Always	371	95.1
Sometimes	19	4.9
<b>Alcohol Drinking</b>		
Never drink	355	91.0
Tried once or twice	26	6.7
Time to time	9	2.3
<b>Smoking cigarettes</b>		
Never smoke	381	97.7
Tried once or twice	4	1.0
Time to time	3	0.8
Daily	2	0.5
<b>Utilizing aqua tablet (water filter)</b>		
No	199	51.1
Yes	191	48.9

factors of *H. pylori* infection (Table 4).

## DISCUSSION

*H. pylori* infection has been known to be more associated with gastritis, duodenal ulcer, gastric cancer, and mucosa associated lymphoid tissue lymphoma (Lepper et al., 2004). The actual infection rates vary from nation to nation; and the developing countries have much higher infection rates (90%) due to different factors when compared to developed countries (1.2-12%) (Frenck et al., 2003).

The current study showed that the prevalence of *H. pylori* infection among HIV infected patients was 17.9%. The finding is lower than the studies reported from Iran (Kafil et al., 2011), India (Nkuize et al., 2010), Ghana

(Sarfo et al., 2015), two studies of Nigeria (Anejo-Okopi et al., 2016; Ejilude et al., 2011) and other part of Ethiopia (Teka et al., 2015), which was 69.7, 33, 51.5, 46.8, 47.4 and 64.2%, respectively. Conversely, Perry et al. (2006) from Romania, reported low rate, which was 8.3%. The differences might be due to the socio-economic differences, environmental sanitation condition and the changes in health care practice across countries (Anejo-Okopi et al., 2016 and Mynepalli et al., 2014).

We found that the high prevalence of *H. pylori* infection in women (11.8%) when compared to males (6.2%). And similar findings were reported by Fialho et al. ((2011) from Brazil and Anejo-Okopi et al. (2016) from Nigeria.

We found that lower prevalence of *H. pylori* infection among patients with CD<sub>4</sub>+ cells count below or equal to 200/mm<sup>3</sup> and the finding is in line with the studies conducted by Fialho et al. (2011) and Sarfo et al. (2015).

**Table 3.** Clinical characteristics and the prevalence of *H. pylori* infection among HIV positive adults at Hawassa comprehensive specialized hospital.

Variable	<i>H. pylori</i> stool antigen test 390 (%)		
	Positive(n=70)	Negative(n=320)	p-value
<b>Gender</b>			
Female	46(11.8)	201(51.5)	0.65
Male	24(6.2)	119(30.5)	
Age, year (mean ± SD)	39.8(7.7)	36.4(8.8)	0.003
≤30 years	9(2.3)	97(24.9)	0.004
31-40 years	31(7.9)	136(34.8)	
≥41years	30(7.7)	87(22.3)	
<b>History dyspepsia</b>			
Yes	17(4.3)	149(38.2)	0.001
No	53(13.6)	171(43.8)	
<b>Residence</b>			
Rural	68(17.4)	294(75.4)	
Urban	2(0.5)	26(6.7)	
<b>Previous <i>H. pylori</i> infection</b>			
No	47(12.1)	161(41.3)	0.01
Yes	23(5.9)	159(40.7)	
<b>Current ART regimen</b>			
TDF/3TC/EFV	29(7.4)	163(41.8)	
TDF/3TC/NVP	9(2.3)	27(6.9)	
AZT/3TC/EFV	17(4.3)	58(14.9)	
AZT/3TC/NVP	15(3.8)	63(16.2)	
Others	0(0.0)	6(1.5)	
<b>Utilizing aqua tablet (water filter)</b>			
Yes	45(11.5)	146(37.4)	0.005
No	25(6.4)	174(44.6)	
<b>Family size</b>			
1-5 house holds	42(10.8)	148(37.9)	0.037
≥6 house holds	28(7.2)	172(44.1)	
<b>History of opportunistic infection</b>			
Yes	47(12)	215(55.1)	0.99
No	23(5.9)	105(26.9)	
<b>CD<sub>4</sub><sup>+</sup> cells/μl, mean (±SD)</b>			
≤200 cells/μl	6(1.5)	37(9.5)	0.64
201-400 cells/μl	22(5.6)	87(22.3)	
>400 cells/μl	42(10.8)	196(50.2)	0.32

AZT, zidovudine; TDF, Tenofovir; 3TC, lamvudine; EFV, efavreniz; NVP, neverapine.

In support, the low rate has been suggested that CD<sub>4</sub> cells play a role in inducing or perpetuating tissue and epithelial damage that may facilitate *H. pylori* colonization (Bontems et al., 2003). Further studies suggested that decreased gastric acid secretion might be predisposed to gastric colonization by other microorganisms that might compete with *H. pylori* bacteria and the use of either

antibiotics or proton pump inhibitors in the low count of CD<sub>4</sub><sup>+</sup> cells in HIV patients may decrease colonization of *H. pylori* (Panos et al., 2007; Nevin et al., 2014).

This study showed that 2.3% of participants with age ≤30 years were infected with *H. pylori*, and this was lower than study report from Nigeria with similar age group, (Anejo-Okopi et al., 2016).

**Table 4.** Factors associated with *H. pylori* infection among HIV positive adults at Hawassa comprehensive specialized hospital.

Parameter	At 95% confidence interval			
	Unadjusted odds ratio	p-value	Adjusted odds ratio	p-value
<b>Family size</b>	1.00		1.00	
1-5 households				
≥6 households	1.7(1.0-2.9)	0.038	0.95(0.34-2.6)	0.76
<b>Age</b>				
≤30 years	3.7(1.7-8.3)	0.001	3.7(1.6-8.8)	0.003
31-40 years	1.5(0.85-27)	0.15	1.4(0.77-2.7)	0.25
≥41years	1.00		1.00	
<b>History dyspepsia</b>				
Yes	2.7(1.5-4.9)	0.001	4.8(1.6-14.7)	0.005
No	1.00		1.00	
<b>Educational</b>				
≤ Primary level	0.7 (0.41-1.2)	0.18	0.7(0.39-1.2)	0.23
≥Secondary level	1.00		1.00	
<b>Residence</b>				
Urban	0.33(0.08-1.4)	0.14	0.7(0.07-1.4)	0.13
Rural	1.00		1.00	
<b>Marital status</b>				
Single	10.7(1.3-87)	0.03	4.8(0.56-42.6)	0.15
Married	1.3(0.63-29)	0.43	0.92(0.4-2.1)	0.85
Divorced	1.2(0.49-3.1)	0.66	0.85(0.31-2.3)	0.76
Separated	1.7(0.55-5.7)	0.34	1.6(0.45-5.6)	0.47
Widow	1.00		1.00	
<b>Previous <i>H. pylori</i> infection</b>				
No	1.00		1.00	
Yes	2(1.2-3.5)	0.01	0.45(0.15-1.3)	0.14
<b>Drink house treated water</b>				
Yes	1.00		1.00	
No	2.1(1.2-3.7)	0.005	2.2(0.76-6.2)	0.15
<b>CD<sub>4</sub><sup>+</sup>, cells/μl</b>				
≤200	2.1(1.2-3.7)	0.18	2.2(0.66-7.2)	0.20
201-400	0.89(0.5-1.6)	0.68	1.0(0.52-1.89)	0.97
>400	1.00		1.00	
<b>Hemoglobin level</b>				
<12 g/dl	0.6(0.28-1.2)	0.13	0.51(0.22-1.1)	0.10
≥12 g/dl	1.00		1.00	

In addition, the current study indicated that the presence of dyspepsia was found to have a significant association with *H. pylori* infection. It is in line with the study reported by Anejo-Okopi et al. (2016) that indicated that the

association of dyspepsia with *H. pylori* infection. Furthermore, the association of *H. pylori* with dyspepsia condition has triggered a major paradigm change in patients' management (Jemilohun et al., 2011).

The present study revealed that no association in between hemoglobin level and *H. pylori* infection. This in line with the study conducted by Fraser et al., 2010 and Kermati et al., 2007. However, one study from Turkish teenager reported that association between *H. pylori* infection and anemia (Süoglu et al., 2007). This might be attributed to favors of poor hygienic status for parasitic infestation and sharing of a similar transmission route with *H. pylori* infection and the condition of co-morbidity might increase risks of anemia.

We found that no association of *H. pylori* infection with CD4+ cells. In support, different studies depicted that CD4+ cells has been shown to be raised in *H. pylori* gastritis, but gastric inflammation has been correlated with lower *H. pylori* bacteria load, and pro-inflammatory genetic profiles are associated to lower *H. pylori* seroprevalence. Besides, *H. pylori* infection requires an intact mucosal cellular immunity, and that the loss of the CD4+ cell population in the gastric mucosa may prevent *H. pylori* persistence (Sarfo et al., 2015; Aebischer et al., 2010).

The present study indicated that the association of *H. pylori* infection with age less than or equal to 30 years of participants and this in line with the report of other studies (Anejo-Okopi et al., 2016; Abebaw et al., 2014; Chen et al., 2013). Moreover, current study showed that no significant association of *H. pylori* infection with family size, educational status, marital status, alcohol consumption, residence and occupation. Furthermore, 48.9% were using either aqua tablet treatment or filters for drinking water and 11.5% of them were positive for *H. pylori* infection. This might indicate the utilization of poor proportions of aqua tablet and water or inappropriate water filtration.

### Limitations of the study

This study was conducted on HIV patients who had many underline disease conditions as a confounding factor that was not completely controlled, so as to have impact on the outcome of the statistical associations between *H. pylori* infection and different variables of interest. The other limitations were Immuno-chromatographic stool antigen test characteristics, (non-ELISA method), lack of HIV negative controls and cross sectional nature of the study that did not show cause and effect relationship between the variables.

### Conclusion

The overall prevalence of *H. pylori* infection in the study participants was 17.9%. About 42.6% of the participants had a history of dyspepsia and of them, 4.3% were positive for *H. pylori* infection. In addition, having a history of dyspepsia and age  $\leq 30$  years were associated factors of *H. pylori* infection. HIV-positive subjects receiving ART

co-infected with *H. pylori* tend to have higher levels of CD4+ T-lymphocytes ( $>200$  cells/ $\mu$ l) when compared to patients with CD4+ T-lymphocytes  $<200$  cells/ $\mu$ l and patients with low immune status, reflected by CD4+ T-lymphocyte levels below 200 cells/ $\mu$ l, are less probable to be infected with *H. pylori*. Moreover, dyspepsia in HIV-positive patients suggests the need to investigate alternative etiologies, besides *H. pylori* infection. In addition, this study indicated the need for further large-scale study in HIV patients to determine the possible factors for infection. Furthermore, cohort type studies are recommended to formulate a cause and effect relationship between associated factors and *H. pylori* infection among HIV infected patients.

### CONFLICT OF INTERESTS

The authors have not declared any conflict of interests.

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### REFERENCES

- Abebaw W, Kibret M, Abera B (2014). Prevalence and Risk Factors of *H. pylori* from Dyspeptic Patients in Northwest Ethiopia: A Hospital Based Cross-sectional Study. *Asian Pacific Journal of Cancer Prevention* 15(11):4459-4463.
- Aebischer T, Meyer TF, Andersen LP (2010). Inflammation, immunity, and vaccines for Helicobacter. *Helicobacter* 15:21-28.
- Anejo-Okopi AJ, Audu O, Adaiche AR, Okojokwu OJ, Ali M, Adekwu A, et al (2016). Prevalence of Helicobacter Pylori Infection among HIV-1 Infected patients using Stool Antigen Tests in Jos, North-Central, Nigeria. *Govares* 21:55-63.
- Bontems P, Fabienne R, Van Gossum A, Cadranet S, Mascart F (2003): Helicobacter pylori modulation of gastric and duodenal mucosal T cell cytokine secretions in children compared with adults. *Helicobacter* 8:216-226.
- Chen S, Ying L, Kong M, Zhang Y, Li Y (2013). The Prevalence of *Helicobacter pylori* Infection Decreases with Older Age in Atrophic Gastritis. *Gastroenterology Research and Practice* 2013:494783. <http://dx.doi.org/10.1155/2013/494783>.
- Ejilude O, Akinduti PA, Idowu M, Ogunbileje JO, Akinbo JA (2011). HIV and Helicobacter Pylori Co- Infection in Dyspeptic Patients In Abeokuta, Nigeria. *ew York Science Journal* 4(9):1-5.
- Fialho AB, Braga-Neto MB, Guerra EJ, Fialho AM, Fernandes KC, Sun JL, Braga LL (2011). Low prevalence of *H. pylori* infection in HIV-positive patients in the northeast of Brazil. *BMC Gastroenterology* 11(1):13.
- Fraser AG, Scragg R, Schaaf D, Metcalf P, Grant CC (2010): Helicobacter pylori infection and iron deficiency in teenage females in New Zealand. *New Zealand Medical Journal* 123:38-45.
- Frenck WR, Clemens J (2003). Helicobacter in the developing world. *Microbes and infection* 5(8):705-713.
- Jemilohun AC, Otegbayo JA, Ola SO, Oluwasola AO, Akere A (2011). Diagnostic accuracy of rapid urease test for the diagnosis of Helicobacter pylori in gastric biopsies in Nigerians with dyspepsia.

- African Journal of Clinical and Experimental Microbiology 12:62-66.
- Kafil HS, Jahromi FF, Hajikhani B, Pirayeh SN, Aghazadeh M (2011). Screening for the presence of *Helicobacter pylori* in stool of HIV-positive patients. *Journal of AIDS and HIV Research* 3:85-87.
- Kermati MR, Siadat Z, Mahmoudi M (2007). The correlation between *H pylori* infection with serum ferritin concentration and iron deficiency anemia. *International Journal of Hematology and Oncology* 27(4):016-020.
- Khamri W, Walker MM, Clark P, Atherton JC, Thursz MR, Bamford KB, Lombardi G (2010). *Helicobacter pylori* stimulates dendritic cells to induce interleukin17 expression from CD4+ T lymphocytes. *Infection and immunity* 78(2):845-853.
- Lepper PM, Moricke A, Vogt K, Bode G, Trautmann M (2004). Comparison of different criteria for interpretation of immunoglobulin G immunoblotting results for diagnosis of *Helicobacter pylori* infection. *Clinical and Diagnostic Laboratory Immunology* 11(3):569-576.
- Marshall B, Adams CP (2008). *Helicobacter pylori*: A Nobel pursuit? *Canadian Journal of Gastroenterology and Hepatology* 22(11):895-896.
- Mitchell P, Germain C, Fiori PL, Khamri W, Foster GR, Ghosh S, et al (2007). Chronic exposure to *Helicobacter pylori* impairs dendritic cell function and inhibits Th1 development. *Infection and immunity* 75:810-819.
- Mynepalli CKS, Maureen O, Mumuni A (2014). Prevalence of *Helicobacter pylori* and hygiene practices among public secondary school students in Ikeja Local Government Area, Lagos, Nigeria. *Journal of Health* 6:250-258.
- Nevin DT, Morgan CJ, Graham DY, Genta RM (2014). *Helicobacter pylori* Gastritis in HIV-Infected Patients: A Review. *Helicobacter* 19:323-329.
- Nkuize M, Dewit S, Muls V, Arvanitakis M, Buset M (2010). Upper gastrointestinal endoscopic findings in the era of highly active antiretroviral therapy. *HIV Medical* 11:412-417.
- Ostrow B (2010) Peptic Ulcer Disease-the impact of *Helicobacter pylori* on management in the developing world. *Surgery in Africa Monthly Review*. <http://www.ptolemy.ca/members/archives/2007/ulcer/index.htm> (Accessed on 28 July 2018).
- Palella Jr FJ, Delaney KM, Moorman AC, Loveless MO, Fuhrer J, Satten GA, HIV Outpatient Study Investigators (1998). Declining morbidity and mortality among patients with advanced human immunodeficiency virus infection. *New England Journal of Medicine* 338(13):853-860.
- Panos GZ, Xirouchakis E, Tzias V, Charatsis G, Bliziotis IA, Douleroglou V, Falagas ME (2007). *Helicobacter pylori* infection in symptomatic HIV-seropositive and-seronegative patients: A case-control study. *AIDS Research and Human Retroviruses* 23(5):709-712.
- Perry S, De La Luz Sanchez M, Yang S, Haggerty TD, Hurst P, Perez-Perez G, Parsonnet J (2006). Gastroenteritis and transmission of *Helicobacter pylori* infection in households. *Emerging Infectious Diseases* 12(11):1701.
- Sarfo FS, Eberhardt KA, Dompok A, Kuffour EO, Soltau M, Schachscheider M, Bedu-Addo G (2015). *Helicobacter pylori* infection is associated with higher CD4 T cell counts and lower HIV-1 viral loads in ART-naïve HIV-positive patients in Ghana. *PLoS one* 10(11):e0143388.
- Süoglu OD, Gökçe S, Sağlam AT, Sökücü S, Saner G (2007). Association of *Helicobacter pylori* infection with gastroduodenal disease, epidemiologic factors and iron-deficiency anemia in Turkish children undergoing endoscopy, and impact on growth. *Pediatrics International* 49(6):858-863.
- Teka B, Gebre-Selassie S, Abebe T (2015). Sero - Prevalence of *Helicobacter Pylori* in HIV Positive Patients and HIV Negative Controls in St. Paul's General Specialized Hospital, Addis Ababa, Ethiopia. *Science Journal of Public Health* 4:387-393.
- Versalovic J (2003). *Helicobacter pylori* Pathology and Diagnostic Strategies. *American Journal of Clinical Pathology* 119(3):403-412.