ASSOCIATION BETWEEN *HELICOBACTER PYLORI* AND INTESTINAL PARASITIC INFECTIONS AND THEIR EFFECTS ON SOME HAEMATOLOGICAL PARAMETERS IN BENIN CITY, NIGERIA

Ogefere, H. O[1]., Anumudu, F. I.[1] and Omoregie, R.[*,1,2]

[1]Department of Medical Laboratory Science, School of Basic Medical Sciences, College of Medical Sciences, University of Benin, Benin City, Nigeria and [2]Medical Microbiology Division, Medical Laboratory Services, University of Benin Teaching Hospital, Benin City, Nigeria

*Corresponding Author's e-mail: richyomos@yahoo.com; richard.omoregie@ubth.org

Tel: +23408105543055

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ABSTRACT

Background: Intestinal parasites and *Helicobacter pylori* are infectious agents with significant global public health implications. Both infections are commonplace increasing the chance of co-infection.

Aim: The study aims to determine the prevalence of *H. pylori*, intestinal parasites and co-infection with both as well as their effect on haematological parameters.

Methods: Blood and stool specimens were collected from 521 patients with gastrointestinal complaints accessing care in General Practice Clinics of the University of Benin Teaching Hospital, Benin City, Nigeria. Socio-demography data were obtained with a questionnaire while full blood count was determined on the blood specimens using an auto-analyzer. The stool samples were used to detect *H. pylori* antigen using an immunochromatographic kit, and intestinal parasites using formol-ether concentration method.

Results: The prevalences of *H. pylori* infection, intestinal parasitic infection and co-infection were 28.21%, 3.26% and 4.76% respectively, and *H. pylori* was insignificantly associated with intestinal parasitic infection (OR=1.820, 95%CI=0.679, 4.877; p=0.3506). *Ascaris lumbricoides* (2.88%) and hookworm (0.38%) were the only intestinal parasites recovered. Patients with single marital status (p=0.0362) had higher prevalence of *H. pylori* while those with primary level of education had higher prevalence of intestinal parasitic infection (p=0.0008). Other demographic data did not significantly (p>0.05) affect the prevalence of *H. pylori* and intestinal parasitic mono-infections. *H. pylori* infection only resulted in significant increase in total white blood cell count (p=0.0020); intestinal parasitic infection caused significant reduction in haematocrit values (p=0.0365) and haemoglobin concentration (p=0.0036) while co-infection only caused a significant reduction in haematocrit values (p=0.0279).

Conclusion: An insignificant association between *H. pylori* and intestinal parasitic infections was observed. Co-infection resulted in lower haematocrit values. Measures to prevent mono- and co-infection and associated sequelae are advocated.

INTRODUCTION

Intestinal parasites and *Helicobacter pylori* are infectious agents with significant global public health implications and are frequent causes of gastrointestinal (GI) discomforts (Pomari *et al*., 2020). According to estimates, more than 50% of the world's population is infected with *H. pylori*, with people in low- and middle-income countries (LMICs) bearing the heaviest burden (Hunt *et al*., 2011; Olokoba *et al*., 2013; Mentis *et al*., 2015; Savoldi *et al*., 2018; Seid *et al*., 2018; Sjomina *et al*., 2018).

In the same way, millions of people suffer from intestinal parasitic infection globally, making *H. pylori* co-infection highly likely (Robertson *et al*., 2018; Majid *et al*., 2019; Pomari *et al*., 2020). Indeed, co-infection between *H. pylori* and intestinal parasites have been reported in developing and developed countries (Pomari *et al*., 2020; Spotts *et al*., 2020; Yousif Abd Elbagi *et al*., 2021) but to our knowledge, there is no report from Nigeria. Both *H. pylori* (Akhimienho *et al*., 2021; Haile and Timerga, 2021) and intestinal parasites (Demeke *et al*., 2021) have been reported to cause changes to haematological parameters. However, data on the effect of co-infection on haematological parameters are lacking, especially, in our setting. Against this background this study aims to determine the prevalence of *H. pylori* and intestinal parasitic infections as well as co-infections among patients with gastrointestinal complaints accessing care at General Practice Clinics of a tertiary health institution. The effect of this single and co-infections on some haematological parameters will be assessed.

MATERIALS AND METHODS

Study location

The study was conducted in the University of Benin Teaching Hospital (UBTH), Benin City, Nigeria. UBTH is in Egor Local Government Area and lies on Latitude 6.39040N and longitude 5.61180E. According to the National Population Commission (2006), Egor Local government area has a population of 340,287. UBTH is a tertiary hospital with referral status and has over 860 beds. It is located in the south-south geopolitical zone of Nigeria. It serves about 6-10 states within and outside the zone.

Study population

A total of 521 patients with gastrointestinal complaint or discomfort and accessing care at the General Practice Clinics of the University of Benin Teaching Hospital, Benin City, Nigeria, were recruited for this study. The participants consisted of 197 males and 324 females with age range of 8 to 93 years. A structured questionnaire was used to obtain socio-demography information. Prior to the collection of specimens, informed consent was obtained from each patient, or in the case of children, from their parents or guardians. The University of Benin Teaching Hospital's Ethical Committee approved the study.

Specimen collection and processing

Stool specimen and 3ml of blood was collected from each participant into sterile universal container and ethylene diamine tetra-acetic acid (EDTA) container respectively. Within an hour of collection, all specimens were sent for analysis to the Medical Microbiology Laboratory of the University of Benin Teaching Hospital.

Stool examination for parasites

The formol-ether concentration method, as described by Akinbo *et al*. (2013), was used to process the stool specimens in order to identify intestinal parasites. In a nutshell, 4ml of formol saline was mixed with approximately 1g of formed stool or approximately 1ml of watery stool suspended in it. After the mixture was sieved, 4 milliliters of diethyl ether was added, and the mixture was stirred. The mixture was centrifuged for one minute at 3000 rpm. Using an applicator, the feces on the tube's side were removed, and the supernatant was thrown away. Using x10 and x40 objectives, preparations of saline and iodine were made from the deposit and analyzed microscopically for the presence of parasites.

Detection of *H. pylori* antigen in stool

H. pylori antigen was detected in stool using an immunochromatographic kit – *H. pylori* Ag fecal (Skytec, USA) following the manufacturer’s instructions.

Determination of full blood count

The full blood count of all patients in this study were determined using a haematology autoanalyzer – Sysmex K21N (Sysmex Corporation, Kobe, Japan) by following the manufacturer's instruction.

Statistical analysis

The unpaired student t-test was used to analyze the parametric data. Odd ratio (OR) analysis and the Chi square (X^2) test, when applicable, Fisher's exact test, were used to analyze the non-parametric data. The analysis was conducted using the statistical program INSTAT® (Graph Pad Software Inc., San Diego, CA, USA).

RESULTS

The prevalence of *H. pylori* infection, intestinal parasitic infection and co-infection was 28.21%, 3.26% and 4.76% respectively. Although there was association between *H. pylori* infection and intestinal parasitic infection (OR=1.820, 95%CI=0.679, 4.877), it was not statistically (p=0.3506) significant (Table 1).

Only *Ascaris lumbricoides* and hookworm were recovered (Table 2). A total of 17 participants had intestinal parasitic infection with *Ascaris lumbricoides* been most the common overall and in subjects with and without *H. pylori* infection (Table 2).

The distribution of *H. pylori* in relation to demography of participants is shown in Table 3. Gender (p=0.4124), age (p=0.3838), level of education (p=0.6910) and occupation (p=0.9733) of participants had no effect on the prevalence of *H. pylori* infection while those who had single as their marital status had significantly higher prevalence of *H. pylori* infection (p=0.0362). Gender (p=0.6370), age (p=0.1837), occupation (p=0.4583) and marital status (p=0.0748) of participants did not affect the prevalence of intestinal parasitic infection (Table 4). Participants with primary level of education had significantly (p=0.0008) higher prevalence of intestinal parasitic infection compared to other participants with different level of education (Table 4).

The effect of *H. pylori* and intestinal parasitic infections and co-infection on some haematological parameters is shown on Tables 5, 6 and 7 respectively. *H. pylori* infection only resulted in significantly higher total white blood cell count (Table 5), intestinal parasitic infection (Table 6) resulted in significantly lower haematicrit values (p=0.0365) and haemoglobin concentration (p=0.0036) while co-infection resulted in only significant (p=0.0279) decrease in haematocrit values (Table 7).

Table 1: Association between *Helicobacter pylori* infection and intestinal parasitic infection

***H. pylori* status**	**Intestinal parasite positive**	**Intestinal parasite negative**	**Total**	**OR**	**95%CI**	**P value**
positive	7 (4.76)	140 (95.24)	147 (28.21)	1.820	0.679, 4.877	0.3506
negative	10 (2.67)	364 (97.33)	374 (71.79)			
Total	**17 (3.26)**	**504 (96.74)**	**521**			

Table 2: Distribution of intestinal parasites in relation to *H. pylori* status

Intestinal parasites	***H. pylori* positive (N=147)**	***H. pylori* negative (N=364)**	**Total (N= 521)**
Ascaris lumbricoides	6 (4.08)	9 (2.47)	15 (2.88)
Hookworm	1 (0.68)	1 (0.27)	2 (0.38)
Total	**7 (4.76)**	**10 (2.75)**	**17 (3.26)**

Table 3: Distribution of *Helicobacter pylori* in relation to demography of participants

Characteristics	No. tested	No. positive for *H. pylori* (%)	P value
Gender			0.4124
Male	197	51 (25.89)	
Female	324	96 (29.63)	
Age (years)			0.3838
8 – 17	39	14 (35.90)	
18 – 27	82	28 (34.15)	
28 – 37	100	30 (30.00)	
38 – 47	107	33 (30.84)	
48 – 57	101	23 (22.77)	
58 – 67	49	10 (20.41)	
68 – 77	38	9 (23.68)	
78 – 87	2	0 (0.00)†	
88 – 97	3	0 (0.00)†	
Level of education			0.6910
No formal	5	1 (20.00)	
Primary	24	7 (29.17)	
Secondary	328	98 (29.88)	
Tertiary	164	41 (25.00)	
Occupation			0.9733
Civil servant	111	33 (29.73)	
Self employed	224	62 (27.68)	
Student	85	23 (27.06)	
Unemployed	101	29 (28.71)	
Marital status			0.0362*
Single	156	57 (36.54)	
Married	341	86 (25.22)	
Divorced	8	1 (12.50)	
Widow	16	3 (18.75)	

*Significant; †Not included in analysis

Table 4: Prevalence of intestinal parasitic infection in relation to demography of participants

Characteristics	No. tested	No. infected with parasites (%)	P value
Gender			0.6370
Male	197	5 (2.54)	
Female	324	12 (3.70)	
Age (years)			0.1837
8 – 17	39	3 (7.69)	
18 – 27	82	1 (1.22)	
28 – 37	100	2 (2.00)	
38 – 47	107	2 (1.87)	
48 – 57	101	3 (2.97)	
58 – 67	49	4 (8.16)	
68 – 77	38	2 (5.26)	
78 – 87	2	0 (0.00)†	
88 – 97	3	0 (0.00)†	
Level of education			0.0008*
No formal	5	0 (0.00)†	
Primary	24	4 (16.67)	
Secondary	328	8 (2.44)	
Tertiary	164	5 (3.05)	
Occupation			0.4583
Civil servant	111	1 (0.90)	
Self employed	224	8 (3.57)	
Student	85	3 (3.53)	
Unemployed	101	5 (4.95)	
Marital status			0.0748
Single	156	5 (3.21)	
Married	341	9 (2.64)	
Divorced	8	1 (12.50)	
Widow	16	2 (12.50)	

*Significant; †Not included in analysis

Table 5: Effect of *H. pylori* infection of some haematological parameters

Haematological parameters	*H. pylori* positive (N=140)	Patients negative for *H. pylori* and intestinal parasites (N=364)	P value
Haematocrit (%)	34.62 ± 7.32	35.82 ± 7.60	0.1094
Haemoglobin concentration (g/dL)	11.77 ± 3.25	12.38 ± 7.42	0.2007
Mean cell volume (fL)	81.54 ± 10.52	82.70 ± 10.96	0.2824
Mean cell haemoglobin (pg)	33.79 ± 3.14	34.22 ± 15.59	0.6170
Mean cell haemoglobin concentration (g/dL)	28.08 ± 4.11	28.40 ± 5.99	0.4948
Total white blood cell count (10^3cells/µL)	8.33 ± 4.55	6.98 ± 3.76	0.0020*
Neutrophil count (%)	51.88 ± 17.32	48.66 ± 15.22	0.0547
Lymphocyte count (%)	40.66 ± 16.72	43.81 ± 20.42	0.0766
Platelet count (10^3cells/µL)	243.01 ± 142.87	218.89 ± 128.69	0.0683
Mean platelet volume (fL)	9.20 ± 1.08	9.79 ± 10.17	0.2760

*Significant

Table 6: Effect of intestinal parasitic infection on some haematological parameters

Haematological parameters	Intestinal parasite positive (N=10)	Patients negative for *H. pylori* and intestinal parasites (N=364)	P value
Haematocrit (%)	30.73 ± 6.06	35.82 ± 7.60	0.0365*
Haemoglobin concentration (g/dL)	10.25 ± 1.65	12.38 ± 7.42	0.0036*
Mean cell volume (fL)	77.52 ± 8.55	82.70 ± 10.96	0.1393
Mean cell haemoglobin (pg)	33.83 ± 2.87	34.22 ± 15.59	0.7518
Mean cell haemoglobin concentration (	26.19 ± 4.06	28.40 ± 5.99	0.2474
Total white blood cell count (10^3cells/µL)	7.72 ± 6.39	6.98 ± 3.76	0.7239
Neutrophil count (%)	51.13 ± 12.63	48.66 ± 15.22	0.6116
Lymphocyte count (%)	39.83 ± 12.08	43.81 ± 20.42	0.3394
Platelet count (10^3cells/µL)	190.50 ± 93.40	218.89 ± 128.69	0.4892
Mean platelet volume (fL)	10.25 ± 1.24	9.79 ± 10.17	0.4894

*Significant

Table 7: Effect of co-infection with *H. pylori* and intestinal parasites on some haematological parameters

Haematological parameters	Patients co-infected with *H. pylori* and intestinal parasitic infection (N=7)	Patients negative for *H. pylori* and intestinal parasites (N=364)	P value
Haematocrit (%)	29.37 ± 10.49	35.82 ± 7.60	0.0279*
Haemoglobin concentration (g/dL)	10.23 ± 3.14	12.38 ± 7.42	0.1288
Mean cell volume (fL)	72.56 ± 21.23	82.70 ± 10.96	0.2543
Mean cell haemoglobin (pg)	33.56 ± 5.21	34.22 ± 15.59	0.7648
Mean cell haemoglobin concentration (	35.33 ± 19.66	28.40 ± 5.99	0.3747
Total white blood cell count (10^3cells/µL)	7.24 ± 2.21	6.98 ± 3.76	0.8555
Neutrophil count (%)	49.31 ± 16.31	48.66 ± 15.22	0.9111
Lymphocyte count (%)	42.14 ± 14.81	43.81 ± 20.42	0.8298
Platelet count (10^3cells/µL)	186.10 ± 87.28	218.89 ± 128.69	0.5028
Mean platelet volume (fL)	9.13 ± 1.21	9.79 ± 10.17	0.3544

*Significant

DISCUSSION

The prevalence of *H. pylori* in this study was 28.21% (Table 1) and agrees with a recent report (Kaya *et al*., 2023). This is lower than 34.2% previously reported in UBTH (Odigie *et al*., 2020), 75.4% in Cotonou (Aguemon *et al*., 2005) as well as the current global estimates of 43.1% (Li *et al*., 2023). The difference could be due to geographical location, type of subjects used, period of study and method of detecting *H. pylori*. Aguemon *et al*. (2005) study was conducted in Benin Republic, Li *et al*. (2023) study was a meta-analysis of various studies from 71 countries while that of Odigie *et al*. (2020) and this study were from the same health institution and country (Nigeria).

Odigie *et al*. (2020) used patients with symptoms of dyspepsia; Aguemon *et al*. (2005) used apparently healthy subjects while patients with gastrointestinal discomfort were used in Kaya *et al*. (2023) study and this study. Li *et al*. (2023) reported a trend of deceasing prevalence of *H. pylori* infection from 58.2% in the 1980 to 1990 to 43.1% in 2011 to 2022. This trend may explain the drop in prevalence from 75.4% in 2005 (Aguemon *et al*., 2005) to 34.2% in 2020 (Odigie *et al*., 2020) and 28.21% observed in this study in 2023. Aguemon *et al*. (2005) detected *H. pylori* IgG antibodies while in both Odigie *et al*. (2020) and this study, *H. pylori* was detected by the stool antigen test. Among children with diarrhea, prevalence of the infection varied with geographical locations, regions within the same country, and even over time in the same location and population (Petri *et al*., 2008). This may explain the difference in prevalence between this study and that of Odigie *et al*. (2020).

The prevalence of intestinal parasitic infection in UBTH from this study was 3.26%. This is comparable to 3.9% previously reported (Akinbo *et al*., 2011b) but is not consistent with recent reports (Elemuwa *et al*., 2023; Kaya *et al*., 2023). It may appear that the prevalence of intestinal parasites in UBTH dropped from 3.9% in 2011 in Akinbo *et al*. (2011b) study to 0% in 2015 in Imade and Eghafona (2015a and 2015b) and Elemuwa *et al*. (2023) studies and rose again to 3.26% in this study. It is important to note that the studies of Imade and Eghafona (2015a and 2015b) used children of 5 years and younger while the age ranges of 8 – 17 years were the youngest in this study.

The prevalence of co-infection or concurrent infection of *H. pylori* and intestinal parasitic infection was 4.76% (Table 1). This is not in agreement with previous reports (Pomari *et al*., 2020; Spotts *et al*., 2020; Yousif Abd Elbagi *et al*., 2021; Kaya *et al*., 2023). The prevalence reported in these studies were 23% (Spotts *et al*., 2020; Yousif Abd Elbagi *et al*., 2021), 74% (Pomari *et al*., 2020) and 17.7% (Kaya *et al*., 2023). The difference may be due to geographical location as Pomari *at al*. (2020) was conducted in Italy, Spotts *et al*. (2020) was in Ethiopia, Yousif Abd Elbagi *et al*. (2021) study was in Sudan and Kaya *et al*. (2023) was in Turkiye. This study was in Nigeria. Also, the age of subjects used in these studies differ from the one used in this study. Spotts *et al*. (2020) used school-age children; Pomari *et al*. (2020) used adults while both children and adults were used in this study. In Yousif Abd Elbagi *et al*. (2021) study, *H. pylori* infected patients were tested for intestinal parasites whereas all patients with gastrointestinal complaints were tested for both *H. pylori* infection and intestinal parasites. These may explain the finding in this study.

An insignificant association (OR=1.820, 95%CI=0.679, 4.877; p=0.3506) between *H. pylori* infection and intestinal parasitic infection was observed in this study (Table 1). This agrees with a recent report (Kaya *et al*., 2023) but disagrees with the study of Pomari *et al*. (2020). Geographical location and type of parasite associated with *H. pylori* may be the reason for the observed difference. Most studies that show association between *H. pylori* infection and intestinal parasites have been with protozoa parasites (*Entamoeba histolytica* and *Entamoeba coli*) and *Enterobius vermicularis* (Spotts *et al*., 2020; Kaya *et al*., 2023). It is important to note that Kaya *et al*. (2023) did not find significant association as mentioned earlier but found significant association when they considered the individual parasites, and found only between *H. pylori* and *Entamoeba histolytica* and *Enterobius vermicularis*. These parasites were not recovered in this study as *Ascaris lumbricoides* and hookworm were the only parasites recovered *H. pylori* infection has been shown to have detrimental effects on the host gastric mucosa (Hussain *et al*., 2020). Co-infection with protozoa may worsen gastric pathology but co-infection with helminths may be potentially beneficial, with gastric outcomes largely mediated by the balance between Th1 and Th2 responses (Hussain *et al*., 2020).

The presence of intestinal protozoa (rather than helminth) together with *H. pylori* has been shown to exaggerate (rather than attenuate) the host immune responses (Krzyżek and Gościniak, 2017). Whary *et al*. (2005) reported that helminth infection may provide protection against *H. pylori*-induced gastric adenocarcinoma. Thus, the patients in this study co-infected with intestinal parasites may not develop gastric cancer. The parasites recovered in this study have been detected in previous studies from same institution (Akinbo *et al*., 2010; Akinbo *et al*., 2011b), albeit, not in relation to *H. pylori* infection. The finding that *Ascaris lumbricoides* was more prevalent than hookworm agrees with previous reports (Akinbo *et al*., 2010; Akinbo *et al*., 2011b; Akinbo *et al*., 2017)

The finding that age, gender and level of education did not significantly affect the prevalence of *H. pylori* infection agrees with a previous report (Aguemon *et al*., 2005). Odigie *et al*. (2020) reported significantly higher prevalence among female participants. Pomari *et al*. (2020) reported higher prevalence of *H. pylori* among males. There is no apparent biological reason why there should be gender differences in the prevalence of *H. pylori* infection. Among the demography factors only marital status significantly affected the prevalence of *H. pylori* with those who are single having the highest prevalence. This finding is not in agreement with the report of Odigie *et al*. (2020).

Only level of education significantly affected the prevalence of intestinal parasitic infection with participants having primary level of education having the highest prevalence. Low level of education is among the risk factors for acquisition of intestinal parasitic infections (Belete *et al*., 2021). Among diabetic patients, the prevalence of intestinal parasitic infection was not affected by gender and occupation (Akinbo *et al*., 2013). This agrees with the finding in this study.

With the exception of total white blood cell count, there was no significant difference ($p>0.05$) in the studied haematological parameters between *H. pylori* infected and non-infected participants. The results of haemoglobin and total white blood cell count in this study agrees with a previous report (Akhimienho *et al*., 2021) but is not consistent with the report of Haile and Timerga (2021). The type of participants used may explain the difference between the finding in this study and those of Haile and Timerga (2021). The controls used in Haile and Timerga (2021) study were apparently healthy staff of the hospital were the study was conducted, whereas in this study, participants with gastrointestinal complaints who were *H. pylori* antigen negative served as controls. Anemia and micronutrient deficiencies (iron and vitamin B12) are two hematological manifestations that have been linked to *H. pylori* infection (Augusto *et al*., 2013; Campuzano-Maya, 2014). The presence of *H. pylori* infection is linked to a worse outcome from oral iron therapy, and it has been independently linked to iron deficiency, iron-deficiency anemia, and vitamin B12 deficiency (Fraser *et al*., 2010; Huang *et al*., 2010; Jasem *et al*., 2011; Demerdash *et al*., 2018; Mwafy *et al*., 2018; Abdel *et al*., 2019). In addition to iron therapy, it has been suggested that *H. pylori* infection therapy may help infected patients' ferritin and hemoglobin levels (Huang *et al*., 2010; Hudak *et al*., 2017). Iron and vitamin B12 levels were not determined in the subjects used in this study. One may surmise that whatever was the cause of the gastrointestinal complaints of participants that were *H. pylori* antigen negative did not result in any significant changes is the studied haematological parameters compared with their counterparts that had *H. pylori* infection.

H. pylori infection has been linked in studies to an increase in vascular and systemic inflammation (Yu *et al*., 2018). The white blood cell count has emerged as a key indicator of infectious diseases because it is a reliable, accessible, and affordable indicator of inflammation (Yu *et al*., 2018).

This may be responsible for the significantly (p=0.0020) higher total white blood cell count in patients infected with *H. pylori* compared with participants that were not infected with *H. pylori*. Neutrophil-lymphocyte ratio and platelet-lymphocyte ratio have been reported not to differ significantly among *H. pylori* infected and uninfected subjects (Boyuk *et al*., 2020). This may explain the non-significant difference (p>0.05) in neutrophil, lymphocyte and platelet counts between *H. pylori* antigen positive and *H. pylori* antigen negative participants in this study. Indeed, Boyuk *et al*. (2020), found no significant difference in neutrophil, lymphocyte and platelet counts in their study subjects.

Haematocrit (HCT) values and haemoglobin (Hb) concentration were the only parameters that were significantly (p<0.05) lower in *H. pylori* infected individuals compared with their uninfected counterparts. Other parameters did not differ significantly (p>0.05). The finding that HCT and Hb concentration were significantly lower in participants infected with intestinal parasites compared with uninfected participants as well as the that fact mean cell volume did not differ among both categories of patients, agrees with a previous report (Demeke *et al*., 2021). The intestinal parasites – *Ascaris lumbricoides* and hookworm, recovered in this study have been reported to be associated with anaemia (Akinbo *et al*., 2011a). The non-significant (p>0.05) difference in total white blood cell count, neutrophil, lymphocyte and platelet counts between *H. pylori* infected and uninfected subjects in this study agrees with the observation of Demeke *et al*. (2021).

Among patients co-infected with *H. pylori* and intestinal parasitic infection, only haematocrit values (among the studied haematological parameters) were significantly lower (p=0.0279) compared to participants not infected. *H. pylori* induce the production of pro-inflammatory cytokines while in helminth infection (even when co-infected with *H. pylori*) pro-inflammatory immune response is suppressed (Hussain *et al*., 2020). This may explain why there was no difference in amount of inflammatory cells and markers of inflammation – white blood cells (total and differential), platelets and mean platelet volume (Horne *et al*., 2005; Sentuk *et al*., 2016), between patients co-infected with *H. pylori* and intestinal parasitic infection and patients without either infection as only helminths were recovered from this study. No study on effect of this type of co-infection on haematological parameters was found for comparison and reason why only haematocrit values were significantly lower was unclear. Perhaps the neutralization of inflammation (Hussain *et al*., 2020), seen in this kind of co-infection may be responsible as inflammation is associated with anaemia (Ganz, 2019).

CONCLUSION

The prevalences of infection caused by *H. pylori*, intestinal parasitic infection and co-infection in this study were 28.21%, 3.26% and 4.76% respectively. *Ascaris lumbricoides* and *Hookworm* were the only parasites recovered. Increased total white blood cell count was seen with *H. pylori* monoinfection, while intestinal parasite monoinfection led to lower haematocrit and hemoglobin concentration values and only decreased haematocrit values with co-infection. Measures to prevent both infections are advocated.

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