Seroprevalence, risk factors and comorbidities associated with *Helicobacter pylori* infection amongst children receiving care at Kilimanjaro Christian Medical Center

Amos Msekandiana[1], Levina Msuya[2], Rune Philemon[2], Blandina M'mbaga[3], Grace Kinabo[2]

1. Mzuzu Central Hospital, Pediatrics; Kilimanjaro Christian Medical University College, Pediatrics.
2. Kilimanjaro Christian Medical University College, Pediatrics.
3. Kilimanjaro Christian Medical University College, Pediatrics; Kilimanjaro Research Institute

Abstract:

Background: *Helicobacter pylori* frequently causes gastritis and peptic ulcers, and affected children are at risk of developing gastric carcinoma later in adulthood.

Methods: This was a Hospital based cross sectional study. A total of 200 children aged 6 months to 14 years were enrolled. Study subjects were tested for *H. pylori* using a standard serology rapid test measuring immunoglobulin G for *H. pylori*. For risk factors, Chi-square tests were used to test for association and then, odds ratios and their corresponding 95% confidence intervals and p-values were computed using logistic regression.

Results: The overall seroprevalence of *H. pylori* was 11.5%. The following factors were associated with H. pylori infection: Age group above 10 years, keeping a dog and household size. The independent predictors of *H. pylori* were: Fathers' occupation, keeping a dog, indoor tap water, age group, household size and diabetes mellitus type 1..

Conclusion: The seroprevalence of *H. pylori* antibodies was lower compared to most developing countries. Keeping a dog, household size, indoor tap water, fathers' occupation and diabetes mellitus type 1 were found to be independent predictors of presence of *H. pylori* antibodies.

Keywords: *Helicobacter Pylori.*

Introduction

Helicobacter pylori (H. pylori) is a spiral-shaped gram negative bacterium found on the human gastric mucosa. It was first isolated by Warren and Marshall in 1982. Initially, this bacterium was classified as *Campylobacter pyloridis* but in 1989 was included in a new genus, *Helicobacter*, and renamed *H. pylori*. In 1994, the international agency for cancer classified *H. pylori* as the number one carcinogen or cancer causing agent and now it is the most common cause of gastric cancer which is the third cause of mortality amongst the cancers worldwide.

Globally, about half of the population, has *H. pylori* and the prevalence and its effects are more pronounced in the developing countries[1,2]. The estimated prevalence among children in developing countries is 30.9%[3,4]. *H. pylori* can cause iron and vitamin B12 depletion in the affected individual, as a result causing iron and vitamin B12 deficiency. Furthermore, *H. pylori* frequently causes gastritis and peptic ulcers, and affected children are at risk of developing gastric carcinoma[5,6].

The risk factors for *H. pylori* include poverty related conditions such as overcrowding, poor hygiene and sanitation, low education level of mothers, and higher number of siblings[7]; all of which are common in Tanzania. In some cases, *H. pylori* among children presents with recurrent abdominal pain due to peptic ulcer disease; in a review article by Eren et al, 2011, *H. pylori* was found to be the most common cause of duodenal ulcers in children. Thus in thistudy the frequency of peptic ulcer disease was 9.4% amongst children and 76% were *H. pylori* positive.[8]

As a matter of fact, the aim of this study was to provide robust evidence on seroprevalence of *H. pylori* and its co-morbidities amongst children. In this case, it implies that clinicians will have a higher index of suspicion on

Corresponding author:
Amos Msekandiana,
Mzuzu Central Hospital, Pediatrics;
Kilimanjaro Christian Medical University
College, Pediatrics.
Email: amsekandiana@gmail.com

presence of *H. pylori* infection and will be able to screen the population at risk and treat before development of any complications.

Methodology

Study population and study design

This was a cross-sectional hospital based study, which was done from June 2015 to May 2016 at the Kilimanjaro christian medical college (KCMC) pediatric department. The hospital is a regional referral health facility that has a pediatric bed capacity of 450 and it serves people within and outside Kilimanjaro region including both in-patients and out-patients. On average100 children are admitted to the ward every month. The study subjects were children admitted to the pediatric ward and those attending pediatrics out-patient clinics who are between 6 months and 14 years. In addition, those whose guardians did not give consent to participate in the study were excluded.

Sampling technique

All children fitting the criterion and coming for health care within the study period were enrolled if consent was granted by guardians until the desired sample size of 200 was achieved. Furthermore, the type 1 diabetes mellitus (T1DM) and Human immunodeficiency virus (HIV) units were purposively selected by the researcher to answer some of the objectives of the study.

Data collection tools

Structured questionnaires were used to collect information on social demographic and hygiene factors while laboratory data sheets were used to collect data on *H. pylori* and co-morbidities such as (T1DM) and (HIV).

Data collection methods

Data on risk factors and co-morbidities was collected using a precoded structured questionnaire which included the following information: Age, gender, residence, source of drinking thus whether it's from a spring, stream, well or tap, total number of people living in the house, guardians' educational level, father's and mother's occupation, contact with a community (a child who has been staying long time in community care services such as school, day care center), breast-feeding, recent antibiotic use, exposure to cigarette smoking, and hand washing before and after use of pit latrine, whether they eat from the same plate as a family or they use separate plate.

Laboratory analysis

A standard serology rapid test (FlexSure® HP) measuring immunoglobulin G for *H. pylori* in the serum was used to confirm the presence of *H. pylori* antibodies amongst the subjects. Thus 1 to 2 mls of whole blood was drawn from a vein by using a 2 mls syringe after observing sterile procedures, thus vein site was cleaned with alcohol swabs. The blood was then left to stand for 10 to 15 minutes in an Ethylenediaminetetraacetic acid tube and later the serum was tested for *H. pylori* antibodies.

Data analysis

The data collected was entered into EPIINFO 7 using double entry validity and exported to STATA 13 for analysis. The main study outcome was presence of *H. pylori*. The exposure variables include socio-demographic, recent antibiotic use, living in a crowded house, hygiene conditions and drinking spring water among others.

The analysis also explored the relationship between *H. pylori* and co-morbidities studied; these included diabetes and HIV.

Descriptive statistics were computed for the variables; frequencies and percentages were obtained for categorical variables while for continuous variables, means and respective standard deviations were presented.

For factors associated with *H. pylori*, at first, chi-square tests were used to test for association and then, odds ratios and their corresponding 95% confidence intervals and p-values were computed using logistic regression. Independent risk factors for *H. pylori* were assessed using the likelihood ratio test.

Ethical clearance

Ethical clearance was obtained from the KCMC ethical committee, college research ethical commitee form number 869 and signed informed consent were obtained from the parents/ legal guardians of the children before they were enrolled in the study. The signed consents were kept in a secure place and accessed only by the principal investigator.

Results

Descriptive analysis

Demographic characteristics

A total of 200 participants were enrolled for this study. Of these, 80 (40%) were below 5 years, 56 (26%) were between 5 to 10 years and 68 (34%) were older than 10

years; a majority of the study participants were male 109 (54.5%) while 91 (45.5%) were female; 109 (54.5%) came from rural residences while the rest came from urban residences; Furthermore, the average number of siblings per study participant was 2.1(SD=1.6). (Table 2)

With regards to caretaker education, majority attended primary school 97 (48.5%) and only 7% had no education. The predominant occupation for mothers and fathers was farming with 61 (30.8%) and 60 (30.9%) respectively falling in these categories.

Table 1: Study participants' demographic characteristics

Variable	Frequency (N=200)	Percentage (100)
Age group		
< 5 years	80	40
5-10 years	52	26
> 10 years	68	34
Sex		
Female	91	45.5
Male	109	54.5
Residence		
Urban	93	46.7
Rural	106	53.3
Caretaker Education		
None	14	07.0
Primary	97	48.5
Secondary	63	31.5
Tertiary	26	13.0
Mother Occupation		
Housewife	49	24.8
Farmer	61	30.8
Business	48	24.2
Professional	30	15.2
Other	10	5.0
Father Occupation		
Farmer	60	30.9
Business	49	25.3
Professional	44	22.7
Other	41	21.1
Household size		
Mean (SD)	5.2 (1.8)	
No. of siblings		
Mean (SD)	2.1 (I.6)	
T1DM		
No	158	79
Yes	42	21
HIV Status		
Negative	159	80
Positive	41	20

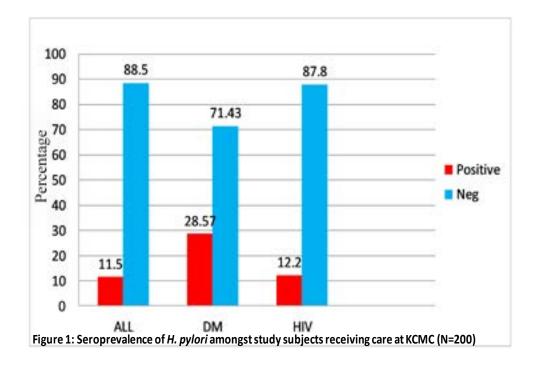In addition, for comorbidities, 42(21%) of the study participants had T1DM whereas 40(20%) had HIV. (Table 1)

Hygiene characteristics
In general, 191 (95.5%) children had the tap as their drinking water source while 9 (4.5%) used wells as their drinking water source; 50% of the study participants came from homes with pit latrines and up to 98 (49%) of the study participants came from homes with indoor toilets, 115 (57.5%) had indoor tap water, 47 (23.5%) of

the children shared a plate while 38 (19%) kept a dog. (Figure 2)

Seroprevalence of *H. pylori* and cormobidity conditions
The overall seroprevalence of H. pylori amongst the study participants was 23(11.5%) while in those with T1DM and HIV it was 12(28.57%) and 5(12.5%), respectively. In this case a higher seroprevalence of *H. pylori* amongst those with T1DM was noted. (Figure 1)
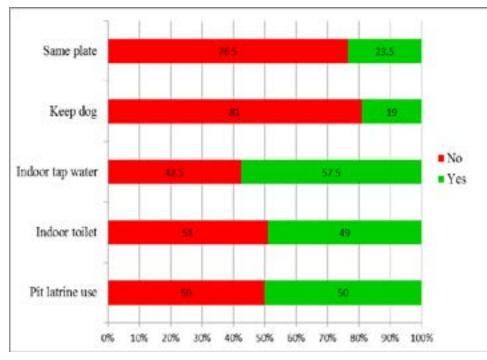
Figure 1: Seroprevalence of *H. pylori* amongst study subjects receiving care at KCMC (N=200)

Figure 2: Hygiene factors amongst study participants receiving care at KCMC (N=200)

Risk factors and *H. pylori* amongst children aged 6months to 14 years

Amongst the social demographic factors, age group above 10 years ($\chi^2=8.5$, p=0.015) and occupation of father ($\chi^2=8.9$, p=0.002) showed a significant relationship with *H. pylori*. In addition, the following hygiene factors were found to have association with *H. pylori*; having indoor tap water ($\chi^2=5.5$, p=0.019), using a pit latrine with hand washing ($\chi^2=4.6$, p=0.032), pit latrine use ($\chi^2=4.0$, p=0.046) and keeping a dog ($\chi^2=6.8$, p=0.02). Other factors such as daycare attendance ($\chi^2=0.1$, p=0.421), antibiotic use ($\chi^2=0.4$, p=0.518) and cigarette smoking ($\chi^2=1.7$, p=0.3) were not associated with *H. pylori* among children in this population.

After adjusting for potential confounders, age above 10 years had 7.13 times higher odds of having *H. pylori*, thus a 3.93-fold increase compared to unadjusted odds ratio. In addition, those with tap water indoor had 90% lower odds for *H. pylori* compared to those without indoor tap water. Furthermore, with regards to household size, there was a 36% reduction in odds for *H. pylori* for each 1 person increase in the household and for those keeping a dog, they had 4.8 times higher odds of having *H. pylori* compared to those without a dog. Age above 10 years (95% CI=1.64-31.0), household size (95% CI=0.45-0.94), and keeping a dog (95% CI=1.23-18.84) were still associated with *H. pylori* in the multivariate analysis. (Table 2)

Table 2: Regression analysis of the risk factors for *H. pylori*

Variable	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Sex				
Female	1			
Male	1.07 (0.4-2.6)	0.836		
No of siblings	0.91 (0.7-1.2)	0.542		
Share plate				
No	1			
Yes	1.50 (0.6-3.9)	0.407		
Day care				
Yes	0.53 (0.1-1.9)	0.326		
Antibiotics				
No	1			
Yes	0.72 (0.3-1.9)	0.520		
Age group				
< 5 years	1		1	
5-10 years	0.76 (0.2-3.2)	0.701	0.89 (0.16-5.03)	0.891
> 10 years	3.20 (1.2-8.9)	0.025*	7.13 (1.64-31.00)	0.009*
Caretaker				
Education				
None	1		1	
Primary	0.35 (0.09-1.30)	0.119	0.25 (0.04-1.63)	0.148
Secondary	0.17 (0.03-0.79)	0.024*	0.15 (0.01-1.58)	0.115
Tertiary	0.33 (0.61-1.73)	0.189	1.32 (0.09-20.18)	0.840
Father Occupation				
Farmer	1		1	
Business	0.14(0.03-0.65)	0.012*	0.15 (0.01-1.95)	0.148
Professional	0.33 (0.1-1.1)	0.067	0.50 (0.04-5.89)	0.584
Other	0.08 (0.01-0.55)	0.018*	0.01 (0.00-0.60)	0.025*
Mother Occupation				
Housewife	1		1	
Farmer	3.05 (0.9-10.0)	0.067	0.39 (0.04-4.29)	0.441
Business	0.75 (0.2-3.5)	0.717	0.34 (0.04-2.55)	0.293
Professional	1.25 (0.3-6.0)	0.781	0.58 (0.05-6.44)	0.659
Household size	0.87 (0.7-1.1)	0.273	0.64 (0.45-0.94)	0.025*
No pit latrine use				
Yes	0.40 (0.15-1.01)	0.052	1.13 (0.24-5.40)	0.881
Lack tap water indoor	2.87(1.15-7.11)	0.023*	4.41 (0.69-27.9)	0.114
Yes				
Cigarette				
Yes	0.28(0.03-2.14)	0.218	0.28 (0.03-2.83)	0.281
Keeping dog				
Yes	3.28 (1.3-8.3)	0.012*	4.80 (1.23-18.84)	0.024*

*Statistically significant at p<0.05

Independent predictors of *H. pylori*

All variables in the multivariate model were tested to see if they were independent predictors of *H. pylori*. Thus, from the Likelihood ratio test, age group (χ2=10.63, p-value=0.005), father's occupation (χ2=9.94, p-value=0.019), water indoor (χ2=4.35, p-value=0.037), keeping a dog (χ2=5.21, p-value=0.022), and household size (χ2=5.96, p-value=0.015) were found to be independent predictors of H. pylori among children aged 6months-14 years.

Relationship between *H. pylori* and T1DM (multivariate analysis)

After running the univariate analysis it was noticed that there was a significant relationship between *H. pylori* and T1DM (p=0.001). However, there was no significant association between *H. pylori* and HIV (p=0.791).

Furthermore, in the multivariate analysis, after adjusting T1DM for the independent risk factors of *H. pylori* such as; fathers occupation, indoor tap water, age group above 10, keeping a dog and household size, it was found out that T1DM still remains significantly associated with *H. pylori* (OR: 8.19, 95% CI: 2.01-33.28) and there was 2.85 fold increase in the odds. In this model, apart from the adjusting T1DM for the independent risk factors of *H pylori*, we also included HIV in order to assess its effect on T1DM if there was any.(Table 3). In addition, we run a likelihood ratio test to test for independence and we found out that T1DM was independently associated with *H. pylori* (χ2=9.3, p=0.002).

Table 3: Relationship between *H. pylori* and T1DM

Variable	Unadjusted OR (95%CI)	p-value	Adjusted OR (95%CI)	p-value
Father Occupation				
Farmer	1		1	
Business	0.14(0.03-0.65)	0.012*	0.17 (0.03-1.02)	0.052
Professional	0.33 (0.1-1.1)	0.067	0.68 (0.15-3.01)	0.608
Other	0.08 (0.01-0.55)	0.018*	0.05 (0.00-0.50)	0.011
No Water indoor				
Yes	2.87 (1.15-7.11)	0.023*	3.58 (0.96-13.36)	0.058
Age group				
< 5 years	1		1	
5-10 years	0.76 (0.2-3.2)	0.701	0.59 (0.11-3.03)	0.524
> 10 years	3.20 (1.2-8.9)	0.025*	1.58 (0.37-6.67)	0.537
Keeping dog				
Yes	3.28 (1.3-8.3)	0.012*	3.47 (1.04-11.50)	0.042*
Household size	0.91 (0.7-1.2)	0.542	0.69 (0.49-0.99)	0.045*
HIV status				
Negative	1		1	
Positive	1.09 (0.38-3.13)	0.876	2.54 (0.63-10.28)	0.190
T1DM				
No	1		1	
Yes	5.34 (2.16-13.25)	<0.0001*	8.19 (2.01-33.28)	0.003*

*Statistically significant at p<0.05

Discussion

In this study, the overall seroprevalence of *H. pylori* antibodies was 11.5% and the seroprevalence was higher in children with T1DM. Furthermore, among the variables we studied, in the multivariate analysis the following risk factors had a significant relationship with *H. pylori* infection: Age group above 10 years, keeping a dog, household size and fathers' occupation. In addition, T1DM was independently associated with presence of *H. pylori* antibodies.

This is the first study looking at *H. pylori* in children done in the Kilimanjaro region and to our knowledge there are no publications seen on studies done in Tanzania on similar topics. This result is similar to those observed in other developed countries where by a prevalence of *H. pylori* of less than 15% was observed[9,10].

In contrast this result is lower compared to most studies done in Nigeria and Kenya where they found the prevalence of *H. pylori* to be 63.3% and 73.3%[11,12], respectively. This difference could be attributed to the fact that in these studies they included only symptomatic children while in our study we screened for *H. pylori* antibodies in all children receiving care within the given period of time at KCMC. In addition, it could also be as a result of

differences in environment and hygiene practices in the places where studies were done.

In our study, we found out that the seroprevalence of *H. pylori* was quite higher with increase in age which was consistent with other studies 7. As a matter of fact, the seroprevalence of *H. pylori* in those above 10 years was 20.6% which was higher compared to those under 5 (6%) and 5 to 10 years (3%). (Table 1). In this case it means this is the age group with highest risk and a clinician should have a higher index of suspicion of *H. pylori* infection if the child in this age group presents with signs and symptoms of the *H. pylori* infection i.e. abdominal pain or dyspepsia.

Furthermore, occupation of father, household size and keeping a dog and indoor tap water were found to be independently associated with *H. pylori* which is similar to some studies[7,13,14]. The knowledge of these factors is important since they can guide the clinician to assess the risk of acquiring *H. pylori* infection especially if the patient is presenting with signs and symptoms of *H. pylori* such as abdominal pain or dyspepsia in a low resource setting. In this case the clinician can undertake a decision to treat the child empirically which is not only clinically sound but also cost effective in the developing countries, especially in hard to reach low resource areas where tools for *H. pylori* detection may not be available.

In our study we did not find any significant relationship between breast feeding, use of antibiotics and cigarrete smoking with *H. pylori*. In general, our results contrast with some studies where they found out that there was no role of environmental factors i.e. hygiene factors, rather advocates person to person transmission i.e. breast feeding. As a matter of fact, they only found association of *H. pylori* to social demographic factors such as age 14. The differences could be explained by sample size differences which probably limited strength of association between *H. pylori* and other risk factors. In addition, study settings could also contribute to the observed differences i.e. some studies were done exclusively in one setting such as Urban or rural, and were community based[15] while in our study it was a mixture of both urban and rural population. Furthermore, it was a hospital based study.

Similar to other studies we found out that T1DM is significantly associated with *H. pylori* (Table 3). A study done in Egypt looking at the relationship between *H. pylori* and T1DM reported a significant association where by children with T1DM had a significant higher level of *H. pylori*[16]. As a matter of fact, Dai et al, 2015, stipulates that poor glycemic control amongst children with T1DM is the reason for increased seroprevalence of *H. pylori* amongst the children with T1DM which was also the case in our study since the average HbA1c was 11.5% which was high and an indication for poorly controlled T1DM[17]. In contrast Candelli et al, 2000, found out that there was no significant association between *H. pylori* and diabetes type 1, instead his explanation was that most previous association may have arisen from failure to consider social economic status and age, or a different prevalence of a specific strain of *H. pylori* known as Cag-A positive cytotoxic strain. Thus Cag A cytotoxic strains induce a higher production of proinflammatory cytokines which cause a remarkable impairment of metabolic control in T1DM patients than Cag-A negative strain[18]. However, in our study after adjusting *H. pylori* for independent risk factors such as age above 10 years, fathers' occupation, household size, keeping a dog and having tap water indoor, thus we run a likelihood ratio test and found out that T1DM has a true association with *H. pylori*. This information is clinically significant since it can help in decision making as far as management of children in diabetic clinic who are presenting with dyspepsia or abdominal pain are concerned. In this case it would be reasonable to start the patient on empirical treatment for *H. pylori* infection.

This study found no association between H. pylori and HIV. Hestivic et al, 2011, from Uganda, found a significant relationship between *H. pylori* and HIV. In this cross-sectional hospital based study and exclusively done in Kampala urban, Hestivic found out that HIV positive children with advanced disease were less likely to be infected with *H. pylori*[15]. In our case absence of association between *H. pylori* and HIV, could be explained by limited sample size and additionally all our children were on anti-retroviral therapy and had had antibiotics or on antibiotics due to some serious bacterial infection or prophylaxis and the latter could possibly have eliminated *H. pylori* in those found *H. pylori* antibody negative.

In general, our study satisfied the objectives as far as a hospital based cross-sectional study is concerned. Thus from this study, we will be able to generate hypotheses for future studies and it will enable us to formulate a

treatment protocol that will include the tools provided for by this study such as understanding of independent predictors of *H. pylori* infection which is cost effective to a resource limited setting. However, our study was a hospital based and that means the guardians of these patients have health seeking behavior thus there is a possibility that the study subjects had had antibiotic treatment at some point which eradicated *H. pylori* infection in some of those who tested *H. pylori* antibody negative. Furthermore, these results cannot be used to generalize presence of active infection since we screened for *H. pylori* using an immunoglobulin G antibody test which detects both exposure as well as chronic infection which means we may have missed the newly infected subjects with very low or no antibody titers.

Conclusion

Conclusively, in this study the seroprevalence of *H. pylori* was lower compared to most studies done in the developing countries. However, the mere presence of the *H. pylori* antibodies in the study subjects on its own has significant clinical implications and should be taken seriously. In addition, T1DM, socio-demographic factors such as age, fathers' occupation, household size as well as hygiene and environmental factors such as lack of indoor tap water and keeping a dog have been identified as independent predictors of *H. pylori* infection. Therefore, routine screening for *H. pylori* in higher risk groups such as those above age of 10 years with T1DM and exposed to the other risk factors such as owning a dog is highly recommended. In this case, it means that improved hygiene and sanitation can help eradicate *H. pylori* in our population.

Abbreviations

KCMC: Kilimanjaro Christian Medical Center
T1DM: Type 1 diabetes mellitus
HIV: Human Immunodeficiency virus
HBA1c: Glycated hemoglobin

Declarations
Ethical approval and consent

The study was approved by KCMC ethics committee and the guardians of the children signed a consent form to grant permission for the researcher to proceed with data collection.

Authors' contribution

AM is the one who developed proposal, collected and

References

1. Brown LM, *Helicobacter pylori*: epidemiology and routes of transmission. *Epidemiol. Rev* 2000; 22, 283–297

2. Perez-Perez GI, Rothenbacher D, Brenner H. Epidemiology of *Helicobacter pylori* Infection. *Helicobacter* 2004; 9, 1–6.

3. Yücel O, Sayan A, Yildiz M, The factors associated with asymptomatic carriage of *Helicobacter pylori* in children and their mothers living in three socio-economic settings. *Jpn. J. Infect. Dis.*2009; 62, 120–124

4. Yucel O, Prevention of *Helicobacter pylori* infection in childhood. *World J. Gastroenterol* 2014; 10348–10354.

5. Malaty HM, Epidemiology of *Helicobacter pylori* infection. Best Pract. Res. Clin. Gastroenterol. *Helicobacter pylori* 2007; 21, 205–214.

6. Salih BA, *Helicobacter pylori* Infection in Developing Countries: The Burden for How Long? *Saudi J. Gastroenterol. Off. J. Saudi Gastroenterol. Assoc* 2009; 15, 201–207.

7. Hasosah M, Satti M, Shehzad A, Alsahafi A, Sukkar G, Alzaben A, et al, Prevalence and risk factors of *Helicobacter pylori* infection in Saudi children: a three-year prospective controlled study. *Helicobacter* 2015; 56–63.

8. Eterm D, *Helicobacter pylori* infection in children, *Journal of Pediatric Sciences* 2011; 3(4): e102.

9. Hoffmann A, Krumbiegel P, Richter T, Richter M, Röder S, Rolle-Kampczyk U, Herbarth O. *Helicobacter pylori* prevalence in children influenced by non-specific antibiotic treatments. *Cent Eur Journal of Public Health* 2014;22 (1):48-53.

10. Segal I, Otley A, Jacobson K. Low prevalence of *H. pylori* infection in Canadian children: a cross-sectional

analysis, *Canadian Journal Gastroenterology* 2008;22(5):585-489.

11. Senbanjo IO, Oshikoya KA, Njokanma OF. *Helicobacter pylori* associated with breastfeeding, nutritional status and recurrent abdominal pain in healthy Nigerian children. *J. Infect. Dev. Ctries* 2014; 8, 448–453.

12. Kimang'a AN, Revathi G, Kariuki S, Sayed S, Devani SS. *H. pylori* prevalence and antibiotic susceptibility among Kenyans. *Afr Med J* 2010;100(1):53-7.

13. Hestvik E, Tylleskar T, Kaddu-Mulindwa DH, Ndeezi G, Grahnquist L, Olafsdottir E, Tumwine JK, *Helicobacter pylori* in apparently healthy children aged 0-12years in Kampala, Uganda. *BMC Gastroenterol* 2010; 16; 10:62. guyen BV, Nguyen KG Phung CD, Kremp O, Kalach N, Dupont C, Raymond J, Vidal-Trecan G. Prevalence and factors associated with *Helicobacter pylori* infection in children in the north of Vietnam. *Am. J. Trop. Med. Hyg* 2006; 74, 536–539.

14. Nguyen BV, Nguyen KG Phung CD, Kremp O, Ka-lach N, Dupont C, Raymond J, Vidal-Trecan G. Prevalence and factors associated with *Helicobacter pylori* infection in children in the north of Vietnam. *Am. J. Trop. Med. Hyg* 2006; 74, 536–539.

15. Hestvik E, Tylleskar T, Kaddu-Mulindwa DH, Ndeezi G, Grahnquist L, Olafsdottir E, et al. Prevalence of *Helicobacter pylori* in HIV-infected, HAART-naïve Ugandan children. *Journal of International Aids Society* 2011;14; 34.

16. Zekry OA, Abd E. The association between *Helicobacter pylori* infection, type 1 DM, and autoimmune thyroiditis. *Journal of Egypt Public Health Association* 2013; (3):143-7.

17. Dai YN, Yu WL, Ding JX, Yu CH, Li YM. Is *Helicobacter pylori* infection associated with glycemic control in diabetes? *World Journal of Gastroenterology* 2015;21(17):5407-18

18. Candelli C, Rigante D, MariettiG, Nista EC, Gasbarrini A. *Helicobacter pylori*, Gastrointestinal symptoms, and metabolic control in young type 1 DM patients. *Official Journal of the American Pediatrics* 2003; 111;800.