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INTESTINAL PARASITES AND *HELICOBACTER PYLORI* CO-INFECTION AMONG SYMPTOMATIC CHILDREN IN DAMIETTA GOVERNORATE, EGYPT

By

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Abstract

Intestinal parasites and *H. pylori* co-infection has significant global public health impacts on children with high prevalence in developing countries. This study evaluated the intestinal parasites and *H. pylori* co-infections among symptomatic children in Damietta Governorate. A questionnaire including socio-demographic, environmental and behavioral variables, and gastrointestinal manifestations was filled. Morning fecal samples were examined microscopically by direct wet mount smear, formol-ether sedimentation concentration and stained with modified Kinyoun's Acid-Fast, and a rapid qualitative sandwich enzyme immunoassay to identify *H. pylori* antigen in fecal samples. Total parasitic prevalence was 31.9%. *G. lamblia* 20.6% followed by *E. histolytica/dispar* 16.8%, *Blastocystis hominis.* 11.4%. 34.1% of the children had *H. pylori* and 13.1% had intestinal parasites and *H. pylori* co-infection. *H. pylori* and *G. lamblia* co-infections were the most common, followed by *H. pylori* and *E. histolytica/dispar*, and *H. pylori* and *B. hominis*. Children aged 13-18 years and practicing hand wash before and after meal had significantly 29% and 37% lower risk of having co-infection respectively. As well as, gastric reflux and vomiting had significantly related with co-infection by 58% and 43% respectively. Finally, abdominal distension was significantly related with co-infection by 72%. The results showed that the co-infection most commonly protozoa, induced strong Th1 cell polarization, synergize *H. pylori*, aggravates mucosal damage leading serious health consequences. Further studies are imperative to select proper therapy, introduce potent eradication strategies, and to appraise underway control and preventive proceedings of co-infection.

Keywords: Children, Parasites, *Helicobacter pylori*, Co-infection, Damietta Governorate.

Introduction

Intestinal parasitic infections (IPIs) are common throughout the world and remain the primary cause of morbidity and mortality in humans, particularly in children in developing countries (Taghipour *et al,* 2021). In Egypt, intestinal parasites continue to be a major concern despite major efforts to enhance the personal hygiene and environmental sanitary conditions (Omar and Abd-elal, 2022). Children are especially susceptible to infection due to the less awareness, developing immune systems, and high nutritional needs (El-Sherbini and Abosdera, 2013). The anemia, impaired physical and mental development, and dietary deficiencies are all strongly linked to children's IPIs (Taylor-Robinson e *et al,* 2015).

Helicobacter pylori is one of the commonest bacterial infections in man and the fourth leading cause of the cancer-related death, with an estimation of 4.4 billion cases globally (Hooi *et al,* 2017). Over the last three decades, the *H. pylori* infection was 48.9% in adults and 32.3% in children and adolescents worldwide (Chen *et al,* 2024).

A number of factors, including a weakened immune system, low socioeconomic status, a lack of education, drinking tainted water, and having a family history of *H. pylori* infection, contribute to the wide variations in incidence and prevalence rates of *H. pylori* infection in children throughout Africa (Smith *et al,* 2019). The three routes of *H. pylori* transmission are feco-oral, gastro-oral, and oral-oral infections. Also, foodborne,

waterborne, and contact with infected animals transmit infection (Hosni *et al,* 2012).

For successful eradication strategies of the infections and to assess feasible control to the co-infection between intestinal parasites and *H. pylori* by choosing appropriate therapies (Ortiz-Princz *et al,* 2016).

Co-infections can modulate disease dynamics through synergistic or antagonistic interactions, host's immune response significantly influenced by the parasites and *H. pylori* (Engwerda *et al,* 2014). Conversely, intestinal helminthic infection is linked to lymphocyte polarization toward Th2, which enhances the digestive tract's regenerative processes and reduces an overreaction by the immune system (Gause *et al,* 2013). Strong Th1 cell polarization was detected after *H. pylori* infection, and protozoan infection aided in the Th1 cells recruitment, exacerbates the host immune response causing damage to st-omach mucosa (Jaka and Smith, 2024).

This study aimed to evaluate the prevalence of intestinal parasite and *H. pylori* co-infections and risk factors linked to these infect ions among out-patient children suffering from gastrointestinal symptoms in Al-Azhar University Hospital Damietta Governorate.

Material and Methods

A cross-sectional study was carried out between October 2023 and March 2025. Damietta Governorate is in the northeastern Nile Delta, Damietta City; the capital is located 200 kilometers north of Cairo. The majority of inhabitants live in rural areas, with an urbanization rate of 38.7%.

A total of 578 symptomatic children with manifestations suggestive IPIs were selected from the outpatient clinic, Al-Azhar University Hospital New Damietta. They were of both sexes, with ages less than 18 years old. Exclusion criteria were chronic or viral diarrhea, symptoms more than four weeks, and received antibiotic and/or anti-parasitic treatment.

A questionnaire was filled out on each chld's parent/guardian about medical, and socio-demographic history as well as hygienic behaviors and attitudes.

Stool samples collections: Three consecutive morning stool samples were collected in clean labeled disposable carton containers, and immediately transported to Department Parasitology's experimental Laboratory.

Parasitological examination: Fresh stool samples were divided into two parts. First part was macroscopically examined for color, consistency and gravid segments or pinworms and microscopic examinations as direct wet mount smear with or without Lugol's iodine, and modified Kinyoun's Acid-fast stain, formol-ether sedimentation concentration test (Garcia, 2016). Second part was frozen at -20°C for *H. pylori* antigen examination in stool samples by rapid qualitative sandwich enzyme immunoassay (Quick Check ^{TM} Kit, Tech-lab, Inc. Blacksburg, USA).

Based on *H. pylori* stool antigen detection and parasitological examination, childrren was divided into four groups; G1:162 with intestinal parasites, G2: 197 with *H. pylori* infection. G3: 76 with co-infection and G4: 143 children neither have *H. pylori* nor parasitosis as negative control.

Ethical considerations: Ethics Committee of Al-Azhar University, Faculty of Medicine approval to the study, which went with the Helsinki Declarations. A written informed consent was obtained from the parents/guardians of children after being informed about the study purpose.

Statistics: IBM-SPSS 21.0 was used for data verification, coding, and analysis. Descriptive statistics were employed to characterize study participants. Co-infections were the analysis's dependent variable. A bi-variable logistic regression analysis evaluated the associated components, and only variables with $P \leq 0.05$ values in former analysis were included in final model to compensate for likely confounding impact, and was considered significantly and adjusted with odds ratio (AOR) and 95% confidence interval (CI) supported connection.

Results

The intestinal parasites were 31.9%. *G. la-*

mblia was the commonest parasite, followed by *E. histolytica/dispar*, *B. hominis*, *C. parvum*, *E. vermicularis*, *A. lumbricoides*, *H. nana*, *A. duodenale* & *S. mansoni*, and *T. trichuris*. Helminthes were less common than protozoa. Most children suffered a mono-parasite. *H. pylori* were 34.1% of whom 13.1% were co-infected with intestinal parasites mainly protozoa. Total of (578) enrolled children ages between 2 and 18 years old and 41.5% of whom aged 7-12 years old, 56.4% were males, 50.5% were rural inhabiitants, 68.9% had educated mothers, and 61.6% with a low income. But, *H. pylori* infection was more among females.

Hygienic behaviors such as hand-washing, washing raw vegetables and fruits, close animals contact and finger nails were more or less practiced.

The details were in tables (1, 2, 3, 4, & 5).

Table 1: Prevalence of IPIs, *H. pylori* and co-infections among symptomatic children.

Intestinal parasites	No.	Percentage
Giardia lambilia	38	23.5%
Entameba histolytica/dispar	31	19.1%
Blastocystis hominis	21	12.9%
Cryptosporidium parvum	18	11.1%
Enterobius vermicularis	15	9.2%
Ascaris lumbricoides	14	8.6%
Hymenolepis nana	12	7.4%
Ancylostoma duodenale	5	3.1%
Schistosoma mansoni	5	3.1%
Trichocephalus trichuris	3	1.8%
Mono-infection	162	28.1%
Poly-infection	22	3.8%
Total IPIs	184	31.8%
Heliobater pylori antigen in stool: Positive	197	34.1%
: Negative	381	65.9%
H. pylori and intestinal parasites co-infection	76	13.1%
Total	578	100%

Table 2: Frequency of parasites among *H. pylori* positive symptomatic children.

Parasites	*H. pylori*		Total
	Positive	Negative	
G. lamblia	24(14.8%)	14(8.6%)	38(23.5%)
E. histolytica/dispar	18(11.1%)	13(8.0%)	31(19.1%)
Blastocystis spp.	13(8.0%)	8(4.9%)	21(12.9%)
Cryptosporidium spp.	9(5.5%)	9(5.5%)	18(11.1%)
E. vermicularis	4(2.5%)	11(6.8%)	15(9.2%)
Ascaris lumbricoides	5(3.2%)	9(5.5%)	14(8.6%)
Hymenolepis nana	3(1.8%)	9(5.5%)	12(7.4%)
Ancylostoma duodenale	0(0%)	5(3.2%)	5(3.2%)
S.chistosoma mansoni	0(0%)	5(3.2%)	5(3.2%)
Trichocephalus trichuris	0(0%)	3(1.8%)	3(1.8%)
Total	76(46.9%)	86(53.1%)	162(100%)

Table 3: Frequency of symptoms among children.

GI symptoms	IPIs (n = 162)	*H. pylori* (n = 197)	*H. Pylori* & IPIs (n = 76)	Negative (n = 143)	P-value
Abdominal pain (No & %)	102 (62.9%)	128 (64.5%)	47 (61.8%)	75(52.4%)	0.094
Vomiting (No & %)	48 (29.6%)	79 (40.1%)	28 (36.8%)	23(16.1%)	<0.001
Gastric reflux (No&%)	32 (19.7%)	74 (37.6%)	38 (56.7%)	12(8.4%)	<0.001
Diarrhea (No & %)	76 (46.9%)	22 (11.1%)	16 (21.1%)	17(11.9%)	<0.001
Anorexia (No & %)	98 (60.5%)	106 (53.8%)	44 (57.8%)	68(47.6%)	0.138
Abd. distension (No & %)	67 (41.3%)	85 (43.1%)	55 (72.3%)	56(39.2%)	<0.001
Bloody stool (No & %)	9 (5.5%)	2 (1.1%)	5 (6.5%)	1(0.7%)	0.006

Table 4: Sociodemographic characteristics and risk factors among groups.

Sociodemographic characteristics		IPIs No. & % (n=162)	*H. Pylori* No & % (n=197)	Co-infections (No & %) (n=76)	Negative (No & %) (n=143)	P-value
Ages: 2-6 (N=156)		57 (35.2%)	64 (32.5%)	22 (28.9%)	25 (17.5%)	<0.001
: 7-12(N=240)		64 (39.5%)	66 (33.5%)	29 (38.2%)	45 (31.4%)	
: 13-18(N=182)		41 (25.3%)	57 (34.0%)	25 (32.9%)	73 (51.1%)	
Sex :Male(N=326)		89 (54.9%)	95 (48.2%)	41 (53.9%)	82 (57.3%)	0. 368
: Female(N=252)		73 (45.1%)	102 (51.8%)	35 (46.1%)	61 (42.7%)	
Residence: Urban(N=286)		56 (34.6%)	84 (42.6%)	32 (42.1%)	74 (57.7%)	0. 024
: Rural(N=292)		106 (65.4%)	113 (57.4%)	44 (57.9%)	69 (42.3%)	
Mother's education: Educated(N=398)		94 (58.1%)	124 (62.9%)	46 (60.5%)	86 (60.1%)	0. 821
: Non educated(N=180)		68 (41.9%)	73 (37.1%)	30 (39.5%)	57 (39.9%)	
Monthly income : Low(N=356)		97 (59.9%)	102 (51.8%)	42 (55.3%)	76 (53.1%)	0. 462
: Enough(N=222)		65 (40.1%)	95 (48.2%)	34 (44.7%)	67 (46.9%)	
Hygiene-related practices						
Good finger nails hygiene	Yes (n=392)	74 (45.6%)	91 (46.2%)	35 (46.1%)	88 (61.5%)	0. 015
	No (n=186)	88 (54.4%)	106 (53.8%)	41 (53.9%)	55 (38.5%)	
Hand wash before & after meals	Yes (n=346)	79 (48.7%)	69 (35.1%)	28 (36.9%)	91 (63.6%)	<0.001
	No (n=232)	83 (51.3%)	128 (64.9%)	48 (63.1%)	52 (36.4%)	
Hand wash after defecation	Yes (n=298)	63 (38.9%)	64 (32.5%)	29 (38.2%)	45 (31.4%)	0.434
	No (n=280)	99 (61.1%)	133 (67.5%)	47 (61.8%)	98 (68.6%)	
Contact with animals	Yes (n=345)	98 (60.5%)	112 (56.9%)	43 (56.6%)	78 (54.5%)	0.756
	No (n=233)	64 (39.5%)	85 (43.1%)	33 (43.4%)	65 (45.5%)	
Washing raw vegetables	Yes (n=398)	74 (45.6%)	89 (45.2%)	33 (43.4%)	60 (41.9%)	0.913
	No (n=180)	88 (54.4%)	108 (54.8%)	43 (56.6%)	83 (58.1%)	
Total number	578	162 (28.1%)	187 (34.1%)	76 (13.1%)	143 (24.7%)	

Table 5: Logistic regression analyses of associated factors with co-infections.

Variables	OR (95% CI) *	P-value**
Ages: 2-6 years	1 (Reference)	
: 7-12 years	0.82 (0.44-1.50)	= 0.425
: 13-18 years	0.71 (0.28-0.94)	= 0.043
Sex: (Female)	0.94 (0.55-1.47)	= 0.661
Residence (Rural)	1.14 (0.69-1.88)	= 0.122
Mother's Education (Educated)	0.99 (0.61-1.65)	= 0.314
Monthly Income (Enough)	0.91 (0.60-1.63)	= 0.242
Hygiene practices: Good hygiene of finger nails	1.01 (0.67-1.51)	= 0.359
: Hand wash before and after meals	0.63 (0.50-0.93)	= 0.032
: Hand wash after defecation	1.13 (0.68-1.88)	= 0.338
: Contact with animals	0.92 (0.56-1.55)	= 0.316
: Washing raw vegetables	0.91 (0.55-1.48)	= 0.507
GI Manifestations: Abdominal pain	1.10 (0.66-1.93)	= 0.480
: Anorexia	0.94 (0.56-1.57)	= 0.501
: Gastric reflux	0.42 (0.25-0.69)	= 0.031
: Vomiting	1.43 (1.07-2.60)	= 0.042
: Diarrhea	0.96 (0.58-1.58)	= 0.474
: Abdominal distension	0.28 (0.16-0.48)	= 0.022
: Bloody stool	0.45 (0.15-1.33)	= 0.331

*OR=Odds Ratio; CI, Confidence Interval

Discussion

Generally speaking, *H. pylori* co-infected with intestinal parasites modulate disease dynamics via synergistic and/or antagonistic interactions, with stronger Th1 cell polarization (Krzyżek and Gościniak, 2017).

In the present study, intestinal parasites were in 31.8% of children with symptoms, protozoa were more common than worms.

This agreed with Ibrahim *et al.* (2019) in the Greater Cairo, and Ahmed and Abu-Sheishaa (2022) in Dakahlia Governorate, they reported that IPIs prevalence was 28.6% and 32.9%, respectively. But, it was less than 58.6% intestinal parasites in Cairo Governorate (Abd El Hameed *et al*, 2021).

In the present study, *G. lamblia* was the most common parasite 20.6% (38/184), foll-

owed by *E. histolytica/dispar* 16.8% (31), *B. hominis* 11.4% (21), *C. parvum* 9.8% (18), *E. vermicularis*, *A. lumbricoides*, *H. nana*, *A. duodenale*, *S. mansoni*, and *T. trichuris*. The intestinal protozoa (67.4%) were the commonest co-infection than the intestinal helminthes (32.6%).

In the present study, symptomatic children 28.1% (162/578) had a mono-parasite, and 3.8% (22/578) had poly-parasites. Generally, gastrointestinal protozoa prevalence was hiher among the Egyptian patients (Mohanmad *et al*, 2012; Al-Agroudi *et al*, 2016; El-Bahnasawy *et al*, 2018).

In the present study, *H. pylori* infection was 34.1%. This more or less agreed with Ibrahim *et al.* (2019) who reported 36.3%. Abroad, Zamani *et al.* (2018) in Iran reported 32.6%, Shiferaw and Abera (2019) in Ethiopia reported 29% Aniekwe *et al.* (2024) in Nigeria reported 33.77%, and Elmas and Akçam (2024) in Turkey reported 36.8%.

In the present study, *G lamblia* was the most common parasite accounted 23.5%, with 63.2% of them were co-infected with *H. pylori*. This indicates that co-infection by both organisms was the highly common (Ibrahim *et al*, 2019; Morsy *et al*, 2023; Aklilu *et al*, 2024). The high rate of both infections was the urease's generation, which lowers acid levels and creates an environment favorable for *G. lamblia* vitality and multiplication, as to *E. histolytica* and gut flora, but didn't intensify the giardiasis clinical picture (Berrilli *et al*, 2012).

The *H. pylori* and intestinal parasites co-infection was reported globally (Seid *et al*, 2018; Abd El-Hameed *et al*, 2021; El-Aska- ry *et al*, 2021; Wondmagegn *et al*, 2025). Both share in, GIT colonization and are prevalent in children (Escobar-Pardo *et al*, 2011; Sabah *et al*, 2015). Furthermore, a potential share of risk factors, modes of transmission, gastrointestinal symptoms, low socioeconomic position, and unsanitary settings may be the cause of both illnesses co-occurring (El-Badrey *et al*, 2015). Undoubtedly, the co-infection of *H. pylori* and with IPIs were risk factors for one another, which cause detrimental health effects with impa- cted by environmental variables and human hosts (Ibrahim *et al*, 2019). However, a parasite infection in the gastrointestinal tract may influence the inflammatory reaction to *H. pylori* (Abd Elbagi *et al*, 2021).

In the present study, co-infection preval- ence among the intestinal symptomatic children was 13.1% (76/578), and the most com-mon co-infections were *H. pylori* and *G. la-mblia*, followed by *H. pylori* and *E. histolytica/dispar*, and *H. pylori* and *Blastocystis* hominis. This agreed with Demirel and Ev-ren (2020) in Turkey, who found that parasites and positive *H. pylori* antigen in stools was (12.3%). Taghipour *et al.* (2022) in Iran reported 11% and Mina *et al.* (2024) in Lebanon reported 11.8% in among children and adolescents.

However, Ibrahim *et al.* (2019) and Osman *et al.* (2024) found greater prevalence rates in other Egyptian research, with 43.9% and 42% of cases, respectively, substantially associated with *G. lamblia*, and *C. parvum*. The findings of Ghallab and Morsy, (2020) in Egypt, who discovered that 83.8% of patients with *H. pylori* were also co-infected with *G. lambelia*, *E. histolytica*, *C. parvum*, and *B. hominis*, were higher than our findings. Schmid *et al.* (2021) reported that *H. pylori* and *G. lamblia* were significant and frequent causes of gastrointestinal diseases in Switzerland. Additionally, in patients with chronic diarrhea, Yakoob *et al.* (2018) disc- overed a substantial association between *H. pylori* and *E. histolytica* and *Blastocystis* spp. infections. This discrepancy may result from differences in how the preventative and control strategies were applied and the populations studied

In the present study, there was significant differences in age, and residence ($P<0.05$), but without significant as to sex, mother's education, or monthly income with nearly identical compositions of various variables across all groups ($p>0.05$). This agreed with Elnadi *et al.* (2015) in Egypt who reported that the intestinal parasites usually cause benign diseases, though they may induce complications with high morbidity and mortality to the immunocompromised persons

In the present study, abdominal pain, anorexia, diarrhea, and distension were the most frequently reported complaints among children with parasitic infection. Also, Ibrahim *et al.* (2019) and Abd El-Hameed *et al.*

(2021) reported significant correlation between parasitic infections and the abdominal pain and/or diarrhea. However, in addition to abdominal pain, anorexia, and distension, vomiting and gastric reflux were more frequently recorded in *H. pylori* infection.

Among children who were co-infected, the most common complaints were gastric reflux, anorexia, distension, and abdominal pain. This agreed with Mina *et al.* (2024), who reported vomiting was the most frequent complaint in co-infected children, and gastric reflux was significantly associated with *H. pylori* infection. This variation in symptoms could be explained by the fact that intestinal parasites (lower GIT) and *H. pylori* (upper GIT) have different habitats of infection. Various gastrointestinal symptoms found in the negative group were ascribed to the existence of additional unidentified infectious viral, bacterial, and/or noninfectious dietary reasons.

In the present study, *H. pylori* infected children; diarrhea was not mentioned as a major symptom (11.1%), which was less common than in other groups. In contrast to what we expected, the frequency of diarrhea was significantly lowered in cases (21.1%) of co-infection than in IPIs (46.9%) patients alone ($P<0.001$). This more or less agreed with Mina *et al.* (2024), they reported that children with intestinal parasite infections (30.8%; $p = 0.013$) had more severe diarrhea than co-infected children (24.7%). It has been reported that children who test positive for *H. pylori* have a lower risk of developing diarrhea than children who test negative, particularly during the giardiasis infection (Abd El Hameed *et al*, 2021).

In the present study, there were five factors associated with co-infection i.e., cases aged 13-18 years had significantly 29% lower risk of having co-infection. Also, practicing hand-wash before and after meal was significantly correlated with 37% decreased risk of having co-infection. As well, gastric reflux was significantly related with co-infection by 58%. Besides, cases with co-infection had 43% significantly more probability of vomiting, and abdominal distension was significantly (72%) due to co-infection. This agreed with Almaw *et al.* (2024), they reported that both *H. pylori* and intestinal parasites, mainly protozoa are transmitted feco-oral, and more or less the inadequate human hygiene measure.

Conclusion

In spite of the increased improvement in sanitation and hygiene in Egypt, intestinal parasites mainly protozoa and *H. pylori* co-infection strongly induced Th1 cell polarization, aggravates gastric mucosal damage, and leading to serious health consequences.

The studies on potent eradication strategies, and preventive proceedings of co-infection are ongoing and will be published in due time elsewhere.

Recommendation

Illustrative health education is must at least to schoolchildren and secondary school students levels.

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