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# *Helicobacter Pylori* infection among asymptomatic schoolchildren: Link with parental educational level

*Infección por Helicobacter Pylori en escolares asintomáticos: Relación con el nivel educativo de los padres*

**Pedro Antonio López Gutiérrez[1], Alexandra Marcela Palma Gonzáles[1], Sarah Angelly Membreño Soto[2], Gabriel Isaías Rodriguez Lagos[1], Wadia Marie Simón Andonie[2], Blanca Nelys Licona Hernández[2]**

*1. Catholic University of Honduras. Faculty of Medicine, General Practitioner*
*2. Catholic University of Honduras. Student of General Medicine*

**Corresponding author**
Pedro Antonio López Gutiérrez
E-mail: unicahinvestigacion20219@gmail.com

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## Abstract

***Objectives:*** Helicobacter pylori is a bacterium that infects the gastric mucosa and causes both local and systemic diseases in children and adults. We aimed to establish Helicobacter pylori prevalence in the population studied and relate its presence with known risk factors for its infection, including parental educational level and nutritional variables.
***Methods:*** This was an analytical cross-sectional study conducted in a public school in Tegucigalpa, Honduras, in August 2019, where 101 students between 6 and 12 years old were randomly selected after the signing of an informed consent form by their legal guardians and the child's own acceptance. Subsequently, a demographic survey was completed, and a stool sample was obtained from the participants to detect Helicobacter pylori antigen.
***Results:*** Of the 101 schoolchildren studied, 18 (17.82%) tested positive. The mean age of participation was 8.9 ± 1.88 years, 58.4% female, 42.6% male. Educational level of the mother and father in relation to the prevalence of Helicobacter pylori had an odds ratio: 6.8 (CI 95: 2.17 - 21.63) and odds ratio: 5.7 (1.45 - 23.8), respectively.
***Conclusions:*** The prevalence of Helicobacter pylori was lower than in similar studies carried out in developing countries, and higher than in research on populations in developed countries. A relationship was identified with the educational level of both parents. No association was found with age, gender, body mass index, overcrowding, housing characteristics, access to basic services, pet ownership, family history of Helicobacter pylori infection or gastric cancer.

*Key words: Helicobacter pylori, prevalence, education, body mass index.*

## *Resumen*

***Objetivos:*** Helicobacter pylori es una bacteria que infecta la mucosa gástrica y que causa enfermedades tanto locales como sistémicas en niños y adultos. El objetivo fue establecer la prevalencia de su infección en la población estudiada y relacionar su presencia con factores de riesgo conocidos, incluyendo el nivel educativo de los progenitores.
***Métodos:*** Estudio analítico, transversal, en una escuela pública de Tegucigalpa, Honduras, en agosto de 2019, donde se seleccionaron aleatoriamente 101 escolares entre 6 y 12 años, previa firma de un consentimiento informado por parte de sus tutores legales, y la aceptación del propio infante. Se completó una encuesta sociodemográfica y se obtuvo una muestra de heces de los participantes para detectar el antígeno de Helicobacter pylori.
***Resultados:*** De 101 escolares estudiados, 18 (17.82%) dieron positivo. La edad media de participación fue de 8.9 ± 1.88 años, 58,4% mujeres y 42.6% hombres. El nivel educativo de la madre y del padre con respecto a la positividad de Helicobacter pylori tuvo un odds ratio: 6.8 (IC 95: 2.17 - 21.63) y odds ratio: 5.7 (1.45 - 23.8), respectivamente.
***Conclusiones:*** La prevalencia de Helicobacter pylori fue inferior a la de estudios similares realizados en países en vías de desarrollo, y superior a la de investigaciones realizadas en poblaciones de países desarrollados. Se identificó una relación con el nivel educativo de ambos padres. No se encontró ninguna asociación con la edad, sexo, índice de masa corporal, hacinamiento, características de la vivienda, acceso a los servicios básicos, posesión de animales domésticos, antecedentes familiares de infección por Helicobacter pylori o de cáncer gástrico.

*Palabras clave: Helicobacter pylori, prevalencia, educación, índice de masa corporal.*

## Introduction

Initially classified and described by a team of Australian physicians through gastroscopic biopsies of the antral muscosa[1], Helicobacter pylori (H.pylori) is a microaerophilic, 4- to 6-flagellated, urease-, catalase- and oxidase-producing, spiral-shaped, gram-negative bacillus-like bacterium[2], that has the capacity to invade the gastric mucosa and reduce the natural acidity of this tissue, thus enabling it to survive in this environment and contribute to the deterioration of human health[3,4].

Even though its infection can occur asymptomatically[5], within the spectrum of diseases to which H. pylori has been related to, in the adult population, we encounter a span extending from chronic gastritis, gastroduodenal ulcer, and vitamin B12 deficiency[6-8], all the way to esophageal and gastric adenocarcinoma and gastric mucosa-associated lymphoid tissue lymphoma (MALT), being neoplasms its most feared consequence[9-11]. In fact, the International Agency for Research on Cancer categorized it as a type I carcinogenic agent due to evidence that demonstrates both a correlative and etiological relationship with gastric cancer in human beings[12,13].

Then again, in children, idiopathic thrombocytopenic purpura has been described as a disease related to H. pylori infection[14], as well as a decreased growth rate and the development of iron deficiency anemia due to the presence of the sabA gene, an encoder of one of the adhesin type proteins in H. pylori[15,16]. In a literary review of international studies published between 1991 and 2014, researches from the University of Urmia, Iran, not only demonstrated the presence of iron deficiency anemia in infected individuals but also the resolution of refractory cases, of the aforementioned type of anemia, once H. pylori was eradicated[17].

Its role as a carcinogenic agent and its connection with a multiplicity of diseases has motivated a variety of studies, including research on the extent of its worldwide presence. Regarding this, prevalence rates corresponding to 79.1% in the African region, 63.4% in Central America and the Caribbean, 54.7% in Asia, 47% in Europe, 37.7% in North America and 24.4% in Oceania have been exposed; figures derived from the analysis of data of studies in the general population from 1970 to 2016[18]. Then again, pediatric population data suggest prevalences higher than 80% in Oceania, higher than 50% in Africa, about 45% in Central America and the Caribbean, about 30% in Asia, less than 20% in Europe and close to 15% in North America[19].

For both adults and infants the prevalence of H. pylori fluctuates widely depending on the characteristics of the population studied. Therefore, although the regions of Europe, North America, and Oceania present a low prevalence for the general population compared to Latin America, Africa and Asia, even within these territories there are significant variations according to the subpopulation studied[19]. Thus, we find in children figures as low as 3.4% in Iceland, close to 24% in Poland and over 40% in indigenous communities in Canada[20-22]. In Latin American, Asian, and African countries, specific analyses of pediatric subpopulations have also shown results ranging from 14.2% in Ghana, 44.3% in Uganda, 41.2% in Ecuador, 77.3% in Colombia, and 31.7% in the United Arab Emirates[23-27].

Regardless of the differences between subpopulations in countries with similar statistical background for Helicobacter pylori, it has been shown that the prevalence in the general population has decreased significantly since 2000 for the territories of Oceania, North America, and Europe; in contrast to Asia and Latin America, where it has remained constant as a plateau, and Africa, where the scarce amount of data prior to the year 2000 does not allow for comparison[18].

Generally, the acquisition of the bacterium, whose onset is suggested to occur during infancy[28-30], is explained by its apparent routes of transmission, being oral-fecal, oral-oral and gastro-oral, the ones proposed[31-33]. Although not necessarily mutually exclusive, the three of them are more likely to occur in conditions of overcrowding, poor hygiene, contact with domestic animals, parental low educational level in pediatric cases, open defecation, and ingestion of uncontrolled or poorly treated water, among other risk factors[34-36], reaching prevalence figures close to 99% in these circumstances[37,38].

In Honduras, the data obtained estimates prevalences ranging from 84.7% in adults in the western part of the country[39], and between 61% and 64% in hospital-based studies in adults with gastric symptomatology[40,41].

In accordance with the information stated above, the present investigation aims to report the prevalence of Helicobacter pylori in schoolchildren ages 6 to 12 years from an urban school in the city of Tegucigalpa, capital of Honduras, and its association with known risk factors.

## Methods

This is an analytical cross-sectional study carried out in August 2019 in asymptomatic children enrolled in the Escuela Mixta Los Robles, located in neighborhood Los Robles, in the urban area of Tegucigalpa. The inclusion criteria included age between 6 and 12 years old, active enrollment in Escuela Mixta Los Robles, Honduran nationality, and signature of informed consent by the legal guardians

and assent of the ward. The exclusion criteria included having gastrointestinal symptoms in the last 15 days and ingestion of antibiotics, proton pump inhibitors, histamine 2 receptor antagonists or bismuth in the last 30 days, due to a decrease in the performance of the stool antigen detection test in these situations[42,43].

The project was approved by both the Institutional Review Board of the Catholic University of Honduras, complying with the Helsinki Declaration, and the local board of education. Meetings were held with the teachers and an informed consent form was sent to each parent explaining the details of the study so that they could evaluate the possibility of participating in the research. A total of 129 signed informed consents were received, after which 101 participants were randomly selected after sample size and sample method were determined using EpiInfo 7.2.4.0 and STATS 2.0, with 5% margin of error and 95% confidence interval.

Measurements of weight and height were taken with a calibrated analog body weight scale and a metal strip tape measure. Each child was given a survey to be answered at home by their legal guardians to be returned on the days of the stool sample collection. A total of 101 stool samples were obtained over 5 collection days. Two new children were included after two of the originally selected failed to provide the stool sample.

To obtain the stool sample parents were provided with a collection jar to deposit it in, instructing them that the sample should be obtained in the morning before the infant attended school or, failing that, to collect an overnight stool sample to be kept in an icebox or refrigerator for no more than 24 hours before its delivery to the research team.

Upon delivery, each sample was placed in an icebox at a temperature of 5 degrees and then transferred to the laboratory 4 hours later where tests were run by means of a qualitative enzyme adsorption immunoassay. The sensitivity and specificity reported for the Quantitative Fecal H. pylori Antigen ELISA Kit according to the manufacturer is, under the indicated conditions, 100% of both specificity and sensitivity[44].

101 stool samples were processed. A sample was considered positive when it was above the cut-off index suggested by the manufacturer, which was greater than 1.1 for the qualitative cut-off index.

The results were computed in Excel 365 and analyzed with EpiInfo 7.2.4.0 statistical software. For the association of H. pylori with categorical variables, the chi-square or Fisher test was used as appropriate, and for numerical variables, the T-student test was used. Statistical significance was considered $p < 0.05$.

## Results

According to the sociodemographic variables of the schoolchildren participating in this study, it was evident that the prevailing sex was female, with 57.42% girls and 42.58% boys. The average age was 8.97 years old with a standard deviation of 1.88. The prevalence of Helicobacter Pylori infection in school children aged 6 to 12 years in an urban educational unit in Tegucigalpa, Honduras, was of 17.82 % (IC:95 10.92 % - 26.7%) due to 18 positive tests out of 101 samples analyzed, as shown in **table I**.

Open defecation was nonexistent among the infants studied, with 98.02% having access to a flush toilet and 1.98% having access to a latrine. All the children ingested drinking water in their homes and 96.04% of their homes also used it for cooking. The type of construction floor of each house was reported as 82.28% ceramic and 17.82% cement; no parent reported that the house they currently lived in had dirt floors. Exactly 47.52 % stated that their dwelling houses had brick walls, while 44.55 % reported they had block walls, 5.94 % wooden walls, and 1.98% adobe walls.

Regarding the relationship of risk factors with Helicobacter pylori infection, statistical significance was found, with $p < 0.05$, for the educational level of the parents as shown in **table II**; 36.1 % of the children of mothers with completed or incomplete primary school were positive compared to 8.33 % of the children of mothers with more than 9 years of schooling. On the other hand, 28.1 % of the children of fathers with complete or incomplete primary schooling were positive compared to 6.25 % positivity for those whose fathers have more than 9 years of schooling.

**Table I:** Frequency distribution of Helicobacter pylori presence among schoolchildren 6-12 years old.

| Variable | Frequency | Percentage |
|---|---|---|
| Helicobacter pylori (+) | 18 | 17.82 % |
| Helicobacter pylori (-) | 83 | 82.18 % |
| Total | 101 | 100 % |

**Table II:** Parent´s educational level and its relationship to Helicobacter pylori prevalence among schoolchildren 6-12 years old.

| Evaluated factors | | Presence of H. pylori | | OR (IC:95) | p - value |
|---|---|---|---|---|---|
| | | Yes | No | | |
| Mother´s educational level | More than 9 years of schooling | 5 | 60 | 6.8 (2.17-21.63) | 0.000351 |
| | 9 years of schooling or less | 13 | 23 | | |
| Father´s educational level | More than 9 years of schooling | 3 | 45 | 5.7 (1.45-23.8) | 0.0105 |
| | 9 years of schooling or less | 9 | 23 | | |

**Table III:** Relationship between other risk factors and Helicobacter pylori prevalence among schoolchildren 6-12 years old.

| Other risk factors studied | | Presence of H. pylori | | OR (IC:95) | p - value |
|---|---|---|---|---|---|
| | | Si | No | | |
| Age | 6 to 8 years<br>9 to 12 years | 5<br>13 | 30<br>53 | 0.68<br>(0.22-2.09) | 0. 498 |
| Sex | Male<br>Female | 8<br>10 | 35<br>48 | 1.1<br>(0.39-3.06) | 0.859 |
| School grade | 1 - 3<br>4 - 6 | 6<br>12 | 31<br>52 | 0.84<br>(0.29-2.46) | 0.748 |
| Abnormal BMI | Yes<br>No | 10<br>8 | 35<br>48 | 1.71<br>(0.61-4.69) | 0.3 |
| Shares sleeping room | Yes<br>No | 16<br>2 | 66<br>17 | 2.06<br>(0.43-9.84) | 0.513 |
| Shares bed | Yes<br>No | 11<br>7 | 42<br>41 | 1.53<br>(0.54-4.34) | 0.418 |
| Has pets at home | Yes<br>No | 10<br>8 | 41<br>42 | 1.28<br>(0.46-3.57) | 0.636 |
| Number of adults at home | More than 3<br>3 or less | 7<br>11 | 40<br>43 | 0.68<br>(0.24-1.94) | 0.473 |
| Number of children at home | More than 3<br>3 or less | 6<br>12 | 27<br>56 | 1.04<br>(0.35-3.06) | 0.947 |
| Overcrowding | Yes<br>No | 4<br>14 | 23<br>60 | 0.75<br>(0.22-2.5) | 0.774 |
| Monthly economic income | More than 10,000 L.*<br>Less than 10,000 L. | 9<br>9 | 60<br>23 | 2.61<br>(0.92-7.39) | 0.065 |
| Family history of Helicobacter pylori | Yes<br>No | 6<br>12 | 23<br>60 | 1.3<br>(0.44-3.89) | 0.633 |
| Family history of gastric cancer | Yes<br>No | 1<br>17 | 11<br>72 | 0.39<br>(0.05-3.19) | 0.688 |

* L. Stands for Honduran currency: Lempira. As of August 2019: L. 24.4 = 1 USD https://www.bch.hn/estadisticos/GIE/_layouts/15/WopiFrame.aspx?sourcedoc=%7B90EEBD7C-D458-446A-AB96-FF39D6D7CB00%7D&file=Precio%20Promedio%20del%20D%C3%B3lar%20-%20Serie%20Mensual.xlsx&action=default

**Table IV:** Frequency distribution of nutritional variables regarding Helicobacter pylori presence among schoolchildren 6-12 years old.

| Studied variables | | Helicobacter pylori (+) | Total (%) |
|---|---|---|---|
| BMI for age | Normal<br>Risk of overweight<br>Overweight<br>Obesity | 8 / 56 (14.28)<br>5 / 24 (20.8)<br>4 / 18 (22.2)<br>1 / 3 (33.3) | 56 /101 (55.4)<br>24/101 (23.8)<br>18/101 (17.8)<br>3/101 (3) |
| Height for age | Normal | 18 /101 (17.8) | 101 /101 (100) |

For the other risk factors evaluated in **table III**, such as age, sex, school grade, BMI, room sharing, bed sharing, pets at home, adults at home, children at home, overcrowding, economic income, family history of H. pylori, and family history of gastric cancer, no statistically significant association was found.

As height for age and BMI for age are nutritional variables, they were evaluated according to the WHO growth charts for children and adolescents between 5 and 19 years of age, the results are shown in **table IV**. No statistically significant difference was shown for BMI and Helicobacter Pylori.

## Discussion

The prevalence of H. pylori obtained in this study was obtained by stool antigen detection due to its wide application in microbiology, cost, high sensitivity and specificity, and because it is a non-invasive method[45]. El-Shabrawi et al. demonstrated in Cairo, Egypt the applicability of the stool antigen test in children, detecting a sensitivity between 89% and 98% and a specificity between 94 and 100%; only slightly lower than the C-13 urea breath test whose operation implies higher economic costs for laboratories and less tolerance by infants[46]. Other non-invasive methods include serological tests and molecular tests on saliva and stool samples[47].

Regarding the results obtained according to the objectives of the study, the prevalence of H. pylori in the population studied, 17.8%, contrasts considerably with other national results in which a higher prevalence of H. pylori than that reported in our study has been stated. In 2006, Morgan et al. identified that 85% of the asymptomatic adult population participating in their study in the western part of the country had a positive seroprevalence[40] Subsequently, in 2013, through positive cultures of gastric biopsies, Morgan et al. also reported 61.4% of 189 adult patients with gastric symptomatology in Hospital de Occidente, as carriers of Helicobacter pylori[39].

In both cases, the conditions of space, time, and population in which the study was carried out should be considered, since although the decline in the prevalence of H. pylori has been demonstrated mainly

in the inhabitants of socioeconomically developed territories [48-50], similar behavior has also been observed in increasingly industrialized countries such as China and Brazil, where its decrease has been attributed to better living conditions[51,52]. Therefore, the high percentage coverage of flush toilets, the absence of open defecation, the construction materials used in dwellings, the high consumption of drinking water, and the pediatric study population probably explain the low prevalence found.

Similarly, in Jordan, a developing country, Eyad Altamimi et al. found in 2019 that the prevalence of H. pylori for asymptomatic pediatric patients, probed by carbon 13 breath test, stood at 14.6 % for infants aged 4 to 17 years, and 25% for those aged 6 to 11 years[53]. In sub-Saharan Africa, in 2017, a study conducted in Ghana by Awuku et al. demonstrated a prevalence, by stool antigen, of 14.2 percent in pediatric villagers aged 5 to 16 years and 14.5 percent in patients aged 5 to 10 years. In those positive patients, open defecation, female gender, and source of drinking water represented risk factors[23].

Regarding the educational level of the mother, at least since 2001 information has been obtained identifying it as a risk factor for H. pylori infection, as demonstrated by Malaty et al. when they studied 356 children between 2 and 16 years of age from the Houston area in the United States between 1996 and 1998, obtaining statistically significant results regarding maternal education as a risk factor with p<0.001 for mothers who had not completed at least 12 years of education[54]. Later Galal et al. examined 630 Egyptian children with gastric symptomatology and found a prevalence of 64.9 % by stool antigen detection and an association between illiterate mothers and stool antigen positivity for H. pylori[55].

In our study, statistically significant differences were found for H. pylori positivity according to the educational level of both parents, not only the mother, taking 9 school years as the cut-off educational level, since in Honduras, according to article 22 of the Fundamental Law of Education published in 2012, basic education consists of 9 years of compulsory schooling[56]. Similarly, in Portugal, Bastos et al. found a lower prevalence in adolescents whose parents had a higher level of education[57]. Wangda et al. also found a similar association in children from 8 public schools in Bhutan where H. pylori positivity reflected a statistically significant difference when comparing children of college-educated mothers with those of non-college educated mothers[58]. Muhsen et al. obtained, in 2012, an association between the fathers' educational level and H. pylori positivity by dividing male parents into 2 groups: those with more than nine grades of schooling and those with less than nine grades of schooling. With respect to the mothers' education, no significant differences were found in that study[59].

The statistical results between the association of Helicobacter pylori and body mass index has sometimes proven to show contradictory data. Previously, Arslan et al. had shown some association in their analysis of 103 obese adult patients and 111 controls, regarding Helicobacter pylori infection and BMI, obtaining results with statistical significance $p < 0.01$ and odds ratio greater than two[60]. Chen et al. also obtained results showing an association between body mass index and H. pylori infection, specifically in adult patients under 50 years of age[61]. However, in pediatric patients, associations inversely proportional to BMI have been found, where after H. pylori eradication this parameter increases[62], even reaching morbid obesity levels[63]. Moran - Lev et al. showed the same phenomenon in symptomatic Israeli children diagnosed by means of gastric biopsies; 31% of the non-infected children presented obesity or overweight, in contrast to the infected children, of only whom 11% presented obesity, generating a statistically significant difference, suggesting an inverse relationship between the ordinal value of BMI and H. pylori positivity[64]. The results of our project have yielded data with no significant statistical difference between BMI, both in its ordinal and numerical values, and H. pylori infection, as can be seen in the publications of Pundak et al. and Choi et al. where, in the former, they report the lack of relationship between obesity or overweight and infection by H. pylori infection[65] whereas in the latter they report that after eradication of the bacteria, the treated infants presented a significantly greater weight gain than those who were not treated, without specifying whether or not the magnitude of the weight gain caused them to move from one BMI category to another[66]. The present investigation did not have the scope to treat infants with positive results.

## Conclusions

More studies covering larger populations will be needed to confirm H. pylorí's prevalence in children. Nonetheless, within the scope of the present report, a lower prevalence was found when compared to similar studies. Moreover, a particular association was observed between the lower educational level of both parents and Helicobacter pylori stool antigen positivity.

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### Conflict of Interests

The authors have no conflict of interest.

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