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NUTRITIONAL STATUS OF *HELICOBACTER PYLORI*–INFECTED CHILDREN IN GUATEMALA AS COMPARED WITH UNINFECTED PEERS

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Abstract. The effect of *Helicobacter pylori* infection on the nutritional status of children in a developing country was studied using a cross-sectional design. Children attending an all-girl public school in inner Guatemala City, Guatemala were evaluated to acquire sociodemographic information and anthropometric nutritional parameters (weight-for-height [WFH] and height-for-age [HFA]), and detect *H. pylori*-specific serum IgG antibodies. Of 211 children 5–10 years of age, 107 (51%) were infected. The WFH values were not different between infected and uninfected subjects, and were not affected by the sociodemographic variables. The HFA values decreased significantly with age ($P = 0.008$), lower income ($P = 0.04$), and *H. pylori* infection ($P = 0.05$). When controlled for age and income level, the effect of infection on HFA became nonsignificant ($P = 0.30$). *Helicobacter pylori* appeared to have no effect on the nutritional status of the studied children; the differences detected were small and likely due to sociodemographic factors.

Helicobacter pylori is now recognized as one of the most common chronic bacterial infections in the world.[1] Most infections are acquired during childhood,[2] with reported prevalences of 50–80% among children in Latin America and Africa,[3–6] and 25% in the United States.[7] In adults, infection by this bacterium has been linked to gastritis, peptic ulcer disease, and gastric cancer.[8] Similar data are being gathered for children, but the full spectrum of manifestations of the infection is still under investigation.[9,10]

Some studies have supported an association between *H. pylori* infection and malnutrition in developing countries.[3,5] These studies described that children with persistent diarrhea and malnutrition harbored the infection more frequently than controls, and that acquisition of the infections predated the growth impairment. Similar evidence has been gathered by studies in developed countries. In the United Kingdom, Patel and others[11] found a blunting of the growth spurt of preadolescent females infected with *H. pylori*, and other investigators described diminished adult height among infected subjects (Mendall MA and others, unpublished data). However, this issue remains controversial, since other studies have failed to identify an association between the presence of *H. pylori* infection and impaired nutritional status.[12–14]

Differences in study design and populations could account for some of the disparate results. Additionally, an important factor is the degree to which confounding variables have been controlled. For example, sociodemographic factors and access to nutrients are strongly linked and they affect importantly both the prevalence of *H. pylori* infection and the presence of malnutrition. Here, we report our experience with children in Guatemala City correlating the presence of *H. pylori* infection to their anthropometric nutritional parameters.

METHODS

The study was performed in an all-girl school of inner Guatemala City during March 1998. All students 5–10 years of age (estimated number = 380) were invited to participate in the study. The study was approved by the Institutional Review Board of Louisiana State University School of Medicine and was reviewed by the Ethics Committee at the Instituto de Nutrición de Centro América y Panamá. Consent was obtained from the parents of all participating subjects and assent was obtained from children more than 7 years of age.

A questionnaire requesting sociodemographic information (age, family income, household crowding, education level of head of household, and bed-sharing) was given to be completed by the child's parents. Also, at enrollment weight and height were obtained from the participating children. Weight was measured with an electronic scale (Mettler-Toledo Inc., Hightstown, NJ) and height was measured with a conventional stadiometer. The nutritional status of the individuals was estimated calculating the ponderal indices weight-for-height (WFH) and height-for-age (HFA) expressed as standard deviation (SD) units (z-score) of international reference growth charts, as recommended by the World Health Organization.[15] The z-scores were calculated using the Program for Nutritional Anthropometry of Epi-Info version 5 (Centers for Disease Control and Prevention, Atlanta, GA) software.[16] For females, the program provides HFA z-scores for subjects less than 18 years of age and WFH z-scores for subjects less than 10 years of age.

A blood sample was also obtained from all participating children, centrifuged, and the serum was collected and frozen until all samples were collected. Sera were then analyzed for the presence of *H. pylori*-specific IgG antibodies using an enzyme immunoassay (HM-CAP; Enteric Products Inc., Stony Brook, NY). Specimens were tested in duplicate, using control sera, and according to the manufacturer's specifications.[17]

Statistical analyses were performed using Epi-Info version 5 and SPSS version 6.1 (SPSS, Inc., Chicago, IL) software. Two-group comparison of continuous variables used the Student's *t*-test for normally distributed data or, otherwise, the nonparametric Mann-Whitney rank sum test. Comparison of proportions used the chi-square test with Yates' correction. The effect of multiple variables was evaluated with logistic regression if the dependent variable was categorical, or multiple linear regression analysis if the dependent variable was continuous (method: Enter; probability $F_{in} = 0.05$; probability $F_{out} = 0.10$). A P value < 0.05 was considered significant for two-tailed tests.

TABLE 1
Sociodemographic characteristics according to *Helicobacter pylori* infection status

Characteristic	*H. pylori*-positive	*H. pylori*-negative	*P*
Number	107	104	
Age (years)*	9.0 (5–10)	7.0 (5–10)	<0.0001
Monthly income (US $)*	130 (15–400)	160 (30–550)	0.13
Crowding (no. persons/room)*	2.3 (0.6–7.0)	2.0 (0.2–6.0)	0.02
Bed sharing†			
Yes	51	44	
No	38	47	0.29
Head of household education†			
Primary	35	37	
Secondary	27	25	
Superior	30	19	0.38

* Values are the median (range); Mann-Whitney rank sum test.
† Values are the number of subjects in each category; chi-square test.

RESULTS

Of the 380 subjects approached 211 (56%) agreed to participate and were enrolled in the study. All were females, with a median age of 8 years (range = 5–10). Their median monthly household income was 900 quetzals (range = 100–3,500) (6.3 quetzals = US$ 1). One hundred seven children (51%) tested positive for IgG antibodies to *H. pylori.* The infected subjects were older and lived in more crowded households (measured as the number of occupants per room in the household) than uninfected ones, as shown in Table 1. Logistic regression analysis identified an independent effect of both age ($P < 0.0001$) and crowding ($P = 0.01$) in the rate of *H. pylori* infection.

The WFH z-scores were available for only 167 of the 211 children enrolled in the study because, for females, the Epi-Info program provides these values only for subjects less than 10 years of age. The mean ± SD WHF z-score for the total group was 0.58 ± 1.16 and 4 (2.4%) children had a value < −2. For most (i.e., 4 of 5) age groups, uninfected subjects tended to have a higher WHF z-score than infected ones (Table 2). However, the differences were small, (on average 0.25 SD units), and not statistically significant for the overall group ($P = 0.25$). Also, two-variate analyses showed that WFH values were not affected by the sociodemographic variables.

The HFA z-scores were calculated for all 211 children. The mean ± SD HFA z-score for the total group was −0.84 ± 1.03 and 24 (11.4%) children had a value < −2. Again, for most (i.e., 5 of 6) age groups the uninfected children tended to have a higher HFA z-score than infected ones (Table 3). The difference was small (on average 0.21 SD units) and close to the significance level for the total group ($P = 0.05$). Two-variate analyses showed that HFA was also significantly lower among children of older age ($P = 0.008$) and lower income ($P = 0.04$). On multivariate analysis, inclusion of the sociodemographic variables (age and income) in the model nullified the effect of *H. pylori* infection on HFA values ($P = 0.30$).

DISCUSSION

Ample epidemiologic information has shown that infections by the bacterium *H. pylori* occur more frequently in socioeconomically deprived populations, the same groups affected by malnutrition. However, the interaction between these variables remains controversial. One problem with interpretation of the published studies is that even if an association is detected, *H. pylori* infection might not be the cause of malnutrition, but a marker for differences between study groups either in their sociodemographic characteristics or dietary habits that determined that one group was infected and the other group was not. In our study, after controlling for sociodemographic variables, we did not find significant differences in the nutritional parameters between infected and uninfected children. Interestingly, for both ponderal indices, WFH and HFA, infected children tended to have lower z-score values across age groups, as shown in Tables 2 and 3; however, the differences were small and did not reach statistical significance. Based on sample sizes our study has an 80% power ($1 - \beta$) to detect differences of at least 0.50 and

TABLE 2
Weight-for-height values according to age and *Helicobacter pylori* infection status

Age group (years)	*H. pylori*-positive		*H. pylori*-negative		*P**
	No.	z-score†	No.	z-score†	
5	5	0.06 ± 0.55	5	1.31 ± 1.61	0.14
6	11	0.42 ± 1.41	18	0.40 ± 1.38	0.97
7	14	0.35 ± 1.81	31	0.56 ± 1.28	0.63
8	11	0.61 ± 0.93	22	0.73 ± 0.98	0.73
9	31	0.55 ± 0.71	19	0.88 ± 1.36	0.25
5–9	72	0.46 ± 0.99	95	0.67 ± 1.26	0.25

* By Student's *t*-test
† Values are the mean ± SD

TABLE 3
Height-for-age values according to age and *Helicobacter pylori* infection status

Age group (years)	*H. pylori*-positive		*H. pylori*-negative		*P**
	No.	z-score†	No.	z-score†	
5	5	−0.52 ± 0.96	5	−0.33 ± 0.94	0.76
6	12	−0.58 ± 1.40	18	−0.67 ± 1.21	0.84
7	14	−0.83 ± 1.23	31	−0.64 ± 1.00	0.59
8	11	−1.17 ± 0.66	22	−0.82 ± 0.92	0.27
9	34	−0.92 ± 0.93	22	−0.76 ± 0.80	0.52
10	31	−1.26 ± 1.08	6	−0.85 ± 1.16	0.59
5–10	107	−0.98 ± 1.06	104	−0.71 ± 0.97	0.05

* By Student's *t*-test.
† Values are the mean ± SD

0.39 SD units in WFH and HFA, respectively (two-sided tests, $\alpha = 0.05$). This means that smaller differences could still conceivably exist between infected and uninfected subjects but were not detected by our tests of significance; however, because of their small size their clinical importance would be uncertain.

Nutritional evaluation of individuals is a complex issue difficult to attain, especially in epidemiologic studies of basically asymptomatic populations. For these situations, the World Health Organization has favored the use of the anthropometric indices HFA and WFH that are simple to obtain and accurate enough for the purpose of most studies.[15,18] These parameters are best validated for children less than 5 years of age, yet they can be used in most prepubertal subjects. The finding of more frequent deficits (z score < -2) in HFA (stunting) than in WFH (wasting) in our study population is in agreement with the concept that they represent two different biologic processes, the former more dependent on food intake and the latter on overall sociodemographic conditions.[18]

The results of our study are subject to some potential limitations. First, this a point-prevalence, cross sectional study which does not evaluate the possible effect of new infections in growth velocity. Second, the definition of socioeconomic status is complex and no set of parameters is fully descriptive. We chose the parameters that we thought were more objective and simpler to obtain from the study population. However, we do not know if we might have missed some important factor(s). Third, the reliability of commercially available serologic tests for the detection of IgG antibodies to *H. pylori* among pediatric populations in developing countries has been questioned.[19] Unfortunately, due to lack of resources, we could not validate our serologic results by using a second assay such as the urea breath test. Yet, the fact that in our study group the presence of *H. pylori* infection did correlate well with other known risk factors (such as age and low socioeconomic status) makes us confident that no apparent bias was introduced in the results. Fourth, our study group included only girls because that was the population we had access to through our links in the community. Also, only 56% of those approached agreed to participate. Our experience, as well as that of others, have shown that in community-based studies, specially those involving a blood specimen, participation is rarely more than 50%.[20] We have no information on the non-participating children; thus, we cannot estimate if any bias was introduced in the results or the generalizability of our findings to other populations. Further studies in other groups will help to elucidate the importance of these factors.

In summary, we conclude that in the studied population the presence of *H. pylori* infection did not affect the nutritional status of the individuals, and that the small differences detected were likely due to sociodemographic factors.

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