Seroepidemiology of *Helicobacter pylori* infection in general population in a northern Mexican city

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ABSTRACT

Background: The seroepidemiology of *Helicobacter pylori* infection in general population in Durango City, Mexico has not been previously studied. Aims: To determine the seroprevalence of anti-*H. pylori* antibodies in the general population in Durango City, Mexico; and to determine socio-demographic, clinical, and behavioral characteristics of the general population associated with *H. pylori* seropositivity. Methods: The prevalence of anti-*H. pylori* IgG antibodies was examined in 345 individuals in Durango City, Mexico, using enzyme-linked immunoassays. Socio-demographic, clinical, and behavioral characteristics of the general population associated with *H. pylori* seroprevalence were also investigated. Results: In total, 231 (67%) of the 345 participants (mean age, 45.3. ± 17.5 years) had *H. pylori* IgG antibodies, 146 (63.2%) of whom had *H. pylori* IgG antibody levels higher than 100 U/mL. Both *H. pylori* seroprevalence and antibody levels increased significantly with age, and were similar in males and females. An increased *H. pylori* seroprevalence was found in subjects with low education and employed. In contrast, a low seroprevalence was found in subjects living in suburban areas. One of four subjects with gastritis symptoms had anti-*H. pylori* antibodies. The seroprevalence of *H. pylori* was significantly higher among women with abortion history than among those without such history. Multivariate analysis of behavioral variables showed that *H. pylori* seropositivity was negatively associated with raising farm animals (OR = 0.48; 95% CI: 0.25 - 0.91; *P* = 0.02). Conclusions: In the general population studied, *H. pylori* seroreactivity increased significantly with age, not only in frequency but also in intensity. Residence, education, and occupation of the study population influenced the seropositivity rate of *H. pylori*.

KEYWORDS

Helicobacter pylori; Seroprevalence; General Population; Epidemiology; Mexico

1. INTRODUCTION

Helicobacter pylori is a widely distributed pathogen causing infections in humans worldwide [1]. Estimates indicate that about one-half of the world's population is currently infected with *H. pylori* [1,2]. Infections with *H. pylori* may lead to severe gastric diseases including chronic gastritis, peptic ulcer, gastric mucosa-associated lymphoid tissue lymphoma, and gastric cancer [1-4]. Furthermore, increasing evidence suggests that *H. pylori* infection may lead to extra gastric diseases including cardiovascular and neurological diseases, hematologic disorders and others [5,6]. Therefore, exploring new clinical manifestations associated with *H. pylori* infection is justified. The routes of transmission of *H. pylori* to humans are not fully understood. However, putative routes of *H. pylori* dissemination include person-to-person [7], oral-oral or fecal-oral [8], and consumption of contaminated water [8,9]. The prevalence of *H. pylori* infection varies substantially among countries and is higher in developing than in developed countries [10]. The seroprevalence of *H. pylori*

infection may be influenced by a number of factors including geographical region, migration pattern, ethnic group [8,11], and lifestyle [12]. Therefore, exploring the association of *H. pylori* infection with new factors might be useful for a better understanding of the *H. pylori* dissemination.

Very little is known about the seroepidemiology of *H. pylori* infection in Mexico in general and in the northern Mexican state of Durango in particular. In the present survey, the seroprevalence of anti-*H. pylori* antibodies in the general population in Durango City, Mexico was examined. In addition, this study was aimed to determine socio-demographic, clinical, and behavioral characteristics of the general population associated with *H. pylori* seropositivity.

2. METHODS

Through a cross-sectional survey, 345 individuals of the general population living in Durango City, Mexico were studied. Inclusion criteria for voluntary participation of the subjects were individuals living in Durango City of 16 years of age and older. Gender, occupation or socio-economic status were not restrictive criteria for enrollment.

Characteristics of the subjects were examined using a standardized questionnaire. Socio-demographic data examined included age, gender, birthplace, residence, educational level, occupation, and socioeconomic status. Clinical data including the presence of: any diseases, history of lymphadenopathy, gastritis, peptic ulcer, and blood transfusion was also obtained from the participants. Obstetric records of women were obtained. Behavioral data examined included animal contact, foreign travel, frequency of eating away from home (in restaurants or fast food outlets), contact with soil (gardening or agriculture), type of flooring at home, type of meat consumed, frequency of meat consumption, degree of meat cooking, consumption of unpasteurized milk, unwashed raw vegetables or fruits, untreated water, or alcohol, and smoking.

Whole blood from the participants was centrifuged and serum samples were kept frozen at $-20°C$ until analyzed. Serum samples were examined by qualitative and quantitative methods for detection of anti-*H. pylori* IgG antibodies using a commercially available enzyme-linked immunosorbent assay (ELISA) kit, Anti-*H. pylori* IgG AccuBind ELISA (Monobind Inc, Lake Forest, California). Anti-*H. pylori* IgG antibody levels were expressed as Units (U)/mL, and a value higher than 20 U/mL was considered a positive result. All tests were performed following the instructions of the manufacturer.

Statistical analysis was performed with the aid of the Epi Info version 3.5.4 software and SPSS version 15.0 software. For calculation of the sample size, a reference seroprevalence of 66% [13] as the expected frequency for the factor under study, 550,000 as the population size from which the sample was selected, 61% as the least acceptable result, and a 95% confidence level were considered. The result of the sample size calculation was 345 subjects. Frequencies between groups were compared with the Pearson's chi-square test and the Fisher exact test (when values were less than 5). Bivariate and multivariate analyses were used to assess the association between *H. pylori* seropositivity and subject characteristics. Variables were included in the multivariate analysis if they had a *P* value ≤ 0.20 in the bivariate analysis. Odd ratio (OR) and 95% confidence interval (CI) were calculated by multivariate analysis, using the Enter method. A *P* value < 0.05 was considered statistically significant.

This study was approved by the Ethical Committee of the Instituto de Seguridad y Servicios Sociales de los Trabajadores del Estado in Durango City. Mexico. The purpose and procedures of the study were explained to all participants. In addition, a written informed consent was obtained from all participants and from the next of kin of minor participants.

3. RESULTS

H. pylori IgG antibodies were detected in 231 (67%) of the 345 subjects studied. A correlation between the seroprevalence of *H. pylori* infection and a selection of socio-demographic and behavioral characteristics of the subjects is shown in Table 1. The majority of participants were born in Durango State; their mean age was 45.3 ± 17.5 years (range, 16 - 91 years). Males and females had comparable rates of *H. pylori* seroprevalence (70.8% and 64.4%, respectively; $P = 0.21$). However, *H. pylori* seroprevalence rates increased significantly with age ($P < 0.001$). An increased seroprevalence was found in subjects with low education and employed. In contrast, a low seroprevalence was found in subjects living in suburban areas. Other socio-demographic characteristics such as origin and socio-economic status did not significantly influence the seroprevalence of *H. pylori*. Of the 231 *H. pylori* IgG positive participants, 145 (62.8%) had IgG levels higher than 100 U/mL, 41 (17.7%) between 51 to 100 U/mL, and 45 (19.5%) between 21 to 50 U/mL. Anti-*H. pylori* IgG antibody levels were similar in men and women ($P = 0.56$). In contrast, the frequency of high (>100 U/mL) anti-*H. pylori* IgG antibody levels increased significantly with age: 20.5% in the ≤ 30 years old group, 44.5% in the 31 - 50 years old group, and 53% in the >50 years old group ($P = 0.00001$).

Bivariate analysis of behavioral characteristics revealed six variables with a *P* value ≤ 0.20: cats at home ($P = 0.18$), dogs at home ($P = 0.10$), raising farm animals ($P < 0.0001$), consumption of untreated water ($P = 0.08$), eating away of home ($P = 0.02$), and smoking ($P = 0.06$).

Table 1. Bivariate analysis of selected exposure variables and seroprevalence of *H. pylori* infection in general population.

Characteristic	No. of Subjects Tested[a]	Positive ELISA results		Odds Ratio	95% Confidence Interval	*P* value
		No.	%			
Gender						
Male	137	97	70.8	1.3	0.82 - 2.19	0.21
Female	208	134	64.4	1.0		
Age (years)						
30 or less	83	35	42.2	1.0		
31 - 50	128	87	68.0	2.9	1.58 - 5.38	0.0002
>50	134	109	81.3	6.0	3.09 - 11.63	<0.0001
Birth place						
Durango State	299	205	68.6	1.0		
Other State	40	23	57.5	0.6	0.30 - 1.28	0.16
Residence place						
Durango State	341	231	67.7	1.0		
Other State	4	0	0.0	0.0	0.00 - 0.74	0.01
Residence area						
Urban	311	212	68.2	1.0		
Suburban	15	6	40.0	0.3	0.09 - 1.01	0.02
Rural	18	12	66.7	0.9	0.31 - 2.89	0.89
Educational level						
Up to 6 years	45	36	80.0	2.4	1.03 - 5.69	0.02
7 - 12	116	81	69.8	1.4	0.82 - 2.34	0.2
>12	182	114	62.6	1.0		
Occupation						
Employed[b]	247	176	71.3	2.1	1.24 - 3.52	0.002
Unemployed[c]	94	51	54.3	1.0		
Cats at home						
Yes	102	63	61.8	0.7	0.43 - 1.20	0.18
No	243	168	69.1	1.0		
Dogs at home						
Yes	244	157	64.3	0.7	0.38 - 1.13	0.1
No	101	74	73.3	1.0		
Raising farm animals						
Yes	131	71	54.2	0.4	0.24 - 0.64	<0.0001
No	213	160	75.1	1.0		
Untreated water						
Yes	135	83	61.5	0.7	0.41 - 1.08	0.08
No	210	148	70.5	1.0		
Eating out of home						
≤10 times/yr	151	111	73.5	1.7	1.06 - 2.82	0.02
>10 times/yr	193	119	61.7	1.0		
Smoking						
Yes	41	32	78	2.1	0.90 - 4.93	0.06
No	228	144	63.2	1.0		

[a]Subjects with available data; [b]Employee: agriculture, business, construction or factory worker professional, other; [c]Unemployed: housewives, students or neither.

Other behavioral characteristics had *P* values > 0.20 in the bivariate analysis including foreign travel, contact with soil, type of flooring at home, type of meat consumption, frequency of meat consumption, degree of meat cooking, consumption of unpasteurized milk, unwashed raw vegetables and fruits, and alcohol. Multivariate analysis of behavioral variables with a *P* value ≤ 0.20 showed that *H. pylori* seropositivity was only negatively associated with raising farm animals (OR = 0.48; 95% CI: 0.25 - 0.91; *P* = 0.02) (**Table 2**).

Analysis of clinical data showed that *H. pylori* positive and *H. pylori* negative participants had similar frequencies of underlying diseases, lymphadenopathy and blood transfusions. Four subjects suffered from gastritis and one of them was positive for anti-*H. pylori* IgG antibodies. None of the participants suffered from peptic ulcer. Of the obstetric characteristics of women, the seroprevalence of *H. pylori* was significantly (*P* = 0.04) higher among women with abortion history (29/34; 85.3%) than among those without such history (72/106; 67.9%). Stratification by number of abortions did not show statistically significant differences in the seroprevalences in women without abortion and those with one (22/26: 84.6%; *P* = 0.09) or between 2 to 5 abortions (7/8: 87.5%; *P* = 0.23). The seroprevalence of *H. pylori* exposure was similar between women who had had pregnancies (93/130; 71.5%), deliveries (77/108; 71.3%), and cesarean sections (31/44; 70.5%), than women without such obstetric characteristics (8/11; 72.7%, 24/33; 72.7% and 70/96; 72.9%; *P* = 0.61. *P* = 0.87 and *P* = 0.76, respectively).

4. DISCUSSION

The 67% seroprevalence of *H. pylori* infection in the general population of Durango City found in the present study is similar to the mean national seroprevalence (66%) reported in another study in Mexico [13]. However, these figures cannot be directly compared since different methods were used in both studies; although this study used a commercial ELISA kit, a homemade ELISA kit was used for the national study. The national study [13] did not provide a specific seroprevalence for Durango. To

Table 2. Results of the multivariate regression analysis.

Variable	Regression coefficient	*P* value	Odds ratio	95% confidence interval
Cats at home	0.09	0.77	1.1	0.56 - 2.13
Dogs at home	−0.39	0.24	0.67	0.34 - 1.31
Raising farm animals	−0.73	0.02	0.48	0.25 - 0.91
Untreated water	−0.21	0.49	0.8	0.42 - 1.51
Low frequency of eating out of home	0.33	0.24	1.39	0.79 - 2.44
Smoking	0.39	0.34	1.48	0.65 - 3.38

the best of our knowledge, the present study is the first one conducted in general population in Durango City. In a regional context, two previous surveys of *H. pylori* infection have been performed, and both of them are in ethnic groups (Mennonites and Tepehuanos) in Durango State. In Mennonites, a 50.7% seroprevalence of *H. pylori* infection was reported [14]. This seroprevalence is lower than the one found in the present study. The difference in the seroprevalence between the two populations might be due to differences in the general characteristics of the subjects studied. The general population in Durango City is urban while Mennonites are rural. On the other hand, the seroprevalence found in the present study is similar to the 66% seroprevalence of *H. pylori* infection found in Tepehuanos [15]. In both studies in Mennonites and Tepehuanos, the same commercial ELISA kit was used. In an international context, the seroprevalence of *H. pylori* infection in the general population of Durango is lower than the estimated 80% to 90% seroprevalence of *H. pylori* infection in developing countries [10].

With respect to socio-demographic characteristics, a number of variables correlated with *H. pylori* infection. Firstly, *H. pylori* seroprevalence increased significantly with age. This finding is consistent with the typical increase in the frequency of infection with age reported elsewhere [7,11,16]. Secondly, subjects with low education and employed had an increased seroprevalence of *H. pylori* infection. A low educational level has been reported as a factor associated with *H. pylori* infection [13]. However, it is not clear why employed subjects had a higher seroprevalence of *H. pylori* infection than those without employment. In a previous study in Tepehuanos in Durango, *H. pylori* infection was similarly associated with a laborer occupation [15]. It is likely that work factors might have contributed to infection. Although work factors were not investigated in this study, other researchers have found a number of work factors associated with *H. pylori* infection including deployment in a crowded commission combined with the absence of air conditioning in military personnel sleeping quarters [17]. Therefore, studying work factors including crowding, presence of air conditioning, and other factors would be useful for determining their role in *H. pylori* infection. Thirdly, subjects living in suburban areas had a low seroprevalence of *H. pylori* infection. Interpretation of such finding should be interpreted with care since a low number of subjects living in suburban areas were enrolled in the study. The low seroprevalence in subjects living in suburban areas found in the present study conflicts with previous observations of an association of *H. pylori* infection with living in a suburban area in studies in Turkey [18] and Nepal [19]. Differences in the associations might be due to differences in socio-demographic and

behavioral characteristics among the populations. Socioeconomic status has been linked to *H. pylori* seropositivity [7,13]. However, in the current study no association between *H. pylori* seropositivity and socioeconomic status was found. Remarkably, in the present study the frequency of high anti-*H. pylori* IgG antibody levels increased significantly with age. To the best of our knowledge, such association in general population has not been reported. This finding raises the question whether older subjects are not only more exposed to *H. pylori* infection but also with more intensity than younger subjects are. Further studies should address this issue.

Concerning behavioral characteristics, logistic regression showed that *H. pylori* seropositivity was only negatively associated with raising farm animals. This finding might reflect a rural origin of some seronegative subjects. The seroprevalence of *H. pylori* infection has been found lower in subjects living in rural areas than those living in urban areas [20]. The variable rural residence was not associated with infection in the current study, and other unknown factors may have contributed to infection. It is possible that crowding, a putative risk factor for *H. pylori* infection [17] could be less intense in subjects who raise farm animals since such occupation is done in open areas in the countryside. Further research to clarify the negative association of raising farm animals with *H. pylori* infection is needed.

Concerning clinical data, the seroprevalence of *H. pylori* was significantly higher among women with abortion history than among those without such history. In a previous study in the ethnic group of Mennonites in Durango, Mexico, a similar association between abortion history and *H. pylori* seropositivity was found [14]. In the present study, the mean age in women with abortion history (52.20 ± 13.60 years old) was comparable with that in women without such obstetric characteristic (47.29 ± 16.68 years old) ($P = 0.12$). This was the case in the present study as well as in the previous study in Mennonites [14]. In a recent study in the ethnic group of Tepehuanos in the region, no association between abortion history and *H. pylori* seropositivity was found [15]. The finding of the association of *H. pylori* seropositivity with abortion history deserves further research.

ACKNOWLEDGEMENTS

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