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Protective effect of yoghurt consumption on *Helicobacter pylori* seropositivity in a Mexican population

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Abstract

Objective: The aim of the study was to determine the relationship between fermented and unfermented dairy product consumption and *Helicobacter pylori* seropositivity in a Mexican population.
Design: Dietary interviews were conducted as part of a population-based case–control study in 2005. Serum was obtained for each participant to determine *H. pylori* seropositivity status. Adjusted odds ratios were estimated from multivariate logistic regression models.
Setting: Mexico City, Mexico.
Subjects: A random sample of 464 healthy adult residents.
Results: The overall seroprevalence of *H. pylori* in the study sample was 75.4%. In fully adjusted models, compared with those who did not consume yoghurt, there was a protective effect of eating up to one serving per week of yoghurt and more than one serving per week of yoghurt (odds ratio (OR) = 0.57, 95% confidence interval (CI) 0.35–0.94 and OR = 0.45, 95% CI 0.24–0.86, respectively), with a *P* for trend of 0.01. There were no effects for the consumption of unfermented dairy products (milk and cheese).
Conclusions: This study suggests that yoghurt consumption may have a protective effect against *H. pylori* seropositivity. Additional studies are needed to determine whether consumption of yoghurt or other fermented dairy products can prevent or eradicate *H. pylori* infection.

Keywords
Helicobacter pylori
Yoghurt
Mexico

Helicobacter pylori is a highly prevalent pathogen with serious long-term health consequences. Recent estimates are that 70% of the adult Mexican population is infected with the bacterium[1]. Although many of those living with the infection are asymptomatic, *H. pylori* can be a significant source of morbidity if left untreated. Chronic *H. pylori* infection causes gastritis and peptic ulcer, and is a risk factor for gastric cancer[2,3]. Therefore, prevention of the infection may have a large public health impact.

The route of transmission of the bacterium is still unknown; however, previous studies have identified several risk factors for *H. pylori* infection. The infection is more prevalent among those with lower socio-economic status, which often influences living conditions and sanitation. Drinking from untreated water sources and not having sewer or septic services in the home are associated with increased risk of infection[4–6]. In addition, consumption of shellfish and high-salt diets has been associated with increased infection; while consumption of vegetables and milk has been associated with decreased prevalence[4,5,7,8].

Because of the high cost of treatment and the risk of antibacterial resistance, researchers have sought alternative therapies for *H. pylori* infection[9]. A recent review of studies on probiotics and *H. pylori* infection found compelling evidence that lactobacilli and bifidobacteria inhibit the adhesion and colonisation of *H. pylori* in humans[10–12]. In addition, clinical trials suggest that adding products containing lactobacilli to treatment regimens for *H. pylori* infection improves eradication rates and reduces side effects of the treatment[10,13].

The ability of lactobacilli to decrease the adverse effects of *H. pylori* infection in humans also has implications for prevention. However, to our knowledge, there are no published reports examining the role of food products which contain probiotics in preventing *H. pylori* infection in a population sample. The current study aims to test the association between fermented and unfermented dairy products and *H. pylori* seropositivity, using data collected in 2005 for a population based case–control study among residents of Mexico City, Mexico.

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Methods

Study population

The study participants ($n = 464$) included all individuals selected as controls for a case–control study of risk factors for gastric cancer in 2005. The controls were identified from a sampling frame used for the Mexican National Health Survey[14]. Households were randomly selected from city blocks in the same geographical area as the cases, and individuals within the households were selected at random to match the age (±3 years) and gender distribution of the cases recruited for the study. Additional eligibility criteria were that the participant was asymptomatic and a resident of Mexico City for at least 5 years. If more than one member of a household fitted the eligibility criteria, one was chosen at random to be interviewed. When no one in the selected household fitted the eligibility criteria, interviewers sought participants in the house to the right of that which was originally selected. The participation rate among controls was 96.4%.

Interviews

For the case–control study, trained personnel administered a questionnaire, including questions on sociodemographic characteristics, diet and health status, in the participants' home. Informed consent was obtained from both cases and controls, and a monetary incentive was offered to control participants in exchange for their time. The research protocol was approved by the Committee of Research and Ethics of Mexico's National Institute of Public Health.

Helicobacter pylori *status*

Trained nurses also collected blood samples from the participants at the time of the interview. The presence of immunoglobulin G antibodies against *H. pylori* was detected using an enzyme-linked immunosorbent assay. An individual was considered to be seropositive when the corresponding adjusted absorbance value for *H. pylori* was >0.99, otherwise the result was considered negative. Laboratory analyses were conducted at the New York University School of Medicine, using tests previously validated in the Mexican population[15].

Food consumption

A food-frequency questionnaire containing 130 foods was used to estimate the consumption of different food types. The instrument, created by Willett *et al.* and adapted for the Mexican diet, has been used and validated in previous studies in Mexico[16]. Only questions used to measure the frequency of consumption of dairy products, processed meats, fruits and vegetables were used in this analysis. In order to assess the differences in fermented and unfermented dairy products, milk and yoghurt were included as individual food items. The variable for cheese included several types of local Mexican cheeses including *queso fresco*, *queso manchego*, *queso oaxaca* and *queso crema* (similar types of cheese include feta, Monterey jack, mozzarella and sour cream). The variable for fruits included banana, orange, apple, melon, watermelon, pineapple, papaya, mango, mandarin oranges, peaches, grapes, strawberries, pears, plums, *mamey* and *zapote*. The variable for vegetables included lettuce, spinach, carrots, tomatoes, onion, cucumbers, cauliflower, broccoli, *chayote*, corn, potato, squash, squash blossoms and avocado. The variable for processed meats included the individual food items of ham, hot dogs, chorizo and bacon. Participants were asked to report their usual consumption of foods over the last 3 years based on 10 response options: never, less than once a month, 1–3 times per month, once a week, 2–4 times per week, 5–6 times per week, once a day, 2–3 times a day, 4–5 times a day and six times a day. These response options were converted to an ordinal score of daily consumption. The frequency of intake of fruits and vegetables was adjusted for seasonality of the food items, by multiplying amounts by the proportion of months the food item was available in a calendar year. We then summed the daily or weekly consumption of foods in each food group and created categories based on approximate tertiles. This allowed us to compare those with the highest and lowest levels of consumption for each food group.

Sociodemographic characteristics

Age, gender and level of education were included as covariates in our analyses. Age was categorised based on the frequency distribution for descriptive statistics and used as a continuous variable in the regression models. Gender was used as a categorical variable (male/female). The level of education of the head of household served as a proxy for socio-economic status. Categories were based on grade levels for elementary school (1–6 years), middle school (7–9 years) and high school or university (10 or more years) in the Mexican educational system.

Statistical analysis

The seroprevalence of *H. pylori* infection was calculated for selected sociodemographic characteristics and food groups. Prevalence ratios and 95% confidence intervals (CIs) were estimated to test for differences in seroprevalence across categories. Odds ratios (ORs) and 95% CIs for the association between *H. pylori* and fermented and unfermented dairy product consumption were estimated using multivariate logistic regression. The first series of logistic regression models produced estimates adjusted for age, gender and level of education. A second series of models added fruits, vegetables, dairy products and processed meats as covariates. All of the covariates were chosen based on previous studies demonstrating associations with *H. pylori* seropositivity[4,5,7,8]. To test for the trend of the association, we included an ordinal score for the variable of interest as a continuous variable in a logistic

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regression model. The statistical software package STATA 9.0 was used for all statistical analyses.

Results

The seroprevalence of *H. pylori* for each variable category and unadjusted prevalence ratios are presented in Table 1. The overall seroprevalence of *H. pylori* in the study sample was 75.4%. There were no significant differences in the prevalence of *H. pylori* infection by age, gender or level of education. Among the food groups, only fruit and yoghurt were associated with seroprevalence. Those who consumed 1–2 portions of fruit per day were less likely to have *H. pylori* infection than those consuming <1 portion per day, although the upper limit of the CI was close to the null value (OR = 0.60, 95% CI 0.36–0.99). Seroprevalence of *H. pylori* was lower among those who consumed up to one or more than one serving of yoghurt a week, compared with those with no yoghurt consumption.

Table 2 shows the results of the adjusted multivariate logistic regression model estimates. Compared with those who did not consume yoghurt, there was a moderate protective effect of consuming up to one serving of yoghurt per week on *H. pylori* seropositivity, adjusted for age, gender and level of education (OR = 0.58, 95% CI 0.36–0.94). The association was stronger among those who consumed more than one serving of yoghurt a week (OR = 0.49, 95% CI 0.26–0.91). The association increased slightly when the estimates were adjusted for other food group covariates. The *P*-value for trend was 0.01 in the models including all covariates. No effect was observed for unfermented milk products (milk and cheese) in either series of models. ORs for increased consumption of milk and cheese were only weakly associated with *H. pylori* infection, and CIs included the null.

Table 1 Influence of demographic and dietary variables on *Helicobacter pylori* seroprevalence, showing unadjusted prevalence ratios

	Number	*H. pylori* seroprevalence (%)	Prevalence ratio	95% CI
Age				
< 50 years	118	79.7	1.00	
50–59 years	106	77.4	0.87	0.46–1.65
60–69 years	122	69.7	0.59	0.32–1.05
> 70 years	118	75.4	0.78	0.42–1.44
Gender				
Male	215	75.8	1.00	
Female	249	75.1	0.96	0.63–1.47
Education				
None	63	71.4	1.00	
1–6 years	265	76.6	1.30	0.71–2.42
7–9 years	76	72.4	1.05	0.50–2.20
≥ 10 years	60	78.3	1.44	0.64–3.29
Yoghurt (portions per week)				
None	196	81.1	1.00	
Up to 1	189	72.0	0.60	0.37–0.96
> 1	79	69.9	0.53	0.29–0.96
Milk (portions per week)				
< 1	146	76.0	1.00	
1–5	162	72.2	0.82	0.49–1.37
> 5	156	78.2	1.13	0.66–1.93
Cheese* (portions per week)				
< 2	220	76.4	1.00	
2–4	106	71.7	0.78	0.46–1.32
> 4	138	76.8	1.02	0.62–1.69
Fruits† (portions per day)				
< 1	184	78.3	1.00	
1–2	136	68.4	0.60	0.36–0.99
> 2	144	78.5	1.01	0.60–1.71
Vegetables‡ (portions per day)				
< 2	192	72.4	1.00	
2–3	169	79.3	1.45	0.89–2.37
> 3	103	74.8	1.12	0.65–1.94
Processed meats§ (portions per week)				
< 1	210	79.3	1.00	
1–2	133	72.2	0.85	0.52–1.36
> 2	121	75.2	1.26	0.73–2.16

CI – confidence interval.
* Includes *queso fresco*, *queso manchego*, *queso oaxaca* and *queso crema*.
† Includes banana, orange, apple, melon, watermelon, pineapple, papaya, mango, mandarin oranges, peaches, grapes, strawberries, pears, plums, *mamey* and *zapote*.
‡ Includes lettuce, spinach, carrots, tomatoes, onion, cucumber, cauliflower, broccoli, *chayote*, corn, potato, squash, squash blossoms and avocado.
§ Includes ham, hot dogs, chorizo and bacon.

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Table 2 Adjusted odds ratios for the association between dairy product consumption and *Helicobacter pylori* seropositivity

	OR*	95% CI	OR†	95% CI
Fermented dairy products				
Yoghurt (portions per week)				
None	1.00		1.00	
Up to 1	0.58	0.36–0.94	0.57	0.35–0.94
> 1	0.49	0.26–0.91	0.45	0.24–0.86
P for trend	0.02		0.01	
Unfermented dairy products				
Milk (portions per week)				
< 1	1.00		1.00	
1–5	0.84	0.50–1.40	0.89	0.52–1.50
> 5	1.12	0.65–1.93	1.21	0.68–2.17
P for trend	0.54		0.53	
Cheese (portions per week)				
< 2	1.00		1.00	
2–4	0.77	0.45–1.30	0.81	0.47–1.40
> 4	0.98	0.59–1.65	1.07	0.60–1.89
P for trend	0.66		0.60	

CI – confidence interval.
* Adjusted for age, gender and level of education.
† Adjusted for age, gender, level of education, fruit, vegetable, processed meat and other dairy product consumption.

Discussion

We found a protective effect of yoghurt consumption on *H. pylori* seropositivity. In addition, the trend was significant and only present for fermented dairy products. Fermented dairy products are a known source of lactobacilli cultures[17]. *In vitro* and *in vivo* studies have shown that lactobacilli inhibit the growth of *H. pylori* in both animal and human models[18–20]. This suggests that eating yoghurt may protect against acquiring *H. pylori* infection. In addition, this study provides additional evidence that yoghurt consumption may help to eradicate the infection among those already infected. Clinical trials testing the efficacy of adding fermented dairy products to standard antibiotic treatment of *H. pylori* have shown that they increase eradication rates and decrease adverse events[10,12]. However, studies testing the efficacy of treating *H. pylori* with fermented dairy products alone have been inconclusive[21].

The mechanisms by which probiotics inhibit the growth of *H. pylori* are still unclear. *H. pylori* are able to survive and colonise the surface of gastric mucosa by releasing a urease, which buffers against gastric acid in the human stomach. Certain types of lactobacilli, lactic-acid producing bacteria, can also survive within the gastrointestinal tract. It is hypothesised that, once in the stomach, lactobacilli inhibit colonisation of *H. pylori* through the following mechanisms: maintaining a protective microbiological environment that prevents adhesion of *H. pylori* to epithelial cells, and releasing bacteriocins or lactic acids that decrease urease activity, inhibit colonisation of *H. pylori* and prevent gastric inflammation[10,13,21].

In contrast to other studies, we did not find significant associations between *H. pylori* infection and age or level of education[22,23]. The lack of association for age may have been due to the fact that our sample had a higher mean age than that of other studies which have found this association[22]. Regarding level of education, it is possible that education is not an appropriate proxy for the socio-economic factors which contribute to increased *H. pylori* infection, such as water and sanitation services. In addition, our study population came from an urban location where water and sanitation services are probably comparable across different socio-economic strata. These results may also have been due to residual confounding for which we were unable to control. For example, people who consume yoghurt may be more likely to be health conscious and thus more likely to practise other behaviours which safeguard health.

Our results must be considered within the context of study limitations. The cross-sectional design of our study prevents us from determining whether yoghurt consumption caused the observed effect in *H. pylori* seropositivity. The food-frequency questionnaire used in the interviews did not include information about whether probiotics were present in the yoghurt consumed. Therefore, we cannot rule out the fact that the relationship observed was due to some other unmeasured factor present in yoghurt. There also may have been bias due to measurement error in the classification of *H. pylori* status, frequency of food consumption or other covariates.

To our knowledge, our study is the first to report an inverse association between yoghurt consumption and risk for *H. pylori* infection. Additional longitudinal epidemiological studies are needed to determine whether the consumption of yoghurt or other foods containing probiotics can prevent or eradicate *H. pylori* infection. If the association we observed is confirmed by additional studies, yoghurt consumption may be an effective and low-cost way to prevent or decrease *H. pylori* seropositivity in countries where the infection is endemic.

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