ORIGINAL ARTICLE

HELICOBACTER PYLORI INFECTION AMONG NON-NATIVE EDUCATORS IN ALASKA

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ABSTRACT

Objectives. To determine seroprevalence of H. pylori infection in non-Native educators residing in urban or rural settings in Alaska, and to determine potential risk factors associated with infection in this population.

Study design. A cross-sectional survey of non-Native educators residing in urban or rural settings in Alaska.

Methods. Participants completed a questionnaire detailing aspects of residential life; H. pylori antibody status was determined by a commercial assay.

Results. Of the 203 non-Native participants, 49 (24%) had antibody to H. pylori. Univariate analysis demonstrated that the mean age of seropositive participants was higher than of seronegatives (48 vs. 42 years, respectively, p=.001). In addition, participants who had experienced childhood crowding were more likely to test seropositive for H. pylori (p=.058). On multivariate analysis, only age ≥ 40 was associated with infection. No difference in median hemoglobin or ferritin levels were noted among seropositive and seronegative participants. There was no increased risk of seropositivity among participants who had lived in an Alaska Native village or in a developing country for ≥ 6 months.

Conclusions. Overall, 24% of non-Native educators residing in rural Alaska tested positive by serology for H. pylori. Age ≥ 40 years was associated with infection. Median hemoglobin or ferritin levels did not differ significantly among seropositive and seronegative participants.

Keywords: Helicobacter pylori, seroprevalence, non-Native, risk factors, Alaska, educators
INTRODUCTION

*Helicobacter pylori* (*H. pylori*) is one of the most common infections in humans affecting 30–40% of persons living in the developed world, and 80–90% of persons living in the developing world (1,2). *H. pylori* is a major cause of duodenal and gastric ulcers (3, 4), and infected persons are at increased risk for mucosa-associated lymphoid tissue (MALT) lymphoma, and gastric adenocarcinoma (5, 6). In addition, infection is also associated with chronic active gastritis (7). Humans appear to be the major reservoir for *H. pylori*. Acquisition occurs by ingestion of the organism; however, transmission is poorly understood with fecal-oral or oral-oral (saliva, vomit) being the most likely modes of transmission (8).

The prevalence of *H. pylori* is chiefly related to age, socioeconomic status and geographic location. In developing countries, acquisition occurs during childhood with up to 70% of persons infected by 10 years of age. In developed countries located in North America and Western Europe, little infection appears to occur during childhood and prevalence slowly increases to approximately 40–60% percent in adulthood (1,9).

Compared with other groups in the U.S., Alaska Native people have a higher prevalence of infection with *H. pylori*. Among Alaska Native people, overall seroprevalence of IgG antibody to *H. pylori* is 74.8% and ranges from 61.3% in the south-central region (Anchorage and vicinity) to 84.4% in the interior region (Fairbanks and vicinity). Seroprevalence appears to increase with age; Alaska Native children by 5 to 9 years of age have a seroprevalence of 66.9% (10). Despite the high overall seroprevalence of IgG antibody to *H. pylori* in the Alaska Native population, little is known about seroprevalence in the non-Native population living in urban or rural Alaska. The objectives of our study were to determine seroprevalence of *H. pylori* infection in non-Native educators residing in urban or rural settings in Alaska and to determine potential risk factors associated with infection in this population.

MATERIALS AND METHODS

Participants and data collection

We conducted a survey among non-Native Alaska educators attending one of three education conferences held between August 1996 and September 1997 in three different locations: Anchorage, Fairbanks and Unalakleet. Conference participants were informed of the study via an information page summarizing the study which was included in all conference registration materials sent to conference attendees. At the start of each conference, study organizers made an announcement about the study and asked educators who wished to participate to sign the informed consent document, fill out a questionnaire and then proceed to a blood-drawing booth for collection of one venous blood sample. The self-administered questionnaire was pre-tested and took 15 to 20 minutes to complete. Data collected included residence (historical and current), living conditions, water source, sewage disposal, recreational activities, pet ownership, dietary habits, medical history, history of gastrointestinal (GI) symptoms and previous diagnosis or treatment of *H. pylori* infection. This study was approved by
the Institutional Review Board at the Centers for Disease Control and Prevention (CDC) in Atlanta, Georgia. Written informed consent was obtained from all participants.

**Laboratory testing**
Serum specimens, obtained by venipuncture, were separated and transported on ice to the laboratory at the Centers for Disease Control and Prevention (CDC), Arctic Investigations Program (AIP) in Anchorage, Alaska. Serum samples were tested for antibody to *H. pylori* by using an enzyme-linked immunosorbent assay as previously described (11). Serum ferritin levels were measured by immunoradiometric assay (Quantimmune Ferritin IRMA, Biorad Diagnostics, Hercules CA). Hemoglobin levels were measured on-site at the time of venipuncture using a portable hemoglobinometer (HemoQue AB, Angelholm, Sweden). Each participant received a copy of their individual laboratory results, and copies of results were sent to health care providers upon request by the participant.

**Definitions**
Places of residence of 6 months duration or longer in Alaska were categorized into urban centers (Anchorage, Fairbanks and Juneau), hub towns and villages. For the purpose of this study, hub towns were distinguished from villages by population size (>1,000 persons), accessibility (jet air service compared with small propeller planes) and access to medical care (small local hospitals compared with rural health clinics). Surface water as a source of drinking water was defined as river or lake water, or melted snow or ice. Participation in subsistence activities was defined as fishing, hunting, trapping and picking greens and/or berries during the previous three months. Consumption of traditional foods was defined as consuming one or more meals consisting of marine mammals, caribou, moose or musk ox during the previous 3 months. An estimate of crowding during childhood was made for each participant, defined as sharing a bed more than 5 nights per week or 3 or more children sharing a bedroom. History of gastrointestinal symptoms was based on the previous 30 days, and participants were asked to rank severity from none to severe for stomach pain, vomiting, nausea, heartburn, diarrhea (>= 3 loose stools per day), blood in stool, constipation or nosebleeds.

**Statistical Analysis**
Univariate odds ratios were calculated using Epi Info software, version 6.04b. P values were two-tailed and values < 0.05 were considered statistically significant. Multivariable logistic regression, performed in STATA version 5, was used to determine independent risk factors for seropositivity. Multivariable models included variables significant at the p \(<\ .20\) level on univariate analysis as well as variables found to be significant in previous studies.

**RESULTS**
Of 800 persons attending the 3 conferences, 224 participants were recruited. Of these, 21 were Alaska Native persons and were excluded from further analysis. The remaining 203 participants represented approximately 25% of conference attendees.

The mean age of the 203 participants was 43.5 years (range 21 to 72); 121 (60%) were female. Overall, 49 participants (24%) were
positive for antibody to *H. pylori*. Most participants reported currently living in an Alaska village (60%), compared with urban centers (34%) or Alaska hub towns (3%). In terms of residence history, 108 participants (53%) had lived in an Alaska village for 6 months or more (minimum 6 months, maximum 33.1 years, median 6.1 years). Twenty-five participants (12%) had lived in a hub community for 6 months or more (minimum 6 months, maximum 20.3 years, median 4.0 years). Forty-four participants (22%) had lived 6 months or more in a developing country (minimum 6 months, maximum 9.0 years, median 2.0 years). Characteristics of seropositive participants were compared with those who were seronegative. The proportion of persons who were seropositive increased with age, from 4% in 21 to 30 year-olds, to 38% in 51 to 60 year-olds. This trend was statistically significant (p < 0.001) (Table I). Mean age of seropositive and seronegative persons were 48 and 42 years, respectively.

Historical places of residence (6 months duration or longer) in Alaska were also examined as potential risk factors. The relative risk of being seropositive was 1.98 times higher for people who had lived 6 months or longer in an Alaska hub town compared with those who had not lived in a potentially high risk setting (p=0.077, 95% CI 1.05, 2.48).

Table I. Seroprevalence of *H. pylori* IgG antibodies by age group.

| Age (years) | HP seropositive/total in category (%) | p-value |
|-------------|-------------------------------------|---------|
| 21-30       | 1/27 (4%)                           |         |
| 31-40       | 4/49 (8%)                           |         |
| 41-50       | 26/76 (34%)                         |         |
| 51-60       | 15/40 (38%)                         |         |
| 61+         | 3/11 (27%)                          |         |

Test for trend < 0.001

No association was seen between seropositivity and a history of living in an Alaska village or a developing country for 6 months or longer, regardless of age at time of residence (Table II).

Current and past living conditions were also examined as potential risk factors. The relative risk of being seropositive was not significantly increased for people who used surface water as their household water source during the previous year, or for those who lacked running water or flush toilets. The relative risk of being seropositive was somewhat increased for those who had experienced crowding during childhood (RR=1.61, p=0.058, 95% CI 1.05, 2.48).

Participants were asked a series of questions related to clinical symptoms experienced during the previous 30 days and about their lifetime medical history. In addition, participants were asked about use of GI medications (e.g., antacids or acid reducers) and non-steroidal anti-inflammatory and Aspirin use during the previous year. Although none of the clinical symptoms or medical history indicators measured were statistically associated with seropositivity, a higher proportion of seropositive participants reported a history of ulcer disease compared with participants without ulcer disease (39% v. 22%, RR 2.07, 95% CI 0.85-5.04, p = 0.187) (Table III).
Table II. *H. pylori* IgG antibody positivity by gender, residence, living conditions, and risk behaviors.

|                      | HP Seropositive/Total (%) | RR*     | 95% CI   | p-value |
|----------------------|----------------------------|---------|----------|---------|
| **Sex**              |                            |         |          |         |
| Male                 | 19/82 (23%)                | 0.95    | (0.64, 1.41) | 0.922   |
| Female               | 30/121 (25%)               | 1.0     |          |         |
| **Residence History**|                            |         |          |         |
| Rural Alaska Village | 25/108 (23%)               | 1.02    | (0.78, 1.33) | 0.961   |
| Rural Alaska Hub     | 11/24 (46%)                | 1.98    | (1.04, 3.75) | 0.077   |
| Developing Country   | 10/43 (23%)                | 1.01    | (0.59, 1.74) | 0.863   |
| Residence in any above | 35/138 (25%)              | 1.05    | (0.86, 1.30) | 0.762   |
| No past residence in above locations | 14/63 (22%) | 1.0 |          |         |
| Any of above at age < 10 years | 3/8 (38%) | 1.59 | (0.63, 4.03) | 0.403   |
| No history of residence in above at < 10 years of age | 46/195 (24%) | 1.0 |          |         |
| **Living conditions**|                            |         |          |         |
| Surface water use in last year | 15/55 (27%) | 1.18 | (0.72, 1.94) | 0.652   |
| No surface water use in last year | 34/148 (23%) | 1.0 |          |         |
| No flush toilet      | 3/27 (11%)                 | 0.43    | (0.14, 1.27) | 0.097   |
| Flush toilet available | 46/176 (26%)              | 1.0     |          |         |
| No running water     | 13/58 (22%)                | 0.91    | (0.54, 1.54) | 0.856   |
| Running water available | 36/145 (25%)              | 1.0     |          |         |
| Childhood crowding   | 20/59 (33%)                | 1.61    | (1.05, 2.48) | 0.058   |
| No crowding in childhood | 29/144 (20%)            | 1.0     |          |         |
| **Education level**  |                            |         |          |         |
| Master’s degree or higher | 29/110 (26%)           | 1.13    | (0.86, 1.48) | 0.508   |
| Less than a master’s degree | 19/90 (21%)            | 1.0     |          |         |
| **Behaviors**        |                            |         |          |         |
| Currently own pet    | 27/111 (24%)               | 1.03    | (0.77, 1.38) | 0.967   |
| Don’t currently own pet | 21/91 (23%)              | 1.0     |          |         |
| Ever owned a pet     | 46/184 (25%)               | 1.58    | (0.54, 4.61) | 0.573   |
| Never owned a pet    | 3/19 (16%)                 | 1.0     |          |         |
| Consume AK Native food | 30/131 (23%)             | 0.93    | (0.73, 1.20) | 0.702   |
| Did not consume AK Native food | 19/72 (26%)          | 1.0     |          |         |
| Collect greens/berries | 24/107 (22%)            | 0.86    | (0.64, 1.15) | 0.372   |
| Fish                 | 27/120 (23%)               | 0.87    | (0.67, 1.13) | 0.363   |
| Hunt                 | 16/64 (25%)                | 0.88    | (0.59, 1.32) | 0.674   |
| Trap                 | 3/11 (27%)                 | 0.89    | (0.26, 3.04) | 0.860   |
| Do not participate in subsistence activities | 18/60 (30%) | 1.0 |          |         |
| Work with preschool children | 15/79 (19%)            | 0.94    | (0.65, 1.36) | 0.896   |
| Work with elementary children | 34/137 (25%)         | 1.05    | (0.86, 1.29) | 0.753   |
| Do not work with preschool or elementary children | 12/56 (21%) | 1.0 |          |         |

* Relative Risk
Hemoglobin and serum ferritin values were measured for each participant. There was no difference in median hemoglobin values among seropositive and seronegative participants. The median ferritin level for seropositive women was 40.7 mcg/L compared with 51.3 mcg/L for seronegative women; however, the difference was not statistically significant (p=0.688). There was no difference among seropositive and seronegative participants in the proportion with ferritin values <15mcg/dl (Table IV). A linear regression of serum ferritin

### Table III. H. pylori IgG antibody positivity by reported GI symptoms and self-reported medical history.

| GI Symptoms in last 30 days | Total with symptom (%) | Total without symptom (%) | RR   | 95% CI       | p-value |
|-----------------------------|------------------------|---------------------------|------|--------------|---------|
| Nausea                      | 10/49 (20%)            | 33/143 (23%)              | 0.89 | (0.48, 1.63) | 0.851   |
| Stomach pain                | 15/66 (23%)            | 31/129 (24%)              | 0.95 | (0.59, 1.53) | 0.980   |
| Vomiting                    | 3/12 (25%)             | 40/180 (22%)              | 1.13 | (0.41, 3.11) | 0.733   |
| Vomiting blood              | 0/1 (0%)               | 43/190 (23%)              | 0.0  | --           | 1.0     |
| Heartburn                   | 21/88 (24%)            | 24/108 (22%)              | 1.05 | (0.73, 1.51) | 0.920   |
| Diarrhea                    | 21/86 (24%)            | 27/112 (24%)              | 1.01 | (0.70, 1.46) | 0.907   |
| Blood in stool              | 3/9 (33%)              | 40/182 (22%)              | 1.52 | (0.58, 3.98) | 0.424   |
| Constipation                | 10/54 (19%)            | 32/138 (23%)              | 0.81 | (0.45, 1.47) | 0.611   |
| Nosebleeds                  | 8/24 (33%)             | 3/34/169 (20%)            | 1.80 | (0.83, 3.91) | 0.230   |

### Medical History

Ever hospitalized for GI symptoms:

|          | HP Seropositive/ Total with symptom (%) | HP Seropositive/ Total without symptom (%) | RR   | 95% CI       | p-value |
|----------|----------------------------------------|--------------------------------------------|------|--------------|---------|
| Ever diagnosed by health care provider: |                                        |                                            |      |              |         |
| Anemia   | 14/47 (30%)                            | 30/148 (20%)                               | 1.53 | (0.90, 2.61) | 0.190   |
| Ulcer    | 7/18 (39%)                             | 40/182 (22%)                               | 2.07 | (0.85, 5.04) | 0.187   |
| Gastritis| 4/12 (33%)                             | 41/181 (23%)                               | 1.47 | (0.63, 3.42) | 0.479   |
| Stomach cancer |                                | 44/193 (23%)                               | --   | --           | --      |
| Hepatitis A |                                    | 44/194 (23%)                               | 4.41 | --           | 0.231   |
| Helicobacter pylori |                                | 41/191 (21%)                               | 4.66 | --           | 0.219   |
| GI meds in last 12 months |                                | 24/100 (24%)                               | 22/100 (22%) | 1.06 | (0.77, 1.46) | 0.867   |
| NSAIDS in last 12 months |                                | 39/174 (22%)                               | 7/25 (28%)    | 0.96 | (0.84, 1.10) | 0.715   |

### Table IV. Serum hemoglobin and ferritin levels by H. pylori IgG antibody and gender.

| Hemoglobin | Females n=116 | Males n=80 |
|------------|---------------|------------|
|            | HP +           | HP -        | HP +       | HP -        |
| < 12 g/dl  | 1/30 (3%)      | 2/86 (2%)   | 0/19 (0%)  | 2/61 (3%)   |
| < 13.5 g/dl| OR=1.45, p=1.0 | 95% CI (0.13, 16.5) | OR=0.0, p=1.0 |
| Median (g/dl) | 13.5           | 14.0        | 16.1       | 16.0        |
| Serum ferritin |                | p=.071      | p=0.870    | p=0.870    |
| < 15 mcg/L | 3/30 (10%)    | 11/91 (12%) | 1/19 (5%)  | 0/63 (0%)   |
| Median (mcg/L) | 40.7           | 51.3        | 196.8      | 151.6       |
| p=0.688    | 40.7           | 51.3        | 196.8      | 151.6       |
| p=0.680    | 40.7           | 51.3        | 196.8      | 151.6       |
values (measured on a logarithmic scale) adjusted for age and sex, failed to show a significant decrease in ferritins for HP sero-positive persons (p=0.238).

Variables found to be significant at the p ≤ 0.20 level on initial analysis (age ≥ 40 years, residence in a hub town for ≥ 6 months, childhood crowding, lack of sewer/flush toilets and history of ulcer disease) were included in the multivariate model. In addition, the variable education level was also included based on previous studies. Being 40 years of age and older was the only factor that was significantly associated with \textit{H. pylori} seropositivity.

\section*{DISCUSSION}

In this study, we found that among a cohort of non-Native educators (mean age 44 years) living in Alaska, 24\% were seropositive for \textit{H. pylori}. Seropositivity rose significantly with increasing age and was found to be associated specifically with age > 40 years. This study is unique because, while previous studies have documented a high prevalence of \textit{H. pylori} infection in Alaska Native people (10, 12), no studies to date have examined \textit{H. pylori} seroprevalence among a cohort of non-Native people residing in Alaska.

Our overall finding of 24\% \textit{H. pylori} seroprevalence among non-Native adults is similar to a previous study of non-Native persons in the U.S. that documented a steady rise in seroprevalence with age at peak seroprevalence of 40-50\% in persons 55 to 60 years of age (9). Despite residence in communities with an increased \textit{H. pylori} prevalence, these non-Native educators were not found to have elevated rates of seropositivity, suggesting that their living conditions may have differed significantly from those of the Alaska Native population. Longer duration of residence in Alaska may increase the risk of acquiring \textit{H. pylori}; however, only information on duration of residence for 6 months or longer was obtained.

We found no association between low hemoglobin or low ferritin values and \textit{H. pylori} seropositivity among our cohort of Alaska non-Native educators. A previous seroprevalence study performed in Alaska in the 1990s documented an association between low ferritin values and \textit{H. pylori} seropositivity in the Alaska Native population (10). More recent treatment studies in Alaska have documented an association between active infection with \textit{H. pylori} and both iron deficiency and iron deficiency anemia in Alaska Native children 7 to 11 years of age; however, no significant improvement in iron deficiency or anemia was documented up to 14 months post cure in this population (13,14).

Among our cohort of non-Native educators in Alaska, we did not find an association between \textit{H. pylori} seropositivity and a variety of well-documented risk factors such as lack of running water, lack of a flush toilet, prior residence in a developing country and low education level. Only a history of age greater than 40 years was associated with \textit{H. pylori} seropositivity on multivariate analysis.

In our study, seropositivity for \textit{H. pylori} was not associated with stomach pain or any other clinical symptoms. Previous studies have documented an association between dyspepsia and infection with \textit{H. pylori}. Olafsson et al. demonstrated an improvement in abdominal pain scores in persons
cured of their *H. pylori* infections (15), and Blum et al. in a randomized, placebo-controlled trial demonstrated some benefit in terms of symptom improvement to patients (16). However, two randomized, placebo-controlled trials demonstrated no benefit in symptom reduction post-treatment (17,18).

Previous studies have documented an association between *H. pylori* seropositivity and socioeconomic factors, including housing conditions. We evaluated a variety of living conditions as potential risk factors and determined that while childhood crowding was associated with seropositivity on univariate analysis, this association was not present in the multivariate analysis.

The data in this study are subject to several limitations. This study was based on a cross-sectional, convenience sample of educators. The self-administered questionnaire allowed for incomplete answers, reducing the responses for some categories. Also, it was impossible to validate responses, including self-reported medical history. There were small numbers of participants in several categories, and duration of residence was not assessed and therefore could not be evaluated as a risk factor for seropositivity. We did not collect data on socioeconomic status or ethnicity (beyond Alaska Native versus non-Native). In addition, no tests for active infection with *H. pylori* were performed, and outcomes such as iron deficiency or anemia may be more related to active than past infection.

In conclusion, non-Native educators residing in Alaska had a lower seroprevalence than that found in previous studies involving adult Alaska Native persons. This finding argues against a ubiquitous common environmental exposure such as water in the transmission of *H. pylori* to adults. Additional studies to determine risk factors for the spread of *H. pylori* are needed, and the possibility of multiple routes of exposure should be considered.

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