Untreated water consumption: *Helicobacter pylori* status and gastritis in a northern Canadian community

Emily V. Hastings[1]*, Ashley Wynne[1], Hsiu-Ju Chang[2], Safwat Girgis[2], Karen J. Goodman[1,2] and The CAN*Help* Working Group

[1]School of Public Health, University of Alberta, Edmonton, AB, Canada; [2]Faculty of Medicine and Dentistry, University of Alberta, Edmonton, AB, Canada

Helicobacter pylori is a bacterium that infects the lining of the stomach, causing persistent inflammation known as gastritis. Chronic severe gastritis has been linked to peptic ulcers and gastric cancer, once-common digestive diseases that have decreased in frequency over the last century in many parts of the world. Believed to be common worldwide a few decades ago, a decline in *H. pylori* prevalence has been observed in developed countries. Aboriginal peoples of the Canadian Arctic, however, continue to experience an elevated frequency of the infection and related disease (1).

The effect of consuming untreated water on the prevalence of *H. pylori* infection and severity of associated conditions remains unclear. This analysis examines 2 ways in which the ingestion of untreated water may affect digestive health:

(a) Untreated water may act as a vehicle for the transmission of *H. pylori* organisms.
(b) Water consumption may be a potential determinant of the severity of gastritis due to the potential presence of chemical irritants.

Methods

Residents of Aklavik, Northwest Territories, located on the Mackenzie River, and Old Crow, Yukon Territory, located at the conflux of the Crow and Porcupine Rivers, participated in a community-based *H. pylori* research project. Residents were screened for the infection by urea breath test (UBT). Data on demographics, medical history and frequency of untreated water consumption were collected through structured interviews. Gastric biopsies were obtained through upper gastrointestinal endoscopy in 2008 (in Aklavik) and 2012 (in Old Crow) and examined by histopathology to assess *H. pylori* and grade gastritis as none, mild, moderate or severe.

To account for lack of independence of response probabilities given a contagious outcome, a mixed effects logistic regression model was used to estimate odds ratios (ORs) and 95% confidence intervals (CIs) for the effect of consuming untreated water in the past year on *H. pylori* prevalence, accounting for a random effect of household. Multivariable logistic regression was used to estimate the OR and 95% CI for the effect of untreated water consumption in the past year on the prevalence of severe gastritis (no household effect was observed for this outcome).

Results

Of 379 participants enrolled in the Aklavik *H. pylori* Project, 345 provided health data, 286 provided individual-level socio-environmental data, 165 provided household-level socio-environmental data, 333 completed a UBT (positivity = 58%), 200 consented to an endoscopy, and stomach biopsies were obtained from 194. Of 179 participants enrolled in the Old Crow *H. pylori* Project, 134 provided health data, 125 provided individual-level socio-environmental data, 83 provided household-level socio-environmental data, 178 completed a UBT (positivity = 69%), 64 consented to an endoscopy, and stomach biopsies were obtained from 63.

Of 278 residents of Old Crow and Aklavik with UBT results and water consumption data, *H. pylori* positivity was 72% in those who consumed untreated water in the past 12 months, compared to 62% in those who did not. Individuals who consumed untreated water had 1.2 (CI = 0.66–2.1) times the odds of *H. pylori* infection relative to those who did not consume untreated water, adjusting for age, gender, ethnicity, education, community and clustering in households.

Of 226 participants with biopsies evaluated, histopathological assessment classified 25% with no inflammation,

7% with mild inflammation, 31% with moderate inflammation and 37% with severe inflammation. The proportion of *H. pylori*-positive individuals from both communities (n = 166) with gastritis graded as mild, moderate or severe was 6, 41 and 50%, respectively. Only 4% of *H. pylori*-positive participants showed no signs of gastritis.

Prevalence of severe gastritis was 55% in those who consumed untreated water in the past 12 months, compared to 44% in those who did not. Among 105 *H. pylori*-positive participants from Aklavik with complete data, the OR for the effect of untreated water consumption in the past 12 months on severe gastritis was 2.6 (CI = 0.93–6.9) adjusting for age, gender, ethnicity, smoking, chronic NSAID use and alcohol consumption. When combined with 31 *H. pylori*-positive participants with complete data from Old Crow, the OR for the effect of untreated water on consumption of severe gastritis was 1.6 (CI = 0.71, 3.6) adjusting for age, gender, ethnicity and community.

Discussion

The role of water in the transmission of *H. pylori* is not clear due to difficulties in identifying the live organism in the natural environment (2). The results of this analysis do not provide evidence of an association between consumption of untreated water and prevalent *H. pylori* infection.

Initial data collected by the CAN*Help* Working Group have demonstrated relatively high frequencies of severe gastritis among *H. pylori*-positive residents of Arctic communities. Exposure to chemical irritants has been shown to contribute to the development of gastritis (3). Due to the direction of atmospheric and ocean currents, the circumpolar north is subject to high levels of pollutants from all over the world. Therefore, regular consumption of water that contains chemical pollutants that irritate the stomach lining may be partially responsible for the severity of gastritis observed in Arctic communities.

Distinct patterns of contamination in river water consumed by residents of Aklavik and Old Crow could lead to variation in the effect, if any, of untreated water consumption on gastritis severity. However, this analysis does not have sufficient statistical precision to rule out random variation as the reason for different effect sizes observed in the 2 communities.

Conclusion

This analysis does not yield evidence of an association between consuming untreated water and the probability of having *H. pylori* infection. Ongoing research will consider additional aspects of the natural environment that may facilitate the transmission of *H. pylori*. This analysis is inconclusive about a link between consuming untreated river water and gastritis severity. Ongoing research will examine environmental contaminants that may influence the prevalence of severe gastritis observed in Canadian Arctic communities.

References

1. Jacobson K. The changing prevalence of *Helicobacter pylori* infection in Canadian children: should screening be performed in high-risk children? Can J Gastroenterol. 2005;19:412–4.
2. Travis PB, Goodman KJ, O'Rourke KM, Groves FD, Sinha D, Nicholas JS, et al. The association of drinking water quality and sewage disposal with *Helicobacter pylori* incidence in infants: the potential role of water-borne transmission. J Water Health. 2010;8:192–203.
3. Dixon MF. The components of gastritis: histology and pathogenesis. In: Graham DY, Genta RM, Dixon MF, editors. Gastritis. Philadelphia, PA: Lippincott Williams & Wilkins; 1999. p. 51–66.

*Emily V. Hastings
Email: evhastin@ualberta.ca