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Introduction and Background

Walpole Island First Nation (WIFN) is an unceded territory, which is situated at the mouth of the St. Clair River, just downstream of Sarnia and Chemical Valley, a site of over twenty industrial complexes. For many years, toxic chemicals have been released from point sources into the St. Clair River by industries located on or near its banks and this practice continues today. More than 300 tonnes of mercury were released into the St. Clair River over several decades by two chlor-alkali plants, resulting in the closure of the WIFN fishing industry in the early 1970s. There are also regular accidental spills that result in advisories not to remove water for treatment for drinking from the St. Clair River. Pollutant release has disrupted the culture, lifestyle, and economy of the WIFN community, as well as created considerable chemophobia in the community. Members of the WIFN are very concerned about the effects of these chemicals on environmental and human health because Ojibwe cultural teachings stress the importance of preserving a healthy environment for seven generations.

The WIFN community has always depended on the St. Clair River and Lake St. Clair as primary sources of food and drinking water. The geographical location of Walpole Island makes it vulnerable to the effects of both water and air pollution, and this has been the case for several decades. As stated by Dellinger (2004), there has been extensive chemical contamination within the Great Lakes Basin; however, there is little research on how efficiently these pollutants transfer from the environment to humans, and even less is known about their effects on human health in this area. This lack of information on the risks to human health calls for

further studies in populations at risk, especially those dependent on traditional food from contaminant-containing water.

In 2004, WIFN approached the University of Western Ontario (UWO) to be a research partner to carry out a feasibility study for an epidemiological assessment of the impact of toxic pollutants—particularly methylmercury—on the health status of adults and children consuming contaminated water and natural foods, such as fish and muskrats. The issues being studied were identified as priorities by WIFN community members, and this led to our ongoing collaborative community-based participatory research (CBPR) projects.

A community-based participatory research partnership has developed over the past four years. The principles of participatory research have been incorporated into all aspects of the work, including development of the research questions, analyses of data, reporting results back to the community, and sign-off by the Chief and Band Council before any presentations or publications. Both WIFN and the UWO Ecosystem Health Research Team are committed that CBPR studies conducted within WIFN must include community input and participation in research activities at all stages; be equipped with mechanisms to facilitate dissemination of research findings to community members; and provide some potential benefits to the community (e.g., building community capacity).

As an indication of the strong support of the WIFN community for evaluating potential adverse health effects of pollutants, the Chief and Band Council have passed two resolutions that will facilitate this project. One resolution, passed on May 16, 2005, grants permission to clinical members of the UWO Ecosystem Health Research Team to access the health records of WIFN band members who agree, to begin to evaluate potential adverse health effects from exposure to environmental contaminants.

More recently, on September 19, 2005, the Chief and Band Council passed a resolution that grants permission to the UWO Ecosystem Health Research Group to collect hair and blood samples from those WIFN members who agree, to determine the content of an array of environmental contaminants.

The research partnership has been built on the foundation of an excellent pre-existing relationship between WIFN and a UWO researcher from the Department of Anthropology (R.D.) who is a participant-researcher in the current work. In addition, the WIFN Heritage Centre has been a force within the WIFN community for more than ten years, developing and implementing research projects of importance to the community. The staff of the Heritage Centre has independent research expertise and experience that ensures a balanced and reciprocal research relationship, without the historical risks experienced by Aboriginal communities that have been subject to “helicopter” research. From the UWO Ecosystem Health Research Team side, Professor Jack Bend has been the persistent champion and lead for funding proposals, reports, and most of the presentations and papers. He has developed, and maintains, a relationship of mutual trust and respect with key members of the WIFN community.

Ethics approval for all aspects of this study (biomonitoring, interviews, and examination of health records) was obtained from the Ethics Review Board of the University of Western Ontario and of the London Health Sciences Centre.

Three funded studies have been undertaken. The 2005 Feasibility Study examined the feasibility of an epidemiological study to assess health risk from exposure to environmental contaminants. The 2006 Fish Consumption Study evaluated exposure through fish consumption. The 2007–08 Biomonitoring Study is still in progress.

Hypotheses being tested are:

The St. Clair River has experienced historical and continuing chemical spills and atmospheric deposition of contaminants, including Persistent Organic Pollutants (POPs) and very large amounts of mercury, suggesting detrimental effects on human health are possible.

The fear of these chemical exposures (chemophobia) can lead to unnecessary changes in traditional subsistence economies and cultural practices, diet and health status, and disease burden.

Methods

2005 Feasibility Study (Bend et al. 2005)

In May 2005 pilot interviews with community members were conducted at the Walpole Island Heritage Centre. Qualitative data in the form of oral histories and personal experiences regarding environmental contaminants was collected and analyzed. Informants included individuals who were recognized in the community as knowledgeable about the ecosystem (i.e., traditional ecological knowledge or TEK) and human health. Community participation in this pilot study was solicited through flyers distributed throughout the community. Approximately twenty semi-structured interviews were conducted. The data collected was analyzed according to the principles of grounded theory (Strauss and Corbin 1990). In addition, information about the amounts and nature of chemicals spilled into the St. Clair River was collected and analyzed. The demographics of the WIFN population were also recorded. Finally, the chemical analysis of drinking water distributed from the Walpole Island treatment facility was evaluated for chemicals of known toxicological potential, particularly those formed as by-products of chlorination. (The analysis of trace chemicals in the drinking water was performed by Health Canada, which also provided the data.)

2006 Fish Consumption Study (Bend et al. 2006)

A template was designed for a Walpole Island Fish Consumption Diary, which was completed over a three-month period in 2006. Volunteers were requested to record the date of each meal, the length of the fish or fillet, the species of fish, the area where the fish was caught, the part of the fish consumed, and the taste of the

fish. Individuals were also asked to make comments that were recorded. The fish consumption diary was distributed to fifty-five families and a total of ninety-one community members completed it. As part of the same study, fish of ten local species were caught in Lake St. Clair and analyzed for their mercury content. Based on average mercury content of the fish species consumed, the average weekly intake of methylmercury was estimated for each participant for comparison to the World Health Organization (WHO) provisional tolerable weekly intake (PTWI) value of 1.6 µg of mercury/kg body weight/week.

Results

In the 2005 Feasibility Study, a number of areas of concern were identified by Walpole Island residents:

Water pollution is a major problem in the community: All of the volunteers identified water contamination as their primary human health concern.

Knowledge of water pollution in the community: Residents are well informed on the issue and there is a strong awareness that the island's location downstream from Chemical Valley puts the community at risk for exposure to contaminated water from chemical spills.

Perceived effects of environmental degradation on human health: Residents commented on the increasing number of deaths and individuals with diseases that were less common (cancer, diabetes) in previous generations. To a large degree this was attributed to water pollution.

Psychosocial stress associated with fear of exposure: The stress manifested in several different ways, particularly worrying about the health of their children and grandchildren in the community.

Willingness of residents to participate in a future epidemiological study using molecular biomarkers: Based on the findings of preliminary interviews, there was a strong interest in the issue of water quality and a willingness to participate in research investigating the health effects.

In the 2006 fish consumption survey, it was found that 72% of the WIFN community members who participated did not consume local fish at all during the three-month survey period. Fourteen members had an estimated methylmercury intake, from fish only, between 0.22 and 1.44 µg/kg body weight/week. Of potential concern, eleven WIFN members (of ninety-one participants) had an estimated intake greater than the WHO PTWI of 1.6 µg mercury/kg body weight/week.

Mercury concentrations that exceed the Ontario guideline limit for sports fish (0.5 ppm) were found in 18% of the total fish sampled, and more than 30% of the predatory fish (pickerel, rock bass, largemouth bass, smallmouth bass, bowfin) exceeded this limit.

The cortisol content of hair from members of the WIFN community (N=40), a marker of psychological stress, was significantly higher than that in hair from our

reference population who live near London, Ontario (N=32); 180 ± 9.5 ng/g hair (ppb) vs. 112.5 ± 9.6 ppb (mean ± SEM); P<0.0001, Mann-Whitney test.

2008 Biomonitoring Study (In Progress)

Results from our two completed studies suggest that WIFN community members may be so concerned with the documented methylmercury contamination of fish in the St. Clair River, and the chlor-alkali plants that historically released huge concentrations of mercury into the river, that they avoid eating local fish. These studies laid the foundation for the 2007–08 baseline monitoring and health survey study recently conducted by members of the UWO Ecosystem Health Research Team and the WIFN community to help clarify current exposures and allow evidence-based decision making by community members, as well as to enable future monitoring. The Biomonitoring Study will also result in a collection of community narratives that will aid in the preservation of cultural teaching and TEK.

We have conducted baseline biomonitoring of whole blood and hair from > fifty WIFN volunteers for a panel of heavy metals and metalloids (antimony, arsenic, cadmium, lead, nickel, and thallium) and of blood plasma from twenty volunteers for ninety-one POPs of concern, including most chemicals identified by the Stockholm Convention (twenty persistent insecticides and seventy-one polychlorinated biphenyl congeners). We also analyzed hair for cortisol, a biomarker of psychological stress.

The Biomonitoring Study is intended to further document local environmental and health concerns and perceptions of risks; discuss health risks and benefits of regular fish consumption; survey community members and health records to determine incidence of illness in children to age nineteen; and record oral histories regarding Indigenous knowledge about health and the environment (TEK) for future community use.

Currently, while results have been presented to the community via an open meeting, we are awaiting permission from the Chief and Band Council, to publicly share the results from the 2008 study. Meanwhile, funding has been obtained for another comparative study with another First Nations community.

Discussion

A sustained community-based participatory research partnership is in place that enables ongoing environmental collaborative research. Essential parts of this research project are community education, training of members of the WIFN in qualitative and quantitative research methodologies, and proposed solutions for complex ecosystem health problems. The Feasibility Study revealed that participants were concerned about how information obtained through epidemiological study would be used; how confidentiality would be assured; what motivation/intent guides community health studies; and how epidemiologic data could be

put to "practical use." However, we determined that an epidemiological study is feasible to assess health risk from exposure to environmental contaminants as long as endpoints are selective, and qualitative and quantitative analyses of chemical contaminants in red cells or plasma lipids and hair are conducted (Bend et al. 2005). The current Biomonitoring Study will provide information to the community to enable evidence-based choices about food intake, and to enable ongoing monitoring of health status in the future.

Community benefits from our studies include:

1. **The creation of community databases**

   The consolidation of health data will help the team assess whether there are any statistically significant associations between exposure to environmental contaminants and morbidity and mortality trends in the community. Databases created through this research will serve as an important resource tool for future community health research.

2. **Capacity building and skills transfer**

   Every effort is being made to promote skills transfer and the training of community members throughout the duration/at all stages of this research project.

3. **Utility and application of research findings**

   The documentation of negative health effects associated with exposure to environmental contaminants can help initiate remedial action in health risk assessment and preventative care. Research findings can also form the basis for remedial action in enforcing environmental protection measures and changing existing policy.

4. **Documentation of Aboriginal traditional knowledge/traditional ecological knowledge**

   Aboriginal traditional knowledge about links between health and the environment will be collected through interviews with WIFN members. Oral histories will be made explicit and recorded for future community use. The collection and documentation of community narratives will aid in the preservation of cultural teachings and traditional ecological knowledge.

5. **Community-based participatory action research (PAR)**

   Research conducted in the WIFN community will include community input and participation. Members of the research team are committed to knowledge transfer/translation and will ensure that information from this study is made available to community members at all stages of the study.

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