



Association between perceptions of public drinking water quality and actual drinking water quality: A community-based exploratory study in Newfoundland (Canada)



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ABSTRACT

Studying public perception on drinking water quality is crucial for managing of water resources, generation of water quality standards, and surveillance of the drinking-water quality. However, in policy discourse, the reliability of public perception concerning drinking water quality and associated health risks is questionable. Does the public perception of water quality equate with the actual water quality? We investigated public perceptions of water quality and the perceived health risks and associated with the actual quality of public water supplies in the same communities. The study was conducted in 45 communities of Newfoundland (Canada) in 2012. First, a telephone survey of 100 households was conducted to examine public perceptions of drinking water quality of their respective public sources. Then we extracted public water quality reports of the same communities (1988–2011) from the provincial government's water resources portal. These reports contained the analysis of 2091 water samples, including levels of Disinfection By-Products (DBPs), nutrients, metals, ions and physical parameters. The reports showed that colour, manganese, total dissolved solids, iron, turbidity, and DBPs were the major detected parameters in the public water. However, the majority of the respondents (> 56%) were either completely satisfied or very satisfied with the quality of drinking water. Older, higher educated and high-income group respondents were more satisfied with water quality than the younger, less educated and low-income group respondents. The study showed that there was no association with public satisfaction level and actual water quality of the respective communities. Even, in the communities, supplied by the same water system, the respondents had differences in opinion. Despite the effort by the provincial government to make the water-test results available on its website for years, the study showed existing disconnectedness between public perception of drinking water quality and actual quality. We had little scope to explore the possible explanations, and hence further studies are required to verify the age, gender educational status and income differential about the satisfaction of public service like water supply.

1. Introduction

Study of the public's perception on drinking water quality is commonly conducted in the integrated management of water resources, generation of water quality standards, and monitoring of the drinking-water quality (Jayyousi, 2001). The World Health Organization (WHO) recognizes the importance of public participation in the surveillance of drinking water quality, since the public is the primary beneficiary of clean and safe water supplies and the first to experience the consequences of deteriorating water quality (WHO, 2011). Public perceptions of risks to drinking water informs a dialogue between governments, drinking water service providers, and community leaders. The

perceptions also highlight the public's thought processes and responses to the perceived risks of drinking water (Doria, 2010; Doria et al., 2005; Dupont, 2005; Johnson, 1993; Kunreuther et al., 1993; Fischhoff et al., 1993; Slovic, 1987). The International Water Association in its 2004 “Bonn Charter for Safe Drinking Water”, gave specific emphasis on increasing effort to supply drinking water that has the trust of consumers (IWA, 2004). Several studies on public perceptions of drinking water quality have focused on various themes such as bottled water (Doria, 2006; Anadu and Harding, 2000), private water supplies (Jones et al., 2005), municipal water (Turgeon et al., 2004), desalinated water (Dolnicar and Schafer, 2009), recycled water (Hurlimann et al., 2008; Po et al., 2003), and factors that influence perceptions and response to

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health risks (Dogaru et al., 2009).

The majority of Canadian households (86%) were connected to a municipal water supply (Statistics Canada, 2011). According to Environmental Performance Index 2010, Canada ranked the second-best (after Sweden) in water-quality among the selected industrialized countries (Environment Canada, 2017). However, Canada has also experienced 48 confirmed water-borne disease events from 1993 to 2007. Such events are occurring less frequently, possibly due to improvements in drinking water awareness and quality following the Walkerton, Ontario outbreak in 2000. A relatively high proportion of water-borne disease outbreaks has occurred in small drinking water systems (serving populations of 5000 or less) (Moffatt and Struck, 2011). A study on the public perception of drinking water from private water supplies in Hamilton, Ontario found that most consumers were confident in the safety of their water supply (Jones et al., 2005). However, the survey could not ascertain the factual basis of their opinion, such as actual water quality (Jones et al., 2005). According to Public Health Agency of Canada, there are more than 1000 active boil water advisories across the country at any given point of time, most of which occur in small communities (PHAC, 2013).

There are several factors that impact public perceptions of drinking water quality, such as flavour, health risk perception, past experience, trust on water service provider, the influence of impersonal and interpersonal information (e.g. media, peers), and demographic variables (Doria et al., 2009). Public perceptions of health risks related to drinking water are influenced by the presence or absence of health problems that are associated with drinking water, the persistence of these health problems, and the level of awareness of the problem (Doria, 2010). Unresolved long-term water quality issues in an area are likely to increase public perceptions of health risk and prompt people to seek other alternatives, such as bottled water (Doria et al., 2009). For example, in North America and Europe, the physical characteristics (such as colour, taste, smell) of water and the associated health concerns were found to be the primary determinants of the use of bottled water (Doria, 2006). Public perceptions of risks related to water quality play large role in influencing health-seeking behavior and practices (Slagle et al., 2015). One assumption in the studies of risk perception is that the willingness of the public to undertake health-seeking behaviours usually depends on how they evaluate the risk (O'Connor et al., 1999).

Perceptions that truly reflect the actual quality of the water and the associated health risks can help ensure that the appropriate policy and decisions are made for corrective measures to improve the quality of the water as well as to minimize health risks. Conversely, misperceptions may interfere with the making of decisions that are effective in mitigating such health risks (Böhm et al., 2001) or compel to take such decision that may not be effective to improve water quality (Bostrom and Fischhoff, 2001). However, in policy discourse, how reliable is the public perception concerning drinking water quality and associated health risks? In other words, does the public perception of water quality equate with the actual water quality? Theoretically the relationship between public perception of water quality and actual water quality can have four possible outcomes; ideally, two matched, satisfaction with good quality and dissatisfaction with poor quality, and two discordant (dissatisfaction with good quality and satisfaction with poor quality). Thus, any survey, which is limited only to public perception, may be biased and lead the concerned authority to make an incorrect policy decision. There are very few studies showing whether drinking water quality (perceivable and/or reported) has any influence on public perception. Hence, it is critical, to study association between the actual water quality (supplied by local public utilities) and the public perception of piped water supplied by the local public utilities of the respective communities. The objectives of this study were three-fold: 1) to determine public perceptions of piped water quality and the perceived health risks, 2) to assess the quality of public water supplies (after treatment of raw water by local public utilities), and 3) to link the

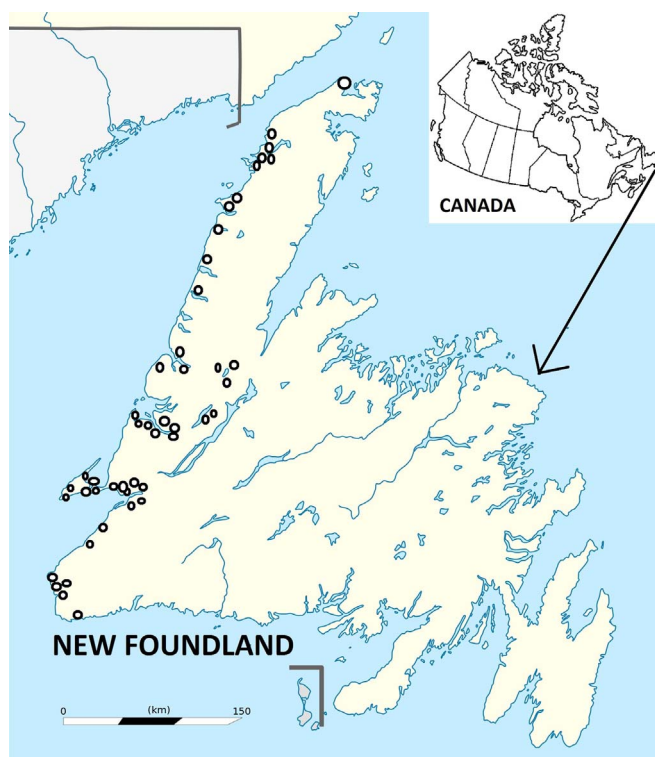


Fig. 1. Map of Newfoundland showing the locations (not according to scale) of 45 communities.

public perception of quality of piped water and the perceived health risks with the actual water quality of piped water.

2. Materials and methods

2.1. Description of the study area

The study was conducted in Western Newfoundland extending about 750 km northwards from Cape Ray in the South to Cape Bauld in the Great Northern Peninsula (see Fig. 1). This region had an estimated population of 73,000 people living in 59 communities in 2011 (AMEC, 2008; GoNL, 2013). The majority of the communities have a population less than 1000, except Corner Brook, the largest community in Western Newfoundland, of approximately 20,000 persons. This study excluded Corner Brook and communities lacking a public water supply. After excluding communities for these reasons, there were 45 eligible communities. Public utilities under these municipalities have selected ponds/lakes for water supply and these water bodies and their surroundings are maintained and protected from human activities (recreation and commercial) (GoNL, 2017a). Raw water from the source (ponds/lakes) undergoes series of treatment (mentioned in discussion) before supplying to each household via pipeline.

2.2. Public perceptions of water quality

The first study was a cross-sectional study, based on a telephone survey that examined public perceptions of their drinking water quality. The households in communities in Western Newfoundland were asked questions regarding their satisfaction with their piped water quality (collected from tap, before any domestic modification such as filtration or boiling), health risks associated with drinking their piped water, and water filter usages.

2.2.1. Questionnaire development

Graduate dissertations that examined perceptions of water quality

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