

“Differences in Water Consumption Choices in Canada: the Role of Socio-demographics, Experiences, and Perceptions of Health Risks”

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Abstract

In 2000 and 2001 Canadians were shocked by water contamination events that took place in two provinces. In 2004 we undertook an Internet-based survey across Canada that asked respondents to identify in percentage terms their total drinking water consumption according to one of three sources: tap water, bottled water, and home filtered water (either some type of container or an in-tap filter device). In this paper we investigate the determinants of these choices and whether choosing to either filter or purchase water is linked to perceptions of health concerns with respect to tap water. A series of one-way ANOVA tests suggest that past experiences with unpleasant water tastes or smells and greater expressed concern that tap water causes health problems lead to significantly greater consumption of bottled and significantly less tap water consumption. In order to examine these choices in a multivariate framework, we estimate a multinomial logit model. Key factors yielding higher probabilities of a respondent being primarily a bottled water drinker (relative to the choice of tap water) include: higher income, unpleasant taste experiences with tap water, non-French-speaking, and being a male with children in one's household. Similar factors yield higher probabilities of a respondent being primarily a filtered tap water drinker. An important finding is that two key variables linking a person's health perceptions regarding tap water quality are significant factors leading to the choice of either filtered tap water or bottled water over tap water. They are: a variable showing the degree of health concerns a respondent has with respect to tap water and a second variable indicating whether the respondent believes bottled water to be safer than tap water.

Keywords: bottled water, consumption choices, public perceptions, health concerns

INTRODUCTION

After many years of being taken for granted by the general public in Canada, the quality of municipally supplied drinking water came to the forefront of both public and government awareness as a result of the outbreaks of waterborne diseases in Walkerton, Ontario, (2000) and North Battleford, Saskatchewan (2001).¹ Events in these communities served to highlight the importance of understanding the link between the environment, human health, and water quality. One outcome was the development of a position paper in 2002 by the Canadian Council of Ministers of the Environment (CCME) advocating the employment of an integrated multi-barrier approach to ensure water quality from “source to tap”. The report urged involvement from multiple stakeholders, including all levels of government (federal, provincial and municipal), as well as industry, non-governmental agencies and the general public.

What these events underscore is the necessity of undertaking research into public concerns, particularly those pertaining to health, as they relate to the public’s tap and bottled water preferences and determinants (Doria, 2006). There have been only a few efforts in the past to shed light on these matters. What these studies have revealed, however, is that large (and growing) numbers of the public have chosen to consume substitutes for their tap water: in the form of either home-filtered tap water or as purchased (bottled) water (Health and Welfare Canada, 1983; Auslander and Langlois, 1993; Levallois, Grondin, and Gingras, 1999; Abrahams, Hubbell, and Jordan, 2000).² Two recent papers in this journal (Jones et al., 2006 and Pintar et al., 2009) surveyed consumers in two different medium sized communities in Ontario, Canada – Hamilton and Kitchener-Waterloo - and found that between

¹ *E coli* O157:H7. contamination in Walkerton, Ontario in 2000 caused seven deaths, close to 100 hospitalizations and many people who experienced less severe symptoms. The North Battleford, Saskatchewan event in 2001 was caused by an outbreak of cryptosporidiosis which infected 6500 but did not cause any deaths.

² Statistics Canada (2002) reports that bottled water sales rose at an annual rate of about 9 % over the period, 1995-2000. Over the more recent period of 2000-2003, Zenith International and Beverage Marketing Corporation has published statistics showing that the total value of bottled water sales in Canada have almost doubled (from 310 to 650 (USD) million) with volume up from 820 to 1,490 million litres (International Council of Bottled Water Associations, 2004).

27 % and 34 % of respondents could be classified as primarily bottled water users (75 % or more of total daily consumption) and 49 % reported using some form of home filtration device. A cross-Canada survey undertaken by Statistics Canada in 2007 (Statistics Canada, 2009) found similar results: almost 3 out of every 10 households drank bottled water predominantly and around 50% of Canadian households treated their tap water with some type of home filtration device. Many factors might help to explain the choices made by these households (Dietz et al. 1998). For example, heterogeneity of preferences arising from socio-demographic characteristics is likely to be an important determining factor. Jones et al. (2006) found evidence of age differences associated with consumption of bottled water but did not find support for income or education factors. They concluded that other considerations - such as perceptions, views, beliefs, and experience - might dictate choices and argued that it would be important to examine the roles played by these factors. While Statistics Canada (2009) did not examine the relationship between these types of perception and experience motivations and bottled water purchases, the report noted that removal of chlorine, metals and minerals, as well as concerns about possible bacterial contamination, e.g., from *E. Coli*, cryptosporidium, or giardia, appeared to be important factors in the decision to filter one's home tap water. Previous research suggests that aesthetics (taste and smell) and convenience might be just as important to consumers as the perception that bottled water is somehow safer than tap water (Grondin et al., 1996; Jardine, Gibson and Hrudey, 1999; Levallois, Grondin, and Gingras, 1999; Abrahams, Hubbell, and Jordan, 2000; Doria, 2006). Statistics Canada (2009), for example, asked respondents to categorize their motivations for filtering or treating tap water at home. Approximately 43 % of respondents indicated that they did so to remove possible bacterial contamination, while 58% indicated that they preferred the taste/smell of home filtered water.

This paper contributes to the literature in a number of ways and provides a response to Doria's (2006) call for more research on bottled and tap water preferences and determinants. First, our paper reports

on the drinking water choices of a representative national sample of Canadian households regarding three sources for home drinking water consumption: tap water, home filtered tap water and bottled water. In addition to providing information for Canada, as a whole, the data allow us to identify similarities/ differences in these choices across four main geographic regions: West (including the provinces of British Columbia, Alberta, Manitoba, and Saskatchewan); Ontario; Quebec, and Atlantic (including the provinces of Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island). This yields an overall picture of water consumption in Canada that expands beyond the work of Jones et al. (2006) and Pintar et al. (2009). Second, the paper examines the association between these three drinking water choices and demographic characteristics of the respondents in each of these regions. Factors such as age, income, gender, and the presence of children in a household – a previously understudied area - are shown to play important roles in findings of differences across individuals and regions. Third, in addition to analyzing choices using a series of one-way ANOVA tests, the paper integrates the socio-demographic factors with additional information on self-reported experiences of common “problems” of tap water (such as unpleasant smell and taste), beliefs about the risks of bacterial contamination for tap water, and perceptions of tap water quality, in a multinomial logit model to explain the probabilities of a respondent choosing to be either a filtered or bottled water drinker rather than a tap water drinker. An important finding is that a respondent’s expressed health concerns regarding tap water and belief that bottled water is safer than tap water are highly significant factors in these choices.

The next section gives a brief description of the survey from which these data are taken. The following section discusses the role played by socio-demographic characteristics in determining differences in the percentages of a respondent’s total water consumption from the three sources: tap, filtered tap water, and bottled water. In the fourth section we report on households’ stated experiences with tap water and the extent of their concerns regarding the quality of their tap water and its relationship to

health. The role played by these factors in determining water consumption choices is also examined using descriptive statistics. In the fifth section we combine both sets of factors: socio-demographics and perceptions/views/concerns in a series of econometric models to explain the probability of choosing one of the two alternatives to tap water (filtered or bottled). The paper concludes with a discussion of the implications of our results from a water and health policy standpoint. In particular, our results show that a majority of people believe that bottled water is safer than tap water and that health concerns are a key component to better understanding water consumption choices made by the public. Ironically, this is occurring at the same time as a number of municipalities are enacting legislation to ban the sale of bottled water in public places. Insofar as these government efforts lead to much needed reinvestment in public water infrastructure, the public interest may be served.

METHODS

Survey Administration

During the summer of 2004 we conducted an Internet-based survey using a secure on-line website administered by Ipsos-Reid, a marketing and public research agency. The survey was developed after extensive focus group testing in various Canadian cities during 2002 and a pre-test in December 2003. At our request Ipsos-Reid sent out 4,563 email invitations to a random sample of its panel of Internet users. The panel consists of over 100,000 members who have been recruited to the panel primarily over the telephone using random digit dialling. The composition of the panel reflects an accurate, balanced representation of Internet-enabled Canadians.³ An adult in the household with the next

³ Nevertheless, we make no claim that the survey is representative of all Canadians as it is estimated that for 2005 32% do not have access to an internet connection from any location (Statistics Canada, 2008). To the extent income and education drive whether a given household has such a connection and these factors tend to favor drinking bottled or treated water, our results probably overestimate the use of these options for the general public.

upcoming birthday was requested to complete the survey. Respondents answered surveys in their choice of either French or English.⁴ 2,520 respondents began the survey and 1,633 completed it.⁵

Data Collected

The questionnaire elicited information from respondents about their consumption of water from three sources described to them as: water direct from the tap, home treated tap water (either filtered or boiled in the home), and purchased water (either bottled or from home delivery). Respondents were asked to indicate the percentage of water that they personally consume at home from each of the three sources. In addition, the survey asked respondents to indicate the type of water filtration or treatment systems that they use in their homes.

A second set of questions told respondents to consider only their tap water. In this part of the survey respondents were asked to indicate which of four different statements best reflected their personal opinion about health concerns relating to their tap water.⁶ Finally, respondents were asked to indicate whether they had heard about the presence of certain items in their tap water and whether any of these had been of special concern in their community. The list of items included: *E. Coli.*, cryptosporidium, giardia, Trihalomethanes, fluoride, pesticides, and metals. A follow-up question asked respondents to rank each of the items in relation to health concerns on a 4-point Likert scale.

Information about a number of socio-demographic variables was requested of respondents. This information included: gender, age (in years), highest level of education attained, household income,

⁴ Free and informed consent of the participants was obtained and the study protocol was approved by the Research Ethics Boards at the University of Alberta, Edmonton, Alberta, Canada, and Brock University, St. Catharines, Ontario, Canada, File No. 02.330, July 2003.

⁵ Four hundred and nineteen individuals quit the survey before completion. In addition, 466 responses were deemed ineligible since we did not include respondents on septic systems. Two responses were deleted due to errors caused when the Ipsos-Reid server went down. It is reasonable to assume that ineligibles are found in the same proportions to those contacted as to those responding ($466/2520 = 18.5\%$).

⁶ The statements were: drinking tap water does not pose a problem for my health or my family's health; drinking tap water poses a minor problem for my health or my family's health; drinking tap water poses a moderate problem for my health or my family's health; and drinking tap water poses a serious problem for my health or my family's health.

Table 1: Percentages of survey respondents (compared to population percentages in parentheses) by socio-demographic characteristics and region

	Canada	West	Ontario	Quebec	Atlantic
Age					
19-29	14 (18)	14 (19)	13 (18)	16 (18)	16 (16)
30-39	18 (18)	18 (18)	20 (18)	17 (16)	12 (16)
40-64	53 (47)	52 (46)	51 (46)	54 (48)	57 (49)
65 and over	15 (18)	16 (17)	16 (18)	13 (18)	16 (19)
Highest Level of Education					
High school or less	28 (25)	29 (26)	25 (26)	30 (21)	37 (23)
University/College	72 (75)	71 (74)	75 (74)	70 (79)	63 (77)
Household Income (\$ 2004)					
Under 29,999	27 (26)	26 (25)	28 (22)	25 (30)	30 (31)
30,000-54,999	27 (25)	30 (25)	24 (23)	26 (28)	36 (34)
55,000-99,999	31 (30)	28 (30)	33 (31)	34 (28)	34 (23)
Over 100,000	15 (19)	16 (20)	15 (24)	15 (14)	12 (12)
Gender					
Female	48 (52)	48 (51)	47 (52)	48 (52)	51 (52)
Male	52 (48)	52 (49)	53 (48)	52 (48)	49 (48)

province, urban/rural location and whether there are children in the household. Since survey respondents were drawn from an Internet-panel across Canada, we were able to obtain a proportional sample of responses from the provinces. Table 1 shows the percentage of respondents in our dataset in each socio-demographic category both across Canada and in each of four regions: West (combining British Columbia, Alberta, Saskatchewan, and Manitoba), province of Ontario, province of Quebec, and Atlantic (combining Nova Scotia, New Brunswick, Newfoundland, and Prince Edward Island). Since the data are proportional to the actual population in Canada the majority of observations come from the two central provinces. We combined data from the western and eastern provinces respectively in order to have comparable sample sizes across the four regions. The Table shows that socio-demographic characteristics are very similar across the four regions, with the exception of slightly lower income levels and slightly lower completed education levels for respondents in the Atlantic region.

RESULTS

Water Consumption Choices

Tables 2, 3, and 4 present data on the self-reported percentage of total drinking water consumption from each of the three sources (tap water, home treated (filtered or boiled) tap water, and bottled water). This information is presented in a number of ways: firstly, for the average respondent in Canada, as a whole; secondly, for the average respondent in each of the four regions; and, then more finely disaggregated by respondents across Canada and within region according to a number of socio-demographic characteristics. Since we are interested in whether there are similarities or differences we include in the tables the p-values from a series of one-way ANOVA tests for the null hypotheses that mean percentages for each type of water are equal across the four regions according to various socio-demographic characteristics.

A comparison of the first rows in each of the three tables shows that, for the average Canadian respondent in our sample, mean tap water consumption is 38% of total drinking water consumption, while filtered is 40% and bottled is 22%. However, there are significant differences ($p=0.014$) across regions in these numbers for tap and bottled water consumption; for example, on average 46 % of water consumed at home by a Quebec resident is tap, while the comparable number for an Ontario resident is only 34%. On the other hand, bottled water consumption at 25 % is significantly greater in Ontario ($p=0.015$) and lower in Quebec (19%).⁷

In addition to examining consumption levels for the average respondent, we split the sample a number of times by various socio-demographic characteristics. Looking first at Table 2, we observe significantly higher tap water consumption among older people in Ontario and the West but significantly lower tap water consumption among older people in Quebec. For Canada, as a whole, and for the province of Ontario, a significant factor in greater tap water consumption is a higher level of education. Finally, the presence of children in a household appears to be a significant factor for decreasing tap water consumption for residents in Ontario (from 36% to 30%; $p=0.068$) and the Atlantic region (from 42% to 21%; $p=0.065$). To the extent that parents are concerned for the health of their children (Teal and Loomis, 2000; Dupont, 2004) and perceive higher health risks from tap water, then we would expect increasing reliance upon the two alternatives to unfiltered tap water.

⁷ It is difficult to compare the results from these data with that of Statistics Canada (where 1 in 3 people claimed to drink bottled water and 50 % claimed to treat their water by either filtering or boiling) since less informative questions were asked. For example, the Statistics Canada survey asked “what type of water does your household primarily drink at home” and gave respondents the following choices: tap, bottled or both tap and bottled. Unfortunately, respondents were not asked to specify the extent to which the tap water was home filtered. Moreover, respondents were not given a specific number intended to represent “primarily”. Respondents obviously could interpret this as being a number from 51% to 100 %. Jones et al., (2006) use a benchmark of 75 % of more consumption in order to categorize their respondents as “bottled water users”. Our data collection process required respondents to state the percentages of home water consumption from each of the three sources (unfiltered tap, filtered tap, and bottled). It further required the answers to sum to 100 % before allowing respondents to proceed to the next question. Thus, when we adopt the Jones et al. benchmark, we find 13 % of our entire sample can be classified as “bottled water users”, while 31 % would be “filtered water users” and 31 % “tap water users”. These percentages do not sum to 100 % since we are only looking at respondents who claimed 75 % or more of a particular source. A number of people (315) consumed all three sources in roughly equal amounts.

Table 2 – Tap Water as a Percentage of Total Water Consumption by Socio-Demographic Characteristics

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Entire Sample	1633	38 (42)	515	38 (42)	624	34 (40)	411	46 (43)	83	37 (44)
Age		p=0.415		p=0.052		p=0.075		p=0.038		p=0.449
18 to 29	231	37 (38)	70	37 (39)	81	29 (34)	67	48 (39)	13	39 (45)
30 to 39	295	35 (40)	92	29 (37)	124	29 (36)	69	55 (43)	10	47 (45)
40 to 64	857	39 (43)	272	39 (43)	317	35 (41)	221	45 (45)	47	31 (42)
65 plus	250	41 (45)	81	46 (47)	102	40 (44)	54	32 (41)	13	51 (49)
Highest Education		p=0.004		p=0.155		p=0.044		p=0.284		p=0.240
High school or less	459	33 (41)	147	33 (40)	158	29 (38)	123	40 (44)	31	30 (41)
Uni/ Coll	1163	41 (42)	364	41 (43)	463	36 (40)	284	49 (43)	52	42 (46)
Income (\$000"s)		p=0.169		p=0.914		p=0.281		p=0.559		p=0.500
> 30	435	38 (43)	133	38 (43)	173	33 (39)	104	48 (44)	25	37 (43)
30-55	442	41 (43)	155	38 (43)	151	38 (42)	106	49 (44)	30	40 (44)
55-100	514	35 (41)	144	37 (41)	205	31 (38)	138	42 (43)	27	33 (46)
< 100	242	41 (41)	83	41 (42)	95	37 (40)	63	45 (41)	1	Insuff data
Gender		p=0.124		p=0.135		p=0.350		p=0.808		p=0.839
Female	779	37 (41)	257	35 (41)	293	32 (39)	247	45 (42)	42	36 (43)
Male	854	40 (43)	268	41 (43)	331	35 (41)	268	46 (45)	41	38 (46)
Urban/Rural		p=0.501		p=0.577		p=0.448		p=0.563		p=0.714
Rural	521	38 (43)	175	36 (43)	195	33 (40)	100	48 (44)	51	40 (45)
Urban	1062	39 (42)	322	39 (42)	409	36 (40)	302	45 (43)	29	36 (44)
Children		p=0.187		p=0.654		p=0.068		p=0.936		p=0.065
No	1096	39 (42)	338	38 (43)	408	36 (40)	286	46 (43)	64	42 (45)
Yes	537	36 (41)	177	39 (42)	16	30 (38)	125	46 (44)	19	21 (38)

Table 3 – Filtered Tap Water as a Percentage of Total Water Consumption by Socio-Demographic Characteristics

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. dev)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Entire Sample	1633	40 (41)	515	42 (42)	624	41 (40)	411	36 (41)	83	43 (42)
Age		p=0.260		p=0.508		p=0.996		p=0.003		p=0.337
18 to 29	231	38 (37)	70	45 (39)	81	41 (36)	67	29 (36)	13	30 (37)
30 to 39	295	38 (40)	92	43 (40)	124	41 (40)	69	25 (37)	10	37 (43)
40 to 64	857	40 (42)	272	39 (43)	317	42 (41)	221	37 (42)	47	50 (43)
65 plus	250	44 (43)	81	45 (46)	102	41 (41)	54	51 (43)	13	34 (40)
Highest Education		p=0.002		p=0.591		p=0.068		p=0.039		p=0.050
High school or less	459	46 (42)	147	45 (43)	158	47 (41)	123	43 (42)	31	54 (40)
Uni/ Coll	1163	38 (41)	364	40 (42)	463	39 (40)	284	32 (40)	52	36 (42)
Income (\$000's)		p=0.189		p=0.859		p=0.340		p=0.519		p=0.752
> 30	435	42 (41)	133	44 (43)	173	43 (40)	104	40 (42)	25	42 (41)
30-55	442	42 (42)	155	42 (44)	151	44 (41)	106	37 (40)	30	46 (44)
55-100	514	38 (40)	144	40 (42)	205	41 (40)	138	32 (40)	27	42 (41)
< 100	242	36 (40)	83	39 (40)	95	35 (39)	63	35 (42)	1	<i>Insuff data</i>
Gender		p=0.140		p=0.802		p=0.327		p=0.260		p=0.452
Female	779	39 (40)	257	41 (41)	293	40 (39)	247	33 (40)	42	39 (40)
Male	854	42 (42)	268	42 (43)	331	43 (41)	268	38 (42)	41	46 (43)
Urban/Rural		p=0.672		p=0.999		p=0.511		p=0.783		p=0.430
Rural	521	39 (42)	175	42 (44)	195	39 (40)	100	34 (41)	51	39 (41)
Urban	1062	40 (41)	322	42 (42)	409	42 (40)	302	36 (41)	29	47 (43)
Children		p=0.021		p=0.006		p=0.135		p=0.586		p=0.044
No	1096	42 (42)	338	45 (43)	408	43 (41)	286	36 (41)	64	38 (41)
Yes	537	37 (40)	177	35 (40)	216	38 (39)	125	34 (41)	19	59 (41)

Table 4 – Bottled Water as a Percentage of Total Water Consumption by Socio-Demographic Characteristics

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Entire Sample	1633	22 (31)	515	20 (32)	624	25 (32)	411	19 (27)	83	20 (30)
Age		p=0.000		p=0.000		p=0.008		p=0.610		p=0.481
18 to 29	231	24 (29)	70	18 (26)	81	30 (30)	67	22 (28)	13	32 (39)
30 to 39	295	27 (34)	92	28 (36)	124	31 (36)	69	20 (28)	10	16 (21)
40 to 64	857	21 (31)	272	22 (33)	317	23 (32)	221	18 (27)	47	19 (30)
65 plus	250	15 (27)	81	8 (21)	102	18 (30)	54	17 (28)	13	15 (24)
Highest Education		p=0.684		p=0.368		p=0.695		p=0.437		p=0.329
High school or less	459	21 (30)	147	23 (33)	158	24 (32)	123	16 (24)	31	16 (25)
Uni/ Coll	1163	22 (31)	364	19 (31)	463	25 (32)	284	20 (29)	52	23 (33)
Income (\$000's)		p=0.000		p=0.625		p=0.016		p=0.000		p=0.496
> 30	435	20 (29)	133	18 (30)	173	25 (31)	104	13 (20)	25	21 (30)
30-55	442	17 (28)	155	20 (32)	151	18 (27)	106	14 (23)	30	15 (26)
55-100	514	26 (34)	144	23 (34)	205	28 (34)	138	26 (34)	27	26 (34)
< 100	242	23 (31)	83	20 (31)	95	28 (35)	63	20 (25)	1	<i>Insuff data</i>
Gender		p=0.000		p=0.020		p=0.018		p=0.039		p=0.178
Female	779	25 (32)	257	24 (33)	293	28 (33)	247	22 (28)	42	24 (32)
Male	854	19 (30)	268	17 (30)	331	22 (32)	268	16 (27)	41	15 (28)
Urban/Rural		p=0.138		p=0.461		p=0.077		p=0.613		p=0.572
Rural	521	23 (32)	175	22 (34)	195	28 (35)	100	18 (26)	51	21 (29)
Urban	1062	21 (30)	322	19 (31)	409	23 (31)	302	19 (28)	29	17 (29)
Children		p=0.000		p=0.002		p=0.000		p=0.493		p=0.931
No	1096	19 (29)	338	17 (29)	408	21 (30)	286	18 (27)	64	20 (31)
Yes	537	27 (34)	177	26 (35)	216	32 (35)	125	20 (29)	19	19 (27)

Turning to the comparison of filtered tap water consumption levels presented in Table 3, the strongest finding is that respondents with lower levels of formal education have much higher filtered water consumption levels. These differences can be substantial and significant (e.g., for the Atlantic region, respondents whose highest level of education is high school consume on average 54 % filtered water compared with 36 % for a respondent who has achieved a higher level of education). These results are similar to those obtained by Janmaat (2007) in a survey of 319 respondents in Nova Scotia's Annapolis Valley. This may arise because less educated individuals are older, although we find limited support for increasing age being related to using filtered tap water (Quebec alone). Alternatively, individuals with a lower level of education may be less able to independently assess health risks and, therefore, may be more influenced by claims of home water filtration manufacturers.

Turning to Table 4 we note the largest number of significant differences in bottled water consumption across regions. For Canada, the West and Ontario, the younger the respondent, the higher is bottled water consumption. In most cases, the percentage consumption in the 18 to 29 age group is double that of the 65 plus age group. While this trend holds in Quebec and the Atlantic region, differences across the age categories are not statistically significant in these regions. Household income is a statistically significant and positive factor for bottled water consumption in Canada, Ontario and Quebec (all $p=0.000$). *A priori* we expect income levels to be positively correlated with increasing bottled water consumption given the high costs of purchasing this source of water; in some areas, the cost per cubic metre for bottled water is 1000 times that of municipally supplied water⁸. Women consistently consume about 6 % more of their total water consumption in the form of bottled water than men ($p=0.000$ for Canada, as a whole, $p=0.020$ West, $p=0.018$ Ontario, and $p=0.039$ Quebec) and the presence of at least once child in a household is a significant factor in Canada, the West, and Ontario

⁸ For the United States, this number might be even higher. The Natural Resources Defense Council (1999) report to the FDA shows research indicating that the price per gallon for bottled water (relative to tap water) could reach from 240 to 10000 times greater.

for encouraging a greater reliance on bottled water ($p=0.000$, Canada; $p=0.002$, West; and $p=0.000$, Ontario). The gap is the biggest in Ontario with households where there are children consuming 32 % of total water in the form of bottled water while childless households consume only 21 % of their total as bottled water.

Experiences with Tap Water and Role of Perceptions for Water Choices

Factors other than socio-demographic characteristics may influence drinking water choices (Dietz et al. 1998; Doria, 2006).⁹ As a number of studies have shown, color, odour and taste of tap water and its substitutes (home filtered tap and bottled water) may be just as, or more, important (Grondin *et al.* 1996; Jardin *et al.* 1999; Levallois *et al.* 1999). Thus, to better understand the proportions of tap/filtered/bottled water consumption we asked respondents whether they had experienced rusty water, sedimentation, unpleasant tastes and smells in their tap water. We also queried them as to their concerns for the presence of common microbial contaminants (*E. coli*; cryptosporidium, and giardia) in their tap water and whether they perceived that their tap water has made anyone in the household sick. As shown in table 5, experiences with rusty water and sediment appear relatively frequently across Canada, particularly for the Atlantic region. Unpleasant taste and smell problems occur for 1 in 3 respondents in the survey in all areas with the exception of Quebec (1 in either 4 or 5), which it may be recalled, had the highest rate of tap water use.

Given the much publicized outbreak of *E. coli* in tap water in Walkerton, it is not surprising that many Canadians (15%) indicate that they believe this contaminant to be a problem for their community; however, fewer recognize cryptosporidium and giardia. Almost 5 % of respondents (particularly those in Quebec) answered yes to the question... “To the best of your knowledge, have you or has anyone in your household ever become sick from drinking the tap water in your home?”

⁹ The price of bottled water is an important factor; however, our survey did not collect information on this variable. It is difficult to ascertain the actual cost of a bottle of water to an individual given that bottles can be purchased individually, as well as by the case.

These past experience and beliefs may color a respondent's perception of the health risks present in their tap water (Jardine *et al.* 1999). Using responses to our 4-point Likert scale question on tap water and health concerns, Table 5 shows that 38 % of respondents indicated that they perceived some degree of problem, with almost half of these people indicating it to be a moderate to serious problem. Residents of Ontario are more inclined to express a greater degree of concern for their health from drinking tap water than do residents elsewhere. Quebecers, on the other hand, in spite of their past negative experiences with tap water do not appear to have translated these experiences into an elevated degree of concern about health. Responses to a more specific question comparing the safety of bottled water to tap water (is bottled water safer than tap water?) found that between 52 and 54 % of the respondents across Canada and in each region said yes.¹⁰

Tables 6 through 8 investigate the extent to which different experiences and degrees of concern translate into differences in mean percentages of consumption for each of the three types of water. For example, Table 6 reveals that the mean percentage of tap water consumption for a respondent who experienced rusty water varies from 23 % (for an individual in the Western provinces) to 35 % (for an individual living in Quebec). While, on the face of it, this does not seem like a large difference, the p-value for the test of means is 0.000. This suggests the presence of significant differences across Canada in the consumption of tap water according to reported experiences with rustiness. Similarly, mean tap water consumption as a percentage for individuals reporting sediment, unpleasant taste and smell events varies significantly across the entire sample of respondents (each separate item obtains $p=0.000$), with the values for people having taste problems showing the widest range of resulting changes in percentage of tap water consumption. Specifically, for those individuals having experienced

¹⁰ Given the differences in bottled water consumption that we observe amongst men and women, we split the sample by gender to see whether men and women feel differently about the safety of bottled water versus tap water. For Canada as a whole 63% of the women said bottled water safer compared with 51% of the males and this difference was significant ($p=0.000$). The scale of this difference was repeated in every region with the biggest difference arising in the Atlantic Provinces where 70 % of women felt bottled water was safer while 47% of men agreed with this ($p=0.044$). These female-male differences were significant in every region but Quebec ($p=0.115$).

unpleasant taste events, mean consumption of tap water in the Atlantic Provinces is only 15.74 %, while it is 33.67 % in Quebec.

The belief that some one in the family has become sick from drinking tap water acts as one might expect. Unfiltered tap water consumption falls to a low of 11 % in Ontario and 10 % in the Atlantic Provinces compared to a high of 32 % in Quebec. There is no significant difference in mean consumption levels of filtered water across the regions ($p=0.347$) when a respondent believes that someone has become sick. However, this belief tends to increase bottled water consumption, particularly in Ontario and the Western Provinces (44 % and 46%, respectively).

The three tables provide evidence of a very clear link between a respondent's expressed degree of health concerns from consumption of tap water and water drinking choices. Briefly, the greater the degree of concern ("*tap water poses moderate or serious problems for health versus tap water poses no or minor problems*"), the lower the percentage of tap water consumed and the higher the percentage of bottled water consumed. These patterns apply for Canada, as a whole, and for each region. The p-values for the one-way ANOVA tests are shown in the tables.

In addition to regional differences in choices and how these are impacted by experiences and beliefs, this paper is also interested in the extent to which experiences and beliefs might result in different water consumption choices of men and women. From the entire sample of responses we selected only those individuals who responded positively to a question which asked them whether they had "...heard about E coli as posing a drinking water problem". Seventy-four percent of the men and 81% of the females in the sample answered yes. For this subset of respondents mean tap/bottled consumption for males was 40%/20% while for females it was 34%/25%. The p values associated with one-way

Table 5: Experiences with Tap Water and Health/Safety Concerns, Percentage of Respondents Across Canada and By Region

	Canada	West	Ontario	Quebec	Atlantic
Rusty Colour in Water	14	13	13	15	22
Sediment in Water	14	19	13	7	22
Unpleasant Smell	33	36	38	22	34
Unpleasant Taste	31	35	32	23	33
E coli is specific concern in my community	16	8	13	29	22
Cryptosporidium is specific concern in my community	6	7	4	10	6
Giardia is specific concern in my community	6	7	3	9	6
Someone has become sick from drinking home tap water	5	4	3	9	4
Belief that Bottled Water is Safer than Tap Water	53	53	54	52	54
Overall Degree of Health Concern for Tap Water					
Tap Water poses no problem for health	62	61	56	72	61
Tap Water poses minor problem for health	23	24	26	19	19
Tap Water poses moderate problem for health	12	11	15	9	16
Tap Water poses serious problem for health	3	4	4	1	4

Table 6 – Tap Water Consumption as a Percentage of Total, According to Experience and Degree of Health Concern

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Rusty Colour in Water	225	29 (38)	66	23 (36)	78	29 (38)	63	35 (41)	18	25 (36)
Sediment in Water	223	27 (36)	96	26 (36)	81	28 (35)	28	32 (39)	18	19 (34)
Unpleasant Smell	542	31 (38)	187	30 (38)	236	30 (38)	91	37 (41)	28	23 (35)
Unpleasant Taste	499	26 (36)	180	27 (37)	198	24 (33)	94	34 (40)	27	16 (28)
E coli is specific concern in my community	258	35 (41)	42	24 (37)	79	27 (38)	119	43 (43)	18	43 (47)
Cryptosporidium is specific concern in my community	105	34 (42)	35	24.00 (36)	23	27 (40)	42	46 (45)	5	39 (53)
Giardia is specific concern in my community	94	35 (41)	37	34 (31)	16	31 (39)	36	41 (44)	5	21 (42)
Someone has become sick from drinking home tap water	76	25 (36)	18	25 (34)	17	11 (24)	38	32 (40)	3	10 (17)
Belief that Bottled Water is Safer than Tap Water	865	27 (36)	273	27 (35)	335	23 (34)	212	34 (39)	45	32 (41)
Overall Degree of Health Concern for Tap Water		p=0.000		p=0.000		p=0.000		p=0.000		p=0.096
Tap Water poses no problem for health	1008	47 (44)	315	47 (44)	347	43 (42)	295	52 (45)	51	46 (46)
Tap Water poses minor problem for health	378	31 (37)	125	32 (38)	159	30 (36)	78	33 (39)	16	31 (43)
Tap Water poses moderate problem for health	196	17 (28)	56	13 (24)	91	16 (29)	36	25 (31)	13	17 (34)
Tap Water poses serious problem for health	51	12 (28)	19	15 (34)	27	7 (21)	2	45 (64)	3	10 (17)

Table 7 – Filtered Tap Water Consumption as a Percentage of Total, According to Experience and Degree of Health Concern

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Rusty Colour in Water	225	43 (40)	66	46 (42)	78	40 (39)	63	40 (39)	18	51 (38)
Sediment in Water	223	46 (40)	96	45 (40)	81	44 (38)	28	49 (40)	18	52 (38)
Unpleasant Smell	542	40 (39)	187	40 (41)	236	42 (39)	91	36 (38)	28	42 (39)
Unpleasant Taste	499	40 (39)	180	39 (41)	198	42 (39)	94	35 (39)	27	44 (39)
E coli is specific concern in my community	258	39 (40)	42	53 (43)	79	37 (38)	119	36 (39)	18	33 (43)
Cryptosporidium is specific concern in my community	105	41 (42)	35	38 (41)	23	46 (42)	42	40 (45)	5	52 (48)
Giardia is specific concern in my community	94	41 (41)	37	38 (40)	16	38 (36)	36	43 (44)	5	62 (37)
Someone has become sick from drinking home tap water	76	37 (38)	18	29 (38)	17	45 (40)	38	36 (38)	3	52 (22)
Belief that Bottled Water is Safer than Tap Water	865	40 (39)	273	41 (40)	335	42 (38)	212	38 (39)	45	38 (38)
Overall Degree of Health Concern for Tap Water		p=0.133		p=0.171		p=0.646		p=0.197		p=0.627
Tap Water poses no problem for health	1008	38 (42)	315	40 (43)	347	40 (41)	295	34 (42)	51	47 (44)
Tap Water poses minor problem for health	378	43 (40)	125	43 (40)	159	43 (39)	78	44 (41)	16	35 (41)
Tap Water poses moderate problem for health	196	44 (39)	56	52 (42)	91	45 (40)	36	32 (34)	13	33 (35)
Tap Water poses serious problem for health	51	36 (39)	19	40 (43)	27	38 (40)	2	18 (11)	3	47 (15)

Table 8 – Bottled Water Consumption as a Percentage of Total, According to Experience and Degree of Health Concern

	Canada		West		Ontario		Quebec		Atlantic	
	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)	# obs.	Mean (St. Dev.)
Rusty Colour in Water	225	28 (34)	66	30 (39)	78	31 (36)	63	24 (28)	18	23 (26)
Sediment in Water	223	27 (33)	96	29 (36)	81	28 (33)	28	19 (26)	18	29 (30)
Unpleasant Smell	542	29 (35)	187	31 (38)	236	29 (35)	91	26 (30)	28	35 (37)
Unpleasant Taste	499	34 (37)	180	34 (39)	198	35 (36)	94	31 (34)	27	40 (39)
E coli is specific concern in my community	258	26 (34)	42	23 (35)	79	36 (38)	119	22 (28)	18	24 (36)
Cryptosporidium is specific concern in my community	105	25 (34)	35	38 (42)	23	27 (35)	42	14 (22)	5	9 (10)
Giardia is specific concern in my community	94	23 (30)	37	28 (34)	16	31 (34)	36	16 (23)	5	17 (15)
Someone has become sick from drinking home tap water	76	39 (36)	18	46 (43)	17	44 (39)	38	32 (32)	3	38 (28)
Belief that Bottled Water is Safer than Tap Water	865	32 (35)	273	32 (37)	335	35 (35)	212	28 (30)	45	30 (35)
Overall Degree of Health Concern for Tap Water		p=0.000		p=0.000		p=0.000		p=0.000		p=0.000
Tap Water poses minor problem for health	1008	15 (25)	315	14 (26)	347	17 (26)	295	15 (25)	51	7 (14)
Tap Water poses minor problem for health	378	26 (33)	125	25 (33)	159	28 (33)	78	23 (29)	16	34 (37)
Tap Water poses moderate problem for health	196	39 (37)	56	35 (40)	91	39 (38)	36	44 (31)	13	50 (38)
Tap Water poses serious problem for health	51	52 (42)	19	51 (45)	27	55 (42)	2	38 (53)	3	43 (25)

ANOVAs to test for gender differences in these choices are 0.015 for tap water, 0.958 for treated, and 0.002 for bottled water. In contrast, for those who had not heard of E coli. as being a problem, mean tap consumption was the same as for men who had heard about it, but bottled water consumption was much smaller at 14%. For females who had not heard of E coli as a problem mean tap/bottled water consumption was 44%/23 %. We then selected those individuals who said that they had heard about E coli as being a specific problem in their community and found slightly less tap water consumed as a proportion of total consumption than above and correspondingly more treated and/or bottled; however, under this selection criterion, men and women showed no significantly different percentages of consumption of any of the three water sources ($p=0.266$ for tap, $p=0.769$ for treated and $p=0.307$ for bottled).

We also selected individuals who reported that they had experienced unpleasant smell and taste episodes with their tap water in order to see whether men and women responded differently to such information. Of the entire sample, 250 men and 292 women said that they had experienced unpleasant smells. The percentage of tap consumption for males/females was 31%/30%, both of which are much lower consumption levels than for the entire sample with bottled consumption being significantly higher than for the entire sample (male 26% and female 32%). Moreover, men and women differed significantly in mean bottled water consumption ($p=0.03$). Thus, while men and women who have experienced unpleasant smells consume more bottled water than the norm, women appear to have a much larger response to these episodes. This provides support for Stern et al (1993) and Bord and O'Connor (1997)'s arguments that women may be more attentive to links between environment and health than men. When we select respondents who reported having experienced unpleasant taste episodes (224 male observations and 275 female observations), and find similar results. However, mean filtered water consumption is significantly higher for males (44% to 36 % for females) while the

opposite is true for bottled (30 % for males to 37 % for females). The p-value for treated is 0.023 and for bottled it is $p=0.040$.

One important aspect that is not controlled in the analysis above is the role that might be played by the presence of children. To the extent that parents are concerned for the health of their children (Teal and Loomis, 2000; Dupont, 2004) and perceive higher health risks from consuming tap water, then we might expect respondents who indicate that they have children to report increasing consumption of the two alternatives to tap water. We examined the consumption choices of men and women with and without children. 238 males/299 females indicated that at least one child (under 18) was present in their household. With children present in the household there were no significant differences in the respondent consumption choices across genders (tap was 35%/38% for males/females; filtered water consumption was 40%/34% for males/females and bottled was 25%/28% for males/females. Interestingly, however, we observed significant differences in mean water consumption choices for individuals with and without children. For example, men/women who indicated that no child was present in their household children consumed 42%/36% tap water, 42%/31% filtered water, and 16%/23% bottled water. Our one-way ANOVAs on these mean percentages revealed these differences in tap water consumption to be significant for men in different demographic categories. For example, men who said there was a child in their household reported consuming a significantly smaller share of tap water ($p=0.024$) and a corresponding significantly higher share of bottled water consumption ($p=0.000$) than those who said they did not have a child in the household. This may represent a “father effect”, which is opposite to that proposed by Blocker and Eckberg (1987) who originally suggested that women with children might express more concern for local environmental problems than do men. However, we do find support for the “mother effect”. Females who said they had a child in the household reported significantly ($p=0.043$) more bottled water consumption than females who said there were no children present in their household.

In summary, our data reveal clear regional differences in consumption patterns that may be tied not only to factors such as income, education, and gender but also to past experiences, beliefs and risk perceptions. However, the analysis to this point has used one way ANOVA analysis that focuses only on one factor at a time and does not control for other factors that may be influencing choices at the same time. In order to examine and control for all of the disparate influences that help to determine water consumption choices we estimate a multinomial logit model described in the next section to predict the probability of a respondent choosing to be either primarily a tap water, a home filtered tap water or a bottled water drinker.

Regression Analysis of Drinking Water Choices

In order to examine the various influences that can assist us in better understanding water consumption choices simultaneously we present the results of a multivariate regression. Each survey respondent is classified as being primarily either a tap, filtered or bottled water drinker if he/she consumes 75% or more of that type of water.¹¹ We estimate a multinomial logit model to predict the probability of a respondent being in one of these three categories.¹² Table 9 presents the results which show how socio-demographic characteristics, experiences with tap water, and beliefs and perceptions about health concerns relating to tap water affect the probabilities of being either a filtered or bottled water drinker relative to the reference point of being a tap water drinker. The overall fit of the model is reasonable for cross-sectional data (the McFadden Pseudo R squared is 0.133 and the chi-squared statistic for the likelihood ratio test is 364.348 (p=0.000)).

¹¹ This corresponds to the definition used in Jones et al. (2006). This gives us 552 respondents who fall into the primarily tap category; 562 who fall into the primarily filtered category, and 223 who fall into the primarily bottled water category with the remainder 296 having no particular or predominant preferences over their water choice. They represent 18 % of the sample of respondents, which is similar to the finding of Pintar et al (2009) that 14 % of their sample drank both tap and bottled water.

¹² We do not include the group of respondents who show no particular preference over one of the three types of water.

A few socio-economic variables are important determinants of choices. First, as expected, household income is a significant and positive determinant for the probability of being primarily a bottled water drinker. In addition, while there are no significant differences in the probabilities of being a filtered or bottled water drinker amongst men and women without children, the presence of a child in a household significantly raises the probability of a man being primarily either a filtered water drinker or a bottled water drinker. An interesting and potentially important finding from a public policy perspective is that education appears to play a role in determining whether one is likely to be a filtered water user. Individuals who are educated beyond high school are significantly less likely to be primarily a filtered water drinker.¹³ Perhaps this reflects the fact that they are better able to assess the scientific information that argues about the excellence of a utility's water quality. Finally, French speaking respondents were significantly less likely to be either filtered tap or bottled water types than English-speaking respondents. (We looked at whether there was a difference in these two groups according to their views on the safety of bottled water relative to tap and found no significant difference in the proportion of those finding tap to be less safe). On the other hand, the French residents were less likely to have taste and smell problems with their tap water.

Turning to the variables pertaining to past experience with tap water and other factors that might make respondents more sensitive to poor water quality, we find that experiences with unpleasant taste are a significant positive determinant of the likelihood of being a bottled water drinker but have no affect on the probability of being primarily a filtered water drinker. Similarly, there is no significant difference in choices amongst those who have heard about *E coli* and those who have not. However, the two factors that stand out as significant determinants of preferences for being a filtered/bottled water user rather than a tap water user are the two health/water safety perception variables: the first asking respondents to state their personal opinion about health concerns with the tap water in their home and

¹³ They are also less likely to be bottled water drinkers but this is significant only at a 7 % level of significance.

the second being the dummy variable identifying respondents who believe bottled water to be safer than tap water.¹⁴

CONCLUSIONS

This paper has examined choices that survey respondents across Canada make with respect to their water consumption. In Canada, a large number of consumers on municipally supplied water systems choose to filter their tap water at home or to purchase bottled water rather than drink their tap water - actions that appear to be seen as improving the quality of the water and/or reducing the health risks from the water that they ingest. In this paper we investigate whether socio-demographic characteristics and/or experiences/beliefs/perceptions play separate roles in determining what type of water a household chooses to consume.

The data reveal some interesting geographic and socio-demographic differences across Canada with respect to water consumption choices, as well as past experiences with tap water problems. For example, 1 in 5 residents of Ontario believe that tap water poses either a moderate or a serious problem for their own health and/or their family's health. Water consumption choices reveal that these residents on average consume greater proportions of tap water substitutes than residents in other regions. Regression analysis reveals that certain socio-demographic factors are important determinants of choices. For example, male respondents living in a household with children are more likely to be either a filtered and bottled water drinker than a tap water drinker as compared to males who do not have children in their household. Second, respondents who report having more than a high school education are significantly less likely than less educated respondents to be filtered or bottled water drinkers. This

¹⁴ This echoes a finding by Doria, Pidgeon, and Hunter (2005). They estimate a model to explain the use of tap water to drink at home and find that the presence of bottled water as an alternative is the most important (and negative) factor.

may indicate a role for government to provide independent information on the benefits and costs of water filtration systems and/or bottled water.

The most important finding, however, is that consumers in Canada appear to have translated their expressed concerns and perceptions about the quality and safety of their municipally supplied tap water as it pertains to their health into their drinking water choices. Two variables (Health Concern about Tap Water and Bottled Water Safer) are the most significant ones in the multinomial logit model. They also play the strongest roles in terms of determining the probability that a given respondent will choose to be either a filtered water drinker or a bottled water drinker over being a tap water drinker. Means wrote in 2002 that water utility managers in the United States have ignored the public's concern about potential health risks in their tap water and urged them to find out exactly what their customers think about water quality. In this paper, the message from Canadians is that they are willing to undertake additional expenditures (defensive expenditures) in order to obtain what they perceive as safer water. Whether these choices alter a person's risk of exposure to waterborne contaminants, however, depends not only upon the share of different water consumption choices but also the total volume of water consumed (Pintar et al. 2009). Such baseline information is crucial to a better understanding and management of waterborne microbial risks to the general population and to individuals in different regions and with different socio-demographic characteristics.

Table 9 – Multinomial Logit Model Results

Explanatory Variable	Probability of being a filtered water user (compared to tap water)		Probability of being a bottled water user (compared to tap water)	
	Estimated coefficient	Estimated standard error (p-value)	Estimated coefficient	Estimated standard error (p-value)
Household size	-0.023	0.072 (0.750)	-0.094	0.099 (0.346)
Household income	0.471E-06	0.195E-05 (0.809)	0.100E-04*	0.272E-05 (0.000)
Educated beyond High School	-0.596*	0.165 (0.000)	-0.429	0.240 (0.073)
Age	0.002	0.005 (0.700)	-0.002	0.007 (0.776)
Quebec resident	0.172	0.259 (0.506)	0.296	0.366 (0.419)
Western Province Resident	-0.060	0.153 (0.694)	-0.371	0.216 (0.087)
Maritimes Province resident	-0.041	0.290 (0.887)	-0.192	0.428 (0.654)
French speaking	-0.740*	0.250 (0.003)	-1.400*	0.380 (0.000)
Male	0.039	0.156 (0.805)	-0.392	0.243 (0.106)
Kids	-0.410	0.234 (0.080)	-0.085	0.316 (0.788)
Male X Kids	0.651**	0.278 (0.019)	1.097*	0.381 (0.004)
Experienced Unpleasant Smell	-0.058	0.162 (0.723)	0.130	0.218 (0.551)
Experienced Unpleasant Taste	0.228	0.173 (0.188)	1.065*	0.222 (0.000)
Experienced Rusty Water	0.232	0.199 (0.245)	0.189	0.267 (0.479)
Someone in household sick from water	-0.043	0.229 (0.851)	0.037	0.276 (0.894)
Stomach ulcers	0.183	0.324 (0.573)	0.659	0.408 (0.106)
Have Food Allergies	0.077	0.195 (0.692)	-0.463	0.285 (0.104)
Heard of E coli	0.014	0.143 (0.922)	-0.013	0.223 (0.953)
Health Concern about Tap water	0.506*	0.105 (0.000)	0.901*	0.126 (0.000)
Bottled Water Safer	0.455*	0.136 (0.001)	1.464*	0.214 (0.000)
Constant	-0.275	0.609 (0.651)	-3.244*	0.810 (0.000)

* significant at 1 % or less; ** significant at 5 % or less

REFERENCES

- Abrahams, N.; Hubbell, B. and Jordan, J. 2000. "Joint production and Averting Expenditure Measures of Willingness to Pay: Do Water Expenditures Really Measure Avoidance Costs?" *American Journal of Agricultural Economics*. 82(2):427-437.
- Anadu, E. and Harding, A. 2000. "Risk Perception and Bottled Water Use" *Journal of the American Water Works Association*. 92(11):82-92.
- Auslander, B.A. and Langlois, P.H. 1993. "Toronto Tap Water: Perception of its Quality and Use of Alternatives" *Canadian Journal of Public Health*. 84(2):99-102.
- Blocker, T.J., Eckberg, D.L., 1989. Environmental issues as women's issues: general concerns and local hazards. *Social Science Quarterly* 70, 586– 593.
- Bord, R.J., O'Connor, R.E., 1997. The gender gap in environmental attitudes: the case of perceived vulnerability to risk. *Social Science Quarterly* 78 (4), 830–840.
- Canadian Council of Ministers of the Environment (CCME). 2002. "From source to tap: the multi-barrier approach to safe drinking water". http://www.ccme.ca/assets/pdf/mba_eng.pdf.
- Dietz, T., Stern, P., and Guanganano, G. 1998. Social structures and social psychological bases of environmental concern. *Environment and Behavior*. 30(4):450-471.
- Doria, M. F., Pidgeon, N., and Hunter, P. 2005. "Perception of Tap Water Risks and Quality: a Structural Equation Model Approach". *Water Science & Technology*. 52(8):143-149.
- Doria, M. F. 2006. "Bottled Water Versus Tap Water: Understanding Consumers' Preferences" *Journal of Water and Health*. 4(2):271-276.
- Dupont, D. P. 2004 "Do children matter? An examination of gender differences in environmental valuation" *Ecological Economics* 49(3): 273-286.
- Grondin, J.; Levallois, P.; Moret, S., and Gingras, S. 1996. "The Influence of Demographics, Risk Perception, Knowledge, and Organoleptics on Water Consumption Patterns". *Proceedings of the AWWA Annual Conference: Management and Regulations*. AWWA, Denver. Pp.537-546.
- Health and Welfare Canada. "Tapwater Consumption in Canada". Environmental Health Directorate. Cat #H46-2/82-80E. (1983).
- International Council of Bottled Water Associations. 2004. "Global Bottled Water Statistics" http://www.icbwa.org/2000-2003_Zenith_and_Beverage_Marketing_Stats.pdf.
- Janmaat, J. 2007. "A Little Knowledge...:Household Water Quality Investment in the Annapolis Valley" *Canadian Journal of Agricultural Economics*. 55(2):233-253.
- Jardine, C.G. N. Gibson and S. Hrudey. 1999. "Detection of Odour and Health Risk Perception of Drinking Water." *Water Science and Technology* Vol 40(6): 91–98.
- Jones, A.Q.; Dewey, C.E., Doré, K., Majowicz, S.E., McEwen, S.A. and Waltner-Toews, D. 2006. "Drinking water consumption patterns of residents in a Canadian community" *Journal of Water and Health*. 4(1):125-138.
- Levallois, P.; Grondin, J. and Gingras, S. 1999. "Evaluation of Consumer Attitudes on Taste and Tap Water Alternatives in Quebec" *Water Science and Technology*. 40(6):135-140.
- Livernois, J. 2001. "The Economic Costs of the Walkerton Water Crisis" Walkerton Inquiry Commissioned Paper No. 14. (<http://www.uoguelph.ca/~live/links.html>)
- Means, E.G. (2002) "Drinking Water Quality In The New Millennium: The Risk Of Underestimating Public Perception" *Journal of the American Water Works Association*. 94: 28-34
- National Resources Defense Council. 1999. *Bottled Water. Pure Drink or Pure Hype?* <http://www.nrdc.org/water/drinking/bw/bwinx.asp>.

- Pintar, K.; Waltner-Toews, D.; Charron, D.; Pollari, F.; Fazil, A.; McEwan, S.; Nesbitt, A.; and Majowicz, S. 2009. "Water consumption habits of a south-western Ontario community" *Journal of Water and Health*. 7(2):332-343.
- Statistics Canada Households and the Environment Survey (HES) 11-526-X. February 2009.
- Statistics Canada. 2008. Cansim Table 3580122 - Canadian Internet Use Survey, Internet Use, by location of access, Canada, provinces and selected census metropolitan area, Data for 01-Jan-2005 to 01-Jan-2007.
- Stern, P., Dietz, T., and Kalof, L. 1993. Value orientations, gender, and environmental concern. *Environment and Behavior* 25 (3), 322– 348.
- Teal, G., and Loomis, J.B. 2000. Effects of gender and parental status on the economic valuation of increasing wetlands, reducing wildlife contamination and increasing salmon populations. *Society and Natural Resources* 13 (1), 1 –14.