
Public perception of population health risks in Canada: health hazards and health outcomes

Daniel Krewski*

Department of Epidemiology and Community Medicine,
McLaughlin Centre for Population Health Risk Assessment,
University of Ottawa, One Stewart Street, Ottawa, Ontario,
Canada K1N 6N5
Email: cphra@uottawa.ca
*Corresponding author

Louise Lemyre

GAP-Santé and McLaughlin Centre, Institute of Population Health,
University of Ottawa, One Stewart Street, Ottawa, Ontario,
Canada K1N 6N5
Email: Louise.Lemyre@uottawa.ca

Michelle C. Turner

McLaughlin Centre for Population Health Risk Assessment,
Institute of Population Health, University of Ottawa,
One Stewart Street, Ottawa, Ontario, Canada K1N 6N5
Email: mturner@uottawa.ca

Jennifer E.C. Lee

School of Psychology, University of Ottawa, One Stewart Street,
Ottawa, Ontario, Canada K1N 6N5
Email: jeclee@alumni.uottawa.ca

Christine Dallaire

Centre de Recherche sur le Sport dans la Société Canadienne,
École des Sciences de l'Activité Physique, Université d'Ottawa,
125 Université, Ottawa, Ontario, Canada K1N 6N5
Email: Christine.Dallaire@uottawa.ca

Louise Bouchard

Department of Sociology/Institute of Population Health,
University of Ottawa, One Stewart Street, Ottawa, Ontario,
Canada K1N 6N5
Email: Louise.Bouchard@uottawa.ca

Kevin Brand

School of Management/Institute of Population Health,
University of Ottawa, One Stewart Street, Ottawa, Ontario,
Canada K1N 6N5
Email: kbrand@uottawa.ca

Pierre Mercier

Université d'Ottawa, École de Psychologie,
Case Postale 450, Succursale A, Ottawa, Ontario, Canada K1N 6N5
Email: Pierre.Mercier@uottawa.ca

Abstract: The focus of this article is a descriptive account of the perceptions of five health hazards (motor vehicles, climate change, recreational physical activity, cellular phones, and terrorism) and five health outcomes (cancer, long-term disabilities, asthma, heart disease, and depression) from a recent survey of 1503 Canadians. In an attempt to shed light on factors that influence risk perception in Canada, the extent to which these exemplars are perceived as high in risk and controllability, as well as the extent to which knowledge and uncertainty surrounding them is high, was examined. The degree to which these exemplars are deemed acceptable and generate worry among Canadians was also examined. Variation was observed in the extent to which different health hazards and outcomes are perceived on the various dimensions. Perceptions of health hazards and outcomes also vary significantly by gender, age, and education. Findings are compared to existing research on risk perception.

Keywords: health risk perception; knowledge; personal control; risk acceptability; uncertainty; worry.

Reference to this paper should be made as follows: Krewski, D., Lemyre, L., Turner, M.C., Lee, J.E.C., Dallaire, C., Bouchard, L., Brand, K. and Mercier, P. (2009) 'Public perception of population health risks in Canada: health hazards and health outcomes', *Int. J. Risk Assessment and Management*, Vol. 11, Nos. 3/4, pp.299–318.

Biographical notes: Daniel Krewski is Professor of Epidemiology and Community Medicine at the University of Ottawa, where he also serves as Scientific Director of the McLaughlin Centre for Population Health Risk Assessment. His research interests include epidemiology, biostatistics, health risk assessment, and risk management. He is a Fellow of the Society for Risk Analysis, the American Statistical Association, and a national affiliate of the US National Academy of Sciences. He served as chair of the Academy's Committee on Toxicity Testing and Assessment of Environmental Agents.

Louise Lemyre is a full professor at the School of Psychology and the McLaughlin Research Chair on Psychosocial Aspects of Risk and Health at the Institute of Population Health at the University of Ottawa, where she leads a research unit on psychosocial analysis of health 'GAP-Santé'. She obtained her Master's from the University of British Columbia (UBC) and her doctorate at Université Laval in Social Psychology. She then went for an interdisciplinary post doctorate in social epidemiology and medical sociology at the British MRC Social Research Unit at the University of London, UK. She is a Member of the Royal Society of Canada.

Michelle C. Turner is a PhD candidate in Population Health at the University of Ottawa. She obtained her Master's degree from the Department of Epidemiology and Community Medicine at the University of Ottawa.

Jennifer E.C. Lee has a PhD in experimental psychology from the University of Ottawa. She obtained her B.A.H. in Psychology from Queen's University in Kingston, ON. Her research focuses on risk perception and preparedness behaviour.

Christine Dallaire has a PhD in multi-disciplinary research with a specialty in sociology of physical activity. Women's health is her main domain of interest along with the social identity and status of francophones. She is a member of the Human Kinetics Department in the Faculty of Health Sciences and a member of the PhD programme in Population Health.

Louise Bouchard obtained her PhD in Medical Sociology at the Université de Montréal. She is jointly appointed to the Sociology Department and the Institute of Population Health at the University of Ottawa. Her general area of research is the social evaluation of technological innovations in medicine.

Kevin Brand obtained his ScD in Environmental Health Management from the Harvard School of Public Health. He is jointly appointed to the School of Management and the Institute of Population Health at the University of Ottawa. He has broad expertise in environmental health risk assessment, with a specific interest in uncertainty analysis and its interplay with policy formulation.

Pierre Mercier is a professor in the School of Psychology at the University of Ottawa where his domain of expertise includes research methods, statistical analysis, computer applications, learning, and cognition. His primary research interest is covariation detection and probabilistic judgment.

1 Introduction

Research on the topic of health risk perception among the lay public has proliferated since the environmentalist movement of the 1970s (Sunstein, 2002). From this body of research, it is now known that public concern about health hazards is not exclusively driven by actuarial risk assessments; rather, it also reflects a wide range of dimensions, ranging from the degree of control one has over health hazards to the amount of uncertainty that surrounds them (Slovic, 1987). As part of a larger national project on health risk perception and acceptability among members of the Canadian public, a national survey was recently conducted that included a detailed assessment of perceptions regarding a selected subset of five health hazards (motor vehicles, climate change, recreational physical activity, cellular phones, and terrorism) as well as five health outcomes (cancer, long-term disabilities, asthma, heart disease, and depression). Findings are presented in the current paper in order to explore various dimensions of Canadians' perceptions regarding each hazard and outcome.

Although environmental hazards have been a primary interest in the literature on health risk perception, more recent studies have shifted their focus to a broader array of hazards including those related to the social environment or lifestyle. With this in mind,

the Canadian national survey of health risk perception was designed and conducted in 2004 as a follow-up to a similar survey that took place in 1992 (Krewski et al., 1995a,b; Slovic et al., 1995). Findings revealed that lifestyle risks such as cigarette smoking, obesity, and unprotected sex were found to be perceived as posing the greatest health risk to Canadians (Krewski et al., 2006). A moderately high level of risk was reported for hazards related to the social environment including homelessness, street crime, and unemployment. The lowest risk ratings tended to be assigned to medical devices or therapies (such as prescription drugs, vaccines, and laser eye surgery). Women, older respondents, and those with a high school education perceived risks as being higher than men, younger respondents, and those with a college education, respectively. However, these findings are limited to only one perceptual dimension of hazards; namely, perceived health risk.

Since the pioneering work of Starr (1969) on the determinants of risk acceptability, it has become relatively well established that public concern over health hazards relates to more than actuarial risk assessments. Indeed, Fischhoff et al.'s (1978) Psychometric Approach has helped identify some of the key dimensions related to public concern over hazards including the level of voluntariness, dread, control, knowledge, catastrophic potential, and novelty that surrounds them. Hazards that involve lower feelings of dread, are controllable, better understood, and have smaller at-risk populations are deemed more acceptable and generate less worry (Leiss and Chociolko, 1994).

In light of the observed multi-dimensional nature of public perceptions of health hazards and outcomes, the present survey included a section through which a detailed assessment of Canadians' perceptions regarding five health hazards and five health outcomes was performed in terms of perceived risk, degree of personal control, knowledge, uncertainty and worry. A descriptive account of findings is presented, along with an examination of differences by socio-demographic groupings.

2 Methods

2.1 Survey content

The present survey was designed as a follow-up to the 1992 Canadian national risk perception survey (Krewski et al., 1995a,b; Slovic et al., 1995). The survey methods and design are described elsewhere (Krewski et al., 2006). In brief, the present survey questionnaire consisted of a number of retained items from the 1992 survey, as well as additional items to assess public perception of emerging health risks. The survey was also designed to reflect the broad determinants of population health (social and behavioural, genetic and biological, environmental and occupational determinants, and health services). The study protocol was reviewed and approved by the Research Ethics Board of the University of Ottawa.

The survey contained questions to ascertain the opinion of respondents on five exemplars related to health hazards (motor vehicles, climate change, recreational physical activity, cellular phone, and terrorism) and five exemplars related to health outcomes (cancer, long-term disabilities, asthma, heart disease, and depression). The specific exemplars were selected to represent different types of hazards and health outcomes with

which the Canadian public might be more or less familiar. Specifically, respondents indicated to what extent each of the health hazards and health outcomes represents a risk to the health of Canadians as well as a risk to their personal health. These were also rated with respect to personal control, knowledge, uncertainty, and worry. Health hazards were additionally rated in terms of risk acceptability. Respondents provided answers using a four point Likert scale (almost none – 1, slight – 2, moderate – 3, high – 4). Respondents could also decline to respond (don't know/no opinion – 0), thus providing a fifth choice in each case. Demographic and background information was also collected from each respondent.

2.2 Survey design and implementation

A representative sample of 1503 adult Canadians were interviewed by telephone between 22 February 2004 and 25 March 2004. Respondents were identified using a random digit dialing procedure, stratified by province, plus by age and gender within province according to the 2001 Canadian population. Design effects due to the stratified sampling procedure were examined and found to be close to 1 (ranging from 0.93 to 1.00), indicating that analysis of the data using simple random sample variance would result in conservative inferences.

The survey included a near equal proportion of males (48%) and females (52%). Respondents were categorised into three age groups: 18–34 years of age (representing 29% of respondents), 35–54 years of age (41%), 55 years of age or older (30%). Thirty-three per cent of respondents had at most a high school education, and 67% had at least some college education. Seventy-eight per cent of the interviews were conducted in English, and 22% were conducted in French.

3 Results and discussion

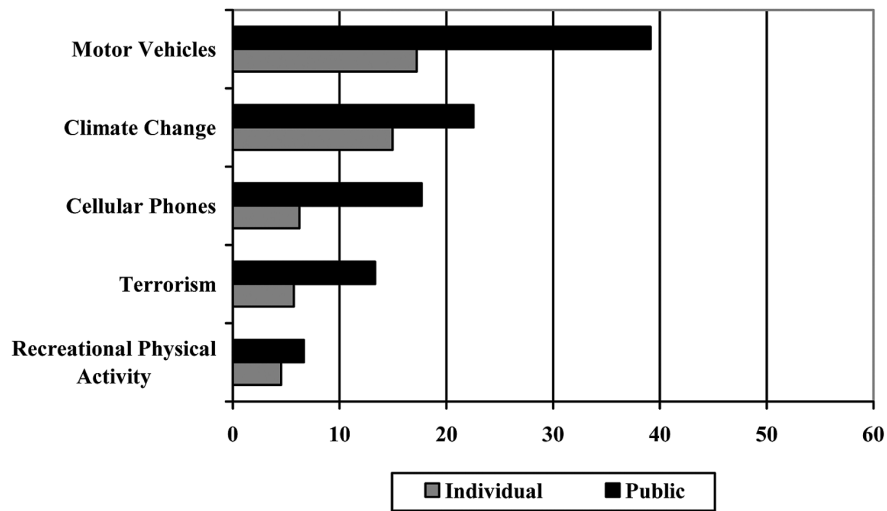
3.1 Health hazards

3.1.1 Perceived risk

Perceived risk of each health hazard to both the health of Canadians and to respondents' personal health is presented in Figure 1, ordered in terms of the percentage of 'high health risk' ratings elicited by each. A high degree of variation was observed in perceptions of health risk associated with different hazards. Motor vehicles were considered to pose the greatest risk to the health of Canadians (39.1%) followed by climate change (22.6%), cellular phones (17.7%), terrorism (13.3%), and recreational physical activity (6.6%), respectively. An important issue to address surrounding the inclusion of motor vehicles and cellular phones as exemplars of health hazards relates to the fact that each can pose health risks through different mechanisms. Indeed, results from the related interview component of this research project revealed that risks from motor vehicles were regarded as either accident-related or resulting from gas emissions, whereas risks from cellular phones were understood as pertaining to radiofrequency fields or distraction related to

their use while driving (Dallaire et al., 2005). Although it remains unclear which aspect of motor vehicles and cellular phones respondents had in mind upon producing their ratings, results from another section of the survey indicated that respondents first thought of accidents (48.8%) upon hearing the phrase ‘risks from motor vehicles’, whereas only 8.2% mentioned environmental issues (Lemyre et al., 2005). Upon hearing ‘risks from cellular phones’, most respondents thought of cancer or radiation (32.7%), although a fair number of others (22.6%) mentioned accidents caused by the use cellular phones while driving. It remains to be examined whether health risk perceptions varied according to the precise aspect of the hazard that respondents had in mind.

Figure 1 Perceived high risk to the Canadian public and to the individual for five health hazards



Despite that fact that terrorism is typically regarded as uncontrollable, and having a high catastrophic potential, few respondents indicated that terrorism posed a high risk to the health of Canadians (13.3%) or to their personal health (5.7%). These results are similar to another recent national survey on terrorism-related risk perceptions (Lemyre et al., 2006), where respondents reported that terrorism was a low to moderate threat to the Canadian population and an even lower threat to themselves as individuals. Thus, it appears that Canadians do not believe that terrorism will affect their country or themselves personally, perhaps since few such attacks have taken place on Canadian soil. Indeed, respondents in the related interview component of this research project who did not worry about terrorism considered that Canada or their region (mostly rural) would not be a target of attacks, and that others elsewhere or younger generations were the probable victims of a terrorism threat (Dallaire et al., 2005).

While climate change is also perceived as a hazard that individuals cannot control and global warming remains a current media and policy concern (i.e. Kyoto agreement), less than a quarter of respondents believe that it poses a high risk to Canadians. Interviews show that the long-term as opposed to immediate consequences of this hazard combined with the perception that these negative outcomes will affect future generations, contributes to this relatively low evaluation of the risks of climate change (Dallaire et al., 2005).

The fact that respondents infrequently perceived recreational physical activity as posing a high health risk may on the one hand be related to the fact that this activity also entails positive effects on health. Indeed, results from another section of the survey in which respondents indicated their first thought or image upon hearing the phrase 'risks from recreational physical activity' revealed that images of good health or fitness were quite salient (Lemyre et al., 2005). Interview results were similar since respondents spontaneously thought of the health benefits of being physically active rather than the potential risks of recreational physical activity and they further explained that the positive health effects were greater than the potential low probability and low severity of injuries (Dallaire et al., 2005).

Although the five hazards ranked in similar order for perceived risk to the health of Canadians as compared to perceived risk to their personal health, for all health hazards considered, respondents were less inclined to rate the hazards as posing a high risk to their personal health. Labelled the optimistic bias, the tendency for individuals to perceive greater levels of risk to the public as compared to themselves has been observed for a wide range of health hazards and diseases in previous studies (Weinstein, 1980). It is suggested that this bias is independent of gender, age, or educational attainment (Weinstein, 1987; Wilcox and Stefanick, 1999). Although the mechanisms explaining this phenomenon have not been fully elucidated, it is suggested that the degree of optimistic bias may be related to a number of factors including perceived control, perceived desirability, perceived frequency of occurrence, as well as personal experience (Klein and Helweg-Larsen, 2002; Price et al., 2002). Alternatively, respondents may simply have been more likely to rate risk to the health of Canadians as high because they considered cumulative health risk across many individuals.

3.1.2 Personal control

Perceived levels of personal control over each health hazard are presented in Figure 2. Respondents frequently reported high personal control over risks from recreational physical activity (53.6%) and cellular phones (47.3%), but not over risks from climate change (8.7%) and terrorism (4.9%). Indeed, respondents to the interview component of this research described how they could personally mitigate risks associated with the first two health hazards by selecting the specific types of recreational physical activity performed, following safety precautions and using protective gear or by choosing whether or not to use a cellular phone and by reducing the amount of time spent using this device (Dallaire et al., 2005). In contrast, individuals are unlikely to personally control severe weather-related events that may be related to climate change as well as the likelihood or magnitude of a terrorist-related attack.

3.1.3 Knowledge

High knowledge about risks from motor vehicles (42.0%) and recreational physical activity (40.3%) was frequently reported (Figure 3), whereas high knowledge about the risks from cellular phones (17.2%), climate change (17.0%), and terrorism (13.7%) was infrequently reported. Since many people are exposed to motor vehicles and recreational physical activity on a daily basis, they may be more likely to have had direct experience with and, hence, more knowledge about their associated risks.

Figure 2 Perceived personal control over five health hazards

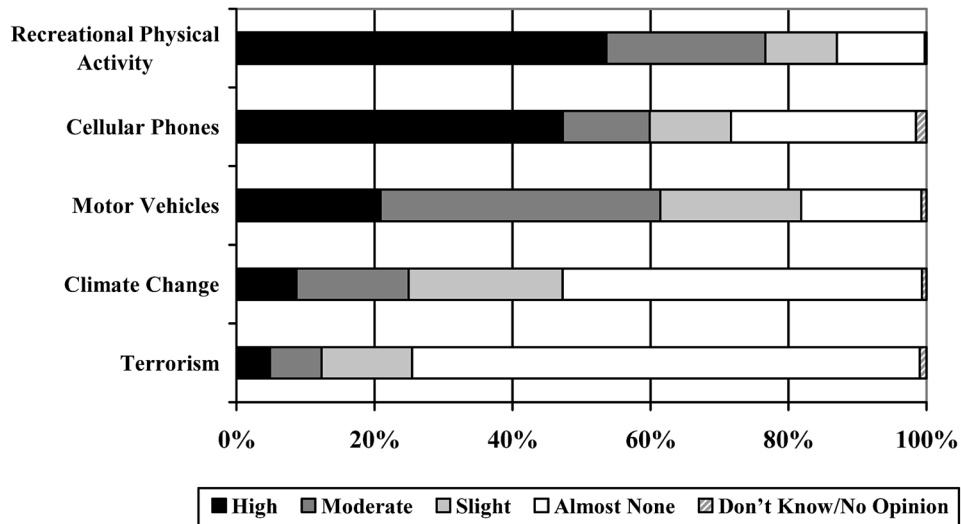
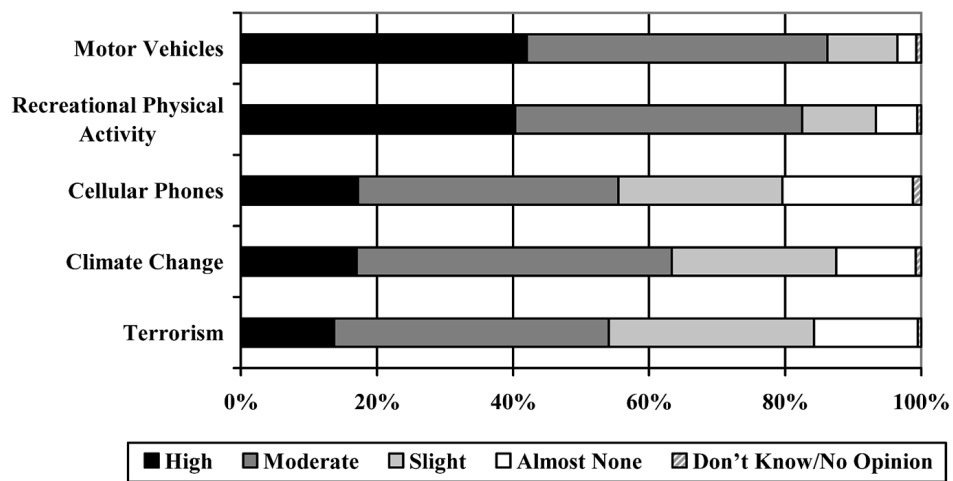


Figure 3 Perceived knowledge about five health hazards

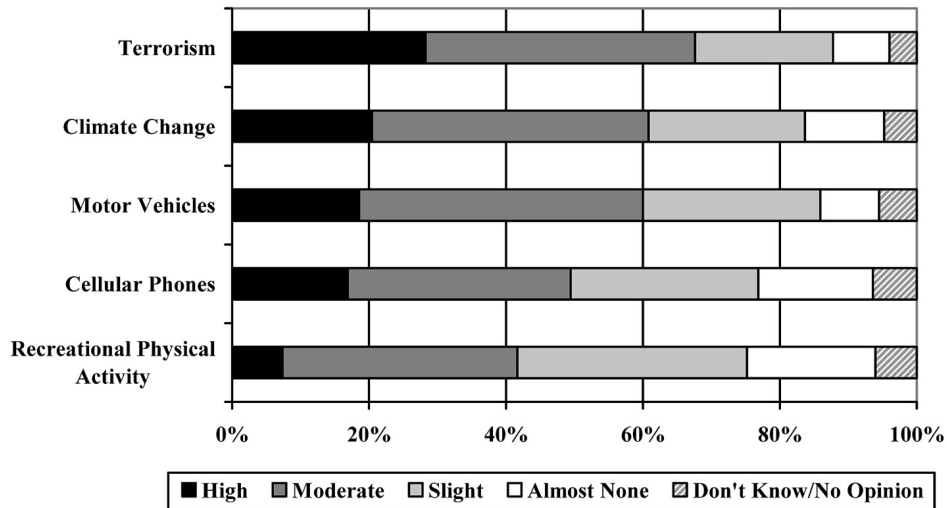


3.1.4 Uncertainty

Respondents most often expressed that uncertainty about the risks of terrorism was high (28.2%), followed by climate change (20.4%), motor vehicles (18.6%), and cellular phones (16.9%) (Figure 4). Fewer reported high uncertainty about health risks from recreational physical activity (7.4%). Indeed, terrorism by nature entails great uncertainty surrounding both the likelihood and location of an attack. Likewise, there exists a certain

degree of scientific uncertainty surrounding the magnitude and nature of specific consequences related to climate change (Patz et al., 2005) and health effects related to radiation exposure from cellular phones (Krewski et al., 2007) whereas the potential health risks from participation in recreational physical activity may be more apparent.

Figure 4 Perceived uncertainty about five health hazards



3.1.5 Risk acceptability

Risk acceptability was very low for all five health hazards considered (Figure 5), ranging from 3.7% of respondents judging the level of risk acceptable from terrorism to be high to 5.5% of respondents judging the level of risk acceptable from motor vehicles to be high. The fact that risk acceptability was very low for all health hazards considered suggests that the Canadian public has a low tolerance for risk regardless of the nature of the health hazard. Indeed, results from another section of the survey revealed that nearly half of respondents agreed that a risk-free environment is an attainable goal in Canada (Krewski et al., 2008). It is also possible that none of the five hazards were perceived as entailing sufficient benefits to offset a risk to their health. Results from a recent study of risk perception in Germany revealed that the perceived magnitude of the risk and the perceived use of the hazard explained a large proportion of risk acceptability (Zwick, 2005). Unfortunately, it was not possible to evaluate this in the present study.

3.1.6 Worry

Worry about each health hazard is presented in Figure 6. Motor vehicles received the greatest percentage of 'high worry' responses (20.0%). Interestingly, the rank order of hazards in terms of high worry ratings most closely mirrored that of health risk ratings, suggesting that worry about hazards may be most strongly related to health risk perceptions. Worry about terrorism, cellular phones, and recreational physical activity were all relatively low, with high worry responses ranging from 6.8 to 7.8%. Results of this, as well as another terrorism-related risk perception survey, indicate that Canadians tend to worry little about terrorism-related risks (Lemyre et al., 2006).

Figure 5 Perceived level of risk acceptable for five health hazards

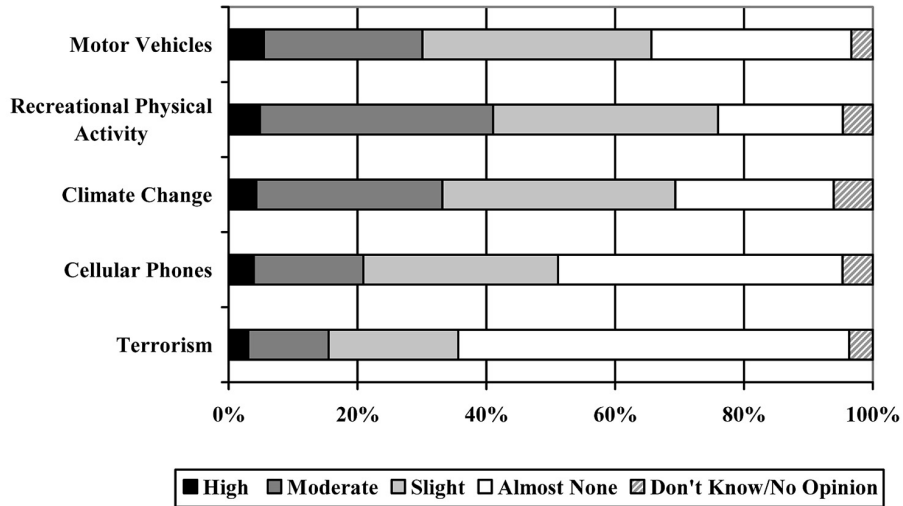
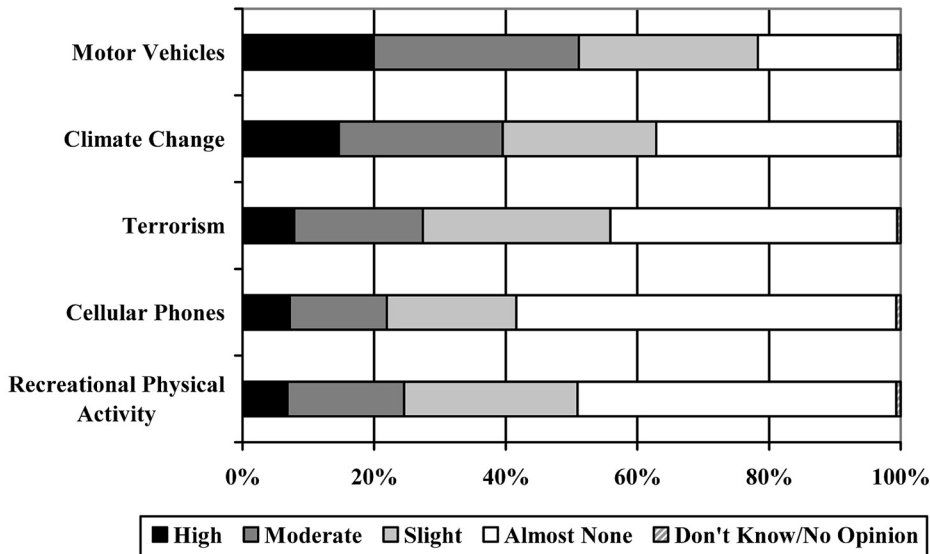


Figure 6 Perceived worry about five health hazards



It has been suggested that perceiving a hazard as a high risk may induce high levels of worry (Baron et al., 2000). If this were the case, then it has also been suggested that providing people with further information relating to the actual probability that certain adverse events will occur may reduce or modify levels of worry of individuals. Conversely, the induction of worry may be due to another source or factor which may in turn cause increased levels of risk perception, or both increased levels of worry and risk perceived simultaneously.

3.1.7 Demographic effects

The results were further analysed by comparing percentage 'high' responses between various demographic subgroups: gender (men versus women), age (respondents 18 to 34 years versus respondents 55 years or greater), and education (at most a high school education versus at least some college education).

3.1.7.1 Gender

Significantly more women (43.5%) perceived motor vehicles as posing a high health risk to Canadians than men (34.4%) ($p < 0.05$). Few differences were observed for risk to personal health: climate change was the only health hazard where women (16.8%) perceived a significantly greater risk than did men (13.0%). The fact that few gender differences were observed in health risk perceptions across the five hazards is in contrast with other findings (Krewski et al., 1995a, 2006), where Canadian women perceived greater levels of health risk compared to men. Nevertheless, it is possible that perceptions of the subset of hazards assessed here are simply less bound by gender.

Large gender differences were observed in perceived knowledge. Significantly more men expressed having high knowledge than women for every health hazard, with the percentage difference between males and females ranging from 4.5% for cellular phones to 12.5% for motor vehicles. This finding is similar to those of previous studies, whereby greater knowledge was found among men for technology-related health knowledge (Beier and Ackerman, 2003). Although fewer gender differences were noted with respect to perceived personal control over the risk, significantly more men reported having high personal control over risks from recreational physical activity (56.6%), motor vehicles (26.4%), and terrorism (6.2%) than women (50.9, 15.9 and 3.6%, respectively). Significantly more men reported high uncertainty about climate change risks (22.9%) than women (18.2%). No gender differences in risk acceptability were observed for any health hazard. With regards to worry, gender differences were only observed for motor vehicles, with a higher number of women (22.6%) reporting high levels of worry as compared to men (17.1%).

3.7.1.2 Age

Older respondents more often reported that hazards posed a high health risk to Canadians than younger respondents. Perceived high risk to the Canadian public was significantly elevated for older respondents for cellular phones (21.3%), terrorism (17.3%), and recreational physical activity (9.8%), as compared to younger respondents (13.6, 7.8 and 3.2%, respectively). Conversely, younger respondents (19.2%) were significantly more likely to rate the personal health risk posed by motor vehicles as high compared to older respondents (13.3%). Indeed, the highest death rates from motor vehicle accidents in Canada are observed among young Canadians 15–24 years of age (Silvi, 2004).

No significant age-related differences were observed for personal control or perceived uncertainty for any of the health hazards considered here. The only age-related difference observed for perceived knowledge was for terrorism, where older respondents (16.0% reported a high level of knowledge) were significantly more likely to report high knowledge about terrorism risks than younger respondents (10.8%). Little difference in perceived risk acceptability was observed, with the exception of cellular phones where older respondents (6.0% expressed a high level of acceptance of potential health risks)

were significantly more likely to report high risk acceptability than younger respondents (2.3%). Although older respondents were significantly more likely than younger respondents to report high worry about cellular phones risks (10.2% older respondents expressed a high level of worry versus 5.1% of younger respondents), younger respondents were significantly more likely to report high worry about motor vehicles risks (24.0% of younger respondents indicated a high level of worry versus 15.8% of older respondents).

3.7.1.3 *Education*

Overall, respondents with a lower level of education were more likely to report high health risks to Canadians than those with a higher level of education. Specifically, those with, at most, a high school education were significantly more likely to report that motor vehicles (43.4% perceived this hazard to pose a high risk), terrorism (20.2%), and recreational physical activity (9.6%) posed a high health risk to Canadians than those with at least a college education (37.1, 9.9 and 5.2%, respectively). Respondents with less education also reported significantly more often that climate change (18.9% perceived this hazard to be a high health risk) and terrorism (8.4%) posed a high risk to their personal health than respondents with higher levels of education (13.1 and 4.4%, respectively).

Respondents with at least a college education were significantly more likely to report high personal control over risks from recreational physical activity (59.5% expressed a high degree of control) and cellular phones (51.7%) than respondents with at most a high school education (41.6 and 38.1% respectively). Those with at least a college education were more likely to perceive themselves as having high knowledge for all health hazards considered. Results were significant for recreational physical activity (45.7 versus 29.1% of respondents fell in the high knowledge category) and cellular phones (19.2 versus 13.0%). Respondents with a higher level of education were also significantly more likely to report high uncertainty about climate change risks (21.8 high uncertainty versus 17.5%). Interestingly, respondents with a lower level of education were significantly more likely to report high risk acceptability of risks from motor vehicles (7.5% indicated a high degree of acceptance of this risk), cellular phones (5.3%), and climate change (5.7%) compared to those with a higher level of education (4.5, 3.3 and 3.6%, respectively); however, the differences were small. These findings are in contrast to what is typically observed in the literature, but may relate to greater perceived benefits or an increased willingness to tolerate certain risks among respondents with lower education. Finally, respondents with a lower level of education were generally more likely to report high worry, although the difference was only significant for terrorism (11.2 high worry versus 6.1%).

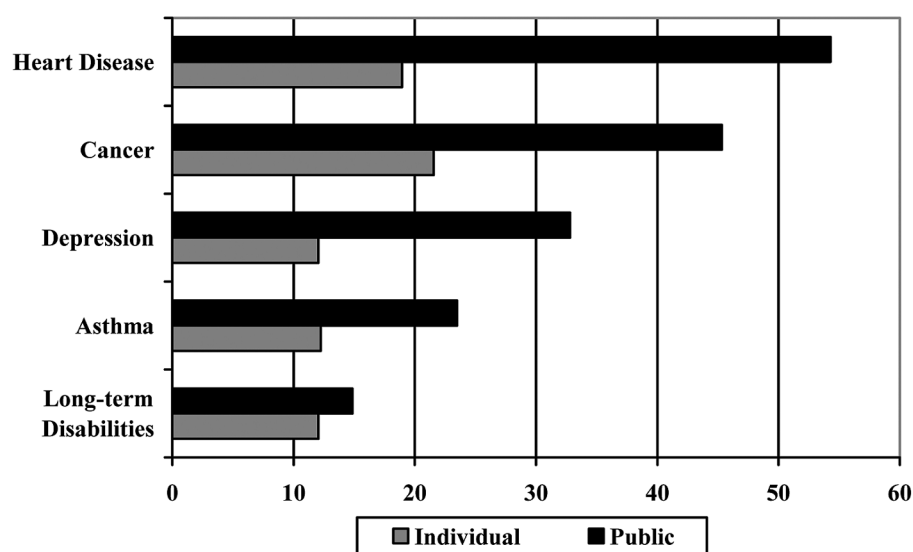
3.2 *Health outcomes*

3.2.1 *Perceived risk*

Perceived risk to Canadians and to personal health for each of the five health outcomes considered here is presented in Figure 7 ordered in terms of percentage 'high risk' response. Heart disease was the most frequently considered outcome to pose a high risk to the Canadian public (54.3% viewed this as a high health risk) followed closely by cancer (45.3%). Indeed, these two health outcomes are currently the leading causes of death in Canada (Statistics Canada, 2005). This finding also parallels those of other related study

components using group and individual interviews and word associations where heart disease and cancer were also among the most frequently mentioned health risks of concern (Dallaire et al., 2005; Lemyre et al., 2005). A fair number of respondents also reported that Canadians were at high risk of depression (32.8%) and asthma (23.5%). Long-term disabilities received the lowest percentage of 'high risk' responses (14.8%).

Figure 7 Perceived high risk to the Canadian public and to the individual for five health outcomes



As was the case for the five health hazards discussed previously, respondents reported that the risk of each health outcome considered to Canadians was greater than personal risk. Respondents indicated that they felt at greatest personal risk of cancer (21.6%) and heart disease (19.0%), and at less risk of asthma (12.2%), depression (12.0%), and long-term disabilities (12.0%). Compared to health hazards, respondents tended to more often rate both risk to Canadians and risk to themselves as high for health outcomes.

3.2.2 Personal control

Perceived personal control over each health outcome is presented in Figure 8. Heart disease received the greatest percentage of 'high' personal control responses (36.0%), followed closely by depression (31.4%). Respondents were the least likely to rate personal control as high for cancer (10.9%). However, it remains unclear whether respondents were considering level of personal control over prevention of the illness, control over disease management, or control over the treatment or the consequences of the disease.

3.2.3 Knowledge

Respondents more often reported having high knowledge about the health outcomes than the health hazards considered in this paper (Figure 9). In terms of health outcomes, respondents most often reported having high knowledge about heart disease (40.0% expressed a high degree of knowledge about this outcome), followed by depression

(36.4%), cancer (32.4%), asthma (26.9%), and long-term disabilities (22.2%), respectively. Again, it is unclear for which aspect of the health outcome respondents felt they had a high degree of knowledge, from what causes such a disease, to its characteristics, to the potential treatments or remedies. It is therefore difficult to establish a relationship between the influence of this knowledge either on lifestyle and health protective behaviours or on the incidence of these health outcomes.

Figure 8 Perceived personal control over five health outcomes

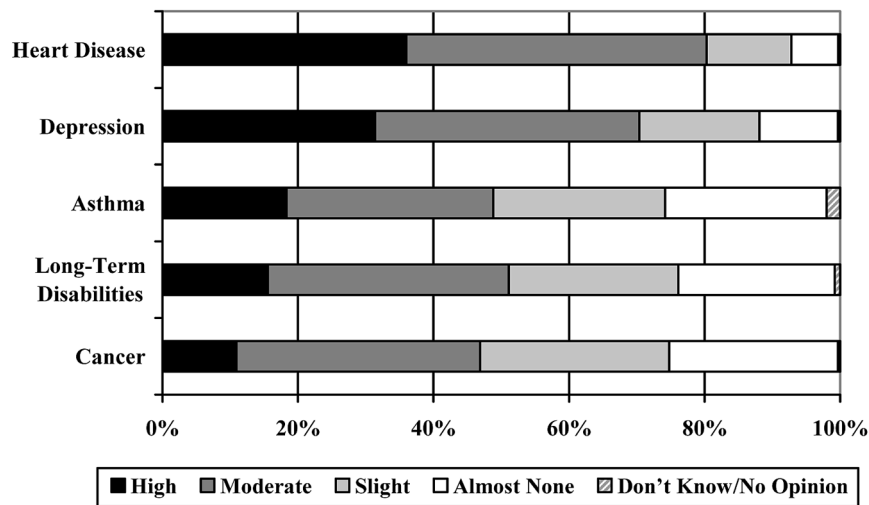
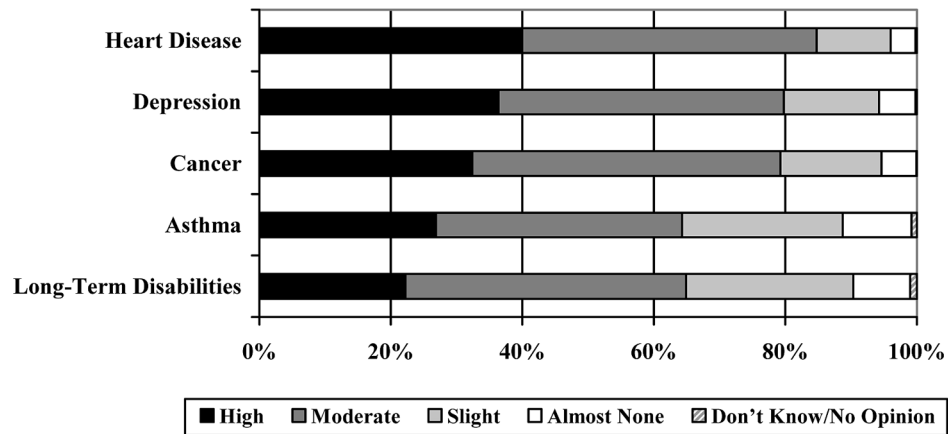


Figure 9 Perceived knowledge about five health outcomes

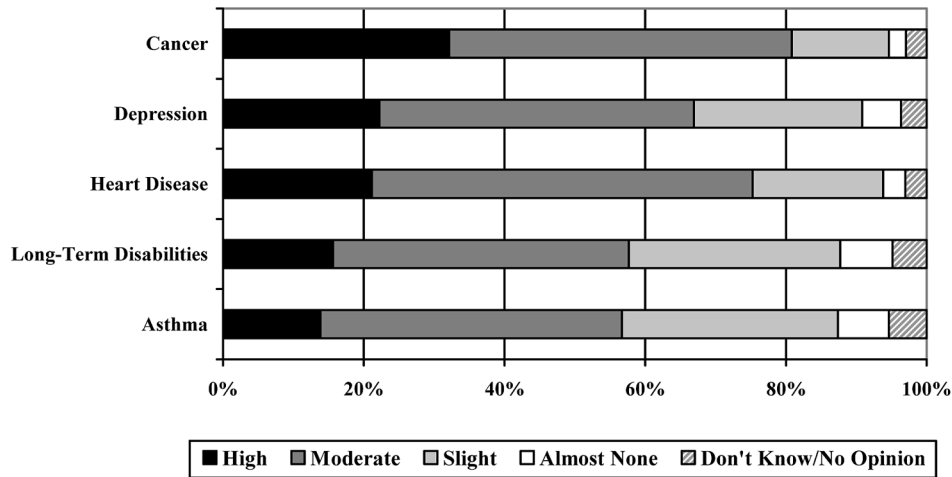


3.2.4 Uncertainty

Respondents were most likely to report high uncertainty about cancer (32.1%) (Figure 10). A moderate number of respondents rated depression (22.2%) and heart disease (21.2%) as high in uncertainty. Long-term disabilities (15.6%) and asthma (13.8%) were the least

likely to be perceived as high in uncertainty. Indeed perceived uncertainty surrounding specific treatment options, consequences, as well as scientific uncertainty associated with each health outcome may indeed be quite distinct.

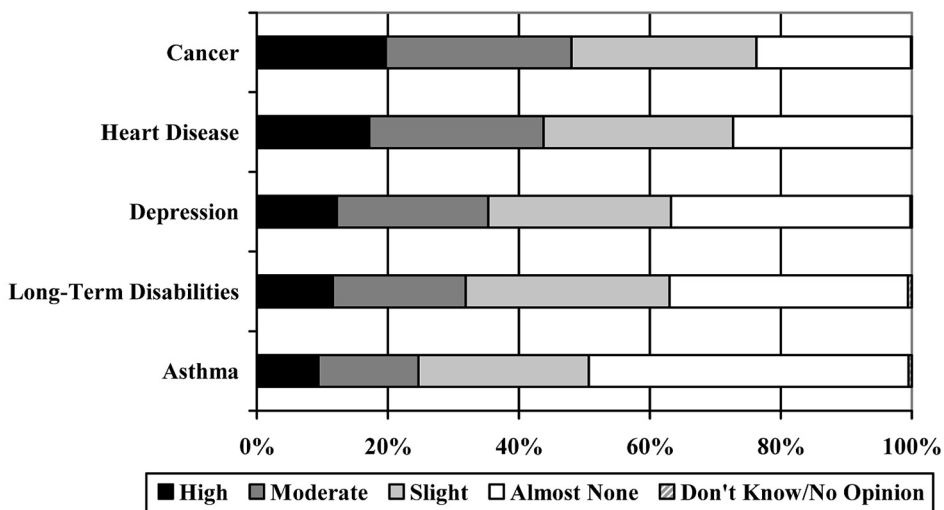
Figure 10 Perceived uncertainty about five health outcomes



3.2.5 Worry

Respondents were most likely to report high worry about cancer (19.7%) and heart disease (17.2%) (Figure 11). Asthma received the lowest percentage of 'high' worry responses (9.4%).

Figure 11 Perceived worry about five health outcomes



3.2.6 *Demographic effects*

3.2.6.1 *Gender*

In contrast to health hazards, many gender differences were observed across the five health outcomes. Specifically, women reported a significantly greater proportion of high risk responses to Canadians for all health outcomes than men (with the percentage difference in high perceived risk ranging from 6.4% for long-term disabilities to 17.2% for heart disease) ($p < 0.05$). Although few significant gender differences were observed for personal risk, men (19.4%) were significantly more likely to report high personal risk of cancer than women (12.5%). Consistent with this, lifetime probabilities of both developing (43.1 for men and 38.4% for women) and dying (28.1 for men and 23.4% for women) from cancer are higher in Canadian men than women (National Cancer Institute of Canada, 2004).

Large gender differences in perceived knowledge were also observed for all health outcomes. Interestingly, while men more frequently reported having high knowledge of health hazards, women more frequently reported having high knowledge of all the health outcomes but long-term disabilities (with percentage differences in reported high knowledge ranging from 5.0% for asthma to 11.1% for cancer). In support of these findings, knowledge of risk factors for heart disease has previously been reported to be higher among women (Avis et al., 1990). Moreover, a study by Beier and Ackerman (2003) also recently reported that women were more knowledgeable in a wide range of health domains than men, particularly for reproduction and early life scales, than men. It was suggested that this gender differences in health knowledge might result from greater experience in caring for the health of family members, as well as greater use of the healthcare system among women than men.

A significantly greater proportion of men (34.5%) reported high levels of personal control over depression risks than women (28.5%); no other gender differences in perceived personal control were noted. Women were also found to be significantly more likely to report high uncertainty about cancer (37.0%) and depression (25.8%) than men (26.9 and 18.3%, respectively). Percentage high worry responses tended to be greater in women than men. Significant differences were observed for cancer (23.3 versus 15.2%), depression (13.9 versus 10.4%), and asthma (11.1 versus 7.5%).

3.2.6.2 *Age*

Older respondents reported significantly more often high risk to Canadians for heart disease (59.3% perceived a high degree of risk), cancer (50.2%), asthma (27.6%), and long-term disabilities (20.7%) than younger respondents (46.4, 38.1, 19.4 and 10.6%, respectively). Fewer age-related differences were observed for personal risk. Older respondents were significantly more likely to report being at high risk of heart disease (25.8%) and long-term disabilities (14.2%) than younger respondents (11.3 and 5.3%, respectively). Indeed, increased rates of heart disease and disability are also seen with increasing age in Canada (Aronow 1999; Brochier and Arwidson, 1998; Human Resources Development Canada, 2003; Krantz and McCeney, 2002).

Older respondents were significantly more likely to report high personal control over asthma (22.9 versus 17.1% expressed a high degree of control) and long-term disability risks (19.1 versus 14.3%). Consistent with findings in other studies (Beier and Ackerman, 2003), they were also more likely to report having high knowledge about health outcomes

than younger respondents, with significant differences observed for heart disease (46.0 versus 29.6%), cancer (37.3 versus 27.0%), and long-term disabilities (26.9 versus 14.3%).

Older respondents were significantly more likely to report high uncertainty with respect to cancer (34.4%), heart disease (25.8%), long-term disability (17.3%), and asthma (17.3%) risks than younger respondents (27.2, 17.1, 11.3 and 10.6%). Conversely, younger respondents were significantly more likely to report high worry for cancer (21.5% expressed a high degree of worry) and depression (13.9%) as compared to older respondents (15.8 and 9.3%, respectively).

3.2.6.3 Education

Respondents with a lower level of education were more likely to report a high risk to Canadians for the health outcomes considered than those with a higher level of education. Specifically, those with, at most, a high school education were significantly more likely to report that Canadians were at a high risk of cancer (51.3% reported a high level of perceived risk), asthma (28.5%), and long-term disability (19.4%) than those with a higher level of education (42.4, 21.0 and 12.6%, respectively). Heart disease was the only health outcome where respondents with less education (23.8%) reported significantly more frequently a high personal risk than respondents with higher levels of education (16.6%). The finding might relate to the fact that risk of heart disease has been found to increase with decreasing socioeconomic status (Aronow 1999; Brochier and Arwidson, 1998; Krantz and McCeney, 2002).

Consistent with findings of previous studies in which those with higher education displayed greater cardiovascular disease risk factor knowledge (Davis et al., 1995), the percentage of respondents expressing high knowledge about the health outcomes was significantly greater among those with at least a college education as compared to those with at most a high school education for all health outcomes, with the exception of long-term disabilities (the percentage differences ranged from 5.4 for cancer to 13.0 for heart disease). Respondents with a higher level of education were also significantly more likely to report high personal control over heart disease risks (39.0 versus 29.7% expressed a high degree of control). Although respondents with a lower level of education tended to report high worry more frequently, the differences were only significant for heart disease (20.4 versus 15.6% in the high worry category), and long-term disabilities (14.9 versus 9.9%).

4 Conclusions

Overall, a great deal of variation was observed in the extent to which different health hazards are perceived as high in risk, controllability, knowledge, and uncertainty, as well as the extent to which they are deemed acceptable and generate worry. Despite the fact that low knowledge and low feelings of personal control over hazards have been well documented as factors contributing to elevated risk perceptions and, hence, public concern over hazards (Slovic et al., 1982; Whyte and Burton, 1982), the rank order of items in terms of health risk did not closely mirror that of ratings of personal control, knowledge, or uncertainty. However, it is notable that the rank order of hazards in terms of personal control ratings was opposite to that of ratings of uncertainty and that participants least

frequently reported having high knowledge about the risks from health hazards that were rated most frequently as highly uncertain (i.e. cellular phones, climate change, and terrorism). Indeed, health risks associated with greater levels of uncertainty surrounding the nature, type, or likelihood of adverse health effects may render the individual to feel less knowledgeable and to have less personal control over such risks.

As with health hazards, a large variation was also observed in ratings of personal control, knowledge, uncertainty and worry for each health outcome, with cancer ranking highest both in terms of perceived uncertainty and worry. The rank ordering of perceived risk to Canadians, in general, tended to mirror the rank ordering of perceived worry and uncertainty about the health outcome. Heart disease, cancer, and depression tended to rank high on all dimensions and asthma and long-term disabilities to rank the lowest. In contrast to the health hazards, perceived knowledge over health outcomes also mirrored perceived risk (although with cancer and depression reversed in order, perhaps due to a relatively higher prevalence or lifetime risk for the former). Indeed, a high ranking in terms of both knowledge and perceived health risk might reflect greater experience with the health outcome, either personally or through others.

Overall, there was a tendency for older respondents and respondents with lower levels of education to perceive risk to Canadians from the health hazards and health outcomes considered as greater. In contrast to results from other survey components, gender was not associated with risk perceptions to Canadians for the five hazards evaluated to a great extent (Krewski et al., 2006). Gender was, however, associated with risk perceptions for health outcomes. The role of these important demographic factors as correlates of risk perception has been well documented (Dosman et al., 2001; Finucane et al., 2000; Slovic et al., 1995). Such demographic differences could also often be interpreted in terms of differences that might be expected regarding personal experience, such that they may reflect actual disease incidence patterns, or increased familiarity among certain demographic groups.

Although beyond the scope of the present paper, an examination of the precise relationships between the various risk perception dimensions, beyond the descriptive evaluation presented here, would be useful in order to better understand potential complex interrelationships and how they relate specifically to risk perceptions. As a first step, the results presented in this paper nevertheless provide valuable insight on public health risk perceptions among Canadians. Ultimately, research of this nature can inform risk managers by highlighting key issues to address in public education initiatives.

References

- Aronow, W. (1999) 'The older man's heart and heart disease', *Medical Clinics of North America*, Vol. 83, No. 5, pp.1291–1303.
- Avis, N., McKinlay, J. and Smith, K. (1990) 'Is cardiovascular risk factor knowledge sufficient to influence behavior?', *American Journal of Preventive Medicine*, Vol. 6, No. 3, pp.137–144.
- Baron, J., Hershey, J. and Kunreuther, H. (2000) 'Determinants of priority for risk reduction: the role of worry', *Risk Analysis*, Vol. 20, No. 4, pp.413–427.
- Beier, M. and Ackerman, P. (2003) 'Determinants of health knowledge: an investigation of age, gender, abilities, personality, and interests', *Journal of Personality and Social Psychology*, Vol. 84, No. 2, pp.439–448.

- Brochier, M. and Arwidson, P. (1998) 'Coronary heart disease risk factors in women', *European Heart Journal*, Vol. 19(suppl. A), pp.45–52.
- Dallaire, C., Lemyre, L., Krewski, D., Bouchard, L., Brand, K. and Mercier, P. (2005) 'Project 1.1: interviewing Canadians about health risk perception and acceptability', Contract report prepared for Health Canada, Institute of Population Health, University of Ottawa, Ottawa, Canada.
- Davis, S., Winkleby, M. and Farquhar, J. (1995) 'Increasing disparity in knowledge of cardiovascular disease risk factors and risk-reduction strategies by socioeconomic status: implications for policy makers', *American Journal of Preventive Medicine*, Vol. 11, No. 5, pp.318–323.
- Dosman, D., Adamowicz, W. and Hrudey, S. (2001) 'Socioeconomic determinants of health and food safety-related risk perception', *Risk Analysis*, Vol. 21, No. 2, pp.307–317.
- Finucane, M., Slovic, P., Mertz, C., Flynn, J. and Satterfield, T. (2000) 'Gender, race, and perceived risk: the "white male" effect', *Health, Risk & Society*, Vol. 2, No. 2, pp.159–172.
- Fischhoff, B., Slovic, P., Lichtenstein, S., Read, S. and Combs, B. (1978) 'How safe is safe enough? A psychometric study of attitudes towards technological risks and benefits', *Policy Science*, Vol. 9, No. 2, pp.127–152.
- Human Resources Development Canada (2003) 'Disability in Canada: A 2001 profile'. Available at: <http://www.hrdc-drhc.gc.ca/bcph.odi>.
- Klein, C. and Helweg-Larsen, M. (2002) 'Perceived control and the optimistic bias: a meta-analytic review', *Psychology and Health*, Vol. 17, No. 4, pp.437–446.
- Krantz, D. and McCeney, M. (2002) 'Effects of psychological and social factors on organic disease: a critical assessment of research on coronary heart disease', *Annual Reviews of Psychology*, Vol. 53, pp.341–369.
- Krewski, D., Lemyre, L., Turner, M.C., Lee, J.E.C., Dallaire, C., Bouchard, L., Brand, K. and Mercier, P. (2006) 'Public perception of population health risks in Canada: health hazards and sources of information', *Human and Ecological Risk Assessment*, Vol. 12, No. 4, pp.626–644.
- Krewski, D., Byus, C.V., Glickman, B.W., Habash, R.W.Y., Habbick, B., Lotz, W.G., Mandeville, R., McBride, M.L., Prato, F.S., Salem, T. and Weaver, D. (2007) 'Recent advances in research on radiofrequency fields and health: 2001–2003', *Journal of Toxicology and Environmental Health*, Vol. 10, No. 4, pp.287–318.
- Krewski, D., Lemyre, L., Turner, M.C., Lee, J.E.C., Dallaire, C., Bouchard, L., Brand, K. and Mercier, P. (2008) 'Public perception of population health risks in Canada: risk perception beliefs', *Health, Risk & Society*, Vol. 10, No. 2, pp.167–179.
- Krewski, D., Slovic, P., Bartlett, S., Flynn, J. and Mertz, C. (1995a) 'Health risk perception in Canada I: rating hazards, sources of information and responsibility for health protection', *Human and Ecological Risk Assessment*, Vol. 1, No. 2, pp.117–132.
- Krewski, D., Slovic, P., Bartlett, S., Flynn, J. and Mertz, C. (1995b) 'Health risk perception in Canada II: worldviews, attitudes and opinions', *Human and Ecological Risk Assessment*, Vol. 1, No. 3, pp.1–48.
- Leiss, W. and Chociolko, C. (1994) *Risk and Responsibility*, Montreal: McGill-Queen's University Press.
- Lemyre, L., Krewski, D., Lee, J.E.C., Turner, M.C., Dallaire, C., Bouchard, L., Brand, K. and Mercier, P. (2005) 'Public perception of population health risks in Canada: salient concepts in word associations to health risk and risks from five cases of hazards', Contract report prepared for Health Canada, Institute of Population Health, University of Ottawa, Ottawa, Canada.
- Lemyre, L., Turner, M.C., Lee, J.E.C. and Krewski, D. (2006) 'Public perception of terrorism threat in Canada: a national survey of risk management and preparedness needs', *Journal of Risk Research*, Vol. 9, No. 7, pp.755–774.
- National Cancer Institute of Canada. (2004) *Canadian Cancer Statistics 2004*, Toronto, Canada.

- Patz, J.A., Campbell-Lendrum, D., Holloway, T. and Foley, J.A. (2005) 'Impact of regional climate change on human health', *Nature*, Vol. 438, pp.310–317.
- Price, P., Pentecost, H. and Voth, R. (2002) 'Perceived event frequency and the optimistic bias: evidence for a two-process model of personal risk judgments', *Journal of Experimental Social Psychology*, Vol. 38, No. 3, pp.242–252.
- Silvi, J. (2004) 'Deaths from motor vehicle traffic accidents in selected countries of the Americas, 1985–2001', *Epidemiological Bulletin*, Vol. 25, No. 1, pp.2–5.
- Slovic, P. (1987) 'Perception of risk', *Science* 236, No. 4799, pp.280–285.
- Slovic, P., Fischhoff, B. and Lichtenstein, S. (1982) 'Why study risk perception?', *Risk Analysis*, Vol. 2, No. 2, pp.83–94.
- Slovic, P., Malmfors, T., Krewski, D., Mertz, C., Neil, N., and Bartlett, S. (1995) 'Intuitive toxicology. II. Expert and lay judgments of chemical risks in Canada', *Risk Analysis*, Vol. 15, No. 6, pp.661–675.
- Starr, C. (1969) 'Social benefit vs. technological risk: what is our society willing to pay for safety?', *Science*, Vol. 165, pp.1232–1238.
- Statistics Canada (2005) 'Age-standardized mortality rates by selected causes, by sex'. Available at: <http://www.statcan.ca/english/Pgdb/health30a.htm>.
- Sunstein, C.R. (Ed.). (2002) *Risk and Reason: Safety, Law, and the Environment*, Cambridge: Cambridge University Press.
- Weinstein, N. (1980) 'Unrealistic optimism about future life events', *Journal of Personality and Social Psychology*, Vol. 39, No. 5, pp.806–820.
- Weinstein, N. (1987) 'Unrealistic optimism about susceptibility to health problems: conclusions of a community wide sample', *Journal of Behavioral Medicine*, Vol. 10, No. 5, pp.481–500.
- Whyte, A. and Burton, I. (1982) 'Perception of risks in Canada', in I. Burton, C.D. Fowle and R.S. McCullough (Eds), *Living With Risk: Environmental Risk Management in Canada*, Toronto: Institute for Environmental Studies, pp.39–69.
- Wilcox, S. and Stefanick, M. (1999) 'Knowledge and perceived risk of major diseases in middle-aged and older women', *Health Psychology*, Vol. 18, No. 4, pp.346–353.
- Zwick, M.M. (2005) 'Risk as perceived by the German public: pervasive risks and "switching" effects', *Journal of Risk Research*, Vol. 8, No. 6, pp.481–498.