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Perceptions and experiences of environmental health risks among new mothers: a qualitative study in Ontario, Canada

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There is a growing awareness and concern in contemporary societies about potential health impacts of environmental contaminants on children. Mothers are traditionally more involved than other family members in managing family health and household decisions and thus targeted by public health campaigns to minimise risks. However little is known about how new mothers perceive and experience environmental health risks to their children. In 2010, we undertook a parallel case study using qualitative, in-depth interviews with new mothers and focus groups with public health key informants in two Public Health Units in Ontario Province, Canada. We found that the concern about environmental hazards among participants ranged from having no concerns to actively incorporating prevention into daily life. Overall, there was a common perception among participants that many risks, particularly in the indoor environment, were controllable and therefore of little concern. But environmental risks that originate outside the home were viewed as less controllable and more threatening. In response to such threats, mothers invoked coping strategies such as relying on the capacity of children's bodies to adapt. Regardless of the strategies adopted, actions (or inactions) were contingent upon active information seeking. We also found an optimistic bias in which new mothers reported that other children were at greater risk despite similar environmental circumstances. The findings suggest that risk communication experts must attend to the social and environmental contexts of risk and coping when designing strategies around risk reducing behaviours.

Keywords: risk perceptions; mothers; infants; environmental hazards; Canada

Introduction

The public is continuously confronted with myriad warnings about potential environmental health risks to children. For example, in recent years, there have been warnings about bisphenol A (BPA) in baby bottles and food packaging, pesticides in produce and on lawns, lead in toys, mould and asbestos in homes and outdoor air pollution. Given the vulnerability of infants to environmental contaminants (Perera *et al*. 1999, Sram *et al*. 2005) and the disproportionate role that mothers play in managing household activities and family health (MacKendrick 2009), pregnant women and new mothers are often the key audience for media and public health campaigns. While information about environmental exposures may encourage many women to take protective action, risk messages may also be a significant source of concern and stress, particularly if opportunities or

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resources required to take protective action are not available (Matthes *et al*. 1998, Breakwell 2000). A better understanding of how risks are perceived and responded to is critical for developing effective risk communication strategies, yet surprisingly little research has been done in this context. Here we report the results of an exploratory qualitative in-depth study involving new mothers (5–10 weeks post-partum) and public health employees in Ontario, Canada, to lay a foundation for understanding how new mothers perceive and experience everyday environmental hazards.

Background

Much of what has been learned in recent decades about environmental risk perceptions and experiences comes from the study of specific contamination events, whether from acute industrial disasters or chronic pollutant releases (Edelstein 2004). Acute community-wide exposure scenarios often prompt widespread stress and anxiety and disrupt social relations and connection to place (Edelstein 2004, Altman *et al*. 2008). Further, *anticipated* environment and health problems have been shown to have similarly powerful psychosocial effects (Elliott *et al*. 1993, Markon *et al*. 2011). While a great deal has been learned from this research, acute exposure scenarios tell us little about how individuals may perceive and experience the numerous contaminant exposures in their everyday lives. Yet it is this latter category of everyday risk exposures that are subject to a significant amount of risk messaging, as public health officials see this as more relevant to their domain of action.

The public is often reminded that they are continuously being exposed to a wide range of harmful contaminants in food, water, air and common household goods (Altman *et al*. 2008, Rustagi *et al*. 2011, Hoekstra *et al*. 2012). 'Everyday' contaminants range from radon and mould in homes, pesticides in food and heavy metals in children's toys (Health Canada 2010a), and unlike contaminants from industrial accidents that are geographically localised, these contaminants are ubiquitous; they can be found at varying levels, every-day, in every home and neighbourhood and in every human body (Altman *et al*. 2008). The American Center for Disease Control and Prevention monitors over 200 chemical pollutants in the blood and urine of the general American population and has identified widespread exposure to plastic additives, pesticides, BPA and flame retardants among many others. The primary source of these contaminants has been identified as everyday consumer products being brought into the home (Centers for Disease Control and Prevention 2009). Similar findings have been reported in the Canadian context (Health Canada 2010b).

While there remains considerable uncertainty around the cumulative health impacts of chemicals (Cole *et al*. 1999), it is well understood that the potential for harm is particularly great during pregnancy and infancy. At the biological level, physiological and metabolic characteristics make foetuses and infants extremely vulnerable to toxicants that may disrupt developmental processes, even at very low doses and during narrow time windows of exposure (Sharpe and Irvine 2004, Wigle *et al*. 2007). At the behavioural level, infants are exposed to greater amounts of such contaminants because of their ingesting behaviours and proximity to potentially contaminated surfaces such as floors and soil (Perera *et al*. 1999, Sram *et al*. 2005). Taking steps to limit exposures at these vulnerable stages is therefore of particular importance.

In an effort to encourage healthy behaviours, pregnant women and new mothers are often the focus of risk communication strategies in public health campaigns (Canadian Partnership for Children's Health and the Environment 2005, Public Health Agency of

Canada 2011). While well designed and informed risk communication can have a positive effect, problematically, some messages may have limited or no benefit and have the potential to cause harm by increasing uncertainty and stress (Matthes *et al*. 1998, Breakwell 2000). This may occur as a result of the complexity, inherent uncertainty and sometimes contradictory nature of the risk information. For example, it is reported on the one hand that eating salmon twice a week is 'heart healthy' (American Heart Association 2010), while on the other hand warnings are issued that the fish may contain dangerous levels of dioxins and heavy metals (Mittelstaedt 2004). Further, women with limited financial or other means may not be able to comply with what for many might be considered taken-for-granted protective actions such as buying organic products, using glass instead of plastic, and purchasing higher quality toys (Schmidt 2008). The most hazardous substances in many cases are the cheapest, and therefore the only accessible option. The result may be a form of unhealthy dissonance whereby the combined recognition of the exposure and the inability to do anything about it either increases stress, or causes cognitive readjustments that inappropriately minimise perceived risk (and protective behaviours) in an effort to reduce stress (Totman *et al*. 1977, Lazarus and Folkman 1984).

Women are disproportionately burdened with day-to-day responsibilities such as household consumption, nutrition decisions and cleaning, that determine levels of environmental exposures and other risks (Gustafson 1998, Zukin and Maguire 2004, MacKendrick 2009) and face considerable social pressure to limit risks to their children (Knaak 2010). This involves being risk conscious about every dimension of their behaviour and to 'discipline virtually all aspects of their bodies and behaviours (what they eat and drink, where they work and recreate, when and how they exercise, and so forth) in accordance with elaborate, ever-proliferating, ever-changing rules of risk minimisation' (Kukla 2010, p. 324). In some cases, the social pressure to minimise risk may exist even in the absence of evidence as is seen in the example of alcohol consumption during pregnancy. Researchers have repeatedly failed to demonstrate foetal harm associated with light to moderate drinking during pregnancy (Lowe and Lee 2010), yet countries such as Canada have long advocated total abstinence for pregnant women (Kukla 2010). Pesticides in food, BPA in toys and flame retardants in fabrics are among the growing list of environmental hazards that pose risks to children and can be added to the dominant discourse around 'good mothering' (Knaak 2010, Kukla 2010, Lowe and Lee 2010).

Considering the gendered nature of family health and pressure to minimise environmental risks, it is perhaps not surprising that women are more likely to perceive higher levels of environmental risk relative to men, and to express greater environmental health concern (Slovic 1999, Krewski *et al*. 2006, Vaughan and Dunton 2007). A 2006 Canadian risk perception survey found that women were more likely to perceive greater environmental health risks towards hazards including nuclear power, genetically modified organisms and pesticides (Krewski *et al*. 2006). Similar findings have been identified in diverse populations and hazard contexts (Flynn *et al*. 1994, Crighton *et al*. 2003, Nickell *et al*. 2004). A study of hospital workers during the SARS outbreak found that women and respondents with young children perceived risks to be greater and expressed greater concern and emotional distress than their male or childless counterparts did (Nickell *et al*. 2004). Similarly, studies of food technology and risk perception (for example genetic modification, pesticide use) have shown that women and those with young children tend to be more concerned and more likely to avoid perceived food risks (Baker 2003). Little is known about how new mothers negotiate perceived environmental risk within the constraints of everyday life.

Popular social theories of risk such as cultural theory and the risk society seem largely ill equipped for handling risk issues surrounding mothers and their children. The former suggests environmental hazard risks are about sustaining social solidarity in the face of marginalisation (Douglas and Wildavsky 1982) while the latter suggests widespread societal reorganisation to focus institutions and social life on hazards amid growing concern about scientific uncertainty, globalised hazard threat and concern about eco-catastrophe (Beck 1992). Wilkinson (2001) provides a useful critique of these theories, but in the most basic sense these theories may be too broad for understanding subgroups whose motivations are embedded in much more proximal aspects of social life – home, work, family. At issue is the potential influence of psychological and social processes that determine how individuals may evaluate and respond to both their own perceptions and the hazards themselves (Breakwell 2000, Vaughan and Dunton 2007). A lack of financial, social or informational resources, for example, may influence a family's ability to adopt protective behaviours. Financial strain can also contribute to attitudes including a lower sense of perceived control over health and a pessimism that may discourage self-protective behaviours even when they may be within an individual's means (Cohen *et al*. 2000).

A number of theories have been developed to understand threat appraisal and how protective behaviours are initiated (Floyd *et al*. 2000, Berry 2004). One example is the Protection Motivation Theory which proposes that protective behavioural decisions are organised along two cognitive mediating processes: the threat appraisal process and the coping appraisal process (Floyd *et al*. 2000). The threat appraisal process evaluates the potential benefits of action versus non-action combined with perception of severity of and vulnerability to a given risk. The coping appraisal process includes assessing the perceived efficacy of taking action as well as the availability of resources (financial and other) to do so. Similarly, the psychosocial model of stress proposed by Lazarus and Folkman (1984) takes diverse coping strategies into consideration. This model suggests that the individual may take direct action (problem focused coping) by trying to 'directly manipulate or alter his or her relationship to the stressful situation' (Baum *et al*. 1982, p. 20) or by removing themselves from the physical presence of the stressor. If this is not possible, then he/she will accommodate a potentially stressful situation and attempt to address dissonance by altering his/her 'internal environment' (emotion focused coping) by developing psychological defence mechanisms such as denial of the situation (motivated reconstrual) (Baum *et al*. 1982, Lazarus and Folkman 1984, Edelstein 2004). An example of this is seen in the tendency for people to be unrealistically optimistic (optimistic bias) about levels of personal risk when making self-other comparisons – considering themselves to be less likely than other similar people to suffer from a given hazard (Weinstein 1989). Less well understood is how optimistic bias towards personal risk may influence mothers' perceptions towards their children.

In this paper, we aim to advance the understanding of how new mothers perceive and cope with everyday environmental hazards in and around their homes and in their daily lives. Our objectives are to: investigate new mothers' experiences, perceptions and meanings of environmental health risks to their children; explore behavioural responses to perceived risks; and, examine potential barriers and facilitators to taking protective actions to minimise risks.

Methodology

To address our objectives, we employed a parallel case study design using qualitative in-depth interviews with new mothers and focus groups with public health key informants in

two Ontario Public Health Units: Peel and Ottawa. This research was approved by the University of Ottawa's Research Ethics Board, Ottawa Public Health Ethics Board and it meets all of the ethics criteria of Peel Public Health.

Study sites

Peel Region and Ottawa Public Health Units were selected as comparative study sites to aid in developing theoretical understandings that cut across geographic, environmental and social contexts (Figure 1). While both are large urban centred Public Health Units with significant rural catchments, Ottawa, Canada's National Capital, faces relatively few overt *outdoor* environmental problems due in part to its location away from the industrial heart of Ontario. Ottawa is relatively affluent, more economically homogeneous and has a highly educated population. Ottawa also has a significant French speaking community and, in comparison to Peel, a smaller immigrant population (22% in Ottawa versus 43% in Peel) (Statistics Canada 2011). Conversely, Peel Public Health which neighbours the City of Toronto and is part of the Greater Toronto Area

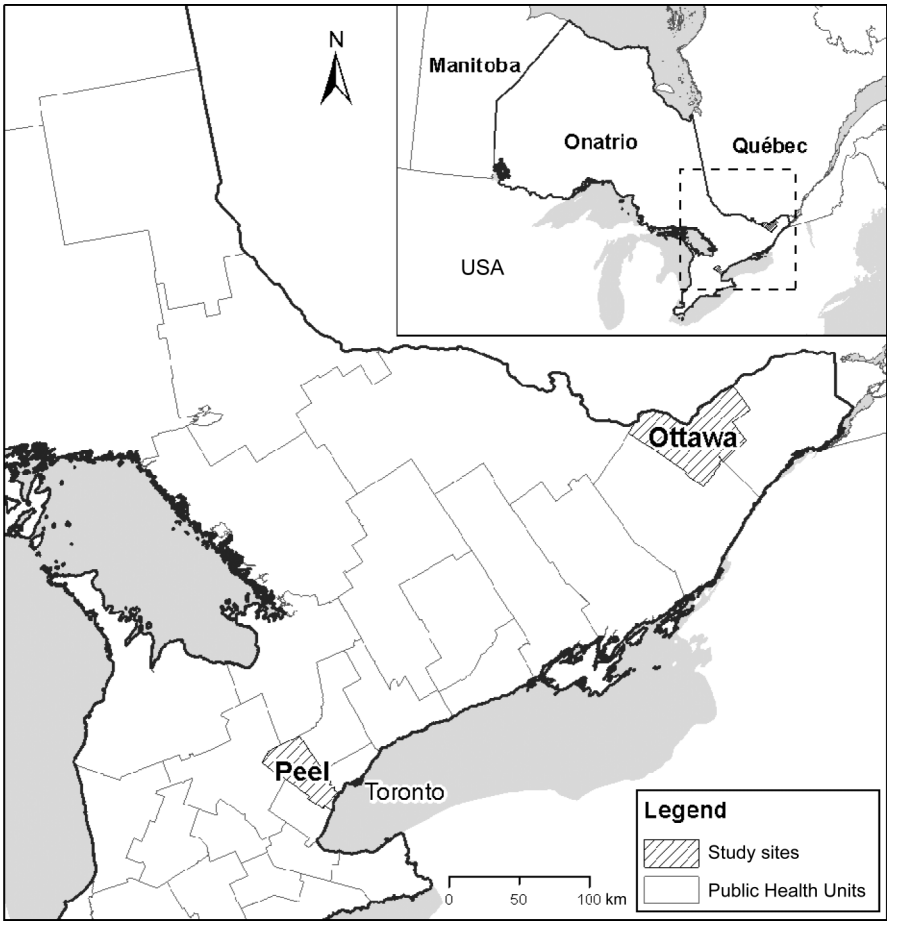

Figure 1. Study sites.

(GTA), faces more outdoor air quality and other environmental problems (Ontario Ministry of the Environment 2011). Peel has over 300 facilities reporting to the National Pollutant Release Inventory in 2009 compared to only 107 in Ottawa (Environment Canada 2009); it has Canada's biggest airport; and it has several of Canada's busiest highways running through it. Further, trans-boundary air pollution from the United States significantly impacts air quality in the Windsor-Quebec City corridor, with Peel being impacted to a greater extent than Ottawa (Ontario Ministry of the Environment 2005). In terms of health, 28% of women in Peel reported high life stress as compared to only 24% in Ottawa and 23% for the whole of Ontario (Statistics Canada 2011).

Interviews with new mothers

We conducted 14 interviews with new mothers, evenly distributed between Peel and Ottawa. New mothers were recruited through the *Healthy Babies, Healthy Children* Programs in both public health units. *Healthy Babies, Healthy Children* is a programme provided by all public health units across Ontario that emphasises early identification and prevention of problems and builds on the strengths of families and community members (Ontario Ministry of Children and Youth Services 2011). *Healthy Babies, Healthy Children* services consist of health screening by a public health nurse, assessments for level of risk to healthy child development and various post-partum support services including a post-partum phone call to all new mothers, counselling and home visits as needed. The *Healthy Babies, Healthy Children* post-partum phone call to all new mothers was used for the initial recruitment into the study. Near the end of each call, the *Healthy Babies, Healthy Children* nurse read a brief statement to the new mother explaining the study and invited each to participate. If they agreed, the new mother was mailed a consent form and letter explaining that they would receive a call to set up an interview appointment with a study researcher. For this study, a new mother refers to any woman who has given birth to a child within the past 3 months. In the interest of flexibility and access to a wide range of new mothers they did not need to be primiparous (that is, first child). We stopped at 14 participants because many of the same ideas were being repeated and we judged that we had reached theoretical saturation (Bowen 2008).

Recruitment in Peel took place in July 2010 and in Ottawa in September/October 2010. Approximately one-third of the individuals who initially agreed to participate at the time of the post-partum phone call agreed to participate in an interview, with others citing time constraints or lack of interest as reasons for not participating. Interviews took place within 5–9 weeks after giving birth and were conducted either in the home or on the phone. Interviews were guided by a checklist of topics including: perceived environmental risks specific to home, neighbourhood and workplace; preventative actions taken and considered; facilitators and barriers to actions; perceptions of inequity and discrimination; sources of information on environment and environmental health and basic demographic and socioeconomic characteristics. To avoid alarming participants, no questions about any *specific* environmental or health issues were asked, but specific issues were discussed if raised by the participant themselves. Given the time demands on new mothers, interviews were kept flexible and short, with most lasting no more than 30 minutes.

Seven new mothers were interviewed in each of the two study sites. Participants' ages ranged between 19 and 39 years, and for half, this was their first child. All but two interviews were conducted in English with two in Ottawa conducted in French. Of the

Peel participants, five of the seven were born outside Canada (India, Trinidad, Philippines, Costa Rica) compared to two in Ottawa (France and Mexico). While there was considerable ethnic variability overall, the samples in both sites were socioeconomically quite homogeneous. Most participants were well educated: 11 new mothers reported a post-secondary education; two reported high school, and one did not provide this information. The majority lived in single family homes and in what could be considered middle class, suburban and urban communities. Due to the nature of the recruitment process, screening new mothers for socioeconomic or other characteristics was not an option.

Focus groups with public health employees

Three focus groups were conducted comprising a total of 21 participants working for Ottawa and Peel Public Health. Focus groups were conducted in an effort to better understand the broad environmental, socioeconomic and public health contexts of the study sites, and to gain insight into environmental risk experiences of new mothers from the perspective of professionals who interact with them on a regular basis and who are responsible for communicating risks. Participants were identified using a purposive sampling method designed to maximise the range of relevant roles within the Units. Following discussions about the study goals with our key public health unit partner contacts, a list of names of potential participants was provided and invitation emails were sent out. Participants included experts in environment and health, and maternal or child health, as well as individuals working in the areas of housing/family shelters, nutrition, early years education, reproductive health and epidemiology. Participants were asked about: environmental, socioeconomic and demographic contexts of each public health unit; at risk populations; their own views on environment and health issues as well as the views of their clients and public health unit programmes and activities (such as education and outreach) related loosely to environment and health and differential strategies to target different groups. Public Health focus groups took place prior to recruitment of new mothers in each of the sites. Focus groups lasted between 1.5 and 2 hours.

Data coding and analysis

All focus groups and in-depth interviews were digitally recorded with permission and transcribed verbatim. Transcripts were entered into NVivo (v.8) software for coding and analysis purposes. Pseudonyms were created for each participant to protect anonymity. The purpose of the analysis was for conceptual/theoretical development so transcripts were coded inductively according to a modified grounded theory approach (Strauss and Corbin 1990). Specifically, three types of coding were used during analysis: open coding (labelling paragraphs that have been selected from the data), axial coding (tying together broad nodes and breaking them down into smaller ‘child’ nodes to make more focused connections) and selective coding (selection of codes most relevant to research objectives, and refining connections to other key codes). Together these coding procedures work to define themes, make links between themes and sub-themes and make connections between different themes to help formulate the resultant theoretical framework (Strauss and Corbin 1990). Coding and analysis were done separately for the focus groups and interview data, but they were merged for presentation in this paper. One researcher took primary responsibility for the coding process, with decisions being made in consultation with the other researchers.

Findings

In our analysis of interview and focus group data, we identified a number of key themes relating to environmental health concerns, environmental health education and environmental health vulnerability. We found that mothers had a range of perceptions about the impact that the environment has on their children's health and different views on how they might deal with potential threats.

Environmental health concerns

Keeping indoors clean

When we asked mothers about their concerns about the indoor environment, they did not talk about the environmental health hazards that underpin many public health messages (such as mould or smoke), but rather talked about household cleanliness, even though their cleaning methods minimise exposure to environmental health hazards. The mothers in our study were more concerned with uncertainty and control than managing the specific identifiable risks. Rita maintained her family has kept in 'pretty good health' partly because she takes control over her home environment by doing everything that 'should be done' to keep indoor air as clean as possible, but she never discussed a particular threat that her cleaning managed such as dirt, dust or smoke. She said

> We have our ducts cleaned, change our filters, and try to do everything that needs to be done regularly. (Rita, Peel)

Similarly, Marie acknowledged the importance of taking steps to keep indoor air clean, but because she lived in an apartment building, she worried about having less control over ventilation and was concerned about how much was actually being done:

> Ah, well, we are not in charge of the maintenance, and in fact, we don't have a lot of control over what is done. I don't know how it [ventilation system] works, I don't know if there are filters. It is true that sometimes I ask myself if it's clean, or well filtered, so, it's true that it worries me a little. (Translation, Marie, Ottawa)

While Marie was aware that indoor pollutants might be present, as she rented her flat she could do little to control it. She did suggest if she owned a house there are more things she would do to ensure clean indoor air.

While the mothers in our study saw keeping their indoor air clean as part of a larger effort to keep their families healthy, they did not articulate their concerns and efforts in terms of specific *environmental* pollutants. Rather, they tended to generalise their actions in relation to the threat of 'germs' and as the enforcer of protective behaviours within the family. Nina's story about the relationship between outdoor, school and home environments (particularly around the baby) illustrated this generalised strategy:

> I tell them to make sure that when they come from outside, clean their hands, everything before they touch the baby. If they touch anything, make sure they wash their hands, sanitise their hands. Yeah, the outside, when they go to school, I tell them not to, like after they go to the washroom, before touching the food, make sure they sanitise your hands in case you can't wash your hands. I send them sanitiser with them to school. (Nina, Peel)

Thus, mothers such as Nina and Marie placed their concerns about environmental health risk in the context of the prevention of infectious disease. For many mothers, infectious disease was seen as the most immediate threat to their child's health, and consequently, other environmental health threats are ignored or given lower priority.

Chemicals in products: inherent health risk or avoidable poisons?

There was, in the interviews, a potential tension between keeping 'clean' to avoid disease, and the risks of the cleaning products themselves. The mothers we talked to tended to be aware of and wanted to reduce the health risks associated with chemicals. When our interviews moved to environmental health concerns associated with specific products, some mothers indicated that they were concerned about their children consuming cleaning products. For those like Mona, this concern translated into risk mitigation behaviour such as replacing toxic substances with ones presumed to be less toxic:

> Well, we have changed our, most of our cleaning products. We used to buy a lot of the regular commercial products like Lysol and all these things. But I stopped buying them. […] I try to look for something that is environmentally friendly, and also not hazardous. I learned that, you know, if you cannot pronounce what's in a product, then maybe you shouldn't let it in your home, or something like that. (Mona, Peel)

Mona's suggestion that you shouldn't use cleaners which contain ingredients you can't pronounce was one way of dealing with the complexity of the modern world. It indicated the difficulty which mothers had of interpreting the information provided on product labels and identifying potential hazards. Using these products involved an act of faith that they were safe not toxic. Some women also worried about risks to their unborn babies. Lindsay said she had switched to greener cleaning products when she was pregnant and kept it up to benefit her baby once he was born:

> Just like the cleaning supplies. I couldn't clean the washroom when I was pregnant because the fumes were pretty tough, so I changed over to something that's a little bit more environmentally friendly. 'Cause I can't stand the smell of strong fumes and I don't think it's good for him to be around that. I think that's the only thing we can do is switch over to something that's a little bit more friendly. (Lindsay, Ottawa)

Other mothers stressed the ways they could minimise risks such as accidental ingestion by storing potentially toxic cleaning products safely out of reach of their children. These mothers talked about their efforts to keep cleaning and/or poisonous products out of reach of infants and children. For example Andrea said:

> [W]e keep all our cleaning products in the back hall closet really high up so we know the kids aren't going to get into that. (Andrea, Ottawa)

Some women such as Kelly were less concerned about specific products than their perceived lack of control over their children's environments in places outside of their direct supervision such as day cares, schools and in this case, other peoples' homes as Kelly put it:

> I would hope that any kind of cleaning products would be kept locked up and that they wouldn't be accessible to the baby in any way. Everybody uses the antibacterial isogel stuff

> but I don't know if that's always going to be out to clean your hands but it's pretty easy for a child to pump that and really not know that it's not to eat, you know? […] So it needs to be kept out of reach. That's definitely going to make them sick and that kind of concerns me when he goes to somebody else's house because I don't know that they'll think to put all of that out of reach. […] We have them put away right now and we're going to have to get things to lock our cupboards so he can't get in to them. (Kelly, Ottawa)

The public health focus groups mainly discussed the questions which mothers asked them about the chemicals in products and there was little discussion of the information they provide to the public. One public health nurse in particular felt that mothers' concerns were higher during their pregnancy and actually waned following the birth of the child:

> I think the idea is more around prenatal, you know, cleaning products and paints and exposure to chemicals that way. I don't get the sense from the moms I talk to that they're as concerned once the child is born. (Public Health Nurse, Peel)

While new mothers may become less concerned about chemicals in products, we did not see evidence to support this waning in any of our interviews. It is possible that environmental concerns that develop during pregnancy remain present after birth, but more immediate concerns around safety, as well as everyday concerns such as their babies feeding and sleep and more immediate concerns.

Lack of concern: control or resignation

Half of the mothers we interviewed said that they had little or no concern about the chemicals in the environment (both indoor and outdoor) or in the household products they may use. The other half did have specific concerns related to various environmental hazards. Their concerns varied according to the type and 'source' of the hazard, indicating a prioritisation of risk concerns based largely on the ability of the mother to control the particular hazard. For example, some of these mothers may have expressed no concern over the environments in their homes, while at the same time, said that they worry about how their children may be at-risk from air pollution in the outdoor environment. The level of concern thus varied not only from mother to mother, but from issue to issue as well.

Being able to exert a certain amount of control over the home (indoor) environment gave some mothers the perception of preventing or minimising the potential environmental health threats that may otherwise be present in their homes. Cindy was very clear in her belief that her house did not pose any environmental risks because it was *her* house:

> I'm okay with my indoor environment. That's my control. (Cindy, Peel)

This sense of control over the indoor environment was often contingent on technologies designed to detect possible risks. For example, Lucie put a great deal of faith in her home's detection systems and how they eased her concerns:

> Well, I think that these days, there are so many detection systems of every kind…gas… carbon monoxide. There are so many of these types of things, smoke detectors…if you make sure everything is working well in the house, there shouldn't be big worries. So, in my case, worrying isn't really in my nature, so in my case, I really go on a day-to-day basis, and we deal with one problem at a time. (Translation: Lucie, Ottawa)

The outdoor environment was a source of more concern due to mothers' limited abilities to control threatening exposures. For example, Lindsay talked about her lack of control over temperature:

> [I]t was pretty difficult to step outside some days and, you know, I can't really control that really, but, that was one of my big concerns, the heat. I don't like being locked up and the weather actually made it kind of impossible, really, to be outside. (Lindsay, Ottawa)

Likewise, Marie was concerned about her inability to do anything to control the outdoor environment:

> Well, I would say that in general, pollution, garbage, well, everything we hear about, you know, for example we hear about plastic in the water and all that kind of pollution we don't actually see. It's true that I find this…well, it worries me a little because it's something I get the feeling we can't do anything about at our level. (Translation: Marie, Ottawa)

To cope with outdoor risks, some participants spoke about adaptation strategies they had developed to protect their children – for example, not taking their babies outside on extremely hot days. The issue of pesticides also came up and Andrea said she attempted to protect her children through proactive measures, by talking to her neighbours to see what they planned on using on their lawns:

> [W]e just ask our neighbours. It's pretty much where she plays. We know Ottawa doesn't use the stuff so, like you know, when she's at the park that's fine, but we just make sure the neighbours if we see them out gardening, or whatever, we just keep communication open so we can talk to them about what they're putting on the lawn, and stuff. […] It's the easiest way to do it. (Andrea, Ottawa)

Other mothers were less proactive, tending to be resigned to their lack of control over the outdoors. For example, Lucie adopted what might be described as a 'what doesn't kill you will only make you stronger' emotion-focused coping strategy, in that exposure to outdoor pollution actually helps her son in the long run:

> Well, we need factories for various reasons. Maybe changing the location of the factories which could be more outside, on the outskirts, but even then, Ottawa is growing, growing, growing and…we're overflowing, so it's really…. I'm not too worried there […] It builds his immune system. (Translation: Lucie, Ottawa)

Brenda also appeared to be resigned to the risk, acknowledging that the outdoors was out of her control and something to which her kids would have to adjust:

> Nothing really seems to faze me anymore, in regards to air pollution and everything like that. I wouldn't move to Hamilton or anything, but I don't really have concerns with my kids being outside or it being a smoggy day or whatever. You know what? They just gotta adjust to it, and that's just the way it is (Brenda, Peel).

The need for more and better information

Almost half of the mothers indicated that they did not have enough information about environmental health risks and these mothers were, for the most part, mothers who demonstrated an existing concern and/or awareness for such issues, rather than mothers who had little interest or knowledge in this area. Lindsay relied on one website,

Babycentre.ca, for much of her environment and health information. However, she also said that it was important to her to confirm her information through multiple sources because she was not confident in her own ability to make decisions based on limited information:

> I would probably go for more because I, like, question myself sometimes so I would like to hear other opinions. So, hearing it from more than one source is good. But yeah, I would probably want to know more. (Lindsay, Ottawa)

Alexa considered herself to be a very knowledgeable mother in regards to environment and health and actively seeking out the environmental health information. Her main criticisms related to specific advice on the 'healthiest' products to use. She felt that there was plenty of existing information on what *not* to do but not enough on what *to do*. She felt that pointing out the problems, so to speak, accomplished nothing, unless some solutions or alternatives were provided. In this area, she felt that the United States government was doing better than the Canadian government. Though she did not list any government websites among those she used, only referring to those non-governmental ones she does use, as 'trustworthy'. She said she often turned to the US Environmental Working Group website because she felt there are no comparable Canadian websites:

> Well, a good example is an article about […] ten things you should not have in your house, but then they never tell you what products you can get here in Canada that would not have those, or what products you should be avoiding. That's something that I find that you really have to kind of try to do yourself. I think there's more awareness of sodium laureth sulphate and various things in cosmetics that you don't want to have. But then trying to figure out, okay, what can I buy that's affordable that doesn't have these things in it? This would be useful. (Alexa, Ottawa)

Alexa's concern was not unique. Although she was the only mother we interviewed who specifically indicated a desire to have information on 'healthier' products, in the public health focus groups, a public health nurse said that it was not unusual for mothers to ask about this:

> Yeah, they'll ask us *if* they should use, *what kind* they should use, so they actually want us to be naming brands for them…[emphasis in the original]. (Public Health Nurse, Peel)

Thus public health professionals and website authors face a tension between providing more specific information on lower risk alternatives and credibility by not implicitly supporting particular brands.

Most mothers said that the internet was their primary source for information on their environment and health questions. However, only one mother mentioned discussing environmental health with a health professional. To at least one public health official, the reliance on the internet was itself a concern given the abundance of misinformation that exists on many websites. She saw the shift towards a reliance on the internet for health information coinciding with a movement away from using the family doctor as the primary source of information:

> I've seen some real changes and one of the biggest changes in that we have a population that is able to access information from sources beyond the professionals. So we have a

> very knowledgeable, *in some ways*, population we are dealing with. Because of the internet […] they can access knowledge now. I use the word "knowledge" rather loosely.[…] I think also we've moved […] away from people revering the doctor as a sole source of instant health information. (nurse's emphasis Public Health Nurse, Peel)

Public health professionals in both Peel and Ottawa felt that municipal public health experts had important environmental and health information for new mothers. However, only two mothers identified public health experts as a source of information.

Environmental health vulnerability

Risk to others: optimistic bias

Despite taking steps to protect their babies from possible environmental health risks, none of the mothers interviewed felt that their baby was more at-risk from environmental hazards than the average child. Further, all but one mother said that there were other groups of children more at-risk than their own, suggesting an optimistic bias with their child being less vulnerable than comparable children (Weinstein 1989, Hsee and Weber 1997). Mothers in both Ottawa and Peel adopted a strategy of 'distancing' risks through comparison of their cities to what they perceive to be as more at-risk locales. Interestingly, both used Toronto and Hamilton as comparison cities. As we noted earlier, Brenda's comment supported this idea when she said that she would not move her family from Peel to Hamilton.

Likewise, Cindy was not too concerned about the vulnerability of her baby in her location (Peel), but says that the environment in 'downtown Toronto' would be a cause of concern for her:

> I think if I lived downtown Toronto and that area, I would be a little more concerned, but where we live, […] it's not that bad. (Cindy, Peel)

The public health experts we interviewed felt that this displacement of risk allowed mothers to ignore real risks at home. For example, participants from the Peel focus groups made it clear that Peel was part of the Greater Toronto Area and has high levels of pollution due to the local concentration of industry and its geographical proximity to three major highways.

Some mothers also demonstrated an optimistic bias in relation to indoor environments. One such example was Alexa, who felt that her children were not particularly vulnerable but without hesitation identified children in lower socioeconomic families as more at-risk. She made specific reference to exposure to toxic personal care products because of her belief that healthier products are too cost-prohibitive:

> In terms of products in the home, I think that a lot of kids in lower socioeconomic situations because the cheapest products are the ones that are going to be the most harmful to you and they would be most at risk. (Alexa, Ottawa)

Mona shares Alexa's concerns about the toxicity of many household products and too felt that there were some groups of children more at-risk to potentially toxic products than her own child. She identified this 'other' vulnerable group of children to be those of parents with limited education. Mona's discussion was underpinned by a moral

judgement suggesting that parents who were uninformed were exposing their children to risks:

> Well, I should think that, I guess, from what I know, it would be, well, children who are being raised in a home where it's, you know, who are using those products, carcinogens, BPA, whatever, all those things you cannot pronounce. […]. Maybe for the people who do not, maybe they're just not informed. I know, just eating properly, kind of thing. If they're not informed they could just be eating whatever, and then they will also end up giving that to their kids. (Mona, Peel)

Prioritisation of risks

The public health experts felt that low-income families were more at-risk to numerous environmental health risks such as mould, smoking in the home and lack of control over their housing. However, they also noted that issues that concerned wealthier citizens, such as the desire to eat organic foods, chemicals in products and proximity to pollution sources were of marginal concern to poorer families as they had more immediate problems to deal with:

> Depending on your socioeconomic status, environmental health could be, like, way down the list or not even on your list, depending on their needs—that's how you respond. I mean for a mom who is having a lot of financial problems or dealing with abuse, what *kind* of baby bottle she gets is not an issue—the fact that she *has* a baby bottle is, right? […]The fact is that there are other things to talk about that are more relevant. They don't…, that conversation doesn't even come up, which is, you know, unfortunate because they probably need it more but that doesn't happen. (nurse's emphasis Public Health Nurse, Peel)

For the public health units, this created a conundrum in their messaging strategies. Participants were concerned that in attempting to balance their environmental health messages with other more pertinent health concerns (particularly in light of limited communications budgets), they ended up having fairly 'dumbed' down messages:

> Well, send the message to everyone, right? We cannot just segregate people and send a different message to those who are better off and, you know, a different message to people with less. It means we kind of dull, in some ways, I think we kind of dull the sharpness of that information. (Public Health Inspector, Peel)

Public health units are limited in their ability to provide targeted environmental health information that the interviewed mothers seek. These mothers are thus obliged to look elsewhere for this information.

Discussion

In the face of myriad threats presented on a daily basis, mothers in this study felt compelled to act, even if their specific knowledge conflated lay and expert knowledge, for example, in relationship to 'germs' and was limited in terms of specific environmental health risks like pollution, toxins or contamination. Crucially, as is consistent with existing theories of change such as Protection Motivation Theory (Floyd *et al*. 2000) and the psychosocial model of stress and action (Lazarus and Folkman 1984), mothers were motivated by the uncertainty surrounding risk on the one hand, and their perceived control (or lack thereof) in mitigating such risks on the other. Mothers' views of their

responsibility must be understood in the context of the largely gendered roles of cleanliness of the home and health protection for the family (Gustafson 1998). This inclination for mothers to act in the face of new information may actually provide some degree of assurance to public health officials who must contend with limited budgets, and hence limited 'reach' for getting environmental health risk messages to the public. As long as actions have the potential for reducing environmental exposures (for example cleaning air ducts and purchasing non-toxic products), it is less important that mothers have a clear understanding of what the specific risks are that they are protecting their children from.

More substantively, the findings suggest that a lack of concern for many environmental health issues was attributable to two things: perceived *control* and *resignation*. Mothers differentiate the indoor environment as a space within which they could control risks from the outdoor environment, where they had far less control. The issue of a lack of control is central in the risk perception literature for explaining heightened concern and worry about toxicological hazards (Renn 2004). Regardless of whether strategies were motivated by control or adaptation, actions (or inactions) were always contingent upon active information seeking by mothers. The mothers said that they relied on the internet rather than on health professionals for questions regarding environmental health issues. Whatever the source, it is instructive that all mothers desired more and better information. Specifically, mothers felt that there was too much focus on avoidance information and not enough on providing practical advice on what actions (purchases, behaviours) one should take to mitigate risks.

Despite mothers' willingness to act, there was also a tendency to distance risk by speaking of it in relative terms, or express optimistic bias about their own situation. Mothers largely identified 'at-risk' children to be elsewhere, with little to no recognition of the possibility that their own children could be more vulnerable. This optimistic bias has been identified previously (Weinstein 1989, Hsee and Weber 1997, Lemyre *et al*. 2006). With respect to this study, the vulnerable *other* children were grouped by geographic and socioeconomic status. Optimistic bias was most clearly demonstrated among mothers living in Peel who reported that children in Toronto and Hamilton were at higher risk. This finding is interesting given that air quality in Peel is similar to that in Hamilton or Toronto for most pollutant indicators (Ontario Ministry of the Environment 2011), reflecting a reliance upon popular reputation (Hamilton is an industrial city and Toronto is known for its traffic). This distancing is consistent with Lazarus and Folkman's (1984) idea of emotion-focused coping; that in the absence of opportunities for action, views towards the stressor must change in order to address the dissonance between risk perception and control.

The results of our study provide some practical insights that may translate into useful guidance for public health practitioners. First, the optimistic bias in perceptions of outdoor risks is an important consideration in the design of risk communication strategies as it may significantly hinder efforts to promote risk reducing behaviour (Weinstein 1989). Second, despite seemingly endless resources available on the internet, mothers demand more and better environmental health information. Moreover, risk information needs to be appealing to new mothers within the context of their busy lives and to focus less on avoidance and more on practical advice on what specific actions (purchases, behaviours) should be taken to mitigate risks. However, issues of equity come into play as messages that encourage health promoting behaviour tend toward higher cost products (for example organic) that may be prohibitive to lower-income mothers.

Some limitations of this study are important to acknowledge. First, interviews were conducted in the summer immediately following the H1N1 outbreak and public health

vaccination campaign. All of the participants would have been pregnant during the H1N1 *crisis* and thus, it is not surprising that germs were an important focus of many mothers and that they would associate germs and cleanliness with indoor environmental health. The immediate spectre of H1N1 may at least partly explain why relatively few environmental concerns were discussed by the mothers without prompting. A second limitation relates to the relatively affluent study sample. Despite concerted efforts to recruit a maximum diversity of participants, most were well educated and middle class and could be expected to perceive environmental risks somewhat differently, and have more opportunities to take protective actions, as compared to less educated or lower income mothers. That being said, there was considerable heterogeneity in the sample with regards to other characteristics including country of birth, age, number of children and ethnic and linguistic backgrounds.

Conclusion

This study has provided important exploratory insights into understanding how new mothers perceive and experience environmental risk perceptions in and around their homes and in their daily lives. Differences in how mothers understand and respond to indoor versus outdoor risks provide important guidance into the design of risk communication strategies. For example, public health practitioners working with limited budgets must find a balance between universal strategies targeting wide audiences with more focused information on the contextual circumstances of particular types and locations of risk. For household risks, more basic knowledge of risk sources is needed, but this must be balanced by practical and affordable guidance as to recommended purchasing behaviours. For risks outside of the household, science based evidence is needed to offset misunderstandings of risks that are based on popular knowledge such as reputations of places. But mothers are correct in their assumption that mitigating such risks is not possible within the realm of individual behaviour. In such cases, public health practitioners should convey action that can be taken at the level of political advocacy to ensure broader policies are put in place to mitigate such risks. While political advocacy could be seen as another way of reducing dissonance, at least it is productive in the longer term, contra risk distancing behaviours found among our sample. Finally, in terms of future research, it would be interesting to examine how mothers' perceptions change as children grow, become more mobile and are increasingly put in the care of others (for example day care and school).

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