

**Identifying opportunities and barriers for creating environmental health
education standards of practice among prenatal healthcare professionals**

Kathryn Watson-Leblanc

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Department of Geography, Environment and Geomatics
Faculty of Arts
University of Ottawa

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Abstract

Studies have reported that the most trusted health care relationship is that of the prenatal healthcare professionals (PHPs) and the prenatal patient. Yet many of the patient's environmental health questions go unanswered for a variety of reasons. To better understand the situation, this research examines environmental health education practices of PHPs – obstetricians, prenatal nurses, family physicians, midwives and doulas - offered during the preconception and prenatal period. Specifically, this thesis discusses some of the PHP self-reported opportunities and barriers surrounding the provision of environmental health education (EHE). In person (n=17) and telephone (n=4) interviews were conducted with PHPs in the Ottawa Region. Additionally, a key informant within the Society of Obstetricians and Gynaecologists of Canada (SOGC) was asked specific questions about the association's role in the development of standardized educational care guidelines. The results show that most PHPs have a limited knowledge of EHE and are reluctant to discuss it without access to more professional research. PHPs feel that there is little professional association support and that guidelines for adding EHE to their current prenatal care plans are non-existent. This study is one of the first studies that uniquely examined EHE in the prenatal period from perspective of prenatal healthcare professionals.

Résumé

Les études signalent que les relations de soins de santé former entre la patiente prénatale et leurs prestataires de soins prénatals (PSP) sont un des plus fiable. En dépit de cette confiance, nombres de questions de santé environnementale continuent d'aller sans réponse pour diverses raisons.

Pour mieux comprendre cette situation, cette recherche examine les pratiques d'éducatons en santé environnementale qui couvres les périodes prénatal et préconception offert par les PSP qui existe dans plusieurs secteur de fournisseur de service - principalement les obstétriciens et les infirmières prénatales, médecins de famille, sages-femmes et accompagnante à la naissance. Spécifiquement, cette thèse discute certaines des opportunités et obstacles auto-déclarées par les PSPs entourant la disposition de l'éducation en matière de santé environnementale (EMSE). Plusieurs entrevues ont eu lieu avec les PSPs dans la région d'Ottawa en personne (n= 17) et par téléphone (n =4). En plus, une professionnelle clé sélectionné de la Société des Obstétriciens et Gynécologues du Canada (SOGC) a été posée des questions spécifiques sur le rôle de l'association et le développement des directives normalisées pour EMSE. Les résultats de cette recherche montrent que la majorité des participants ont une connaissance limitée de l'éducation en matière de santé environnementale et sont réticents à en discuter sans avoir accès à des recherches plus professionnelles. Les professionnels de santé estiment qu'il y a peu de soutien disponible des Associations professionnelles et que les lignes directrices pour l'ajout de l'éducation en matière de santé environnementale à leurs plans de soins prénatals actuels sont inexistantes. Cette recherche est l'une des premières études qui examine de manière

unique l'éducation prénatale en matière de santé environnementale du point de vue des
PSPs.

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List of Abbreviations:

ADHD: Attention Deficit Hyperactivity Disorder

BPA: Bisphenol A

CDC: Center for Disease Control and Prevention

CEPA: Canadian Environmental Protection Act

CMAJ: Canadian Medical Association Journal

CMP: Chemicals Management Plan

COPD: Chronic Obstructive Pulmonary Disease

CPCHE: Canadian Partnership for Children's Health and Environment

EMSE : l'Éducation en Matière de Santé Environnementale

E.U.: European Union

EDC: Endocrine Disrupting Chemicals or Endocrine Disrupting Compounds

EHE: Environmental Health Education

MD.: Medical Doctor

OBS.: Obstetrician

P. E.: Prenatal Educator

PAH: Polycyclic Aromatic Hydrocarbons

PBDE: Polybrominated Diphenyl Ethers

PCB: Polychlorinated Biphenyl

PFOA: Perfluorooctanoic acid

PHP: Prenatal Healthcare Professional

PSP: Prestataires de Soins Prénatals

REACH: Registration, Evaluation, Authorization and Restriction of Chemicals

RN.: Registered Nurse

SOGC: Society of Obstetricians and Gynaecologists of Canada

U.S.: United States

WHO: World Health Organization

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Chapter One

Introduction

Background

Pesticides, lead, mercury, organochloride products, perfluorooctanoic acid, and plastics (including phthalates and BPA) are among the many environmental toxicants that are present in every aspect of our lives (Wiseman & Stefanovic, 2009; Landrigan et al., 1998; Stillerman, Mattison, Giudice, & Woodruff, 2008; Wigle et al., 2007; Lassi, Imam, Dean, & Bhutta, 2014; Lanphear, Vorhees, & Bellinger, 2005). They are in the food we eat, the products we use, the homes we live in, and the air we breathe (Lanphear et al., 2005; MacKendrick 2018; Landrigan & Goldman, 2011). Research suggests that the impacts of these chemical exposures include a wide range of negative health outcomes including asthma, various cancers, male infertility, genital abnormalities, and neurodevelopmental challenges (Lanphear et al., 2005; Lassi et al, 2014; Sutton et al, 2012). Infants and children are typically more exposed to these substances due to hand-to-mouth behaviour and the fact that they eat more, drink more, and breathe more relative to their size than adults (Lanphear et al., 2005; MacKendrick 2018; Landrigan & Goldman, 2011). They are also more vulnerable due to their immature immune systems, bioaccumulation (primarily through non-excrement), and rapidly-developing physiology, particularly during the fetal period (Landrigan & Goldman, 2011; Valenzuela et al., 2011; Lanphear et al., 2005). Previously, the blood-placental barrier was thought to protect the fetus from most toxicants. However, it is now understood that

many compounds pass freely through the placenta, acting directly on the developing fetus (National Scientific Council on the Developing Child, 2006).

Much like the current efforts in prenatal care to educate prospective parents about the dangers of smoking and drinking during pregnancy, there is a need to provide information about common environmental toxicants and strategies to reduce exposures. However, most prenatal healthcare professionals (PHPs) lack the training and resources necessary to properly educate their patients (Wiseman & Stefanovic, 2009; Stotland et al., 2014). Given the role that PHPs play in maternal-fetal health, it is important that they educate their patients about exposure to common environmental toxicants, and advise them on possible avoidance strategies during the sensitive prenatal growth period.

Common Environmental Toxicants

The effects of lead and mercury, which have been found to disrupt the neuro-chemical construction of many foundational neurological structures during the fetal period, leading to cognitive and intellectual impairments and delays, have been well established (Campbell, C., Greenberg, R., Mankikar, D., Ross, R., 2016; Lanphear et al., 2005; National Scientific Council on the Developing Child, 2006). Low-level lead exposure during the first trimester of pregnancy is reported to be a predictor of adverse neurodevelopment later in life, along with spontaneous abortion and low birth weight (Abelsohn & Sanborn, 2010; Lanphear et al., 2005; Earl, Burns, Nettelbeck, & Baghurst, 2015; Hu et al., 2006; ACOG, 2012). In the case of mercury, exposure leads to lifelong damage to the cerebral cortex and developmental delay due to extensive neurological damage to peripheral nerves and anatomical structures (Grandjean et al., 2015; Bose-O'Reilly et al., 2010). Exposure can be direct or indirect

through maternal ingestion, inhalation or trans-placental transmission (Bose-O'Reilly et al. 2010).

On the other hand, the evidence of the effects of endocrine disrupting chemicals (EDCs) on human health is less well established. EDCs are a large class of chemicals that negatively impact the production of estrogen or androgen (Heindel, 2015; Bergman, Heindel, Jobling, Kidd, & Zoeller, 2012; Association of Reproductive Health Professionals, 2010; Caseria et al., 2008). They include chemicals such as bisphenyl A (BPA), polychlorobiphenyls (PCBs), dioxins, triazoles, perfluorooctanoic acid (PFOA), polybrominated diphenyl ethers (PBDEs), parabens, cadmium, and persistent organic pollutants, many of which are found in soil, air, and water, as well as in many of the products we use on a daily basis, including personal care products, plastics, non-stick cookware, and common adhesives. EDCs are suspected of affecting biological synthesis functioning, resulting in an excess production of estrogen or an incomplete production of androgen (Landrigan & Goldman, 2011; Wigle et al., 2007). In the fetus, these hormonal disruptions may impact reproductive organ development, male fertility, species feminization, and genital development (Association of Reproductive Health Professionals, 2010; Bergman et al., 2012; Vogel, 2005). There is, for example, growing evidence to indicate that declining human male fertility and non-human species feminization are due to the interruption and non-recovery of androgen levels associated with EDC exposures (Bergman et al., 2012; Vogel, 2005). Further research is required to understand the impact of specific EDCs on reproductive development, particularly during the first two trimesters of pregnancy as the reproductive system develops (Diamanti-Kandarakis et al., 2009 ; Trasande et al., 2015; Landrigan & Goldman, 2011).

Exposure to air pollutants, such as polycyclic aromatic hydrocarbons (PAHs), carbon monoxide, and nitrogen dioxide, as well as other ambient and traffic-related pollutants, have also been shown to have profound impacts on fetal development (Ritz & Wilhelm, 2008; Sutton et al., 2012; MacKendrick, 2018). Such effects include interrupted placenta development (impacting fetal growth, low birth weight and preterm birth) and heart defects (Ritz & Wilhelm, 2008).

Current policy on environmental toxicants

Current estimates suggest that annually between 70,000 and 100,000 chemicals are released into the environment in North America (Woodruff, Carlson, Schwartz, & Giudice, 2008). The significant impacts of these chemicals on both the environment and human health are becoming increasingly well understood. However, regulatory practices and processes differ considerably between countries. The standard process for the introduction of new chemicals into the American or Canadian market is that the chemical is approved on a general safety basis, and then assigned hazardous status as required. Only if proof-of-harm to people or the environment can be established within the court system will removal or restriction of that chemical be considered (Government of Canada, 2004; Markowitz & Rosner, 2002; MacKendrick, 2018). By way of comparison, the European Union (E.U.) has developed recommendations through a system called REACH: Registration, Evaluation, Authorisation and Restriction of Chemicals. REACH is based on the philosophy of the precautionary principle in the development of regulatory restrictions imposed prior to the release of all chemicals (Martuzzi & Tickner, 2004; Čihák, 2009; Lanphear et al., 2005). Basically, the precautionary principle (within the REACH model) means that despite

incomplete scientific evidence, a chemical or product is not approved for use until it has completed safety testing for human and environmental impact. The full definition and description of the REACH program, from the original website, can be viewed in Appendix 3. It should be noted that studies have pointed out that the applications of the precautionary principle within the REACH program could be considered as simply barriers to trade in situations such as agricultural trade (Martuzzi, 2004). However, outside of the political forum, the requirement for extensive human health impact studies remains the key difference between the U.S. and the E.U. In the E.U. these results are required by the manufacturer prior to market release, while in the U.S. the human health impact studies are done by the regulator after market release.

Currently, the Canadian Environmental Protection Act, (CEPA, 1999) mirrors the U.S. model of chemical regulation more closely than the E.U. REACH regulatory model. Although amendments to the Act are due to be enacted in 2020, currently all chemicals are reviewed and considered for addition to the “toxic substances list” prior to evaluation by multiple governmental departments. This is referred to as the Chemicals Management Plan (CMP). A comprehensive overview of CMP can be found in Appendix 4. Adoption of the full CMP in 2020 will bring Canadian regulations closer to the E.U. model of REACH. Currently in Canada, this includes all-level dose-response threshold testing, whereas only the high-level dose-response testing is used in the U.S. (MacKendrick, 2018). In the case of BPA, for example, low-level exposure doses are more problematic than the higher doses, resulting in BPA not being regulated in the U.S., yet BPA is restricted in Canada (MacKendrick, 2018). Manufacturers complain that these additional low-level exposure tests slow the regulatory

process down, as definitive scientific evidence must be presented to avoid having the chemicals added to the list of toxic substances. While manufacturers in Canada might argue that newer chemicals follow all existing safety regulations, many have not yet adopted the upcoming 2020 regulations which will include more studies on human health impacts as currently required by the REACH model.

Given the current limitations of our regulatory system and recognizing that chemicals with known and suspected toxicity continue to be in widespread use, it is important that individuals be made aware of lifestyle precautionary actions they can take to reduce exposures at home, outdoors and in work environments, through for example, precautionary consumption (MacKendrick, 2018). Precautionary consumption refers to the conscious avoidance of known or suspected toxicants, such as household cleaners, pesticides, fragrances and personal care products (MacKendrick, 2018). Organizations, such as the Canadian Partnership for Children's Health and Environment (CPCHE) and the World Health Organization (WHO), suggest that the ideal situation would be to have restrictive policies aimed at the regulation of certain toxicants. However, these organizations recognize that regulatory change is unlikely to occur quickly and, therefore, it is critical that individuals be educated about lifestyle precautionary actions to reduce personal exposure (Landrigan et al., 1998; WHO, 2010; CPCHE, 2012).

Timing of exposure

Current studies show that the critical periods of susceptibility vary for different toxicants such as lead, mercury, EDCs, and many air pollutants. In the gestational period, the timing of the fetus' exposure to a toxicant will directly impact the viability and health of the fetus

(Lanphear, 2005). Figure 1 illustrates different effects of exposure to air pollution on body systems during various stages of fetal development (Ritz and Wilhelm, 2008). It is important to recognize these critical periods in fetal development, as the effects of exposures are most severe during the embryonic stages. For example, exposure to certain air pollutants, such as PAH, between 3 and 8 weeks gestation has been shown to increase the risk of heart defects (Ritz and Wilhelm, 2008). To reduce the risk of negative health outcomes associated with environmental exposures, it is important that information and avoidance strategies be communicated earlier, rather than later, in a pregnancy.

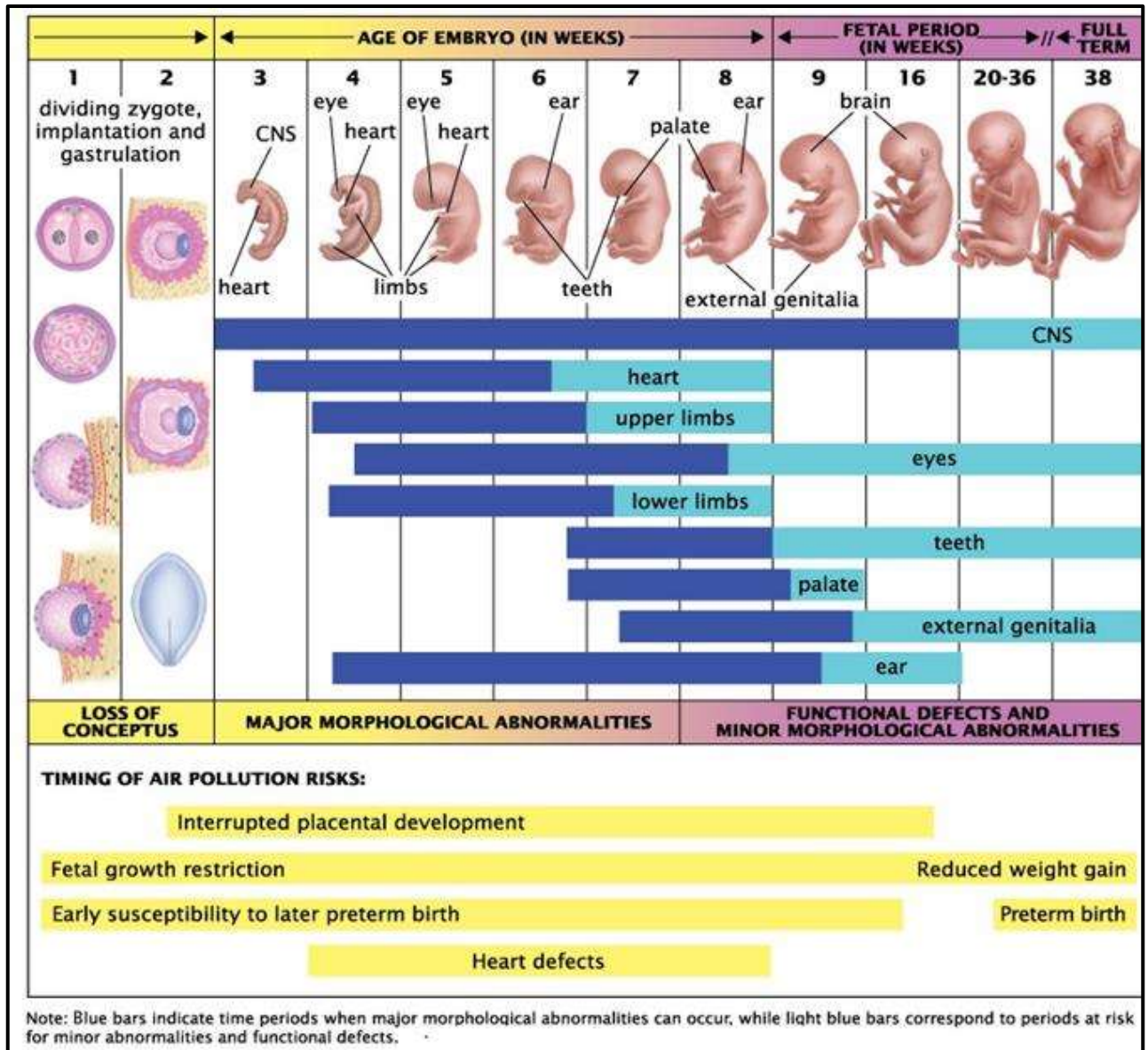


Figure 1: Critical periods in fetal development related to the timing of exposure to common air pollutants (Source: Ritz and Wilhelm, 2008, www.environment.ucla.edu)

Environmental health education

Without consistent regulation, it may be advisable for women of child-bearing age, pregnant woman, and new mothers (e.g., who are breastfeeding) to minimize their exposure to potentially harmful chemicals through precautionary consumption and avoidance. While the adoption of protective and precautionary actions cannot eliminate all environmental

toxicant exposure, simple lifestyle changes can reduce the overall body burden for some toxicants (Sweeney, 2017). Some examples include dietary avoidance (e.g. of certain high mercury fish), using of low-toxicity personal care and cleaning products, or consuming organic produce (MacKendrick, 2018). Professional guidance and advice surrounding EHE focuses primarily on precautionary consumption (Hennig, 2007).

Healthcare professionals are in a unique position to provide reliable and consistent advice to their patients about environmental health risks (Laferriere & Crighton, 2017; Stotland et al., 2014). Unfortunately, the EHE training that PHPs receive is severely lacking (Woodruff, Carlson, Schwartz, & Giudice, 2008 ; Tinney, Paulson, Bathgate, & Larsen, 2015; Sutton et al., 2012). While most research on this topic has focused on PHPs in the U.S., a 2009 Canadian study reported that 48% of physician respondents reported having no or inadequate EHE training (Wiseman & Stefanovic, 2009). An Ontario study looking at perceptions of environmental health risks found that only 8% of new mothers received any environmental health information from their PHPs (Laferriere et al., 2016). Since parents are not typically being educated about environmental exposures by their PHPs (Crighton et al., 2013), they are turning to other sources for information. For example, using the internet or pregnancy guide books is standard for many new parents (or soon-to-be parents); however this information is not often grounded in evidence-based research, and environmental health information is often missing (Crighton & et al., 2015). In one study, mothers reported that although their most common source of information related to environmental health risks was the internet, they would have preferred to receive this information from their PHP (Laferriere & Crighton, 2017).

The need to improve both the quality and availability of EHE is recognized by PHP associations worldwide (Wiseman & Stefanovic, 2009; Stotland et al., 2014). Acknowledging the significant and growing body of evidence demonstrating the link between environmental exposures during pregnancy and the lifelong health of the child (Sathyanarayana et al., 2012; Watterson, Thomson, Malcolm, Shepherd, & McIntosh, 2005; Wiseman & Stefanovic, 2009; Woodruff & Sutton, 2014), major professional obstetrical associations are recommending the inclusion of EHE in prenatal professional training (Royal College of Obstetrics and Gynaecology, 2013; American College of Obstetricians and Gynecologists, 2013; Canadian Nursing Association, 2009). As well, most professional colleges agree that although definitive evidence is not yet available, taking action to identify and reduce exposure to toxicants is critical (American College of Obstetricians and Gynecologists, 2013). The lack of training for PHPs is the primary barrier to the integration of EHE into standard prenatal care practices (Wiseman & Stefanovic, 2009; Stotland et al., 2014; Watterson et al, 2005).

The National Scientific Council on the Developing Child recommends that public awareness programs about environmental health risks should be developed and made available to all women of childbearing age (National Scientific Council on the Developing Child, 2006). Non-governmental organizations such as CPCHE and the WHO are providing education to prospective parents in simple, multi-media formats (e.g., online tutorials). Further expansion of these awareness programs, including informational support aimed at PHPs, will help educate women about the need for precautionary consumption and exposure avoidance.

Putting knowledge into practice, successful public health awareness programs

It is well established that exposure to common toxicants, including tobacco smoke and alcohol, can have profound effects on the developing fetus. Prenatal care providers have had considerable success in putting knowledge into practice and educating patients about these risks. Public health programs on smoking cessation, which are run in all prenatal clinics, are strong examples of successful preventative educational programs that are now embedded in prenatal care (Tong et al., 2013). While patient education programs represent only one factor contributing to the reduction of smoking prevalence, there is evidence to suggest that they have been effective. Notably, the percentage of homes in the U.S. where children under 7 years old are exposed to second-hand smoke declined from 29% in 1994 to 19% in 1999, and more recently to 8.4% in 2014 (National Scientific Council on the Developing Child, 2006; CDC, 2017). Educational programs aimed at reducing alcohol consumption during pregnancy have also been found to be effective. In 1994, it was estimated that 25% of pregnant women in the U.S. were consuming alcohol while pregnant but this rate decreased to 13.3% by 2001 and 10.5% by 2005 (Zelner & Koren, 2013; Thanh & Jonsson, 2010). Standards of care were developed first through increasing PHP awareness and education, then developing specific diagnostic tools for fetal alcohol syndrome (Chudley et al. 2005) and finally the association (SOGC) guidelines (2013). Following these successes, there is reason to believe that EHE programs could prove equally successful in reducing prenatal environmental exposures.

Conceptual Framework

The focus of this thesis is the delivery of EHE from the perspective of the PHP. The conceptual framework (Figure 2), modified from the Walsh/McPhee model of clinical

prevention, illustrates the numerous factors that directly impact the delivery of EHE from the perspective of both the patient and the PHP (Walsh and McPhee, 1992). The understanding that the success of the health education is influenced by both the patient and the PHP mirrors Walsh/McPhee's premise that a variety of factors (predisposing, reinforcing, enabling, and healthcare/physical factors) all interact with each other, the patient, the PHP, and affect the final outcome. In this study, the outcome is the provision of EHE by the PHP. However, it is recognized that the patient has her own unique factors affecting the acquisition and integration of EHE, such as her age, experience, education, socioeconomic status, individual needs, etc. When there are challenges in any of these patient areas, the PHP could tailor the counselling information to best meet that patient's needs. It is critical in the delivery of EHE and in the information flow process that the programs are dynamic and continually reviewed (Masuda et al., 2014).

Definitions from the conceptual framework

Many factors impact both the delivery and acceptance of EHE within the PHP-patient relationship. In the Walsh/McPhee model, there are two sets of factors that determine the success of outcome; those of the PHP and those of the patient. All factors overlap to some degree, and the outcome becomes the combination of all of the four factors that impact the provision of EHE. This study is focused on the impacts of PHP factors on the delivery of EHE. These factors are grouped into four categories: 1) **Predisposing factors** – for the PHP these include individual characteristics of the PHP, namely personal experiences, gender, age, language, to which resources the PHP may have access to or understanding of available research. For the patient these factors are personal health experiences, personal

demographics, expectations, prenatal history, and personal motivation; 2) **Reinforcing factors** - for the PHP these may include observational knowledge of patient needs, history, and experience, as well as peer and association support. For the patient they are social support, perceived value of preventative behaviours, and perceived risk of exposure; 3) **Enabling factors** – For the PHP, these include professional training and technical expertise within their practice, as well as financial resources within the practice. For the patient enabling factors include personal education, personal health, and financial resources that would allow individuals to take protective action; and finally, 4) **Health care facility factors** – for the PHP these include availability of technology, supporting personnel, or community resources. For the patient health care facility factors include mobility, distance to PHP services and indirect costs.

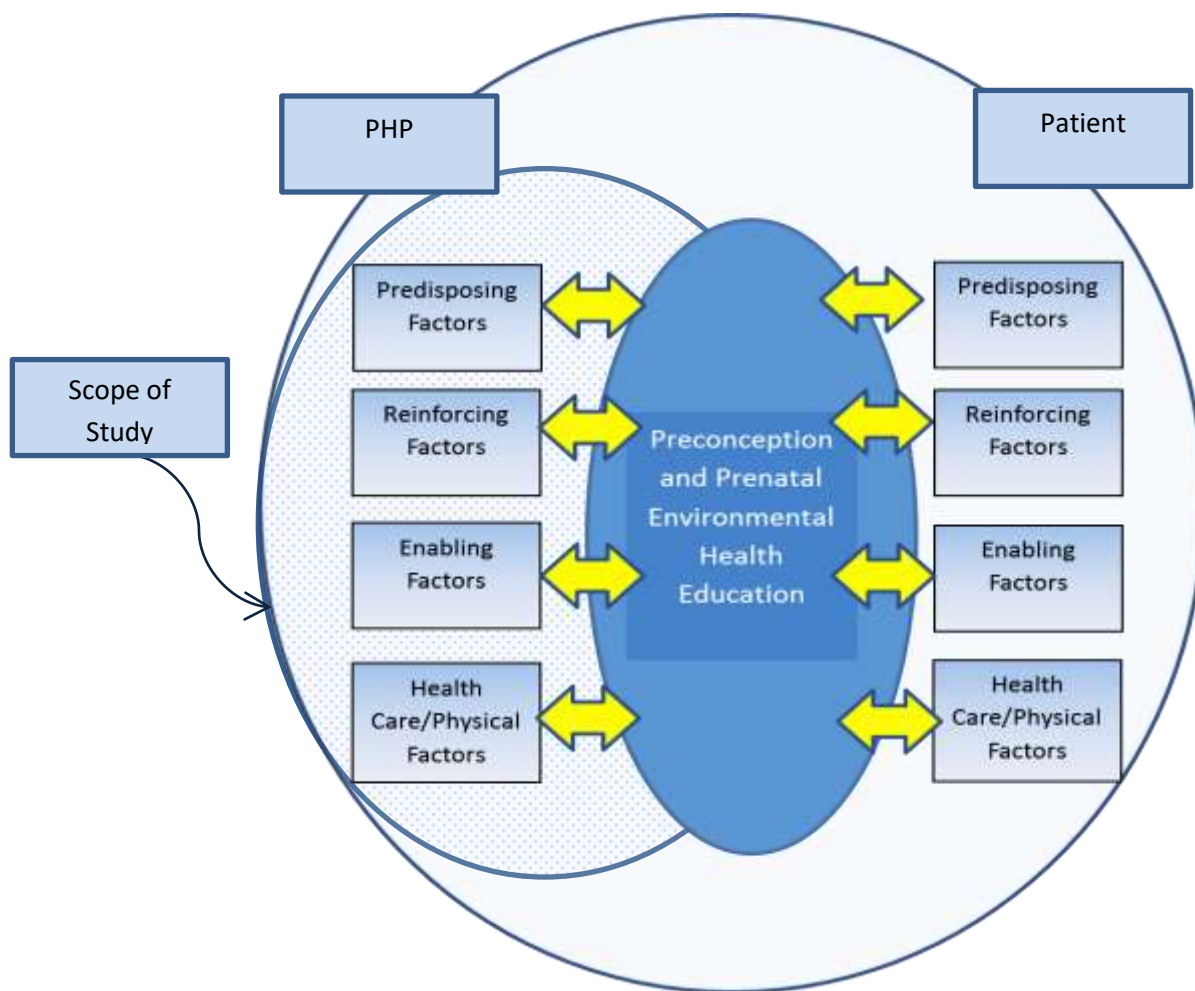


Figure 2: Conceptual Framework (modified from Walsh and McPhee, 1992)

Thesis objectives

While exposure to environmental toxicants during pregnancy may have long-term negative consequences to the developing fetus, there is a lack of prenatal education focused specifically on environmental health. Ideally, toxicant exposure could be reduced through better regulation of chemicals in the environment, however, regulatory change is slow and the political enthusiasm is lacking. In the meantime, future parents need to be made aware of some of the risks and require information about strategies to reduce exposures during the critical prenatal period. Prenatal PHPs are uniquely positioned to provide this advice. Thus, the overall aim of this research is to better understand barriers to, and opportunities for, environmental health education (EHE) in the prenatal care setting among Canadian healthcare providers. A qualitative methodology involving face-to-face interviews with PHPs in the Ottawa region was employed to address the following objectives:

- a) Examine knowledge, knowledge flow, attitudes, and practices regarding prenatal EHE among PHPs; and,
- b) Identify opportunities and barriers to integrating EHE into the prenatal and reproductive care contexts.

In addressing these objectives, the hope is that this work may help to inform the development of effective prenatal standards of care for EHE in Canada, and ultimately reduce prenatal exposures to common environmental toxicants and the associated health risks.

Organization of the thesis

This thesis follows an article format and consists of three chapters, including one publishable manuscript that is in preparation for submission to a peer-reviewed journal. This current chapter (Chapter 1) provided a review of current literature and the objectives of this work. Chapter 2 is a manuscript entitled “Examining Prenatal Environmental Health Education Standards of Care among Prenatal Healthcare Professionals”. This manuscript is in preparation for submission to the Canadian Journal of Public Health. The final chapter (Chapter 3) summarizes the research findings, major contributions, and conclusions. As the first author and Master’s candidate, I take primary responsibility for this work, which includes including receiving ethical approval, the interview guide development, data collection and interpretation, and preparation of the final manuscript. Dr. Eric Crighton, my thesis supervisor, conceptualized the initial project, provided support in the development of the questionnaire guide, provided support for data analysis and interpretation, and critically revised the thesis. This project evolved from the recommendations of the Prenatal Environmental Health Education Forum that was held at the University of Ottawa in 2014.

Chapter Two

Abstract

Objectives: This study examines the current prenatal environmental health education (EHE) knowledge, attitudes, and practices of prenatal healthcare professionals (PHPs) to identify barriers and determine opportunities to improve environmental health education within the prenatal clinical care context.

Methods: A qualitative approach was employed, involving in-depth, semi-structured interviews with prenatal educators, nurses, midwives, doulas, family doctors, and obstetricians (n=21) in Ottawa, Canada. The data were coded and analyzed using a thematic approach.

Results: The PHP participants reported that the lack of environmental health professional training, professional guidelines, and professional support directly impacted their patient care plans. While avoidance of classic toxicants such as alcohol, tobacco, and illicit drugs is widely promoted during pregnancy, strategies for avoiding environmental health risks were not consistently offered to patients. It was found that one of the primary barriers for the inclusion of EHE to patients was a lack of time; including time spent educating patients and needed to pursue professional education. Additionally, many PHPs felt that the risk of environmental toxicant exposure was insignificant. This belief was largely based on an assumption that there is little evidence to the contrary was offered by their professional associations. The information that was available was reported to be unusable in the prenatal

care context due to language or cultural limitations, and was rarely applied to developing individualized patient care guidelines.

Conclusion: The findings indicate that there is a need to create patient care guidelines and provide accurate, up-to-date information for PHPs to use in prenatal care contexts.

Guidelines need to be simple and multilingual in order to meet PHP needs and reach a variety of demographic patient groups. Use of current technologies (interactive questionnaires, video and references) would simplify the patient education process, and the delegation of the review of exposure history to other staff would allow more PHPs to focus on developing individual care plans. The results of this research are important in the development of a national prenatal environmental health education strategy.

Keywords: prenatal health education, environmental health, education barriers, prenatal care, practice guidelines

Introduction

Many chemicals are released into the environment without undergoing full human health risk assessments (Woodruff, Carlson, Schwartz & Giudice, 2008; Wigle et al, 2007; MacKendrick, 2018). As a result, we are all exposed to dozens of toxicants on a daily basis (MacKendrick, 2018; Earl, Burns, Nettelbeck & Baghurst, 2015) and there is a growing body of evidence indicating that these toxicants are contributing factors to negative health outcomes (Landrigan et al, 1999; Grason & Misra, 2009). Toxicant exposures pose a higher risk during the fetal period due to bioaccumulation and immature neurological and endocrine systems (Bearer, 1995). The evidence is still inconclusive whether this has had an impact on the

increasing rates of diagnosing cancers, asthma, and neurodevelopmental disorders in children (National Cancer Institute, 2015; National Scientific Council on the Developing Child, 2006; American College of Obstetricians and Gynecologists, 2013; Valenzuela, Matus, Araya, & Paris, 2011). Many consumers have been found to be aware and concerned about toxicant exposure, but are unsure of how, or are unable, to take precautionary measures (Laferriere & Crighton, 2017; MacKendrick, 2018). Research indicates that even low doses of toxicants can affect the fetus, thus increasing the need for prenatal education about toxicant avoidance and precautionary consumption (Lanphear, 2009; MacKendrick, 2018). However, studies show that there is little environmental health guidance or education provided by PHPs to their patients (Laferriere & Crighton, 2017; Stotland et al, 2014).

The aim of this research is to examine general knowledge, attitudes, and practices regarding prenatal environmental health education among PHPs, and to identify opportunities and barriers to integrating EHE into the prenatal and reproductive care contexts. The findings of this research will help to inform the development of EHE strategies and resources, as well as professional practice guidelines and policies suitable for the prenatal care.

Background

Environmental toxicants, such as pesticides, organochloride products, perchlorate, ethylene dibromide, lead, mercury, phthalates, and plastics, including BPA compounds, are ubiquitous in our day-to-day lives (Wiseman & Stefanovic, 2009; Landrigan et al., 1998; Stillerman, Mattison, Giudice, & Woodruff, 2008; Lassi, Imam, Dean, & Bhutta, 2014;

Lanphear, Vorhees, & Bellinger, 2005). There is Evidence indicates that rates of chronic diseases such as COPD, emphysema, and other respiratory problems, cancers involving the body's excretory and filtration systems (liver, kidney, blood), as well as neurodevelopmental disorders (ADHD, autism, and learning disabilities) are increasing globally, and that these increases are due in part to exposure to environmental toxicants (Goodson, 2015; Lui et al., 2014; Lanphear, 2005; Zhang et al., 2009). Both the young and the old are at higher risk of environmental toxicant exposure due to reduced capacity for the body to filter toxins. The fetus is at the highest risk of negative health impacts from environmental toxicant exposure due to immature filtration systems, developing physiology, and accelerated cell growth (Landrigan & Goldman, 2011; Valenzuela et al., 2011). Historically, it was believed that the placental barrier protected the fetus, however, studies have shown that many toxicants move freely through the placenta and potentially have profound impacts on the neurodevelopmental sequence (Bearer, 1995; National Scientific Council on the Developing Child, 2006).

The health effects of prenatal exposure to some toxicants may not be fully established, but the effects of lead and mercury are well understood. With over 40 years of intensive study of lead and mercury toxicity, exposures have been correlated with below-normal scores on infant neurodevelopmental screenings (Abelsohn & Sanborn, 2010; Lanphear et al., 2005; Earl, Burns, Nettelbeck, & Baghurst, 2015). Governmental regulations have significantly reduced environmental and body burden levels of both lead and mercury by restricting lead in gasoline and paint, and mercury in industrial effluent (Markowitz, & Rosner, 2002; MacKendrick 2018). These restrictive regulatory changes are effective.

Studies have considered the negative health effects of other chemicals, such as bisphenol A, polychlorobiphenyls (PCB), perfluorooctanoic acid (PFOA), polybrominated diphenyl ethers (PBDEs), parabens, cadmium, and persistent organic compounds (Serrano et al, 2014; MacKendrick 2018). Endocrine disrupting compounds (EDCs) are abundant in our environment and are found in soil, water, and the air, as well as in many everyday products such as plastics, personal care products, non-stick cookware and adhesives. Studies suggest that exposure to EDCs can negatively impact the production of estrogen or androgen (Caseria et al., 2008; Heindel, 2015; Bergman et al., 2013). Interruptions within the estrogen-androgen synthesis process can reduce androgen production or increase estrogen production, which in turn can interfere with genital and reproductive development (Association of Reproductive Health Professionals, 2010; Chalupka & Chalupka, 2010 ; Wigle et al., 2008). Despite the everyday use of the aforementioned compounds, neither the effects of EDC exposure nor the mechanisms of trans-placental permeability is fully understood (Landrigan & Goldman, 2011; Diamanti-Kandarakis et al., 2009). Evidence suggests that declining male fertility and species feminization may be directly related to the interruption of androgen production resulting from EDC exposure (Vogel, 2005; Bergman et al., 2012). While animal studies have isolated causative chemical triggers, these triggers are less well understood in humans (MacKendrick 2018).

The uncertainty of the evidence poses a policy issue in the North American regulatory process. Manufacturers do not have to submit long-term human health risk assessments for the chemicals they introduce to the market, and the uncertainty in the available risk evidence

allows for certain regulatory loopholes. In North America, restrictive regulations are only developed in response to the 'proof-of-harm' model of risk assessment (MacKendrick, 2018).

In contrast, in the European Union (E.U.), a manufacturer must conduct conclusive studies and prove safe human exposure before a chemical is allowed on the market. The E.U. has adopted a precautionary approach to the regulation of chemicals in manufacturing through its REACH (Regulation, Evaluation, Authorization, and Restrictions of Chemicals) program (Čihák, 2009; Martuzzi & Tickner, 2004; Lanphear et al., 2005), a program which is similar to North American pharmaceutical regulations. However, within the North American chemical regulation process, most of the pre-marketplace regulations relate to shipping, handling, and containment of chemicals. Human safety testing is often limited to a 'dose-response threshold' assessment, measuring high threshold exposure. However, this test has been shown to be ineffective in monitoring many EDCs, such as BPA, which has been shown to be more damaging at low doses over extended periods of time than at higher doses (MacKendrick, 2018). In Canada, the low dose exposure studies caused the restriction of BPA in the market. Health impacts of chemical exposures are only addressed after the introduction of a product to the market, thus governmental controls are likely to be considered only after there has been significant human exposure or health problems have been identified.

After lead was first recognized as a toxicant, it took over 50 years for it to be removed from gasoline and paint (Government of Canada, 2004; Markowitz, & Rosner, 2002), allowing decades of exposure to occur. It is estimated that 70,000-100,000 chemicals are released into the North American environment annually, yet long-term health studies have only been

conducted on a handful of them and not in combination with other toxicants (Woodruff, et al., 2008; MacKendrick, 2018). While a precautionary regulatory approach similar to that of Europe is required, the status quo is not expected to change soon (Landrigan et al., 1998; MacKendrick 2018). Thus, in the absence of regulations aimed at reducing exposures, there is a need to raise public environmental health awareness and promote precautionary consumption. Precautionary consumption is guided by the application of the precautionary principle (Wingspread Statement, 1998; see Appendix 2), to environmental avoidance practices. Precautionary consumption is about deploying a personal standard of safety by, for example, avoiding certain types of fish high in mercury, using nontoxic cosmetics and cleaning products and switching to organic produce. While this approach problematically “...directs attention away from the responsibility of government and chemical companies to enforce and enact responsible testing and manufacturing protocols” (MacKendrick, 2018, p. 4), in the current absence of adequate regulatory controls, individual protective actions are needed. Thus, until regulations are strengthened, is important to educate individuals, and in particular pregnant women, about environmental health risks and strategies to reduce exposures through precautionary consumption and other toxicant avoidance strategies.

A recent study about environmental health risk perceptions among new mothers in Ontario found that PHPs were the preferred source for environmental health information (Laferriere & Crighton, 2017). Despite this, only 8% of participants reported that they received any environmental health information from their PHP during pregnancy (Laferriere et al., 2016). This finding is perhaps not surprising given that most PHPs receive only limited environmental health training (Sathyanarayana, Focareta, Dailey, & Buchanan, 2012;

Stotland et al., 2014). In a Canadian study of formal EHE training of physicians, 48% of respondents reported having little or no training in EHE (Wiseman & Stefanovic, 2009). Other studies with PHPs have reported that many are uncertain about which exposures on which to focus in patient education (Sathyanarayana et al., 2012; Gehle, Crawford, & Hatcher, 2011).

At the educational support level, many professional associations recognize that environmental health education training is severely lacking and needs improvement among PHPs (American College of Obstetricians and Gynecologists, 2013; Canadian Nursing Association, 2009; Watterson et al, 2005; Sathyanarayana et al., 2012; Wiseman & Stefanovic, 2009; Woodruff & Sutton, 2014). It has also been recognized that although the evidence of exposure outcomes is incomplete, there is an immediate need to reduce environmental toxicant exposure and to take a precautionary approach (American College of Obstetricians and Gynecologists, 2013). The lack of PHP environmental health training is seen as one of the primary barriers to the integration of prenatal exposure avoidance information into the standards of practice and care (Wiseman & Stefanovic, 2009; Stotland et al., 2014; Sutton et al., 2012). The development of education care plans that adopt the precautionary approach will be crucial to providing education and resources to prenatal patients.

The PHP is not the only information source for prenatal patients. Other important information sources include the Internet and pregnancy guidebooks (Crighton, 2014; Crighton & et al., 2015). In both cases, however, there are intrinsic problems with the content, which has been found to be incomplete and unreliable. Although reliable information is available on-line, finding it can often be complicated and often circuitous, challenging even the most persistent of researchers (Crighton, 2014). Both printed literature

and information found on the Internet have credibility issues and are restricted for those who have the financial resources to access the Internet or the literacy competency to understand the information. In a recent study, some parents reported that, in moments of overwhelming confusion, they simply ignored all of the information they uncovered and did what their parents had done in their own childhood (Laferriere & Crighton, 2017).

It is well established that exposure to common toxicants, including tobacco smoke and alcohol, can have profound effects on the developing fetus. Prenatal care providers have had considerable success in putting knowledge into practice and educating patients about these risks. Public health programs on smoking cessation, which are run in all prenatal clinics, are strong examples of successful preventative educational programs that are now embedded in prenatal care (Tong et al., 2013). Measured health outcomes and changes in habits are impacted by many factors. While planned patient education is only one factor contributing to the reduction of smoking prevalence, the percentage of homes in the U.S. where children under 7 years old are exposed to second-hand smoke declined from 29% in 1994 to 19% in 1999, and more recently to 8.4% in 2014 (National Scientific Council on the Developing Child, 2006; CDC, 2017). Alcohol avoidance programs, along with education aimed at pregnant women, have also proven to be effective in decreasing alcohol consumption during pregnancy. In 1994, it was estimated that 25% of pregnant women in the U.S. were consuming alcohol while pregnant; this rate decreased to 13.3% in 2001, 12.4% in 2003, and 10.5% in 2005 (Zelner & Koren, 2013; Thanh & Jonsson, 2010). Early scientific evidence of risk first informed PHP awareness and education, and then diagnostic tools were developed for fetal alcohol syndrome (Chudley et al. 2005) and finally the Society of Obstetricians and

Gynaecologists of Canada's (SOGC) care guidelines (2013). Following these successes, there is reason to believe that EHE programs could prove equally successful in reducing prenatal environmental exposures.

Given the importance of reducing prenatal environmental exposures and recognizing the important role PHPs can play in ensuring that prospective parents have the information they need to make the safest choices possible, this research addresses the following objectives: a) examine knowledge, attitudes, and practices regarding prenatal environmental health education among PHPs; b) identify opportunities and barriers to integrating EHE into the prenatal and reproductive care context.

Methodology

This research is based on interviews with PHPs. Research was conducted in Ottawa, Canada over a 6-month period in 2016 and the project was approved by the University of Ottawa's Research Ethics Board.

Ottawa was chosen as the case study site for a number of reasons: first, Ottawa hosts seven post-secondary institutions, including universities, nursing schools, medical schools, and collegiate level institutions, and supports many teaching hospital sites, research institutes, and diverse specialty health and research units; secondly, being a capital city, Ottawa is home to key national prenatal care associations such as the Society of Obstetricians and Gynaecologists of Canada (SOGC) and affiliated decision makers; and finally, the principal author has a large network of contacts who work in health care health care in the city, which helped facilitate participant recruitment.

Participants were selected for interviews from among prenatal care groups, namely midwives, family physicians, obstetricians, obstetrical nurses and doulas, using a stratified purposeful sampling approach (Mays & Pope, 1995; Issacs, 2014; Hays, 2005). This approach was used in an effort to maximize the range of professional perspectives. Once a total of 21 PHPs were interviewed, it became obvious that the interview data being elicited was somewhat repetitive, it was estimated that data saturation had been reached (Bowen, Martens, & Team, 2005; Issacs, 2014) and data collection was concluded.

Interviews

Data collection involved semi-structured, face-to-face, in-depth interviews with PHPs. Participants were contacted and interviews were scheduled at a location of their choice. Detailed field notes were taken during the interviews to supplement the recordings and inform future analysis. Due to expressed concerns about time constraints among PHPs, efforts were made to keep interviews within 30 minutes.

The interview guide that was used for all participants (Appendix 1) was divided into four sections: (1) participant background, namely experience, education, and personal attitudes towards EHE; (2) practice characteristics, including patient demographics, existing standards of care, and EHE offered to patients; (3) opportunities and barriers to integrating EHE into standard practice and patient care; and (4) patient views or questions on EHE. Open-ended questions were used in the interviews to encourage dialogue. For this study, the term 'environmental exposure' was purposefully not predefined. This allowed PHPs to identify environmental toxicants themselves, which helped determine their personal biases and

understanding of environmental health risks. By determining their own unique list of environmental toxicants, each PHP was able to speak about the EHE that they provided.

Participant demographics

A total of 21 PHPs were interviewed for this study. There were four family doctors who had prenatal practices, four obstetrical specialists, four prenatal nursing instructors, three prenatal instructors (not nurses), three midwives, and three doulas. One obstetrician was speaking as a key informant from the SOGC. The sample represented a broad spectrum of PHPs, each of whom presented their own opinions on EHE in the prenatal period. To ensure anonymity, a pseudonym was chosen for each participant (except the identified SOGC key informant) and combined with their profession (e.g. Lucy, Doctor or Simon, Midwife). Table 1 presents a profile of each participant.

Table 1: Participant Characteristics

Pseudonym	Professional sector	Age	Years of experience	PHP years of education	Patients seen per year	Income level of patient population ¹	Education level of patient population ¹
Allison	Doula	37	6	2	12	Mid-high SES	high
Denny	Doula	36	4	2	12	Mid-high SES	high
Pattie	Doula	35	3	2	10	Mid-high SES	high
Debbie	MD (Family Doctor)	68	35	8+	100	low SES	low
Darlene	MD	56	22	8+	100	low SES	high*
Donald	MD	54	27	8+	200	Mid-high SES	high
Rosie	MD	37	10	8+	15	Mid-high SES	high
Liz	Midwife	28	2	4+	8	high SES	low
Georgie	Midwife	38	16	4+	25	Mid-high SES	high
Sally	Midwife	42	12	4+	11	Mid-high SES	high
Jennifer	OBS-KEY INFORMANT	64	30	10+	n/a	n/a	n/a
Leslie	OBS (Obstetrician)	56	20	10+	300	Mid-high SES	high
Yvette	OBS	60	25	10+	425	Mid-high SES	high
Bella	OBS	62	30	10+	375	Mid-high SES	high
Peter	OBS	68	35	10+	350	Mid-high SES	high
Roxanne	PE (Prenatal Educator)	49	12	4+	100	low SES	high*

Ericka	PE	64	31	4+	100	Mid-high SES	high
Madison	PE	35	10	4+	200	Mid-high SES	high
Jill	RN (Prenatal Nurse)	52	30	6+	200	mid SES	low
Shukla	RN	35	10	6+	200	Mid-high SES	high
Judy	RN	64	35	6+	150	Mid-high SES	high
Sam	RN	57	30	6+	200	low SES	high

*Note: patients with low income and high education suggests patients are recent immigrants.

¹SES and education determination was made by the PHP (no parameters stated)

Table 1 demonstrates that patient demographics varied significantly between PHPs. Most of the obstetricians and family doctors worked with patients with higher income and education levels. In the case of the least experienced family doctor, patients came from a broader variety of income groups, and included immigrants and English as Second Language (ESL) patients. Only one established family doctor worked exclusively with new immigrants and ESL patients. Among prenatal nurses and midwives, the majority of patients were from mid-to-high-income groups. Notably, the doulas reported only seeing patients from mid-to-high-income groups, which is likely due to the fact that doula services are not covered by public health insurance.

Data collection, coding and analysis

All interviews were digitally recorded with participant consent, transcribed verbatim, and entered into Dedoose analytical software. The data were coded to determine similarities and differences among PHPs, in relation to the themes and objectives of the study (Kitchin and Tate, 2000; Hay, 2010; Issacs, 2014). Initially, open coding was used to identify broad themes, followed by axial coding to develop child nodes with more narrowly focused themes. Finally, the most pertinent data were selected based on relevance to the research objectives,

using selective coding (Corbin & Strauss, 1990). Coding is a dynamic process, and re-coding occurred as needed throughout the analytical process.

Results

During analysis of the interview data, a number of key themes were identified related to definitions of environmental toxicants and perceptions of the risks they represent, as well as the challenges PHPs face in educating patients, including a lack of time, a lack of professional educational resources, an inability to stay abreast of the evolving science, and a lack of professional association guidance. The participants provided a variety of suggestions for how EHE could be incorporated into the clinical setting.

Definitions and perceptions of environmental health exposures, toxicants and the priority of environmental education

There was significant confusion around the whole topic of environmental health exposure, toxicants, and education. The most common question that PHPs asked the interviewer during the interview was “*what do you mean by environmental exposure or toxicants?*” When the PHPs were asked to define environmental toxicants on their own, the definitions varied. Most PHPs gave smoking, alcohol, and illicit drugs as examples of environmental toxicants. However, some participants also included dietary concerns (deli meat, unpasteurized cheese, and shellfish). When asked about occupational exposure risk, two of the family doctors mentioned x-ray exposure, while the rest said that they advised their patients to check with their human resources departments. One of the midwives included stress on her list of environmental health exposures:

“I feel that domestic violence and stress cause problems for the developing fetus and help counsel the parent to reduce and report these situations to deal with that issue” Sally, Midwife

Although the definitions offered by PHPs varied widely, most were aware that current prenatal EHE education is inadequate.

“I guess today I will learn all the things I should be adding to my teaching [about environmental health risks].” Donald, MD.

PHPs explained that they felt the current education that they offered was incomplete as there was a lack of guidance and attention from their professional associations and therefore they did not place EHE as an educational priority in their practices.

“SOGC will say this is what we are recommending here is our guidelines [...]. If the SOGC would sign off on it, it would be good. It would give [EHE] credibility.” Peter, OBS.

“If the SOGC thinks it is critical to advise my patients then I will mention it, right now EHE is not on my standard of practice.” Debbie, MD.

So much to do and so little time

PHPs reported that one of the most significant barriers to educating parents was the lack of time with the prospective parents. For example, most prenatal educators and nurses, who taught community and public health prenatal classes, reported that there was rarely enough time to teach all of the aspects of healthy pregnancy; therefore, environmental risks and exposures were not covered. The majority of PHPs indicated that they tried to answer specific questions when asked by their patients but, otherwise, did not bring up the topic. In fact, according to one participant, the length of prenatal classes had been shortened over the

past few years, forcing them to further condense the material they covered and remove any environmental health discussions:

We have gone from 8 to 6 to 4 to 3 [classes]. We used to [discuss environmental issues] when we had more classes, not now as there is not as much time to do that. Judy, RN.

Within the clinical setting, time and billable services to educate patients is limited for all PHPs. As medical facilities struggle to meet their budgets, some routine physician care is shared with other practitioners. This results in more patients discussing EH concerns with other PHPs, such as RNs, midwives, and even doulas. Therefore, EHE has to be more widely available to all professional sectors so that patient education can be more collaborative and not directed or researched solely by the physician:

“I don't have the time to look up to see, or to go to the different pre-natal classes and see what exactly is being said. It's beyond the time.” Bella, OBS.

Not keeping up with the science

Most PHPs want to take the time to assess the environmental risk information they uncover and fully understand the evidence. Most PHPs reported feeling reluctant to share informational resources that they had discovered as they did not have enough time, experience, or training to judge its accuracy. Many respondents reported relying on third party research organizations such as Up-to-Date, Motherisk, SOGC, and Public Health to offer advice on particular concerns. The physicians, both family doctors and specialists, voiced the strongest complaints about the lack of reliable and useful information suitable for counselling their patients:

"I read the CMAJ, JOGC, Canadian Journal of Diagnosis [....] I read all the SOGC updates that come out. ... [I go to these sites] everyday, multiple times a day but not for [environmental] substances in pregnancy because you can't read anything that is useful regarding EHE." Darlene, MD.

In addition to the lack of time to read the current research, a lack of access to the research literature was mentioned by all participants as a major barrier to providing EHE. While many advanced research subscriptions, such as *Up-to-Date*, can be accessed by physicians in group offices or among those affiliated with universities, they are unavailable to independent or unaffiliated PHPs due to cost. In particular, prenatal instructors and midwives were very upset about these barriers to accessing information and their lack of time to research environmental health issues, and recognized that the lack of resources represents significant professional inequity and barriers to educating patients. The lack of accessibility and thus the inequity of exclusion from the "inside information" was reported by all PHPs aside from the physicians:

"[What we are talking about] is your physical ability to get everything, to access everything, just the time required but also to the inclusiveness to be included in the community of getting new information that's out there. It's hard to keep up to date." Sam, P.E.

"There is so much out there and people [PHPs] just don't have the time." Shulka, RN.

"Knowledge translation is the biggest problem in improving public health. There is so much research, nobody can keep up with it, and I don't keep up with it." Liz, Midwife

“I don't have time to read a whole study and I might read the abstract but I also know that I'm not...of 10 abstracts that I read, 7 of them are actually poor quality studies.” Georgie, Midwife

Patient-related barriers

Certain patient characteristics were reported by PHPs to present barriers to educating prenatal patients about environmental health risks. PHPs reported that language and cultural barriers created significant challenges when advising clients about environmental exposures that can be avoided. There are situations where patients lack the capacity to reduce exposure (i.e. lead within water supply), but there are other, more minor exposures can be easily minimized through practices such as wet-mopping floors for dust control, avoiding pesticides, reducing plastic usage etc. Providing explanations for these mitigation practices was challenging when the PHP was bridging language barriers. An interesting example of a cultural barrier to EHE relates to educating patients about household moulds. In older Canadian homes, and particularly in rental units, mould can be a serious concern. Educating families on how to modify household habits in order to limit the growth of mould is challenging, particularly if they are only familiar with homes in hot and arid countries where mould does not thrive. This barrier was clearly defined by Roxanne, a prenatal educator:

“We talk about pollution, carpets, moulds, some of [my families] are living in mouldy houses and they don't understand it because it is not in their culture [...] but they don't have it [in their homeland] because the sun kills everything [...] it is hard for them to understand that if there is a little bit of green or mould you need to address that issue” Roxanne, P.E.

PHPs reported that the slower pace of discussion simply due to language barriers and some literacy issues results in compressed educational time within the appointment timeframe. This is complicated by a secondary barrier in that there are few simple multi-language tools and brochures available to assist with low-literacy situations. The barrier of health literacy is complicated for some family doctors:

“All of the resources and education are English, [with] some French; [...] it is tricky. The resources that I see developed are sophisticated; we need to pay attention to some very basic stuff for people who don't have that level of competency. Health literacy is a big thing, not just for newcomers.”
Debbie, MD.

Research and resources for PHPs; so much is unknown

One participant, Shulka (RN.), was involved in the development of a Toronto Public Health prenatal website that addressed many of the information requests the PHPs were asking for in their interviews. However, none of the other interviewees knew about the website. Shulka reported that the funding for the website and future resource development was precarious as few PHPs used the site. Reportedly, over 80,000 introductory letters were sent to PHPs around the province; however, none of the Ottawa PHPs in this study had heard of it. There are two issues that may help explain the low levels of awareness and use of this site: the lack of professional association sharing of this website resulted in the information being ignored, and secondly, not overcoming the state of information saturation and overload that most PHPs experience. This is unfortunate, as the site offers valuable opportunities for prenatal education:

“[The public health information site] contains 25 topics that provide key messages on these topics that have been written in a format that can be directly shared with clients. [...] The thing is it's all based on current evidence. [...] The [prenatal] educators have a much harder time accessing [evidence-based topics], which is why this was created.” Shulka, RN.

Many PHPs reported that face-to-face sharing of information, current evidence, and practices amongst the professional sectors would be preferable to online instruction about EHE. A collective information forum similar to the Prenatal Environmental Health Education Forum, which was held in Ottawa in November of 2014, would be an excellent option for sharing EHE and research. This format would increase collaborative efforts and minimize future research silo effects:

“Using a forum format is great to share EHE ideas and strategies and should be repeated as a learning option for all PHPs.” Genia, Midwife

Guidance from professional associations and the role of the SOGC

A key theme that emerged from the interviews was the need for guidance from recognized and trusted sources about how to educate patients about environmental health risks. All PHPs suggested that a single-source, open access format is the best solution. Repeatedly, participants indicated that not only does the source have to be evidence-based, but it should also advise on the practicalities of standards of care guidelines that employ a precautionary approach. Most participants, irrespective of their professional credentials, favoured the use of one lead agency and identified SOGC as their most trusted source for advice regarding prenatal care in general. All PHP groups wanted a clinical-based association to provide the information and guidelines that they needed:

“I use the SOGC guidelines and their website quite often. I read their stuff that they talk about [...] like all the parts of the preventive risk assessment kind of stuff [...] there is never anything about environmental health risk”
Darlene, MD.

“I use the Midwives Association site but always refer to the SOGC for complicated issues or evidence-based research” Liz, Midwife

In the ideal situation, a PHP could log in and access up-to-date Canadian standards to apply directly in their clinical practices. Most participants mentioned that the SOGC’s lack of EHE guidelines forced them to re-consider their own strategies for educating their patients. While there is an abundance of sites that provide information, few are Canadian or fully vetted. Unlike the sites similar to Up-to-Date, the SOGC has no subscription costs and unrestricted access. All PHPs were very definite about the potential benefits of the SOGC providing environmental health practices guidelines, provided that they are updated frequently:

They [SOGC] have sent out some information in the past to all the obstetrical care providers and [...] SOGC has these practical clinical guidelines. Why don't we have an environmental health guideline? In addition, [why don't they have] a group reviewing the literature and updating it on the databases”, Bella, OBS.

“I do access them [the SOGC website] for their [standards of practice] guidelines. The problem is that sometimes their [practice] guidelines are not updated as frequently as I'd like them to be”, Leslie, OBS.

All of the family doctors and obstetricians who were interviewed frequented the SOGC site to get information regarding standards of care for all other aspects of their

prenatal practices. The most common feedback from the participants can be summarized by this comment: *“if the SOGC was concerned then they would tell me”* (Debbie, MD.). Both the SOGC key informant and the doctors reported wanting more complete and comprehensive guidelines to emerge, helping them focus on the most important EHE concerns in a timely fashion. A downloadable checklist would be useful to augment the current antenatal records. Jennifer Blake, CEO of the SOGC, indicated that advancement of the standard operating procedure regarding prenatal EHE is limited by funding within her association:

“I think environmental risks are one of those areas on our pregnancy website that we need to devote more time and energy to. [...] We are working on it but we are nowhere near where we need to be in terms of resources we would like see [...] We are constantly updating the site [...] At this point this is unfunded, whatever we do is what we are able to do with the resources that we have.” Jennifer Blake, CEO of the of SOGC

Moving forward from here

As patients turn to the Internet for medical definitions and information, most PHPs report that their role has shifted. Instead of providing the information to patients themselves, they now have to confirm the validity of information that patients have found. The time and energy required to validate this information presents a significant challenge to PHPs:

“My role has changed over the last 25 years from one of the provider of all information to the confirmer of bits of information. My patients check it out on the internet, ask Dr. Google, and then ask my opinion. [It’s] challenging to keep abreast of it all.” Bella, OBS.

Most participants felt that having evidence-based information from the SOGC would help eliminate this stress and allow EHE to be included within their clinical care plans.

Many participants reported having mixed feelings about the responsibility of environmental toxicant avoidance being placed on the patient, rather than on the regulators or manufacturers. Many felt that avoidance and precautionary consumption had a minimal impact, except when it came to alcohol, smoking and illicit drugs. There is a distinct need for PHPs to provide the best information possible for their patients, without creating undue stress or anxiety:

“Every day we are warned on social media of another food, activity, or place we should avoid. What happens if that was my supper the day before? I get calls from my patients terrified they had done something to their fetus because they had a drink before they knew they were pregnant. The stress causes them more problems than the alcohol. [...] And does it matter to the fetus’ health? Can we really avoid enough of the things that will harm us? What about lead pipes, second hand smoke, stress.”
Sally, Midwife

Jennifer Blake, CEO of the SOGC, reported that her organization wanted to build on the existing evidence and act in a precautionary fashion to avoid potential long-term harm, while incorporating all of the known evidence:

“We are dealing with complexity here and it's not a thing that you can isolate and say that we are looking at this one particular toxin; you get all the interactions with multiple toxins and all the circumstances of the person's life. I think that the precautionary principle is a very novel way of going around the problem. You do have an opportunity to give best advice, so what is the best advice based on the evidence that you have?” Jennifer Blake, CEO of SOGC

On the surface, the solution appears simple. However, the development of fully vetted, comprehensive prenatal EHE guidelines remains elusive. As Jennifer Blake suggests, acting within the existing evidence and the precautionary principle seems to be the timeliest solution.

Discussion

Protection of the fetus from environmental toxicant exposure may help to reduce the development of various chronic diseases. In the absence of adequate regulations limiting the production and release of many known toxicants into the environment, it is important that in the short-term, women be educated about ways to reduce exposures during pregnancy that might impact their child (Stillerman et al., 2008; Crighton & et al., 2015; MacKendrick, 2018). While it is recognized that PHPs could be an important source for this education, most of the PHPs interviewed in this study reported feeling inadequately trained, under-supported, and overwhelmed by the vast amount of information and research that could be integrated into patient care plans and prenatal EHE. As a result, PHPs in this study reported sharing only minimal environmental health information with patients, and usually only in direct response to specific patient questions. The lack of training and guidelines are consistent with findings reported in studies conducted in other Canadian and U.S. contexts (American College of Obstetricians and Gynecologists, 2013; Royal College of Obstetrics and Gynaecology, 2013; Health Canada, Government of Canada, 2011).

Beyond a lack of training, this study found that PHPs face a range of barriers to providing environmental health information to their patients. The period in pregnancy during which

the most rapid development occurs happens in the first 12-16 weeks of pregnancy. However, many PHPs reported that women seek prenatal care only after this period which limits the value of any guidance regarding precautionary consumption. It was also suggested that the lack of billable hours within the existing system made it impossible to extend prenatal visits to include EHE. Participants stated that one of the major barriers to providing environmental health education in the prenatal care context was the lack of time available during a visit. Participants pointed out that delivering the information, ensuring that the patient has fully comprehended it, and addressing any remaining questions is time-consuming and makes it difficult to schedule appointments. To save time during the appointment period, some participants suggested that the development of interactive technologies (i.e. surveys, questionnaires), as well as multimedia options (i.e. videos, YouTube presentations, and written brochures), would allow the PHPs to quickly offer education in a format that can be customized to the needs of each prenatal family. One family doctor mentioned that this format could allow time for the family to self-identify any concerns with a specialized medical associate and improve time management for the appointments with the primary PHP.

The time barrier discussed above is compounded when multiple environmental concerns are raised by a patient. The lack of simple, usable information is often missing, making the educational process more time-consuming. Participants defined usable information as simple instructional guidelines, brochures, and handouts that would not be misinterpreted as alarmist or fear-provoking (Stillerman et al., 2008; Lui et al, 2014). More than half of the PHPs interviewed referred to the lack of usable information as another barrier in providing EHE to their patients. PHPs suggest that language, literacy, and cultural barriers present challenges

when offering any education, not only EHE, to parents. To offer care with the best use of their counselling time, many PHPs reflected on the need to have a diversity of educational options to help with the variety of languages and cultures of their patients. Participants felt that developing unilingual EHE resources would have the unintended consequence of marginalizing non-English/non-French parents. Usable tools resulting in easy translation and understanding through technology would be critical within the development of guidelines that the PHPs can use with their patients. Without the tools and guidelines, assessing what information is of highest value and priority for each prenatal patient becomes the responsibility of the PHP, which could add to the already significant burden reported by PHPs to stay up-to-date with all resources and information.

An important finding that emerged from this research was the lack of awareness among PHPs regarding the subject of environmental toxicants. Many were concerned that there was a need for discussion, but they did not have the time or resources to investigate further. Correspondingly, all PHPs interviewed in this study reported that there was a lack of professional training EHE programs available. Among many participants there was an overall attitude of ambivalence regarding the inclusion of EHE into care plans, as evidenced by comments such as: “nothing that could be done anyway” and “it was not important enough.” Most PHPs felt that environmental risk management was within the jurisdiction of the federal government and beyond anything they could influence on an individual level. Some PHPs justified this belief based on their observation that their leading professional association (SOGC) did not provide practice guidelines or offer any sort of continuing education programs related to environmental health.

All of the PHPs indicated that they had little or no formal training in EHE and that they often have to work with incomplete or inaccurate information, and struggle to find professional and governmental guidance for developing their day-to-day patient care guidelines. This problem was similarly identified in a previous study involving physicians in Toronto, where it was reported that little professional education [was](#) available, with the least being offered in the medical and nursing programs (Wiseman & Stefanovic, 2009). In this study, many PHPs lacked confidence in their ability to offer EHE, and were unsure whether this teaching was actually the responsibility of their practice. Many of the PHPs indicated that since EHE is not associated with a continuing education credit for maintaining their professional licensing it was not a training priority.

The findings also suggest that access to current, evidence-based research was inconsistent, further complicating the perceived lack of educational support. PHPs, other than doctors, often referred to the difficulty in obtaining evidence-based information due to the financial barriers to accessing subscription-based resources within their clinical parameters. The financial barrier seemed to particularly increase the sense of inequity from the perspective of midwives and prenatal instructors. On the other hand, some openly available research was often not accessed due to a lack of awareness (Watterson et al, 2005; Wiseman & Stefanovic, 2009). Varying levels of awareness of available research and the existence of isolated knowledge silos are not unique to this field. This was demonstrated in the lack of knowledge about the CPCHE information brochures and video, and the accidental discovery of the Toronto Public Health information site. Professional associations, such as

SOGC, could improve awareness of environmental health issues among PHPs by bringing attention to current research and information.

Many of the PHPs interviewed in this study expressed that the SOGC could play a bigger role in prenatal EHE and take the lead on developing EHE guideline recommendations. All participants understood that waiting for governmental regulations aimed at reducing environmental exposure is not an option and that patient care guidelines need to be put into place immediately. Jennifer Blake, CEO of the SOGC, indicated that the Society's aim moving forward will be to provide standard of care guidelines and EHE training to PHPs using the precautionary principle. As evidence continues to emerge, the guidelines should be updated accordingly. Canadian policy is slowly evolving and the new research continues to provide evidence and support for the development of regulations. One of the objectives of the Second Report on Human Biomonitoring of Environmental Chemicals is "to act to protect the health of Canadians specifically from exposure to environmental chemicals," yet the slow pace of regulatory change means that generation after generation are still exposed to the same toxicants with mostly unknown long-term consequences (Health Canada 2013b, paragraph 2). To deal with this exposure and potentially reduce long-term consequences within the immediate timeframe, the SOGC guidelines would include recommendations for avoiding environmental toxicants through precautionary consumption.

Although the need for regulatory controls is the primary goal for most organizations, in the short term, the action that would support toxicant exposure avoidance is precautionary consumption (MacKendrick, 2010, 2015, 2018; Scott, Haw, & Lee, 2017). The efficacy of this environmental health strategy is undetermined. Most experts in the field are reluctant to

transfer the responsibility of environmental toxicant avoidance through precautionary consumption onto the prenatal family. Instead they feel that government toxicant regulation would be preferable (MacKendrick, 2010, 2015, 2018; Weir, Schabas, Wilson, & Mackie, 2010). Though not all PHPs in this study believed in the efficacy of precautionary consumption, all participants felt that waiting for regulations to be developed without offering guidance in the meantime was reckless, and therefore advocated for avoidance. Some research has shown that although precautionary consumption offered a sense of control to the parent, the actual chemical body burden reduction was minimal (Scott, Haw, & Lee, 2017; MacKendrick, 2018). Additional research is needed to determine the impact of precautionary consumption as an EHE strategy in reducing toxicant body burdens and negative long-term health outcomes.

This study is preliminary rather than definitive and a number of limitations must be mentioned. First, it can be expected that there is a certain level of selection bias in the study. There were some participants who removed themselves from the study as they indicated that the 'cost' of their participation (removal from patient/revenue generating office time) was too great for them to consider participating. Those who participated did so despite the time cost, which may reflect a bias towards individuals who already had a significant interest in the topic. Secondly, interviews were conducted exclusively in English and it is possible that the perspective of Francophone PHPs has been missed. Finally, the research was limited to the urban geographic region of Ottawa-Carleton and thus it only represents the opinions of PHPs within an urban context. To address these limitations, future studies should be

conducted in French and English, be national in scope and consider both urban and rural perspectives.

Conclusion

In conclusion, the key findings related to PHPs' definitions of environmental toxicants, the perceptions of toxicant risk in the prenatal period, and the educational challenges faced by PHPs, including time constraints, an inability to keep up with ongoing research, and the lack of resources and guidance from professional associations. All PHPs felt that better EHE guidelines and communication from their professional associations, would translate into better educational options for each prenatal family. To assist with these options, developing enhanced technologies could provide unique, usable information for each family.

Information that can easily be accessed in multiple languages and modified to serve a variety of cultures, administered by specialized staff assisting the primary PHP, would likely result in the best use of appointment and educational time. All participants reported that these technologies would be best implemented through a professional organization, such as the SOGC, to offer immediate and ongoing EHE support to PHPs. Additionally, the participants wanted the role of the SOGC to include patient care EHE guidelines, as well as training around precautionary consumption and current research. Meanwhile, training and promotion of the importance of EHE in the prenatal period would be best addressed through a multi-sector forum where all front-line PHPs could share advances in the field. This forum-style training would fill the gap between what is currently offered and the development of professional care guidelines.

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Chapter Three

Summary and Conclusions

Introduction

This research examined the perceptions and practices of prenatal healthcare professionals (PHPs) regarding prenatal environmental health education (EHE) in the context of Ottawa, Ontario, as well as the opportunities and barriers that exist to integrating EHE into the prenatal and reproductive care. Several issues defined the scope of this research. First, it is well established that we are all exposed to dozens of toxicants on a daily basis (MacKendrick, 2018; Earl, Burns, Nettelbeck & Baghurst, 2015), and there is a growing body of evidence indicating that these toxicants are contributing factors to negative health outcomes (Landrigan et al, 1999; Grason & Misra, 2009). Secondly, toxicant exposures pose a higher risk during the fetal period due to bioaccumulation, as well as immature neurological and endocrine systems (Landrigan & Goldman, 2011; Valenzuela et al., 2011; Lanphear et al., 2005; Bearer, 1995). The evidence is still inconclusive whether this has had an impact on the increasing rates of diagnosing cancers, asthma, and neurodevelopmental disorders in children (National Cancer Institute, 2015; National Scientific Council on the Developing Child, 2006; American College of Obstetricians and Gynecologists, 2013; Valenzuela, Matus, Araya, & Paris, 2011; Sweeney, 2107). Thirdly, many people have been found to be aware and concerned about toxicant exposures, but are unsure of how, or are unable, to take precautionary measures (Laferriere & Crighton, 2017; MacKendrick, 2018). Finally, increasing prenatal education about toxicant avoidance has the potential to reduce exposures, and

PHPs are in an ideal position to help provide this education (Lanphear, 2009; MacKendrick, 2018). Despite this, PHPs rarely discuss environmental health issues with their patients (Laferriere & Crighton, 2017; Stotland et al, 2014). Research aimed at informing strategies to integrate EHE into prenatal care is therefore needed. In light of these issues, this research addressed the following objectives: a) to evaluate knowledge, attitudes, and practices regarding prenatal environmental health education among PHPs; and, b) to identify opportunities and barriers to integrating EHE into the prenatal and reproductive care context.

Summary of Results

The conceptual framework discussed in Chapter 1 (Figure 2) illustrates four groups of factors that affect the PHP-patient relationship, which in turn influence the provision of EHE to patients. Specifically, these are predisposing factors (individual characteristics of the PHP, namely personal experiences, gender, age, language, and resources the PHP has to access or understand available research), reinforcing factors (observational knowledge of patient needs, history, and experience, as well as peer and association support), enabling factors (professional training and technical expertise within their practice, as well as financial resources within the practice), and health care or physical factors (availability of technology, supporting personnel, or community resources). The research results confirm many of the relationships between the PHP and the provision of EHE to patients that are hypothesized in the conceptual framework, especially as they relate to barriers.

Objective one: Examining knowledge, attitudes and practices around EHE

Most of the PHPs interviewed in this study reported feeling inadequately trained, under-supported, and overwhelmed by the vast amount of information and research that could be integrated into patient care plans and prenatal EHE. Across all participant groups, it was reported that minimal effort is made to educate prenatal patients in the clinical context about environmental health issues. One of the most common reasons given was a lack of knowledge about current environmental concerns such as exposure to endocrine disrupting chemicals (EDCs), mould, lead, and other common toxicants. When prompted to identify environmental toxicants that they discussed with their patients, most PHPs mentioned alcohol, cigarette smoke and illicit drugs, and some mentioned dietary exposures such as mercury in fish or lead in household water. However, none of the PHPs mentioned EDCs (e.g. plastics, PBDE, PFOA, phthalates) despite their ubiquitous presence in our lives and the numerous opportunities that exist to reduce exposures (e.g. not heating food in microwaves with plastic cookware, avoiding cooking at high temperatures with Teflon pans, and avoiding canned foods). Occupational exposures were reportedly occasionally raised by PHPs who had patients who were, for example, x-ray or laboratory technicians. Most PHPs reported that discussions with patients about any other type of exposure (supplements, dietary additives, etc.), if they occurred at all, were almost always initiated by the patient, and not by the PHP.

Another reported reason for not educating patients about environmental health risks was a lack of time to verify current evidence, or to create new patient care plans. Some were skeptical about the value of investing the time. It was suggested that if EHE was really needed, the issue would have received more attention from professional associations, which

would then offer guidance and develop standardized care plans or educational materials. At the same time, many PHPs indicated that much more needed to be done and felt that the needs of some of their patients were not being met. For example, some PHPs who commonly dealt with either new immigrant patient groups or low socio-economic status patient groups, reported significant time barriers associated with patient contact. This barrier was reported to be particularly significant in cases where English or French is not the patient's first language, since language barriers result in slower discussions.

Many PHPs were concerned that there was a need for discussion but they did not have the time or resources to investigate further. Correspondingly, all PHPs interviewed in this study reported that there was a lack of professional EHE training programs available. Among many of the participants there was an overall attitude of ambivalence regarding the inclusion of EHE into care plans, as evidenced by comments such as: "nothing could be done anyway" and "it was not important enough." Most PHPs felt that environmental health risk management was within the jurisdiction of the federal government and beyond anything they could influence on an individual level. Some PHPs justified this belief based on their observation that their leading professional association, the Society of Obstetricians and Gynaecologists Canada (SOGC), did not provide practice guidelines or offer any sort of continuing education programs related to environmental health. Continuing education credits are an essential requirement in the maintenance of professional status. All of the PHPs indicated that they had little or no formal training in EHE and that they often have to work with incomplete or inaccurate information, and struggle to find professional and governmental guidance for developing their day-to-day patient care guidelines. This problem

was similarly identified in a previous study involving physicians in Toronto, where it was reported that little professional education was available, with the least being offered in the medical and nursing programs (Wiseman & Stefanovic, 2009). In this study, many PHPs reported lacking the confidence in their ability to offer EHE, and were unsure whether it fell within their scope of practice. Many of the PHPs indicated that since EHE is not associated with a continuing education credit, it was not considered to be a training priority.

Objective two: Identification of opportunities and barriers in EHE

Participants in the study were eager to discuss existing barriers and opportunities in delivering EHE to patients. Barriers included their own lack of knowledge about EHE, the lack of professional association support and guidance, the time required to create new EHE plans, and the accessibility of limited resources. Despite all of these barriers, PHPs were still able to identify some of the opportunities that were available.

Most participants felt that their knowledge of EHE was very limited, and difficult or impossible to upgrade. Keeping up to date with new environmental health information was reported by PHPs to be a daily challenge and therefore often neglected. Further to this, there was a lack of motivation in the form of continuing education credits and training to keep up to date. They received little guidance about including EHE in their practice, and they felt confident that if there was something to worry about, their professional associations would immediately address it. They also reported that one of the biggest barriers to providing EHE was a lack of time, not only in terms of the time required to self-educate on the topic, but also the time available for education during prenatal appointments. Furthermore, some PHPs

faced barriers in terms of accessing resources; for example, financial constraints in some clinical and private settings prevented access to subscription-based, peer-reviewed research. Even when resources were available, PHPs were not always aware of them. For instance, the participants were not aware of existing environmental health resources provided by the Canadian Partnership for Children's Health & Environment (CPCHE) or Toronto Public Health. They remarked that there was a need for one central website that they could recommend to their patients for up-to-date information about environmental health, ideally from a trusted source such as the SOGC, Health Canada, or the Public Health Agency of Canada. The other major barrier with the limited available resources (e.g. brochures, handouts) was the lack of multi-lingual, multi-cultural options that could be shared directly with patients.

Despite these barriers, PHPs identified a number of opportunities for the development of EHE in the prenatal care context. First, with regard to training and the role of professional associations, PHPs felt that their associations should include EHE guidelines, resources, and supporting evidence on their websites. The participants suggested that information and training on EHE should be organized as an annual forum or workshop that would be eligible for continuing education validation. Secondly, they recommended the development of billable costing codes (financial codes used to charge for services rendered) so that EHE can be offered as part of the prenatal care plan, as well as guidelines for using auxiliary staff and questionnaires to narrow the scope of EHE to suit each patient. Thirdly, the PHPs proposed the use of interactive technological aids (e.g. surveys, questionnaires, etc.) as well as a one-stop informational resource for parents (e.g. website or brochure) as possible solutions to limited time for EHE during appointments. Such tools and resources would need to be

available in multiple languages and appropriate across cultures. Finally, they highlighted that better regulation of toxicants available in the marketplace would be the most inclusive solution to reducing EHE needs, but each of the PHPs recognized that in the meantime, mitigation through avoidance is the only immediate option available.

Contributions of this work

Theoretical contributions

The theoretical contribution of this research relates to the modification and use of an existing conceptual framework, a model of clinical prevention (Figure 2), developed originally by Walsh and McPhee (1992). This modified version focuses on the individual impacts of the more subjective factors (predisposing, reinforcing, enabling, and health care facility factors) associated with the PHP, that may influence the delivery of EHE to patients. As professionals, PHPs bring distinct backgrounds, personal interests, and biases to their relationships with their patients, which are influenced by their training, experience, and even their physical clinical location. There is significant overlap in each of the factors to ensure that most of the subtle influences on the EHE process are taken into consideration. These factors and influences on EHE could be different from other clinical practices (e.g. physical care). Within this framework, there are factors from the perspective of the PHP that will impact the final delivery of EHE to the patient. The results confirm that some of the reinforcing factors and enabling factors can influence the delivery of EHE to the patient. For example, it was found that the lack of professional association support and training available to PHPs, as well as the

lack of current guidelines, contributed to EHE not being provided to patients. The patient factors that may influence the delivery of EHE were not examined in this research.

Substantive contributions

This research offers significant substantive contributions. First, this work suggests that PHPs lack training, time, and ability to keep up with the latest research on environmental health and advances in EHE. This research supports the notion that EHE should be added to professional training programs and professional certification exams, that it should be offered as continuing education modules to all currently practicing PHPs, and that a collaborative forum for educating and updating PHPs should be established. Secondly, since most professional associations, including the SOGC, have little EHE information, resources, or guidelines available for practitioners, there is a sense that the topic is unimportant or of lesser priority than other health topics. The development of practice guidelines that are readily available for PHPs would help to encourage them to add EHE to their prenatal care plans. Additionally, by focusing on EHE, the professional associations would help demystify the concerns, uncertainties, barriers, and challenges that most PHPs experience when dealing with toxicant exposure.

This research adds to the growing body of information that will inform the development of standards of care surrounding prenatal EHE within Canada, by contributing to the understanding of what is currently being offered to parents. Within the conceptual framework of this research, the larger goal of meeting patient needs through the provision of comprehensive EHE can only be accomplished if the PHP ‘educator’ receives direction and

resources. As a group, PHPs have been left on their own to determine standards of care guidelines, and have thus either focused only on the basic topics (alcohol, tobacco, and illicit drugs) or in some cases have ignored the topic of toxicant exposures entirely. Further, this research has determined that in the case of certain demographic groups, in particular when there are language and/or literacy challenges, the entire EHE process is even more restricted during the prenatal period. This finding highlights the need for EHE tools and resources that are accessible across languages, cultures, and socioeconomic classes.

Limitations

There are a number of limitations associated with this work. First, the entire process only considered the perspectives of PHPs and did not examine those of prospective parents as it has been previously addressed through an earlier study. Secondly, there were some challenges in recruiting PHPs due to scheduling and availability. Some potential interviewees indicated that the ‘cost’ of their participation (removal from patient/revenue-generating office time) was too great. As such, this could reflect a degree of self-selection bias in that only PHPs, who regarded environmental health issues as sufficiently important to warrant taking time away from their practice, did so. In an effort to offset this bias, purposeful sampling was used to select PHPs from many different sectors, with a wide range of ages and experiential backgrounds however the relatively the small sample size of 21 participants is not representative of all PHPs.

A further limitation relates to the fact that many of PHPs primarily served clients in higher SES groups. As a result, the specific needs that might uniquely relate to lower SES

groups (e.g. food security, inadequate housing) are not issues that that are routinely addressed by these PHPs. Similarly, while many of the PHPs were cognizant of the language and cultural barriers that many new immigrant prenatal patients might experience, most of the participants in this study did not work with new immigrants directly. Finally, the scope of the research was limited to the urban area of Ottawa, Ontario, thus it only considers a very limited environmental context.

Directions for future research, and suggestions around EHE training

Future direction and suggestions from the PHPs included the need for professional associations, like the SOGC, to provide standards of care guidelines, as well as evidence-informed training and resources. Ideally, training would be eligible for continuing education credits for professional licensing. An in-person information and training forum was the preferred option for the dissemination of information across all professional sectors, as opposed to online options. The development of billable costing codes for auxiliary staff (medical assistants, nurses) to administer questionnaires was suggested as a potential method to increase the integration of EHE into the existing prenatal care context.

Further research on this topic needs to be carried out in diverse communities across Canada, including rural and Northern communities, industrial centres, and lower-income communities. Doing so would provide important additional insights into different environmental contexts, differences in PHP awareness and perceptions, context-specific EHE practices, and different patient needs. The data would inform the development of both

national standards of practice as well as context-specific standards of practice for EHE by professional organizations.

This work offers insight in to the EHE currently offered to prenatal families. It has been stated in other studies (Laferriere & Crighton, 2017) that these families do not receive much information about environmental health risks from their PHP. This work supports these findings, and suggests that from the perspective of the PHP, EHE is rarely offered directly to prenatal families for a variety of reasons. Future national studies need to further consider PHPs' awareness of environmental health issues and should consider diverse patient perspectives as well as indicated in the initial conceptual framework. Collection of information in both English and French would decrease the inherent limitations of this study.

In the future, national studies are required that will examine both the differences in professional awareness of environmental health and risk management, as well as the variations in perceptions, experiences, and needs across different patient demographic groups. This research would provide valuable insights to inform the development of national guidelines.

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Appendix 1: Interview Guide for PHPs

Preconception and Prenatal Environmental Health Education: Standards of Practice among Prenatal Healthcare Professionals		
Introduction: I am a graduate student from the University of Ottawa studying environmental health education practices among Healthcare Professionals. I am interested in discussing these issues with you. Today's discussion should take no more than 30-45 minutes. With your agreement, we would like to tape record the interview to ensure that we accurately document your views.		
Topic	Questions	Probes
First I would like to learn a little bit about you and your practice		
1. background	Could you tell me a little bit about yourself? Environmental Health background?	- Position? - Year's in position? - Main duties? - Type of clients you work with? - Education? - Years working in the field? - Related experience? -
	Could you tell me a bit about your practice?	- Any take-away brochures? - Online sites?
Now I would like to talk a little bit generally about your patients		
		-
2. Your Patients	In your practice, how would you define your average patient? Are some patients more vulnerable than others? Why?	- Positive and negative - PEHE impact : - SES? Occupation? - Residence - Age - Ethnicity
	What environmental health problems that do you consider the most serious in your practice?	- Inside/outside homes - Most/least affected? Why? - Products purchased etc. - Made the news? (local, national) - Education, pollution laws, enforcement product bans, housing standards? -
		-
	What impact do you think that the	- Types of health problems?

	environmental issues you have mentioned affect maternal health	- Specific to pregnant women/ children?
	Does someone do EH education in your practice? Yourself or other HCP	- Type of EHE? - Who does it,
	What suggestions do you offer for any higher risk groups do? What are limiting factors to taking action?	- Behavioural changes, modify their environments? - Financial resources, information resources, education, other priorities?
4. Your Patients' views on environmental health	What types of environmental concerns are most commonly raised by patients? Do all patients ask? How do you address their questions?	indoor/outdoor environment consumer products food
	What specific health concerns, if any, are typically associated with these environmental issues? Do different groups report different concerns?	- Pregnant women/new mothers? - New immigrants? - Wealthy/poor?
	How would you judge the level of concern among women/new mothers? Do different types of environmental problems affect concern differently?	- Groups: New immigrants? - Literacy, SES, education
5. Activities and information	Please describe research work being done, if any, by your practice on environmental health issues?	- Research - education - programs - policy - advocacy
	Do you tailor your environment and health information or health strategies to specific groups? (i.e. high risk) If yes, what are you doing differently? Do these groups get the help that they feel they need? Explain.	- What groups? -
	Describe some of the challenges in getting the right information about environment and health risks to people needing it most.	- Literacy? - Access to internet? - Language?
		-
	What can you tell me about other local groups/ organizations doing related outreach work on the issues of environmental health risks? Who do you	- Motherisk, Born, Public Health Unit? CPCHE? - -

	typically refer to? Do you use any variations on these tools?	- Which tools?
	Please describe your most common sources of information related to environmental health risks and children? References that you suggest? Would you consider the information most people are getting to be reliable?	- - Professional training - Prenatal Care Forums and Conferences - Professional Associations or updates - Newspapers, TV, internet, parenting books, prenatal classes, other? - Most trusted sources? - Most helpful sources? - Sources of misinformation?
Conclusions That is all of the questions I have for you. Is there anything else you would like to add? Thank-you very much for your time. The information you have provided is very important to us and will go a long way in helping us better understand your work and environmental health issues in the area. If you have any questions about this study please feel free to contact me.		

Appendix 2: Wingspread Definition of Precautionary Principle

Wingspread Statement on the Precautionary Principle

“The release and use of toxic substances, the exploitation of resources, and physical alterations of the environment have had substantial unintended consequences affecting human health and the environment. Some of these concerns are high rates of learning deficiencies, asthma, cancer, birth defects and species extinctions; along with global climate change, stratospheric ozone depletion and worldwide contamination with toxic substances and nuclear materials.

We believe existing environmental regulations and other decisions, particularly those based on risk assessment, have failed to protect adequately human health and the environment - the larger system of which humans are but a part.

We believe there is compelling evidence that damage to humans and the worldwide environment is of such magnitude and seriousness that new principles for conducting human activities are necessary.

While we realize that human activities may involve hazards, people must proceed more carefully than has been the case in recent history. Corporations, government entities, organizations, communities, scientists and other individuals must adopt a precautionary approach to all human endeavors.

Therefore, it is necessary to implement the Precautionary Principle: When an activity raises threats of harm to human health or the environment, precautionary measures should be taken even if some cause and effect relationships are not fully established scientifically.

In this context the proponent of an activity, rather than the public, should bear the burden of proof.

The process of applying the Precautionary Principle must be open, informed and democratic and must include potentially affected parties. It must also involve an examination of the full range of alternatives, including no action.”

--Racine, WI, January 20, 1998

Wingspread Participants:

(Affiliations are noted for identification purposes only.)

Dr. Nicholas Ashford, Massachusetts Institute of Technology
Katherine Barrett, Univ. of British Columbia
Anita Bernstein, Chicago-Kent College of Law
Dr. Robert Costanza, University of Maryland
Pat Costner, Greenpeace
Dr. Carl Cranor, Univ. of California, Riverside

Dr. Peter deFur, Virginia Commonwealth Univ.
 Gordon Durnil, attorney
 Dr. Kenneth Geiser, Toxics Use Reduction Institute, Univ. of Mass., Lowell
 Dr. Andrew Jordan, Centre for Social and Economic Research on the Global Environment,
 Univ. Of East Anglia, United Kingdom
 Andrew King, United Steelworkers of America, Canadian Office, Toronto, Canada
 Dr. Frederick Kirschenmann, farmer
 Stephen Lester, Center for Health, Environment and Justice
 Sue Maret, Union Institute
 Dr. Michael M'Gonigle, University of Victoria, British Columbia, Canada
 Dr. Peter Montague, Environmental Research Foundation
 Dr. John Peterson Myers, W. Alton Jones Foundation
 Dr. Mary O'Brien, environmental consultant
 Dr. David Ozonoff, Boston University
 Carolyn Raffensperger, Science and Environmental Health Network
 Hon. Pamela Resor, Massachusetts House of Representatives
 Florence Robinson, Louisiana Environmental Network
 Dr. Ted Schettler, Physicians for Social Responsibility
 Ted Smith, Silicon Valley Toxics Coalition
 Dr. Klaus-Richard Sperling, Alfred-Wegener- Institut, Hamburg, Germany
 Dr. Sandra Steingraber, author
 Diane Takvorian, Environmental Health Coalition
 Joel Tickner, University of Mass., Lowell
 Dr. Konrad von Moltke, Dartmouth College
 Dr. Bo Wahlstrom, KEMI (National Chemical Inspectorate), Sweden
 Jackie Warledo, Indigenous Environmental Network

Appendix 3: REACH, E.U. chemical regulations:

Registration, evaluation, authorisation and restriction of chemicals

“REACH ([EC 1907/2006](#)) aims to improve the protection of human health and the environment through the better and earlier identification of the intrinsic properties of chemical substances. This is done by the four processes of REACH, namely the registration, evaluation, authorisation and restriction of chemicals. REACH also aims to enhance innovation and competitiveness of the EU chemicals industry.

"No data no market": the REACH Regulation places responsibility on industry to manage the risks from chemicals and to provide safety information on the substances. Manufacturers and importers are required to gather information on the properties of their chemical substances, which will allow their safe handling, and to register the information in a central database in the [European Chemicals Agency \(ECHA\)](#) in Helsinki. The Agency is the central point in the REACH system: it manages the databases necessary to operate the system, co-ordinates the in-depth evaluation of suspicious chemicals and is building up a public database in which consumers and professionals can find hazard information.

The Regulation also calls for the progressive substitution of the most dangerous chemicals (referred to as "substances of very high concern") when suitable alternatives have been identified.

One of the main reasons for developing and adopting the REACH Regulation was that a large number of substances have been manufactured and placed on the market in Europe for many years, sometimes in very high amounts, and yet there is insufficient information on the hazards that they pose to human health and the environment. There is a need to fill these information gaps to ensure that industry is able to assess hazards and risks of the substances, and to identify and implement the risk management measures to protect humans and the environment.

Having entered into force in 2007, REACH provisions are being phased-in over 11 years. Companies can find explanations of REACH on the [DG GROWTH](#) (Internal Market, Industry, Entrepreneurship and SMEs) or [ECHA](#) websites, and can contact [national helpdesks](#)".

Directly accessed from REACH information website:

http://ec.europa.eu/environment/chemicals/reach/reach_en.htm

Appendix 4: Chemicals Management Plan

OVERVIEW OF THE CHEMICALS MANAGEMENT PLAN

Why the CMP exists

Chemicals are an integral part of everyday life, essential to our economy, our communities and our homes. While chemical substances provide benefits, they may also have harmful effects on human health and the environment if not properly managed. The Government of Canada created the Chemicals Management Plan (CMP) in 2006. The CMP builds on previous initiatives to protect human health and the environment by assessing chemicals used in Canada and by taking action on chemicals found to be harmful. Delivered jointly by Environment Canada and Health Canada through partnership and engagement with stakeholders, the CMP helps protect Canadians and their environment from the harmful effects of chemical substances.

What the CMP does

The CMP assesses environmental and human health risks posed by chemical substances, and develops and implements measures to prevent or manage those risks. It does so by using the most appropriate management tools from a broad suite of federal laws, including the *Canadian Environmental Protection Act, 1999*, the *Canada Consumer Product Safety Act*, the *Food and Drugs Act*, the *Pest Control Products Act*, and others.

The figure below sums up the chemicals management cycle.

The CMP Cycle



CHEMICALS
MANAGEMENT
PLAN
PLAN DE
GESTION DES
PRODUITS CHIMIQUES





In 2006, the Government of Canada completed a triage of some 23,000 chemicals that had been in commercial use during the previous two decades. That triage process identified 4,300 substances for further attention. The goal of the CMP is to address all 4,300 of those substances by 2020.

Furthermore, prior to the introduction of substances new to Canada, the Government assesses and, when necessary, manages any potential risks to Canadians and their environment.

Risk Assessment – CMP risk assessors conduct scientific evaluations to identify potential environmental and health risks from the generation, transportation, use and disposal of substances. This assessment allows the government to determine if some form of management of the substance is needed.

Risk Management – Some substances can have harmful short- or long-term effects. In these cases, the government develops measures to prevent or manage those risks. The CMP tailors these measures to the substance and the risks it poses. Risk management actions may include restrictions on how a chemical substance can be used; how it is made; or the amount or concentration that can be released into the environment. A suite of risk management measures under different federal statutes is available, including regulations, agreements, pollution prevention notices, labelling requirements, guidelines and codes of practice.

Compliance Promotion and Enforcement – The government ensures that businesses and other organizations are aware of and comply with applicable risk management obligations.

Research and Monitoring – The government invests in research and monitoring, including <biomonitoring>, to provide essential information about chemical exposures and their effects on human health and the environment. These data provide the basis for developing sound and effective public health and environmental health policies and interventions, as well as for measuring the efficacy of control measures.

Stakeholder Engagement and Outreach – Engaging stakeholders and the public is central to the CMP. Stakeholders remain informed and contribute to CMP through regular public information sessions and consultations. In addition, the CMP Stakeholder Advisory Council offers advice and input from industry, non-governmental organizations and Aboriginal groups on the implementation of the plan. Outreach to the public is key to ensuring that Canadians understand information on the risks and safe use of chemicals.

Information Gathering and Reporting – It is important to base decisions on the best available information. The government collects information to support risk assessment and risk management decisions using a variety of approaches, such as information-gathering requirements issued under the *Canadian Environmental Protection Act, 1999*, voluntary information-gathering initiatives conducted in cooperation with industry, as well as research, monitoring and surveillance and international cooperation activities.

Cooperation and Collaboration – in Canada and Internationally

The government works with industry, academics, other stakeholders and other governments, both domestically and internationally, to share information, avoid duplication and work towards the sound management of chemicals globally.

How the public can get involved

The <Chemical Substances> website provides information on all activities related to the CMP, including opportunities for the public to comment on all significant documents and decisions, and how to participate in information sessions. <Subscribe> to receive the latest news when updates are posted on the website.