Regulating Toxics: Sex and Gender in Canada's Chemicals Management Plan

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Abstract:
Chemical substances are found everywhere in our environment. Whether it be at home, outdoors, or in the workplace, we are continuously coming into contact with various chemicals through our air, water, food, cosmetics, clothes, personal care products and everyday household items (Cooper, Vanderlinden, and Ursitti 2011; Program on Reproductive Health and the Environment 2008). As our detection methods improve, we are increasingly forced to confront the evidence of these exposures: biomonitoring studies now show that nearly everyone has measurable amounts of almost all known toxic chemicals stored somewhere in their bodies (CDC 2013; Environmental Defence 2009; Statistics Canada 2012). At the same time, we are witnessing a rise in incidence of a number of diseases and disorders in men and women. These include mutagenic illnesses, irreversible developmental and neurodevelopmental syndromes, reproductive disorders, and a number of autoimmune diseases. Many scientists, environmental groups and health practitioners suggest that the rising incidence of many of these disorders and diseases can be tied to chemical exposures in our environment (Cooper, Vanderlinden, and Ursitti 2011).

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Chemical substances are found everywhere in our environment. Whether it be at home, outdoors, or in the workplace, we are continuously coming into contact with various chemicals through our air, water, food, cosmetics, clothes, personal care products and everyday household items (Cooper, Vanderlinden, and Ursitti 2011; Program on Reproductive Health and the Environment 2008). As our detection methods improve, we are increasingly forced to confront the evidence of these exposures: biomonitoring studies now show that nearly everyone has measurable amounts of almost all known toxic chemicals stored somewhere in their bodies (CDC 2013; Environmental Defence 2009; Statistics Canada 2012).

At the same time, we are witnessing a rise in incidence of a number of diseases and disorders in men and women. These include mutagenic illnesses, irreversible developmental and neurodevelopmental syndromes, reproductive disorders, and a number of autoimmune diseases. Many scientists, environmental groups and health practitioners suggest that the rising incidence of many of these disorders and diseases can be tied to chemical exposures in our environment (Cooper, Vanderlinden, and Ursitti 2011).

There is also growing evidence that these exposures affect different bodies in different ways, due to the fact that people’s lives and health are influenced by both biological (sex-related) and social (gender-related) factors. Not only do women, men, boys and girls possess different vulnerabilities to exposure based on biology; they also face different health risks based on gendered practices, socioeconomic and cultural circumstances, structural disparities in access to basic resources, varied health-seeking behaviours, and different responses from health systems leading to diverse health outcomes (Clow et al. 2009). The Canadian federal government has a clear primary responsibility and
role in ensuring a safe environment and healthy population. An analysis of chemical exposures, their biological and social impacts, and the implications for the evaluation and management of toxic substances should therefore be undertaken with sex and gender considerations in mind.

**Chemicals Management in Canada**

As mentioned in the introduction, while there are several federal, provincial and municipal regulatory frameworks that influence the degree to which Canadians come into contact with chemicals, the *Canadian Environmental Protection Act, 1999* (CEPA) (Part 5) is the primary legislative tool for managing toxic chemical risks. It includes specific requirements for assessing and managing approximately 23,000 substances currently used in commerce or being released in Canada in significant quantities. These substances are listed in an inventory called the *Domestic Substances List (DSL)*, and are jointly assessed by The Minister of the Environment and the Minister of Health to determine if they meet the definition of “toxic” under CEPA (“CEPA-toxic”). The process of categorization of the DSL, which took place between 1999 and 2006, involved the identification of low, medium, and high priority substances based on whether they are persistent, bioaccumulative, and inherently toxic (PBiT), or present significant potential for human exposure.

On December 8, 2006, following the completion of the categorization process, the federal government introduced the ‘Chemicals Management Plan’ (CMP) (Environment Canada 2012; Government of Canada 2013a). The CMP is a joint initiative of Health Canada and Environment Canada aimed at improving the degree of protection against hazardous chemicals in Canada and ensuring their proper management through a number of proactive measures (Government of Canada 2013b). The Plan focuses on chemicals flagged as potentially harmful in the categorization process. These substances include those that were put into commercial use before 1987 without ever being subjected to a health and environmental assessment. The stated intention of the CMP is to provide a
basis for sound and effective public and environmental health policies, interventions, and control measures through substance identification, tracking of exposures, monitoring, and surveillance.

The CMP mandates the evaluation of substances to determine whether they meet the criteria for CEPA-toxicity and should be added to the List of Toxic Substances in Schedule 1 of the Act (Schedule 1) (Government of Canada 2013b; Environment Canada 2012). The decision to add a substance to Schedule 1 is based on several factors. One factor is whether a substance meets the ecological criteria of persistence, potential for bioaccumulation, and inherent toxicity (PBiT), and presents a significant risk of exposure. Another factor is whether the substance is identified as posing considerable hazard to human health based on available evidence on carcinogenicity, mutagenicity, developmental toxicity, or reproductive toxicity (Environment Canada 2012; Government of Canada 2013b).

Adding a chemical to Schedule 1 gives the federal government the authority under CEPA to place restrictions—known as “risk management measures”—on the substance. Measures can include: regulations limiting substance-related activities or substance concentrations in the environment; pollution prevention plans that outline actions to prevent or minimize the creation or release of pollutants; environmental emergency plans; guidelines to recommend a concentration for toxic substances; and voluntary codes of practice, among others. It is important to note that adding a chemical to Schedule 1 does not necessarily require further action on the part of the government to restrict or manage the substance (Scott 2009).

One of the most contentious elements of the CMP has been the Ministerial Challenge program (“The Challenge”). The program called on chemical manufacturers, importers, and industrial users to provide new information about the properties, uses, releases, and management of 200 high priority chemical substances which are PBiT and present a high likelihood of exposure (Canada Gazette 2006; Government of Canada 2013b). Regulators indicated that they would find substances “CEPA-toxic” under The Challenge, based on a ‘weight-of-evidence’ approach and the precautionary principle, unless industry submitted evidence convincing them otherwise.
Environment Canada and Health Canada began by drafting a risk assessment (also called a “screening assessment”) for each substance to evaluate exposure and harm to human health and the environment. This was done using a voluntary questionnaire, technical substance profiles, and mandatory surveys, as well as data from original literature, assessment documents, stakeholder research reports, literature reviews, and computer modeling records. In the assessment, the government developed conclusions about the toxicity of the substance, and decided whether or not to list it on Schedule 1 (Government of Canada 2013b). Decisions to add a substance to Schedule 1 based on harm to human health were determined through a comparison of known and estimated chemical exposure and effect, as well as an assessment of how confident the government was that the data set was complete (Government of Canada 2013c; Health Canada 2008). This first phase of the CMP was completed in 2011.

A second phase, starting in 2011 and spanning five years, is meant to build on the government’s stated commitment to protect the health of Canadians and the environment, by further improving product safety in Canada; completing assessments of 500 substances across nine categories including phthalates; and investing in additional research for substances like Bisphenol A, flame retardants, substances that affect hormone function and substances that affect the environment (Government of Canada 2013b; Health Canada 2011). In addition, approximately 1,000 substances will be addressed through other initiatives, including rapid screening assessments of substances which pose little or no risk (Government of Canada 2013b; Health Canada 2011).

Despite more optimistic beginnings (see Scott 2009), our analysis after one completed phase is that the CMP process has resulted in a relatively modest number of substances being designated as “CEPA-toxic” and added to Schedule 1 (Environment Canada 2013a). Further, and more disappointing is that even for the substances added to Schedule 1, corresponding risk management measures have been inadequate and slow in coming. The result is that the ultimate goal of the CMP—reductions in exposures to harmful substances for everyone—is not likely to be met in the near future. As we argue
in the next section, the failure to effectively regulate toxic substances has disproportionate impacts on women.

**How the CMP is Failing Canadian Women**

Sex and gender are important considerations in the assessment and regulation of toxic substances, as male and female bodies respond to harmful chemicals in different ways, and men and women tend to have distinct patterns of use and exposures to chemicals based on their particular social location. Women have a unique susceptibility to chemicals as a result of subtle sex-specific differences in biochemical pathways, hormones, metabolism, body fat composition, blood chemistry, and the size of body tissues (Arbuckle 2006; Buckingham and Kulcur 2009; Clow et al. 2009; Public Health Agency of Canada 2009). As discussed in Phillips and MacKendrick (this volume), the timing of exposures can further influence the effect of chemicals on a woman’s body, with emerging epidemiological evidence showing that women can be more biologically vulnerable to certain exposures during *critical windows of vulnerability* (Batt 2008/9; Cooper and Vanderlinden 2009; Eyles et al. 2011; Gray, Nudelman, and Engel 2010). These windows, which include the prenatal period, early life, puberty, pregnancy, lactation, menstruation, and menopause, represent times of development or hormonal activity in which women are more sensitive or susceptible to chemical exposures, and their ability to adapt to these exposures may be compromised. Additionally, while traditional toxicology has been based on the understanding that the greater the dose to a toxic substance, the greater the harm, new research points to low doses of some chemicals having more severe effects than high doses, especially during critical windows of vulnerability (Brophy et al., this volume; Kortenkamp 2008; Kortenkamp et al. 2012; Vandenberg et al. 2012). Exposures during these critical windows can interrupt hormonal processes and can lead to health problems, such as chronic disease, disorders, and developmental or reproductive problems in a woman, her fetus, children, and subsequent generations (Butter 2006; Gray, Nudelman, and Engel 2010; CHE 2011; Reuben 2009).
Exposure to contaminants at various developmental stages is also strongly influenced by social, economic, and cultural factors. As noted in the chapters by Phillips and Mackendrick, a woman’s risk of exposure depends on her social location, which is characterized according to what the experts call the “social determinants of health.” These include: socioeconomic or occupational status, race or ethnicity, sexual orientation, education, age, language, living conditions or geography, nutrition, and access to safe drinking water (Chakravartty 2010; Cooper, Vanderlinden, and Ursitti 2011; Gupta and Ross 2007; Hamm 2009; MacGregor 2010; Public Health Agency of Canada 2011; Scott and Stiver 2009). Sometimes a woman will experience disadvantage in multiple areas of her life, compounding her risk of chemical exposure. For example, women’s work in the domestic sphere, a space that is largely unsupervised and unregulated, often brings women into direct contact with chemicals. In this case, avoiding or minimizing exposures requires navigation among the needs and health of the family, economics, time and environmental considerations (Buckingham and Kulcur 2009). Additionally, women constitute a large percentage of the country’s poor (Rahder 2009). Poverty and low social status put women in these circumstances at greater risk of exposure to environmental contaminants and less likely to be involved in decision-making about environmental health issues. These factors are often shaped by gender norms framed by social institutions such as the media, academia, and health care systems that define, reproduce, and often justify different expectations and opportunities for women, men, girls and boys (Clow et al. 2009; MacGregor 2010). The present CMP process does not explicitly acknowledge the unique set of considerations raised by these sex and gender differences with respect to chemical exposures and effects, or consider how women’s social or economic situations might influence their capacity to manage chemical exposure and risk. As a result, the differential impacts women experience from contact with chemical substances are overlooked in assessments. Final decisions about chemical use in Canada often fail to take into account possible long-term health implications for women. It is important that the CMP undertake an analysis that recognizes women as a vulnerable group, and works to confront the reasons why chemical evaluation cannot be a ‘one-size-
fits-all’ practice.

**Burdens of Managing Risk Fall on Women**

To date, the CMP process has fallen short: it has not delivered on its mandate to reduce and ultimately eliminate toxic chemical exposures, with the aim of safeguarding human health. Instead, the work of decreasing exposures seems to have fallen on individual Canadians. This can be seen in the frequent calls for effective “labeling” of consumer products containing toxic substances, a staple of groups seeking policy change around toxics (Boyd 2010; David Suzuki Foundation 2012; Deacon 2011; Smith and Lourie 2009). These demands are usually voiced in the language of the consumer’s “right-to-know” about the contents of the products they use, so that consumers may make informed decisions about their purchases. But in the end, labeling only serves short-term needs, and ultimately encourages practices of precautionary consumption discussed by Norah MacKendrick (MacKendrick 2010, and this volume). Instead of ensuring that chemicals are eliminated from various consumer products based on their risk of exposure and potential to harm human health, the responsibility is instead placed on the consumer to make decisions on products based on what they believe is healthy and safe (Altman et al. 2008; MacKendrick, this volume).

Because women are often the primary caregivers within the home and family, and usually control household consumption, the burden of this individualized regulatory regime and the duty to make ‘informed choices’ often falls on women. This practice reinforces women’s socially prescribed roles as providers for the household, adding to their ‘care burden’ from both a physical and emotional perspective, and contributing to the gendered divisions of labour and exploitation of women’s unpaid work in the home (Buckingham and Kulcur 2009; MacGregor 2010; Picchio 1992; The Source Women’s Health Data Directory (The Source) 2013).

Further, practices of precautionary consumption cannot guarantee reduced exposures or fewer adverse health outcomes. Exposures to a certain chemical could theoretically be avoided by staying
away from certain labeled products, but exposures to the same chemical might occur as additives or residues in other consumer products that are unlabeled (MacKendrick, this volume). The stakes for women are high, as personal care and cleaning products are heavily marketed towards—and used by—women, thereby increasing women’s exposure to harmful chemicals.

As noted by MacKendrick (2011), precautionary consumption raises equity concerns: we know that women will vary in their capacities to engage in informed decision making around product purchases based on levels of education, income, language proficiency, scientific literacy, time and geography. As a result, precautionary consumption is more likely to happen within groups with higher socioeconomic and education status who are able to obtain "green" alternatives that are not affordable to all Canadians—a particular concern for women who make up the majority of Canada’s poor (Chakravartty 2009; MacKendrick, 2011). Further, labeling is a policy response that fails to address the production of chemicals, and their use in manufacturing processes that may have impacts on workers or communities in which those facilities are located, as explored later in this volume.

Canadian chemicals regulation should be more sensitive to how burdens of exposure might be placed on women as a result of their societal roles and responsibilities. This type of social analysis is regrettably missing from assessments of chemicals within the CMP, ultimately encouraging risk management to fall disproportionately onto women. Regulatory frameworks, as well as campaign priorities of environmental non-governmental organizations (ENGOs), need to shift from those of individual action to ideas of collectivized care, that emphasize public decision-making and government policy, and work to support and protect all women (MacGregor 2010).

**Why the CMP is Failing Canadian Women**

There are various elements of the CMP that neglect to include sex and gender considerations. The current assessment process under the CMP employs inadequate endpoints, dated assessment
Methodologies suffer from several data gaps, and are hindered by a lack of legislative requirements for examining cumulative and longitudinal chemical effects (Lewis 2011). Further, fragmentation in the regulatory regime means that occupational exposures are not included in overall exposure estimates. Finally, there are restrictions in public participation, inadequate risk management measures, and a lack of commitment to implement a genuinely precautionary approach. As a result of these weaknesses in the process, health issues unique to women are not appropriately recognized or researched, women’s voices have been left out of important decisions about their health, and Canada is failing to advance towards a safer and more inclusive chemicals management regime. Only in acknowledging and properly addressing these gaps in the assessment and management of chemicals, will the federal government be able to provide a comprehensive tool that adequately integrates sex and gender concerns.

**Inadequate Endpoints**

A toxicity hazard endpoint is a biological event used to determine when a change in the normal function of the human body occurs as a result of toxic exposure. Such an event can include the growth of cancerous tumours, or the development of reproductive irregularities (e.g. infertility, miscarriage). Under CEPA, the government is required to assess substances for carcinogenicity, mutagenicity, developmental toxicity and reproductive toxicity (the “endpoints” for assessing a chemical’s effect on human health) (Government of Canada 2013b). Critics allege that the government’s assessment and management decisions have been based almost exclusively on carcinogenicity, and have neglected endpoints that may have more importance for women’s health (Tilman 2010a). These include neurodevelopmental impacts, and hormonal and endocrine disrupting effects.

Endocrine disrupting chemicals (EDCs) are structurally similar to hormones and are capable of triggering changes in how cells and organs function, having an impact on a diverse array of metabolic, growth and reproductive processes in the body (European Commission 2013; Schwartz and Korach
In recent years, evidence has proliferated related to the significant impact EDCs are having on the health of Canadians (Hanahan and Weinberg 2000; Thornton 2000; vom Saal and Sheehan 1998). Beyond physical changes to the body, evidence has demonstrated that EDCs can have an impact on the imprinting of genes (these are known as ‘epigenetic’ changes) (Crews and McLauchlan 2006; TEDX 2013). Changes in gene expression through chemical exposure can lead to detrimental impacts on a person’s health and the health of their children, contributing to the development of cancer and other diseases later in life (Crews and McLauchlan 2006; Eyles et al. 2011; Gray, Nudelman, and Engel 2010; Kloc 2011; TEDX 2013). A growing body of knowledge suggests that epigenetic effects extend to gender differences in brain function and behaviour. Many psychiatric disorders—such as depression—that are controlled by hormones and often manifest after critical windows of vulnerability, tend to disproportionately affect women (Crews and McLauchlan 2006).

A number of studies have also demonstrated a relationship between early life exposures to EDCs and the dramatic increase in incidence of contested diseases and disorders over the last two decades, especially in women (Brown 2007; Crews and McLachlan 2006; Gray, Nudelman, and Engel 2010; Moss and Teghtsoonian 2008; Program on Reproductive Health and the Environment 2008; TEDX 2013). Breast and thyroid cancer, multiple chemical sensitivity, fibromyalgia, and autoimmune diseases produce symptoms that are often ignored or poorly understood by traditional medical practitioners, have delayed diagnoses, and result in women having unequal access to health care services and qualifying for or acquiring insurance and disability (Butter 2006; Genius 2010; Moss and Teghtsoonian 2008).

Despite these understandings, detailed knowledge about exposure to endocrine disruptors and their potential health effects exists for only a handful of substances under the CMP (e.g., bisphenol A (BPA)), even though endocrine disruptive potential is suspected for many more substances (Cooper and Vanderlinden 2009; Environment Canada and Health Canada 2008b; TEDX 2013). Additionally,
endocrine disruption potential was not explicitly requested in mandatory surveys sent to industry to collect information on the extent and nature of manufacture, import, export and use of a particular ‘Challenge’ substance being considered ‘CEPA-toxic’; nor was it required under the voluntary questionnaire, an invitation to interested stakeholders to submit additional data relating to the use of these substances (CELA/CSM 2010c; Environment Canada 2010; Tilman et al. 2010). As a result, risk assessments continue to overlook understudied diseases that disproportionately affect women. It is important that additional data be gathered for alternative toxicity hazard endpoints, even if it means conducting new biomonitoring studies and laboratory tests, in order to account for sex- and gender-specific effects of chemical exposure (Crews and McLachlan 2006; de Leon, Richardson, and Madray 2010).

Use of Dated Assessment Methodologies

New theoretical considerations around toxicology and modes of action of various chemicals challenge pre-existing assessment methodologies currently used under the CMP. Current risk assessments are based on two key assumptions: (1) the greater the dose of chemical exposure, the greater the harm to human health, and (2) human bodies can safely accommodate some degree of chemical exposure based on the idea of “thresholds.” New research now shows that a number of chemicals, including EDCs, can cause adverse health impacts at low doses, can increase risk at any level of exposure, and can have different modes of action (eg. epigenetic effects) that lead to diverse health outcomes (Hanahan and Weinberg 2000; Thornton 2000; Vandenberg et al. 2012; vom Saal and Sheehan 1998). As a result, the accepted assessment approach is inadequate in ensuring the safety of Canadians, and the health of women in particular.
Gaps in Research Data

Inconsistent and insufficient data coupled with analytical shortcomings in risk assessment documents contribute to difficulty in ascertaining health outcomes that are sex and gender specific. Frequent data gaps exist in information collected for high priority chemicals with respect to hazard, exposure scenarios, and use applications. Numerous questions still go unanswered in assessments, including what constitutes a high and low dose, the timing of exposures, the delayed effects of exposure, and confounding variables. Adverse effects of a substance are often acknowledged but rarely explored. Some studies have been found to be deficient or of low reliability based on highly uncertain modeling data, or not following scientific protocol, yet they have still been judged as of satisfactory confidence (Tilman 2010b; Tilman et al. 2010). In a number of cases, risk assessments have been critiqued for the practice of filling information gaps with informed guesswork, and using discretion where there was limited information, leading to no-risk conclusions and justifying a refusal to regulate (Cooper and Vanderlinden 2009; Gray, Nudelman and Engel 2010). Obtaining comprehensive scientific research on environmental exposure is made more difficult by the absence of a well-recognized Canadian institute of environmental health research or equivalent body that could provide sufficient funds for research and the training of researchers in environmental exposures.

Additionally, studies used by Health Canada to assess chemicals under the CMP rarely focus on gender-specific responses to exposure, and physical effects on women are often only measured in relation to the health of the fetus and newborns. A large percentage of research in the lab is still done using male rats and mice, even in the study of diseases that disproportionately affect women (Beery and Zucker 2011; Hughes 2007; Mergler 2012; Pigg 2011; Wald and Wu 2010). This dependency, and the lack of critical reflection on research practices in clinical studies, may hamper efforts to understand the unique biological effects of chemical exposure on women, and to tackle diseases that affect women more than men through more inclusive science and health policy.
Finally, while there are some assessments that separate data on chemical use or exposure based on sex (also known as sex- and gender- ‘disaggregated’ data), the government has yet to employ these data in a meaningful way, and continues to apply a mean all-person daily intake approach for many substances (Environment Canada and Health Canada 2010). There is a critical need for more disaggregated data to be made available, to be incorporated into a greater number of chemical assessments, and to be sufficiently considered in final decisions (Clow et al. 2009; Mergler 2012).

These weaknesses in data collection and methodology highlight the need for comprehensive monitoring and new research that is both current and addresses sex and gender concerns (Chakravartty 2010). The absence of such information, however, should not prevent the government from taking action to protect Canadians more fully from these chemicals through precautionary measures.

*No Legislative Requirements to Consider Possible Cumulative, Synergistic, Longitudinal or Delayed Effects*

Research has demonstrated that exposure to a mixture of chemicals can be much more toxic than exposure to chemicals on an individual basis (Eyles et al. 2011; Program on Reproductive Health and the Environment 2008). With the exception of a limited number of chemical ingredients in pesticides under the *Pest Control Products Act*, chemicals management policy in Canada remains committed to the unsatisfactory and narrow practice of examining the effects of chemicals one at a time, failing to consider the real-world circumstances of exposure to multiple chemicals. Assessments rarely acknowledge that certain chemicals might interact in combination with other chemicals in the environment to produce effects that none could produce on their own, and that cumulative or aggregate impacts are possible in relation to other environmental stressors. All of this is relevant and important as we characterize actual exposures and assess toxicity (Boyd 2003; Eyles et al. 2011; Ginsburg and de Leon 2010; Tilman et al. 2010). In particular, the potential for multiple exposures to chemicals with a common mechanism of toxicity (or “mode of action”) calls for attention to the effects of mixtures
(Scott 2008). Some substances that belong to the same chemical class or family may have similar toxicity impacts and use patterns, and additive or cumulative effects for these chemicals need to be included in federal chemical assessments (CELA/CSM 2010a). This is of particular concern when considering gender, and the cumulative chemical exposures women may experience on a daily basis as a result of the particular environments they occupy and the products they use in and outside the home.

Additionally, little research has been done on the longitudinal effects of chemical exposure on health and the environment. Other than the Maternal-Infant Research on Environmental Chemicals (MIREC) study, a longitudinal study following exposures in pregnant women, the government has not demonstrated a commitment to long-term biomonitoring initiatives that could deliver reliable evidence about the effects of prenatal exposures to chemicals on the health of individuals later in life (Arbuckle et al. 2013; MIREC 2013). This is in contrast to a number of more indepth studies in other jurisdictions, such as the National Children's Study being developed in the U.S., that will follow the effects of exposure on the children of 100,000 families across the country from conception to the age of 21 (Eunice Kennedy Shriver National Institute of Child Health and Human Development of the National Institutes of Health 2012).

New data needs to be generated around the cumulative, synergistic and long-term effects of chemicals, and mixtures that contain potentially toxic chemicals, in order to understand how chemical interactions affect sex and gender. There is also a need for more long-term exposure monitoring/biomonitoring studies that show the effects of exposures to specific chemicals at various windows of vulnerability, how those exposures affect gendered development and health later in life, and how a phase-out of a chemical can lead to a weakened association between exposure and negative health impacts (Cooper and Vanderlinden 2009).

_Lack of a Regime for Occupational Exposure_

Occupational exposures to chemical substances can play a considerable role in exacerbating health
disparities. Despite evidence that workers are getting sick from exposure, and more studies that show a connection between occupational exposure and disease, there continues to be widespread exclusion of women from many occupational health studies and a lack of longitudinal data on women’s exposures in the workplace (Messing and Stellman 2006). This is of concern when gender discrimination in the workplace and gendered divisions in labour often lead to inequalities in risk of occupational exposure for women workers (Smith and Stiver and Brophy et al., this volume; Messing et al. 2003; Quinn 2011). Because women are disproportionately in the low-income bracket, they are more likely to take on precarious employment and are found in greater numbers in hazardous work environments (Noack and Vosko 2011). Occupations like automotive plastics manufacturing, agriculture, aesthetics, cleaning and housekeeping services, and health care bring women workers into direct contact with a number of harmful carcinogenic substances and EDCs, such as solvents, flame retardants, pesticides and detergents, sometimes at levels above what is considered safe (Brophy et al., this volume). Workers are also often exposed to a mixture of chemicals that may have harmful additive or synergistic effects on health. A shortage in research on women’s health and exposure in the workplace makes it difficult to evaluate relationships between gender-specific disease and occupational exposures, especially during windows of vulnerability (Thompson et al. 2005).

These types of industrial workplaces also tend to be less regulated and have poor health and safety protections. The precarious nature of this work can have a chilling effect on efforts to gain occupational health improvements because of the fear of job loss (Lewchuk, Clarke and de Wolff 2008). Many of these jobs are held by new immigrants or racialized groups who enjoy fewer legal protections, lower rates of unionization, and less access to health care than the general population. These factors limit the ability of many to protect themselves from exposure or to seek medical care in response to chemically-induced health problems (BOLS 2005; Gray, Nudelman, and Engel 2010; Jackson 2004).

Finally, aside from general terms set out in national occupational health and safety legislation
and provisions in Quebec's *Occupational Health and Safety Act* (2013) providing for preventive leave during pregnancy, very little attention has been paid to pregnant women's exposures in the workplace and the possible dangers to the health of the foetus (Julvez and Grandjean 2009; Regulation Respecting Occupational Health and Safety, RRQ, c S-2.1, r 13). More research needs to be done in this area to fully understand the effects of in utero exposures on the health of individuals later in life. See for example the growing body of literature known as FOAD (Fetal Origins of Adult Disease).

Workplace health and safety regulation is currently split between federal and provincial jurisdiction. A small percentage of the Canadian workforce is covered by federal legislation (e.g. the Canada Labour Code, Federal Occupational Health and Safety regulations) for work that is outside the authority of provincial legislatures (Canadian Centre for Occupational Health and Safety 2013). Federal jurisdiction over occupational health and safety has also been established in certain cases where federal and provincial regulations overlap (see Bell v. CSST, SCC 1998). All other workplaces fall under provincial health and safety legislation, such as the Ontario Occupational Health and Safety Act. This division in regulatory powers has contributed to a federal chemicals management regime that fails to capture occupational exposure in the creation of policy around potentially toxic chemicals, and excludes workplace exposures in risk assessments of chemicals under the CMP. As a result, negligible attention is paid to how the combination of exposures in the workplace, the home, and the external environment might increase hazards to workers and elevate harm to human health (Brophy et al., this volume; Gray, Nudelman and Engel 2010). In order to adequately address the risks of toxic exposures and to allow for better correlations between exposures and health outcomes, it is important that occupational exposures be fully and meaningfully included in assessments of chemicals under the CMP and their impact on health incorporated into understandings of risk.

**Consequences of Information Gaps**
The above gaps in assessment information lead to weaknesses in evaluations by the federal government to ascertain whether a chemical is safe. The margin of exposure evaluation within an assessment tries to determine whether a chemical is safe by calculating the difference between the estimated threshold at which a chemical is considered harmful to human health, and its estimated exposure level. This evaluation rarely takes into account the ways in which sex and gender considerations might influence margin values (see Figure 1). For example, the estimated threshold of a chemical can be much lower for women depending on the timing of exposure (if the exposure occurs during critical windows of vulnerability). Moreover, the estimated exposure level can be elevated as a result of a woman’s domestic responsibilities and their disproportionate contact with gender-specific products. Exposure levels would be even higher if additional toxic loads, such as occupational exposure, were included in chemical assessments. The margin of exposure evaluation also fails to take

![Narrowing Margin of Exposure](image)

**Figure 1**: The ways in which timing of exposure, gendered vulnerabilities of exposure, occupational toxic loads and similar modes of action of various chemicals can culminate in a margin of exposure (MOE) that is much lower than what is estimated by government risk assessments under the CMP (source: Lewis 2011).
into account chemicals that have similar modes of action. This includes chemicals with similar structures or substances with common mechanisms of toxicity that, when combined in the body, could exacerbate toxic effects. Considering all of these variables, it is likely that in many cases the margin of exposure is vastly over-estimated, especially in relation to women’s exposures.

**Restricted Public participation**

An emphasis by government and ENGOs on individual consumption strategies to mediate chemical exposure encourages women to assume that their contribution to regulating chemicals is by “doing good shopping” for safe product choices (Boyd 2010; David Suzuki Foundation 2012; Deacon 2011; Government of Canada 2011; Health Canada 2013a; Smith and Lourie 2009). This practice does not ensure the protection of Canadians from exposures to many harmful substances or to the additive effects of chemical mixtures, and assumes that women have the education and funds to make safe choices (MacKendrick, 2011). For women to be truly engaged in the CMP process, transparency in the decision-making practices of government officials around chemicals regulation is paramount. The public requires a better understanding of what is found in products, the potential risks of chemical exposure in everyday products, and how regulators have analyzed and compared the costs and benefits of potential risk management actions for each toxic chemical, in order to allow for meaningful participation in government decision-making on chemicals management and regulation (de Leon, Richardson, and Madray 2010). For example, the structure of the CMP allows for important decisions about the toxicity of chemicals to be based on confidential information or studies that are not peer-assessed (Scott 2009; Tilman et al. 2010). Restricting public access to information impedes others from obtaining adequate information on a substance and assessing the quality of the data provided. This lack of transparency affects the ability to make decisions that adequately address the health and well-being of Canadians and the integration of understandings of sex and gender into the risk assessment process.
An Emphasis on Risk Management over Pollution Prevention

The federal government made a clear commitment to pollution prevention in chemicals management with its 1995 federal Pollution Prevention Strategy, and its positioning of pollution prevention as a cornerstone of CEPA 1999. Unfortunately, to date few pollution prevention plans have been proposed under the CMP for high priority substances found to be toxic, with rare exceptions like BPA (Environment Canada and Health Canada 2008a). The government’s approach to risk management so far reveals a preference for non-regulatory mechanisms that have little legal standing, focusing action on end-of-the-pipe solutions, and generally aiming to maintain continuous chemical use with only slight reductions in releases (Chakravartty 2010; de Leon, Richardson and Madray 2010). An observable trend in risk management over recent years is the increasing use of Significant New Activity Notifications (SNAs). This mechanism allows for the preservation of the regulatory ‘status quo’ in relation to a substance that could pose harm, but for which, at present, there is not a significant level of exposure in Canada. SNAs involve imposing a requirement on industry to submit additional information on existing chemicals under the CMP whenever a new activity is proposed that could increase exposure potential and contribute to a substance becoming ‘CEPA-toxic’ (Government of Canada 2012). Another common tool has been the addition of chemicals to the Cosmetic Ingredient Hotlist, a record of prohibited and restricted cosmetic ingredients published by Health Canada (Health Canada 2013b). Once a chemical is placed on the Hotlist, the government can require industry to remove the ingredient from a formulation, reduce the concentration of the ingredient, provide evidence that the product is safe for its intended use, or confirm that the product is labeled as required.

Such actions are not adequate in addressing hazards and risks posed by chemicals. These approaches do not require industry to submit data on vulnerable populations (such as women), chronic toxicity, endocrine disruption potential, neurotoxicity or cumulative/synergistic effects that might differentially affect women’s health. Additionally, these mechanisms provide little information on what they involve, have only limited opportunities for the public to engage in subsequent assessments, and
can permit the continued usage of a range of toxic chemicals (CELA/CSM 2010b; de Leon, Richardson, and Madray 2010). Non-regulatory, end-of-pipe risk management is inadequate in achieving the overall goal of the CMP to eliminate or reduce toxic chemicals at the source (production, sale and use), identify safe alternatives, or remove inefficiencies in industrial processes (Government of Canada 2013b).

**Failing to Apply Precaution**

The need to use precaution has been recognized since the CEPA was enacted in 1999. As mentioned in chapters 1 and 2, the precautionary principle asserts that a lack of full scientific certainty shall not be used as a reason to postpone cost-effective measures to prevent threats of harm to human health or the environment (Rio Declaration on Environment and Development 1992). While new policies concerning chemical use and exposure, such as Europe’s REACH program, have been lauded globally for embodying a truly precautionary orientation, critics argue that to date, Canada’s regulation of toxic chemicals has failed to meaningfully apply the precautionary principle (Boyd 2003; Cooper and Vanderlinden 2009; Health and Safety Executive 2013; Scott 2009). For the most part, assessments and responses to risk continue to be reactive, based on the assumption that risk is unavoidable and that human bodies can accommodate some degree of chemical exposure. As a result, the focus has been placed on risk management over precaution. It is seen as acceptable for there to be delays in responding, or refusals to act based on gaps in the research data. Despite the government’s transparency about the many uncertainties regarding chemical exposure and harm in its assessments, it has rarely taken preventive measures in face of these uncertainties, thereby allowing existing exposures to continue (Cooper and Vanderlinden 2009).

Additionally, designations of toxicity under CEPA require both a potential for exposure, and a potential for harm, so that even a substance demonstrating a high probability of harm at any exposure level will not be listed as toxic if estimates of exposure are currently considered low (Environment
Further, even if a substance is listed as toxic, no mandatory risk management measures will flow from this designation. These fundamental weaknesses of CEPA undermine the ability of advocates to demand precautionary action in the face of risks to human health and the environment by toxic exposures, especially when it comes to considerations of sex and gender.

**Moving Towards Chemicals Management in Canada that Works for Women**

The government must begin to work towards a chemicals assessment and management regime more responsive to issues of sex and gender and more inclusive and comprehensive in addressing women’s disproportionate risks and burdens. In light of evidence tying environmental chemical exposures to the rising incidence of diseases and disorders, the federal government has an obligation to take precautionary action to prevent illness to all Canadians, including those that have a disproportionate impact on women.

The CMP process needs to encourage increased public engagement by presenting information on chemical substances in a more understandable and accessible format (de Leon, Richardson, and Madray 2010). The government should establish a process to enhance public transparency in any notifications regarding new substances or future use, and create reporting that is targeted to specific communities and subgroups (such as women). It should support women both technically and financially in mobilizing around chemical prevention and management before final decisions are made regarding the use of substances. Additionally, the government should include organizations focused on women’s health in advisory and technical groups related to assessment and management of chemicals (Altman et al. 2008; de Leon, Richardson, and Madray 2010).

Further, it is paramount that the endpoints for toxicity under the CMP be expanded through alternative testing methods to address gendered concerns. A study in the United States by the National Academy of Sciences (NAS) recommends screening chemicals based on toxicity pathways linked to
the development of disease, rather than relying on traditional toxicology or epidemiological studies that focus exclusively on overt disease endpoints. These early biological indicators of harm, such as interference with cellular signalling, hormone disruption, or alterations in gene expression, occur “upstream” of disease endpoints and can potentially be evaluated using in vivo and in vitro cell-based tests (NAS/NRC 2007; Program on Reproductive Health and the Environment 2008; Schwarzman and Janssen 2010). To accurately evaluate the potential of a chemical to raise the risk of a woman-specific illness, toxicity tests need to: (1) assess the impact of chemical exposure during a variety of life stages, including gestation, puberty, pregnancy, and post-menopause; (2) account for increased susceptibility due to genetic variation, underlying disease, or exposure to other chemicals and environmental stressors; and (3) account for other disparities in the incidence of the disease, such as those that might derive from ethnicity or processes of racialization (Program on Reproductive Health and the Environment 2008; Schwarzman and Janssen 2010).

Other important actions the government should take to fully address sex and gender in chemical assessment, management and regulation include:

- Generating new data and creating legislative requirements around cumulative and synergistic chemical effects, in order to understand exposures to a mixture of chemicals (e.g. some provincial workplace legislation uses a formula to calculate multiple exposures to a chemical (see Schedule 1 of O. Reg 833 of the Ontario Occupational Health and Safety Act);
- Including occupational exposures in overall exposure estimates;
- Updating chemical assessments using new understandings of toxicology to articulate how human harm relates to high and low dose, the timing of exposure, the delayed effects of exposure, and confounding variables;
- Supporting more long-term monitoring and biomonitoring studies to track the effects of exposures to specific chemicals and how they affect gendered development and health.
Most importantly, as argued in other chapters, the federal government must find ways to meaningfully implement precaution in its regulation of chemicals: this is the only way to fully protect the environment and human health from effects of toxic substances (Cooper and Vanderlinden 2009; de Leon, Richardson, and Madray 2010). This requires designating chemicals as “CEPA-toxic” that are not necessarily in use, manufactured or imported into Canada, but which have potentially harmful ecological and health impacts, or may be hazardous to human health (de Leon, Richardson, and Madray 2010). Such action might ultimately involve the redesigning of CEPA legislation to put a greater emphasis on the hazard of a substance rather than its potential exposure. A ‘Hazards Identification Approach’ would detect a chemical’s effect on key events in biological processes known or suspected to raise the risk of development of a specific disease or disorder, thereby guiding policy makers in making more informed decisions about what chemicals merit regulation (Schwarzman and Janssen 2010). Priority would be given to those chemicals that have these preliminary indicators of hazard to the development or progression of a specific disorder or disease. In conjunction with these amendments, the federal government should shift its current approach from chemicals management to focus on pollution prevention measures that eliminate or significantly reduce exposures to toxic chemicals over time. This could include developing federal toxic chemical substitution and toxic use reduction programs, as well as green chemistry strategies linked to the CMP (de Leon, Richardson, and Madray 2010).

With the appropriate law reform, the CEPA could more effectively incorporate sex and gender-based concerns into the CMP process. Such reforms could ultimately provide more universal forms of protection, eliminate some of the burdens of responsibility on women, and prompt more effective engagement of the public in challenging the production of harmful chemicals through a stringent, inclusive and comprehensive regulatory regime.
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