Overview of the

Report on Human Biomonitoring of Environmental Chemicals in Canada

Canada

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August 2010

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. *We assess the safety of drugs and many consumer products, help improve the safety of food, and provide information to Canadians to help them make healthy decisions. We provide health services to First Nations people and to Inuit communities. We work with the provinces to ensure our health care system serves the needs of Canadians.*

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This overview is a companion piece to the Report on Human Biomonitoring of Environmental Chemicals in Canada. *It provides context for the Report as well as some background information on biomonitoring.*

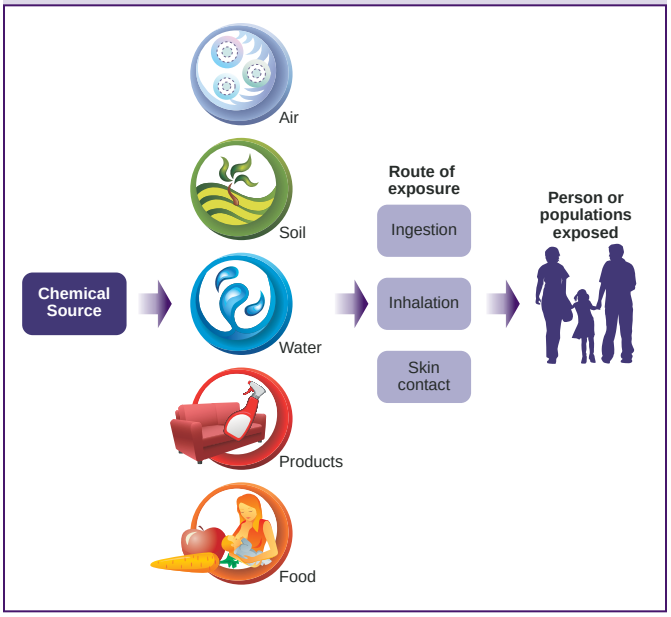
Chemical substances are everywhere – in air, soil, water, products, and food – and can enter the body through ingestion, inhalation, and skin contact. The Government of Canada uses a variety of methods, tools, and models to assess human exposure to environmental chemicals and the potential effects this exposure may have on health. Human exposure to chemicals can be estimated *indirectly* by measuring chemicals in the environment, food, or products, or *directly* using biomonitoring (see Figure 1).

Health Canada's *Report on Human Biomonitoring of Environmental Chemicals in Canada* presents the first-ever comprehensive set of biomonitoring data on the Canadian population's exposure to environmental chemicals, collected as part of the Canadian Health Measures Survey. The Report provides information to scientists and decision makers on the levels of chemical substances in Canadians. These baseline measures are an important starting point for future monitoring and research related to chemical exposure.

Figure 1

Understanding Human Biomonitoring

Biomonitoring is the measurement, in people, of a chemical or the products a chemical makes when it breaks down. This measurement is usually taken in blood and urine and sometimes in other tissues and fluids such as hair, nails, and breast milk. The measurement indicates how much of a chemical is present in a person.



The Canadian Health Measures Survey

The Canadian Health Measures Survey (CHMS), led by Statistics Canada in partnership with Health Canada and the Public Health Agency of Canada, is the most comprehensive, direct measures health survey conducted in Canada. The survey, which is designed to represent the Canadian population, collects information on the general health and lifestyles of Canadians through interviews and direct physical measurements (for example, weight and height), to provide information on chronic and infectious disease, physical fitness, nutrition, and other factors that influence health. The CHMS also includes a biomonitoring component, in which blood and urine samples are collected to provide information on exposure to environmental chemicals.

The first cycle of the CHMS involved approximately 5,600 Canadians between the ages of 6 and 79 years at 15 sites across the country. Data collection took place between March 2007 and February 2009.

Collection for the second cycle of the CHMS began in September 2009 and includes children as young as 3 years of age. The second cycle will be completed in 2011, while planning for future cycles is already underway.

The *Report on Human Biomonitoring of Environmental Chemicals in Canada*

The *Report on Human Biomonitoring of Environmental Chemicals in Canada* provides the results of the biomonitoring component from the first cycle of the CHMS. This first set of national data will be used as an important baseline, or starting point, for future monitoring and research. The primary purpose of the Report is to provide chemical exposure information, based on human biomonitoring, to scientists, health professionals, and policy makers. This information will help with the evaluation of chemical exposure and the development of policies to protect the health of Canadians.

Format of the Report

The Report describes the survey methods used and includes the following information for each chemical or chemical group:

- A scientific description of the chemical
- Common uses of the chemical
- Potential sources of exposure
- Information about possible health effects (if known)
- Biomonitoring data

The Report provides biomonitoring results, presented in tables, for the total Canadian population, further sub-divided by sex and age group. The data tables indicate how many samples were included and the average concentration of the chemical in the blood or urine of that group, as well as its percentile. A percentile provides an idea of how the measurements are distributed in the population. For example, if a measured concentration is at the 95th percentile, then 95 percent of the people measured are below this concentration and 5 percent of people are above it.

Chemicals Selected for Biomonitoring in the Canadian Health Measures Survey

The 91 chemicals measured in the first cycle of the CHMS were selected based on one or more of the following considerations:

- Known or suspected health effects
- The level of public concern
- Evidence of exposure in the Canadian population
- New or existing requirements for public health action
- The ability to detect and measure the chemical or its breakdown products in humans
- Similarity to chemicals monitored in other national and international programs to allow for meaningful comparisons
- The costs of performing the analysis

Table 1 lists the types of substances measured in the CHMS. Detailed chemical summaries are available in the full Report.

Table 1

Chemicals measured in the first cycle of the Canadian Health Measures Survey	
Metals	antimony, arsenic, cadmium, copper, lead, manganese, mercury, molybdenum, nickel, selenium, uranium, vanadium, zinc
Organochlorines	14 substances, including aldrin, chlordane, DDT, hexachlorobenzene, hexachlorocyclohexane, mirex, toxaphene
Polychlorinated biphenyls (PCBs)	24 substances and Aroclor 1260
Polybrominated flame retardants (PBDEs)	10 substances
Perfluorinated compounds (PFCs)	PFOS, PFOA, PFHxS
Phthalates*	11 metabolites (breakdown products)
Environmental phenol	bisphenol A
Pesticides	6 organophosphate metabolites, 5 pyrethroid metabolites, 2,4-dichlorophenoxyacetic acid (2,4-D)
Chlorophenols	2,4-dichlorophenol (2,4-DCP)
Tobacco	cotinine

* Phthalate metabolites were measured in Cycle 1 of the CHMS but the data are not presented in the Report due to ongoing data verification.

Uses of CHMS Biomonitoring Data

The biomonitoring data obtained in the CHMS survey will enable scientists, health professionals, and policy makers to do the following:

- Establish baseline levels of chemicals in the Canadian population.

  For the majority of substances, the data will serve as a starting point for comparison with data from future surveys, to determine how and why these levels may be changing over time.

- Compare exposure to environmental chemicals among different populations.

  This could include comparisons with sub-populations within Canada or with populations of other countries.

- Help identify priority chemicals for which further action should be taken to protect the public's health.

  Risk management actions could include tighter restrictions on chemical use or even removal of use altogether. Information can also be provided to help Canadians reduce their own exposure to chemicals of concern.

- Assess the effectiveness of regulatory and environmental risk management actions intended to reduce exposure to specific chemicals and the associated health risks.

  Preliminary data from the CHMS (released in November 2008) show a decline in lead levels in blood since the 1978–79 Canada Health Survey (which measured lead, copper, and zinc), suggesting that public health measures to reduce lead exposure have been effective.

- Support future research on potential links between exposure to certain chemicals and specific health effects.

  Researchers will be able to explore the relationships between the biomonitoring data and the other health measurements collected in the CHMS. This may, in turn, help focus future research efforts on the links between chemical exposure and health.

- Contribute to international monitoring programs.

  For example, Canada is a participant in the United Nations Environment Programme's Stockholm Convention on Persistent Organic Pollutants, as well as other international initiatives.

Limitations of CHMS Biomonitoring Data

Biomonitoring is a valuable tool to measure exposure to environmental chemicals; however, its limitations, as well as the reasons for these limitations, must be understood in order to use the data appropriately.

- Biomonitoring can estimate how much of a chemical is present in a person, but when considered alone cannot tell you what health effects, if any, may result from that exposure.

  The ability to measure environmental chemicals at very low levels continues to progress. However, the presence of a chemical in a person's body does not necessarily mean that it will affect a person's health. Factors such as the amount to which a person is exposed, the duration and timing of exposure, and the toxicity of the chemical are important to determine whether adverse health effects may occur. In addition, the way a chemical acts in the body differs between individuals and cannot be predicted with certainty. Certain populations (for example, pregnant women and their developing fetuses, children, the elderly, and individuals with compromised immune systems) may be more susceptible to the effects of exposure to chemicals. Furthermore, certain chemicals, such as manganese and zinc, are essential nutrients required for the maintenance of good health and therefore should be present.

  For chemicals such as lead or mercury, scientific studies have provided a good understanding of the health risks associated with elevated levels in blood. However, for many chemicals, further research is needed to understand what health effects, if any, are related to different levels of these chemicals in blood or urine.

- The absence of a chemical does not necessarily mean a person has not been exposed.

  Existing technology may not be capable of measuring a very small amount, or the exposure may have occurred at an earlier time, allowing for the chemical to be eliminated from the person's body before measurement took place.

- Biomonitoring cannot determine the source or route of the exposure.

  The measurement of a chemical indicates exposure from any or all sources (e.g., air, water, soil, food, products) and any or all routes (ingestion, inhalation, or skin contact). The detection of a chemical may be the result of exposure to a single source or multiple sources. As well, in most cases, biomonitoring cannot distinguish between natural and man-made sources.

What Does Biomonitoring Say About Health Risk?

Biomonitoring provides an estimate of exposure to a chemical. However, a chemical's presence alone will not necessarily result in adverse health effects. The risk a chemical substance poses is determined by evaluating both its toxicity and the levels to which people may be exposed. The Government of Canada conducts risk assessments for chemicals used, manufactured, and imported into Canada, including the majority of chemicals measured in the CHMS. It has developed guidance values for mercury and lead in blood, to indicate what levels of exposure may be of concern. If measured levels are above the guidance values, actions may be considered to reduce exposure. The Government is currently developing guidance values for biomonitoring of additional chemicals measured in the CHMS where there is enough information.

The Government of Canada's Management of Chemicals

The Government of Canada plays a key role in protecting Canadians from exposure to harmful chemicals through legislation that governs chemical substances in food, water, drugs, pesticides, and consumer products. This legislation includes the *Canadian Environmental Protection Act, 1999*, the *Pest Control Products Act*, the *Food and Drugs Act*, and the *Hazardous Products Act.*

The Government takes a risk-based approach to the management of chemical substances, using strong science, assessment, and monitoring, combined with a variety of tools to protect human health. Many standards and guidelines are in place (for example, *Guidelines for Canadian Drinking Water Quality*) to protect Canadians and the environment from the risks of potentially harmful chemicals.

Risk management strategies (such as the removal of lead from gasoline and other products) are designed to reduce exposure to chemicals. The effectiveness of these strategies may be observed by comparing biomonitoring data from future cycles of the CHMS with the current results.

The Chemicals Management Plan

In 2006, the Government of Canada launched the Chemicals Management Plan (CMP) to further enhance its role in protecting Canadians and their environment from exposure to harmful chemicals. In addition to risk assessment and risk management activities, research and monitoring initiatives, including biomonitoring, are key components that inform decisions made under this plan. Monitoring initiatives include a comprehensive national biomonitoring component, of which the CHMS is the cornerstone.

Other Biomonitoring Activities

The CMP supports a number of additional research, monitoring, and assessment activities to help Canadians better understand their exposure and the potential effects on human health. These include biomonitoring studies targeting vulnerable populations (such as the Maternal-Infant Research on Environmental Chemicals study), environmental monitoring studies, and research to support biomonitoring. Health Canada also partners with Indian and Northern Affairs Canada's Northern Contaminants Program to undertake health research and biomonitoring in Canada's northern populations. Detailed information about CMP-supported monitoring studies can be found on the Government of Canada's Chemical Substances website:
www.chemicalsubstanceschimiques.gc.ca/plan/surveil/index-eng.php

Next Steps

The biomonitoring component of the CHMS is a first and very important step to increase scientific knowledge about Canadians' exposure to environmental chemicals. The Government of Canada can expect researchers from Canada and around the world to extensively use the biomonitoring data in the *Report on Human Biomonitoring of Environmental Chemicals in Canada*. Health Canada scientists will study associations, if any, between biomonitoring measurements and other health and lifestyle factors measured in the CHMS. Where possible, the data will be compared with population data from other countries that have performed national biomonitoring studies. Compiling data from future cycles of the CHMS will allow Health Canada to track changes in exposure to chemicals in the Canadian population over time. All of this information will assist the Government in its assessment and management of environmental chemicals in Canada.

For More Information

Additional information about how the Government of Canada manages chemicals can be found on the Chemicals Substances website at ***www.chemicalsubstances.gc.ca***.

Additional information about the CHMS can be found on the Statistics Canada website at ***www.statcan.gc.ca/survey-enquete/household-menages/5071-eng.htm***.

For additional information on some of the chemicals included in the CHMS and advice on how to reduce exposure, visit the following links:

Chemical	For More Information
Metals	It's Your Health – Effects of Lead on Human Health www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/lead-plomb-eng.php It's Your Health – Mercury and Human Health www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/merc-eng.php Food and Nutrition – Mercury www.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/mercur/index-eng.php It's Your Health – Arsenic in Drinking Water www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/arsenic-eng.php Food and Nutrition – Arsenic www.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/arsenic-eng.php
Polychlorinated biphenyls (PCBs)	Chemicals At A Glance – Polychlorinated Biphenyls (PCBs) www.chemicalsubstanceschimiques.gc.ca/fact-fait/pcb-bpc-eng.php Food and Nutrition – Polychlorinated Biphenyls (PCBs) www.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/pcb-bpc/index-eng.php
Organochlorines	Persistent Organic Pollutants (POPs) Fact Sheet Series: Dichlorodiphenyltrichloroethane (DDT) www.ainc-inac.gc.ca/ai/scr/yt/pubs/2010fs/ddt-eng.asp Persistent Organic Pollutants (POPs) Fact Sheet Series: Toxaphene www.ainc-inac.gc.ca/ai/scr/yt/pubs/2010fs/txp-eng.asp Chemicals At A Glance – Lindane (gamma-hexachlorocyclohexane) www.chemicalsubstanceschimiques.gc.ca/fact-fait/lindane-eng.php
Polybrominated flame retardants (PBDEs)	It's Your Health – PBDE Flame Retardants and Human Health www.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/pbde-eng.php Food and Nutrition – Polybrominated Diphenyl Ethers (PBDEs) www.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/pbde-edpb/index-eng.php
Perfluorinated compounds (PFCs)	Perfluorooctane Sulfonate (PFOS) and Health www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/perflurooctane_sulfonate-eng.php Food and Nutrition – Perfluorinated Chemicals in Food www.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/pcf-cpa/index-eng.php

Chemical	For More Information
Phthalates	Chemicals At A Glance – Phthalates www.chemicalsubstanceschimiques.gc.ca/fact-fait/phthalates-eng.php
Bisphenol A	Chemicals At A Glance – Bisphenol A www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a-eng.php Questions and Answers on Bisphenol A www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a_qa-qr-eng.php Food and Nutrition – Bisphenol A www.hc-sc.gc.ca/fn-an/securit/packag-emball/bpa/index-eng.php
Organophosphate insecticides	Pesticides and Health http://hc-sc.gc.ca/ewh-semt/pubs/contaminants/pesticides-eng.php Pesticides and Food www.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pesticide-food-alim/index-eng.php
Pyrethroid pesticides	Pesticides and Health http://hc-sc.gc.ca/ewh-semt/pubs/contaminants/pesticides-eng.php Homeowner Guidelines for Pesticide Use www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/use-utiliser/_home-maison/index-eng.php
Phenoxy herbicides	Homeowner Guidelines for Pesticide Use www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/use-utiliser/_home-maison/index-eng.php Questions and Answers – Final Decision on the Re-evaluation of 2,4-D www.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/use-utiliser/_24d/24d-faq-eng.php
Tobacco Exposure – Cotinine	It's Your Health – Second-hand Smoke www.hc-sc.gc.ca/hl-vs/iyh-vsv/life-vie/shs-fs-eng.php