



Health  
Canada Santé  
Canada

Your health and  
safety... our priority.

Votre santé et votre  
sécurité... notre priorité.

# Overview of the Third Report on Human Biomonitoring of Environmental Chemicals in Canada



Canada



*Overview of the*  
**Third Report on  
Human Biomonitoring  
of Environmental  
Chemicals in Canada**

July 2015

**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.

Également disponible en français sous le titre :

*Vue d'ensemble du Troisième rapport sur la biosurveillance humaine des substances chimiques de l'environnement au Canada*

To obtain additional information, please contact:

Health Canada  
Address Locator 0900C2  
Ottawa, ON K1A 0K9  
Tel.: 613-957-2991  
Toll free: 1-866-225-0709  
Fax: 613-941-5366  
TTY: 1-800-465-7735  
E-mail: [publications@hc-sc.gc.ca](mailto:publications@hc-sc.gc.ca)

This publication can be made available in alternative formats upon request.

© Her Majesty the Queen in Right of Canada, as represented by the Minister of Health, 2015

Publication date: July 2015

This publication may be reproduced for personal or internal use only without permission provided the source is fully acknowledged.

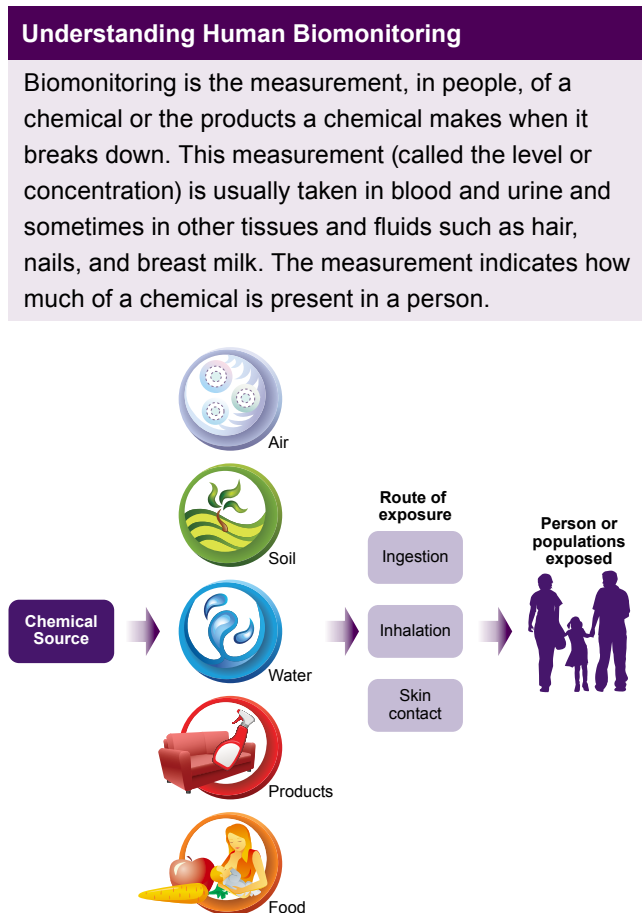
Cat.: H129-53/2015E-PDF  
ISBN: 978-0-660-03092-0  
Pub.: 150035

This overview is a companion piece to the *Third 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 chemicals (both natural and synthetic) and the potential effects that these exposures may have on human health. Human exposure to chemicals can be estimated *indirectly* by measuring chemicals in the environment, food, or products, or *directly* in the human body using biomonitoring (see Figure 1).

Biomonitoring information for Canadians is collected on an ongoing basis through the Canadian Health Measures Survey (CHMS). To date, three cycles of the CHMS have been completed, the first cycle conducted in 2007–2009, the second cycle in 2009–2011, and the third cycle in 2012–2013. Health Canada’s *Third Report on Human Biomonitoring of Environmental Chemicals in Canada* presents national biomonitoring data on the Canadian population’s exposure to chemicals, collected as part of the CHMS. *The Third Report* provides information to scientists, health professionals, and policy makers on the levels of chemicals in Canadians. These measures are an important starting point for monitoring and research related to chemical exposure and to track trends in levels of chemicals in Canadians over time.

Figure 1



## 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 health measures survey conducted in Canada. The survey is designed to represent the Canadian population. It collects information on the general health and lifestyles of Canadians through interviews and

direct physical measurements (for example, weight and height) and provides 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 chemicals.

The first *Report on Human Biomonitoring of Environmental Chemicals in Canada* was published in August 2010 with baseline data for 92 chemicals measured in Canadians aged 6 to 79 years at 15 sites across the country during the first cycle of the CHMS (2007–2009).

The *Second Report on Human Biomonitoring of Environmental Chemicals in Canada* was published in April 2013 with data for 91 environmental chemicals, 42 of which were also measured in cycle 1. Data for cycle 2 of the CHMS (2009–2011) were

collected from 6,400 Canadians between the ages of 3 and 79 years at 18 sites across the country.

The third cycle of the CHMS included 5,800 Canadians between the ages of 3 and 79 years at 16 sites across Canada. Cycle 3 included 48 environmental chemicals measured in individual samples, 33 of which have been measured in previous cycles. Collection for the third cycle of the CHMS took place between January 2012 and December 2013. Planning for future cycles is underway.

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

The *Third Report on Human Biomonitoring of Environmental Chemicals in Canada* provides the results of the biomonitoring component from the third cycle of the CHMS (2012–2013). The primary purpose of the *Third 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 Third Report**

The *Third 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
- Existing Canadian biomonitoring data
- Relevant acts and regulations

The *Third Report* provides biomonitoring results, presented in tables, representing 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 (or level) 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 95<sup>th</sup> percentile, then 95% of the people measured are below this concentration and 5% of people are above it.

For chemicals that were measured in cycle 3 as well as in cycle 1 and/or cycle 2, all sets of data are shown for comparison. Data for chemicals measured in all 3 cycles will be used to track trends of levels in Canadians over time and to assess the effectiveness of regulatory and health risk management actions. For new chemicals included in cycle 3, these national data will be used as an important baseline, or starting point, for future monitoring and research. Data for chemicals that were measured only in cycle 1 and/or cycle 2 can be found in the first and second *Reports*.

## Chemicals Selected for Biomonitoring in the Canadian Health Measures Survey

The 48 chemicals measured in the third cycle of the CHMS were selected based on one or more of the following considerations:

- Known or suspected health effects
- 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
- Costs of performing the analysis

The third cycle of the CHMS contains approximately 69% of the same chemicals measured in cycles 1 and/or 2, and approximately 31% new chemicals. The CHMS is an ongoing study conducted in two-year cycles. As such, chemicals can be rotated in and out of the biomonitoring component. In some cases, chemicals have been repeated in cycle 3 to obtain additional information or a larger number of samples. In other cases, chemicals have been removed and may be added back in later cycles. New chemicals have been included to obtain national baseline data where none may have existed before.

Figure 2: Summary of chemicals measured in cycle 1 (2007–2009), cycle 2 (2009–2011), and cycle 3 (2012–2013) of the Canadian Health Measures Survey

Cycle 1	Cycle 2	Cycle 3
Organochlorines Polybrominated flame retardants Polychlorinated biphenyls		
Chlorophenols Perfluoroalkyl substances Phthalate metabolites Pesticides		
Environmental phenols Metals and trace elements Nicotine metabolite		
	Polycyclic aromatic hydrocarbons Volatile organic compounds: Benzene metabolites	
		Volatile organic compounds Acrylamide

Table 1 lists the groups of chemicals measured in cycle 3 of the CHMS. Detailed chemical summaries are available in the full *Third Report*.

Metals and trace elements	6 arsenic species, cadmium, fluoride, lead, 3 forms of mercury
Acrylamide	acrylamide, glycidamide
Environmental phenols	bisphenol A, triclosan
Polycyclic aromatic hydrocarbons	4 chrysene metabolites, 1 fluoranthene metabolite, 3 fluorene metabolites, 5 phenanthrene metabolites, 1 pyrene metabolite, 1 benzo[a]pyrene metabolite, 2 naphthalene metabolites
Nicotine metabolite	cotinine
Volatile organic compounds	benzene (and 2 benzene metabolites), ethylbenzene, styrene, tetrachloroethylene, toluene, trichloroethylene, xylenes, bromodichloromethane, dibromochloromethane, tribromomethane, trichloromethane

## 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:

- **Determine baseline levels of chemicals in the Canadian population.**  
For the majority of chemicals, 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 levels of chemicals among different populations.**  
This could include comparisons with sub-populations within Canada or with populations of other countries.
- **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 health and environmental risk management actions intended to reduce exposure to specific chemicals and the associated health risks.**  
Data from cycle 1 and 2 of the CHMS show a decline in lead levels in blood since the 1978–79 Canada Health Survey 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 chemicals management programs.**  
For example, to fulfill Canada's commitments for monitoring as a Party to 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 chemicals; however, its limitations, as well as the reasons for these limitations, must be understood in order to use the data appropriately.

- Biomonitoring measures how much of a chemical is present in a person at a point in time, but when considered alone cannot tell you what health effects, if any, may result from that exposure. The ability to measure chemicals at 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 are normally 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 synthetic 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 of Canada may consider developing guidance values for 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 chemicals through legislation that governs chemicals in food, soil, 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 *Canada Consumer Product Safety Act*.

The Government of Canada takes a risk-based approach to the management of chemicals, 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.

### Next Steps

The biomonitoring component of the CHMS is an important step to increase scientific knowledge about Canadians' exposure to chemicals. The Government of Canada can expect researchers from Canada and around the world to use the biomonitoring data in the *Third 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.

### 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 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 activities 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 Aboriginal Affairs and Northern Development 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.

Where possible, the data will be compared with population data from other countries that have performed national biomonitoring studies. Compiling data from past and future cycles of the CHMS will allow Health Canada to track changes in levels of chemicals in the Canadian population over time. All of this information will assist the Government in its assessment and management of chemicals in Canada.

## For More Information

Additional information about how the Government of Canada manages chemicals can be found on the [Chemicals Substances website](#).

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

Additional information about the CHMS can be found on the [Statistics Canada website](#).

Chemical	For More Information
Metals	<p><a href="#">Chemicals At A Glance—Lead</a>  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/lead-plomb-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/lead-plomb-eng.php</a></p> <p><a href="#">It's Your Health—Lead and Human Health</a>  <a href="http://publications.gc.ca/collections/collection_2013/sc-hc/H13-7-101-2013-eng.pdf">http://publications.gc.ca/collections/collection_2013/sc-hc/H13-7-101-2013-eng.pdf</a></p> <p><a href="#">Chemicals At A Glance—Mercury and its Compounds</a>  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/mercury-mercure-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/mercury-mercure-eng.php</a></p> <p><a href="#">It's Your Health—Mercury and Human Health</a>  <a href="http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/merc-eng.php">http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/merc-eng.php</a></p> <p><a href="#">Food and Nutrition—Mercury</a>  <a href="http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/mercur/index-eng.php">http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/mercur/index-eng.php</a></p> <p><a href="#">It's Your Health—Arsenic in Drinking Water</a>  <a href="http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/arsenic-eng.php">http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/arsenic-eng.php</a></p> <p><a href="#">Food and Nutrition—Arsenic</a>  <a href="http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/arsenic-eng.php">http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/arsenic-eng.php</a></p> <p><a href="#">It's Your Health—Fluoride and Human Health</a>  <a href="http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/fluor-eng.php">http://web.hc-sc.gc.ca/hl-vs/iyh-vsv/environ/fluor-eng.php</a></p> <p><a href="#">Metals of Concern Fact Sheet Series: Cadmium</a>  <a href="http://www.aadnc-aandc.gc.ca/eng/1316038300971/1316038365744">www.aadnc-aandc.gc.ca/eng/1316038300971/1316038365744</a></p>
Perfluoroalkyl substances	<p><a href="#">Perfluorooctane Sulfonate (PFOS) and Health</a>  <a href="http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/perfluorooctane_sulfonate-eng.php">http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/perfluorooctane_sulfonate-eng.php</a></p> <p><a href="#">Food and Nutrition—Perfluorinated Chemicals in Food</a>  <a href="http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/pcf-cpa/index-eng.php">http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/environ/pcf-cpa/index-eng.php</a></p>
Phthalates	<p><a href="#">Chemicals At A Glance—Phthalates</a>  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/phthalates-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/phthalates-eng.php</a></p>

Chemical	For More Information
Environmental Phenols	<p>Chemicals At A Glance—Bisphenol A  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a-eng.php</a></p> <p>Questions and Answers on Bisphenol A  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a_qa-qr-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/bisphenol-a_qa-qr-eng.php</a></p> <p>Food and Nutrition—Bisphenol A  <a href="http://web.hc-sc.gc.ca/fn-an/securit/packag-emball/bpa/index-eng.php">http://web.hc-sc.gc.ca/fn-an/securit/packag-emball/bpa/index-eng.php</a></p> <p>Chemicals At A Glance—Triclosan  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/glance-bref/triclosan-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/glance-bref/triclosan-eng.php</a></p> <p>Questions and Answers on Triclosan  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/triclosan-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/triclosan-eng.php</a></p>
Polycyclic Aromatic Hydrocarbons	<p>Environmental and Workplace Health—Polycyclic Aromatic Hydrocarbons  <a href="http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl1-lsp1/hydrocarb_aromat_polycycl/index-eng.php">http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/psl1-lsp1/hydrocarb_aromat_polycycl/index-eng.php</a></p>
Pyrethroid and 2,4-D pesticides	<p>Pesticides and Health  <a href="http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/pesticides-eng.php">http://web.hc-sc.gc.ca/ewh-semt/pubs/contaminants/pesticides-eng.php</a></p> <p>Pesticides and Food  <a href="http://web.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pesticide-food-alim/index-eng.php">http://web.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/pesticide-food-alim/index-eng.php</a></p> <p>Homeowner Guidelines for Using Pesticides  <a href="http://web.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/home-maison/index-eng.php">http://web.hc-sc.gc.ca/cps-spc/pubs/pest/_fact-fiche/home-maison/index-eng.php</a></p> <p>Questions and Answers—Final Decision on the Re-evaluation of 2,4-D  <a href="http://web.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/24d/index-eng.php">http://web.hc-sc.gc.ca/cps-spc/pest/part/protect-proteger/24d/index-eng.php</a></p>
Nicotine exposure—Cotinine	<p>It's Your Health—Second-hand Smoke  <a href="http://publications.gc.ca/collections/collection_2012/sc-hc/H13-7-25-2011-eng.pdf">http://publications.gc.ca/collections/collection_2012/sc-hc/H13-7-25-2011-eng.pdf</a></p>
Acrylamide	<p>Chemicals at a Glance—Acrylamide  <a href="http://www.chemicalsubstanceschimiques.gc.ca/challenge-defi/summary-sommaire/batch-lot-5/79-06-1-eng.php">www.chemicalsubstanceschimiques.gc.ca/challenge-defi/summary-sommaire/batch-lot-5/79-06-1-eng.php</a></p> <p>Questions and Answers—Acrylamide and Food  <a href="http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/food-aliment/acrylamide/acrylamide_and_food-acrylamide_et_aliment-eng.php">http://web.hc-sc.gc.ca/fn-an/securit/chem-chim/food-aliment/acrylamide/acrylamide_and_food-acrylamide_et_aliment-eng.php</a></p>
Volatile Organic Compounds	<p>Chemicals At A Glance—Ethylbenzene  <a href="http://www.chemicalsubstanceschimiques.gc.ca/fact-fait/glance-bref/ethylbenzene-eng.php">www.chemicalsubstanceschimiques.gc.ca/fact-fait/glance-bref/ethylbenzene-eng.php</a></p>