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Data Sources and Methods for the Levels of Exposure to Substances of Concern Indicator

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1 Introduction

The Levels of Exposure to Substances of Concern indicator is part of the Canadian Environmental Sustainability Indicators (CESI) program (<http://www.ec.gc.ca/indicateurs-indicators/default.asp?lang=En&n=47F48106-1>), which provides data and information to track Canada's performance on key environmental sustainability issues.

2 Description and rationale of the Levels of Exposure to Substances of Concern indicator

2.1 Description

The Canadian Environmental Sustainability Indicators (CESI) Levels of Exposure to Substances of Concern indicator presents the concentrations of cadmium, lead and mercury in blood for participants in the Canadian Health Measures Survey (CHMS) (aged 6-79 years), and the concentrations of polybrominated diphenyl ether (PBDE-47) and perfluorooctane sulfonate (PFOS) in blood plasma (aged 20-79 years). These results are intended to establish baseline levels of chemicals to track trends in Canadians over time.

2.2 Rationale

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.

Biomonitoring is the measurement, in people, of a chemical, the products it makes after it has broken down, or the products that might result from interactions in the body. These measurements are usually taken in blood and urine and sometimes in other tissues and fluids such as hair, fingernails, toenails, and breast milk. The measurements show how much of a chemical or its elements are present in that person at a given time.

The Levels of Exposure to Substances of Concern Indicator uses human biomonitoring data on environmental chemicals collected in the biomonitoring component of the Canadian Health Measures Survey (CHMS). The biomonitoring component, developed by Health Canada, assesses the exposure to environmental chemicals and helps to develop and assess the effectiveness of policies to reduce exposure to chemicals for the protection of the health of Canadians.

3 Data

3.1 Data source

The data used to establish the Levels of Exposure to Substances of Concern indicator are from Health Canada's Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 1 (2007-2009) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/index-eng.php>) and the Second Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 2 (2009-2011) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms-cycle2/index-eng.php>). These reports present national baseline data on concentrations of environmental chemicals in Canadians. These data were collected as part of Cycles 1 and 2 of the Canadian Health Measures Survey (CHMS) (<http://www.statcan.gc.ca/survey-enquete/household-menages/5071-eng.htm>), the most

comprehensive national direct health-measures survey conducted in Canada to date. Statistics Canada, in partnership with Health Canada and the Public Health Agency of Canada, launched the CHMS to collect health and wellness data as well as biological specimens, from a nationally representative sample of Canadians. In Cycle 1, data were collected between March 2007 and February 2009 from approximately 5600 Canadians aged 6-79 years at 15 sites across Canada. For Cycle 2, data were collected between August 2009 and November 2011 from approximately 6400 Canadians aged 3-79 years at 18 sites across Canada. Although data were collected on children as young as 3 years of age in Cycle 2 of the survey, the indicator only includes data from people aged 6 and older.

3.2 Spatial coverage

The indicator includes data collected in Cycle 1 and 2 of the CHMS. In Cycle 1, data were collected at 15 sites across Canada (Moncton, Québec, Montréal, Montérégie, South Mauricie, Clarington, North York, Don Valley, St. Catharines-Niagara, Kitchener-Waterloo, Northumberland County, Edmonton, Red Deer, Vancouver and William Lakes & Quesnel). In Cycle 2, data were collected at 18 sites across Canada (St. John's, Colchester and Pictou Counties, Laval, South Montérégie, Gaspésie, North Shore Montréal, Central and East Ottawa, South of Brantford, Southwest Toronto, East Toronto, Kingston, Oakville, Edmonton, Winnipeg, Calgary, Richmond, Central and East Kootenay, Coquitlam).

3.3 Temporal coverage

The indicator includes data collected in Cycle 1 and 2 of the CHMS. In Cycle 1, data were collected between March 2007 and February 2009. In Cycle 2, data were collected between August 2009 and November 2011. Cycle 3 was launched in January 2012.

3.4 Data completeness

CHMS data are collected over a 2-year period, and, subsequently, analysts require approximately an additional 18 months for data interpretation, quality control and verification. Data collection for Cycle 3 of the CHMS began in January 2012 and will be completed in late 2013.

4 Methods

The data collected by the CHMS is representative of approximately 96% of the Canadian population aged 6-79 years (Cycle 1) and 3-79 years (Cycle 2). The results highlighted by the Levels of Exposure to Substances of Concern indicator are only those for those aged 6-79 years.

The following tables provide a summary of the data characteristics for the selected chemicals for the indicator.

Concentrations of mercury, lead and cadmium in blood and polybrominated diphenyl ethers (PBDE-47) and perflurooctane sulfonate (PFOS) in blood plasma, Canada, 2007-2009

Chemicals	Sample size	Percentage of results that fall below the limit of detection (% < LOD)	Geometric mean** (µg/L)	95% Confidence interval (µg/L)
Cadmium	5319	2.91	0.34	0.31-0.37
Lead	5319	0.02	13	12-14
Mercury*	5319	11.64	0.69	0.56-0.86

Chemicals	Sample size	Percentage of results that fall below the limit of detection (% < LOD)	Geometric mean** (µg/L)	95% Confidence interval (µg/L)
PBDE-47	1668	25.24	0.06	0.05-0.07
PFOS	2880	0.14	8.9	8.0-9.8

Note: *Mercury is shown as total mercury (organic and inorganic). **Geometric mean calculated at the 95% confidence interval (CI). The concentrations of cadmium, lead and mercury in blood were from participants in the Canadian Health Measures Survey (CHMS) aged 6-79 years, while the concentrations of polybrominated diphenyl ether (PBDE-47) and perfluorooctane sulfonate (PFOS) in blood plasma were from participants aged 20-79 years.

Source: For PBDE-47, Health Canada (2010) Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 1 (2007-2009) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/index-eng.php>). Retrieved on 30 January, 2012. For other chemicals, Health Canada (2013) Second Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 2 (2009-2011) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms-cycle2/index-eng.php>). Retrieved on 20 June, 2013.

Concentrations of mercury, lead and cadmium in blood and perfluorooctane sulfonate (PFOS) in blood plasma, Canada, 2009-2011

Chemicals	Sample size	Percentage of results that fall below the limit of detection (% < LOD)	Geometric mean** (µg/L)	95% Confidence interval (µg/L)
Cadmium	5575	4.27	0.31	0.28-0.34
Lead	5575	0	12	11-13
Mercury*	5575	14.28	0.72	0.57-0.90
PBDE-47	n/a	n/a	n/a	n/a
PFOS	1017	0.39	6.9	6.2-7.6

Note: *Mercury is shown as total mercury (organic and inorganic). **Geometric mean calculated at the 95% confidence interval (CI). The concentrations of cadmium, lead and mercury in blood were from participants in the Canadian Health Measures Survey (CHMS) aged 6-79 years, while the concentrations of polybrominated diphenyl ether (PBDE-47) and perfluorooctane sulfonate (PFOS) in blood plasma were from participants aged 20-79 years.

Source: Health Canada (2013) Second Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 2 (2009-2011) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms-cycle2/index-eng.php>). Retrieved on 20 June, 2013.

The geometric mean was used because it is less influenced by extreme values and it provides a better estimate of central tendency. This type of mean is commonly used with biomonitoring data.

Further information on survey methodology can be obtained by consulting Health Canada's Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures Survey Cycle 1 (2007-2009) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/index-eng.php>) and the Second Report on Human Biomonitoring of Environmental Chemicals in Canada: Results of the Canadian Health Measures

Survey Cycle 2 (2009-2011) (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms-cycle2/index-eng.php>) which detail survey design, fieldwork, laboratory analysis and statistical data analysis.

5 Caveats and limitations

The Canadian Health Measures Survey (CHMS) was designed to provide national-level estimates and does not permit further breakdown of data by collection site. In addition, the CHMS design did not target specific exposure scenarios, and consequently did not select or exclude participants on the basis of their potential for low or high exposures to environmental chemicals.

People living on reserves or in other Aboriginal settlements in the provinces, residents of institutions, full-time members of the Canadian Forces, people living in certain remote areas, and people living in areas with a low population density were excluded.

While not every province and territory in Canada had a collection site, the CHMS sites were chosen to represent the Canadian population, east to west, including larger and smaller population densities. Regardless, the CHMS covers approximately 96% of the Canadian population.

A statistical analysis of differences between the data of Cycles 1 and 2 is not provided, but in-depth statistical analyses of the CHMS biomonitoring data may be performed in the future, as results from future cycles of CHMS are compared with the baseline data from Cycle 1 and Cycle 2 to examine trends in Canadians' exposures to selected environmental chemicals.

While participants in Cycle 2 were as young as 3 years of age, only data from participants aged 6 and older were included in the indicator.

For further reading on considerations when using the biomonitoring data please consult chapter 7 of the Health Canada's Report on Human Biomonitoring of Environmental Chemicals in Canada (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms/index-eng.php>) and Second Report on Human Biomonitoring of Environmental Chemicals in Canada (<http://www.hc-sc.gc.ca/ewh-semt/pubs/contaminants/chms-ecms-cycle2/index-eng.php>).

6 References and further reading

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