International Journal of Hygiene and Environmental Health 220 (2017) 13–28

Contents lists available at ScienceDirect

International Journal of Hygiene and Environmental Health

journal homepage: www.elsevier.com/locate/ijheh

An overview of human biomonitoring of environmental chemicals in the Canadian Health Measures Survey: 2007–2019

Douglas A. Haines*, Gurusankar Saravanabhavan, Kate Werry, Cheryl Khoury

Healthy Environments and Consumer Safety Branch, Health Canada, Ottawa, ON, Canada

ARTICLE INFO

Article history:
Received 15 June 2016
Received in revised form 19 August 2016
Accepted 22 August 2016

Keywords:
Human biomonitoring
HBM
Canadian Health Measures Survey
CHMS

ABSTRACT

Human biomonitoring (HBM) is used to indicate and quantify exposure by measuring environmental chemicals, their metabolites or reaction products in biological specimens. The biomonitoring component of the Canadian Health Measures Survey (CHMS) is the most comprehensive initiative providing general population HBM data in Canada.

The CHMS is an ongoing cross-sectional direct measures survey implemented in 2-year cycles. It provides nationally-representative data on health, nutritional status, environmental exposures, and related risks and protective characteristics. The survey follows a robust planning, design and sampling protocol as well as a comprehensive quality assurance and quality control regime implemented for all aspect of the survey to ensure the validity of the HBM results.

HBM blood and urine data are available for CHMS cycles 1 (2007–2009), 2 (2009–2011) and 3 (2012–2013). Field collection has been completed for cycle 4 (2014–2015), with cycle 5 (2016–2017) in progress and cycle 6 planning (2018–2019) being finalized. Biomonitoring results for 279 chemicals are expected over the six cycles of the CHMS (220 in individual blood, urine or hair samples, and 59 in pooled serum samples). The chemicals include metals and trace elements, polychlorinated biphenyls (PCBs), organochlorines, flame retardants, perfluoroalkyl substances, volatile organic compounds (VOCs) and metabolites, environmental phenols, triclocarban, acrylamide, pesticides (e.g., triazines, carbamates, organophosphates, phenoxy, pyrethroids) and/or their metabolites, chlorophenols, polycyclic aromatic hydrocarbon (PAH) metabolites, phthalates and alternate plasticizer metabolites, and tobacco biomarkers. Approximately one half of the chemicals measured in individual blood and urine samples over the first three cycles were detected in more than 60% of samples.

CHMS biomonitoring data have been used to establish baseline HBM concentrations in Canadians; inform public health, regulatory risk assessment and management decisions; and fulfil national and international reporting requirements. Concurrent efforts are underway in Canada to develop statistically- and risk-based concepts and tools to interpret biomonitoring data.

Crown Copyright © 2016 Published by Elsevier GmbH. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

Contents

* Corresponding author at: Healthy Environments and Consumer Safety Branch, Health Canada, 269 Laurier Ave West, Ottawa, ON K1A 0K9, Canada.
E-mail address: doug.haines@hc-sc.gc.ca (D.A. Haines).

http://dx.doi.org/10.1016/j.ijheh.2016.08.002
1438-4639/Crown Copyright © 2016 Published by Elsevier GmbH. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

1. Introduction

Chemical substances are everywhere, in air, soil, water, food and products and can enter the body through ingestion, inhalation, and skin contact. Human biomonitoring (HBM) is used increasingly to indicate and quantify exposure to environmental chemicals by measuring the chemicals and/or their biotransformation products in biological samples such as blood, urine, hair or milk (NRC, 2006; Sexton et al., 2004). HBM is a rapidly advancing discipline used for exposure and risk assessment in environmental and occupational health and contributes to the development of policies and programs to protect human health (Gurusankar et al., 2016; Haines et al., 2012).

Prior to 2007, HBM studies in Canada were limited in scope and were carried out primarily on targeted populations such as those in the Great Lakes and St. Lawrence basin (Tremblay and Gilman, 1995; Human Health Component – St. Lawrence Vision 2000, 2003), northern populations (Donaldson et al., 2010), and Aboriginal peoples (Wheatley and Paradis, 1995). Although important information and knowledge were derived from these studies, they were not population-representative and could not be used to characterize the overall Canadian population.

In order to establish representative human biomonitoring data for the Canadian general population, an extensive HBM component has been incorporated into the Canadian Health Measures Survey (CHMS) (Haines and Murray, 2012). The CHMS, which was launched in 2007, is the most comprehensive direct health measures survey conducted in Canada and is designed to provide nationally-representative data on indicators of environmental exposures, health and nutritional status, and related risks and protective characteristics (Tremblay et al., 2007). The HBM component of the CHMS assesses blood, urine and hair collected from survey participants for a wide range of environmental chemicals. CHMS surveys have been completed and HBM data are available currently for cycle 1 (2007–2009), cycle 2 (2009–2011) and cycle 3 (2012–2013).

The purpose of this paper is to describe the methods followed for the HBM component of the first three cycles of the CHMS survey, provide summary results for the chemicals measured in these three cycles, and highlight plans for future cycles and uses of CHMS biomonitoring data.

2. Methods

2.1. Selection of environmental chemicals for CHMS biomonitoring

The chemicals selected for the biomonitoring component of the CHMS were based on a 2003 HBM expert workshop and a 2008 national consultation implemented through a questionnaire distributed to stakeholders across Canada. Participants in these consultations included Health Canada and other federal government departments, provincial and territorial health and environment departments, public health and medical laboratories, the United States Centers for Disease Control and Prevention, industry groups, non-governmental organizations, and academics. In both these consultations, the following criteria were used as a general guide for selecting the chemicals: seriousness of known or suspected health effects related to the substance; current and anticipated health policy development and implementations; level of public concern about exposures and possible health effects; evidence of exposure of the Canadian population to the substance and existing data gaps; feasibility of collecting biological specimens in a national survey and associated burden on survey participants; availability, efficiency and costs of laboratory analytical methods; parity of selected chemicals with other national and international surveys; and commitments under national and international treaties, conventions, and agreements. The chemical groups selected for biomonitoring in CHMS cycles 1–6 (2007–2019) are presented in Table 1 (the detailed list of chemicals, matrices and age ranges measured in CHMS cycles 1–5 (2007–2017) and proposed for cycle 6 (2018–2019) is provided in Supplemental Table S1).

2.2. Target population

The CHMS cycles 1 and 2 targeted the population aged 6–79 years and 3–79 years, respectively, living at home and residing in the 10 provinces and three territories of Canada. The CHMS cycle 3 targeted the population aged 3–79 years living at home and residing in the 10 provinces. Full-time members of Canadian Forces, people living on Crown lands, First Nations reserves or in other Aboriginal settlements in the provinces, residents of institutions and certain remote regions, and persons living in areas with a low population density were excluded from all three cycles of the survey. Notwithstanding these exclusions, the CHMS covers about 96% of the general Canadian population (Giroux, 2007).

2.3. Sample size and allocation

In order to produce reliable estimates at the national level by age group and sex, CHMS cycle 1 required a sample of at least 5000 persons equally distributed among five age groups (6–11, 12–19, 20–39, 40–59, 60–79 years) and sex for a total of 10 groups (Giroux, 2007). Cycles 2 and 3 each required a minimum sample of at least 5700 participants distributed among six age groups (3–5, 6–11, 12–19, 20–39, 40–59, and 60–79 years) and sex (except for 3–5 years), for a total of 11 groups (Statistics Canada, 2015, 2013). The survey was not designed to provide estimates by sex for the 3–5 year age group.

2.4. Sampling strategy

2.4.1. Sampling of collection sites

The CHMS used a stratified, multi-stage household-based sampling strategy. For CHMS cycles 1 and 2, the Canadian Labour Force Survey sampling frame (Statistics Canada, 2008) was used to create 257 collection sites across the country. A geographic area with

Download English Version:

https://daneshyari.com/en/article/5560523

Download Persian Version:

https://daneshyari.com/article/5560523

Daneshyari.com