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Health Fact Sheet

Inorganic-related arsenic concentrations in Canadians, 2014 and 2015

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Inorganic-related arsenic concentrations in Canadians, 2014 and 2015

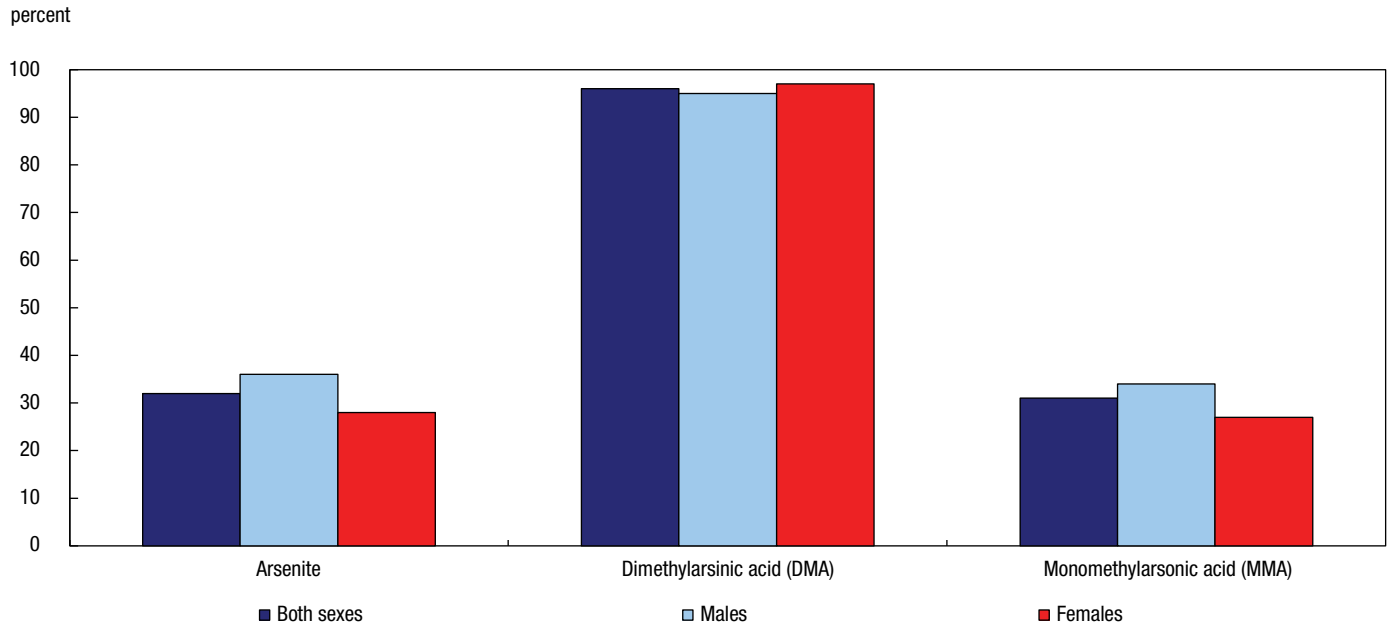
Inorganic and organic arsenic occurs naturally in the environment. Both forms of arsenic can enter the human body through ingestion of food or drinking water, absorption through the skin from direct contact with soil, or by inhalation of ambient air. Inorganic arsenic is more abundant and toxic compared to organic arsenic[1] and will be the focus of this fact sheet. Once it has entered into the body, inorganic arsenic is distributed and stored primarily in skin, bone, and muscle.[2] Absorption and metabolism of inorganic arsenic in the body results in the presence of inorganic-related arsenic species such as arsenate, arsenite and their metabolites dimethylarsinic acid (DMA) and monomethylarsonic acid (MMA). These inorganic-related arsenic species are removed from the body through urine. While DMA and MMA may also originate from exposure to organic arsenic, the measures of these four analytes provide an indicator of overall recent exposure to inorganic arsenic.[3,4,5,6,7] Depending on the type and duration of exposure, inorganic arsenic may cause cancer, neurological problems, circulatory problems, respiratory problems, skin irritation, or nausea and vomiting.[8] While the presence of any of these arsenic species in urine is an indicator of recent exposure, it does not necessarily mean that an adverse health effect will occur.

Cycle 4 (2014 and 2015) of the Canadian Health Measures Survey (CHMS), measured the concentrations of the inorganic-related arsenic species (arsenate, arsenite, DMA and MMA) in the urine of approximately 2500 Canadians aged 3 to 79. Results were reported in micrograms of arsenic per litre (µg As/L).

Arsenic detected in the majority of the Canadian population

Results from the 2014 and 2015 CHMS indicate that the vast majority of Canadians had at least one of the four species of inorganic-related arsenic detected in their urine. Arsenite was detected in 32%, DMA in 96% and MMA in 31% of the Canadian population aged 3 to 79 (Chart 1). For a chemical to be detected, it means that the concentration in urine was above the limit of detection (LOD). In contrast to the other species, arsenate was below the limit of detection for nearly 100% of the population. For more information on the LOD, see the "Analytical Notes" section.

Chart 1 Proportion of select arsenic species found in the urine of Canadians aged 3 to 79, by sex, household population, Canada, 2014 and 2015

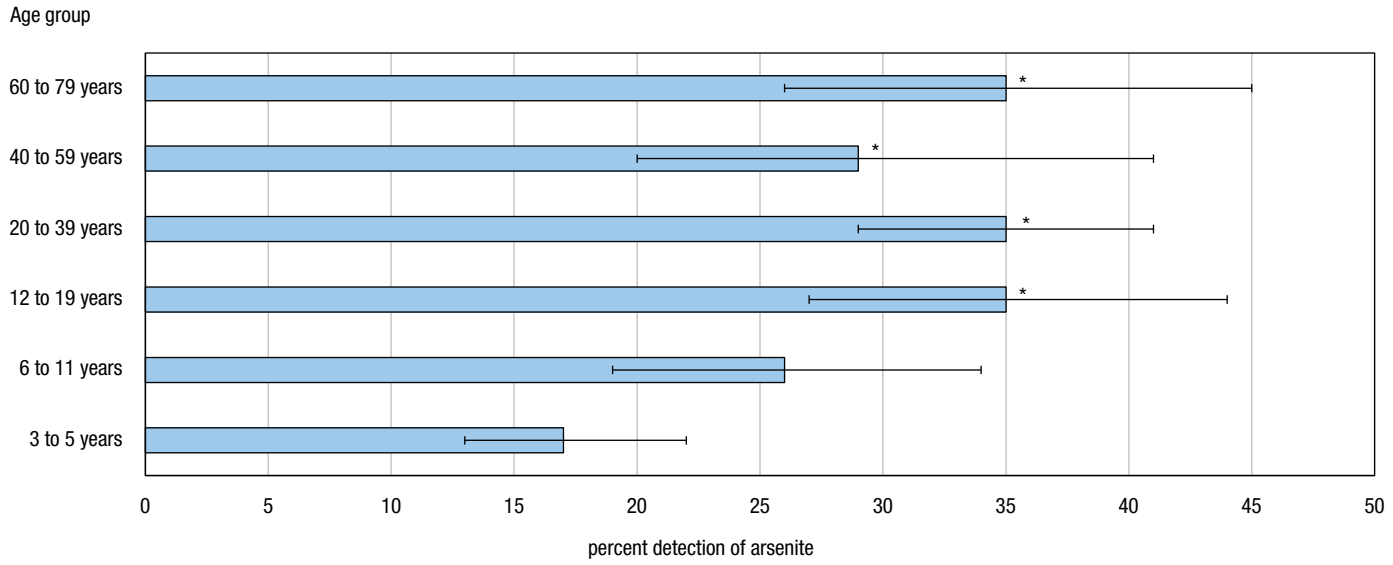


Source: Canadian Health Measures Survey, Cycle 4 (2014 and 2015).

Males (95%) and females (97%) had a similar detectable level of DMA. While more males (36%) than females (28%) had a detectable level of arsenite, and more males (34%) than females (27%) had a detectable level of MMA, neither difference was statistically significant (Chart 1).

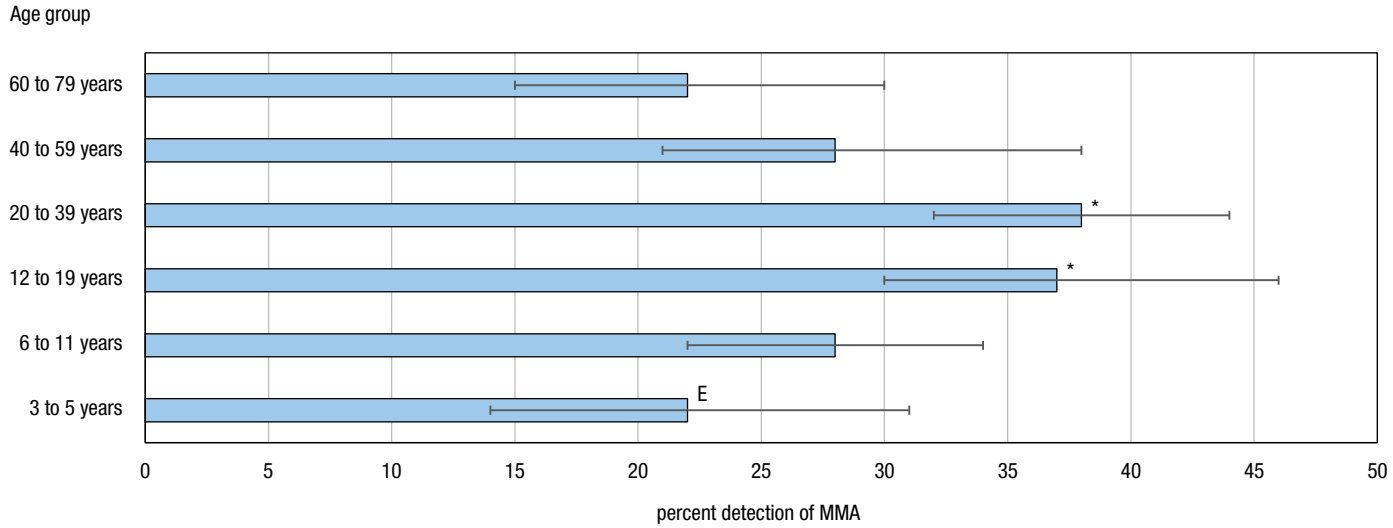
Significant differences were observed when comparing arsenite and MMA each by age group. Age groups 12 to 19 and older were significantly more likely to have a detectable level of arsenite than children aged 3 to 5 (Chart 2a). In addition, those aged 12 to 19 (37%) and 20 to 39 (38%) were significantly more likely to have a detectable level of MMA than 3 to 5 year olds (22%) and 60 to 79 year olds (22%) (Chart 2b).

Chart 2a Proportion of Canadians with detectable levels of arsenite in urine, by age group, 2014 and 2015



* significantly higher than the 3-to-5 year old age group
Source: Canadian Health Measures Survey, Cycle 4 (2014 and 2015).

Chart 2b Proportion of Canadians with detectable levels of monomethylarsonic acid (MMA) in urine, by age group, 2014 and 2015



[E] use with caution
* significantly higher than the 3-to-5 year old age group and the 60-to-79 year old age group
Source: Canadian Health Measures Survey, Cycle 4 (2014 and 2015).

Average concentrations of dimethylarsinic acid (DMA)

The average concentration of DMA in Canadians aged 3 to 79 was 3.5 µg As/L. Males had a higher average concentration (3.6 µg As/L) than females (3.4 µg As/L), although this difference was not significant. The greatest difference by sex within the same age group was between males (4.0 µg As/L) and females (3.2 µg As/L) aged 20 to 39 years, however this difference was also not significant. For more information about averages for arsenate, arsenite or MMA, see the "Analytical Notes" section.

Analytical Notes

Detectable was defined as the respondent having a level of an arsenic analyte in their urine equal to or greater than the limit of detection (LOD). The LOD is the lowest concentration of an analyte that the equipment used for the measurement is able to accurately detect. The LOD for the measured arsenic analytes was 0.75 µg As/L.

Before analysis of the data was performed, any values that were indicated as being less than the LOD were replaced with half the value of the LOD. Average concentrations are calculated as a geometric mean, which provides a better estimate of central tendency for highly skewed data (i.e. extreme values). Skewed data is common in the measurement of environmental chemicals in blood and urine.

More than 40% of the respondents had urine concentrations less than the LOD for arsenate, arsenite and MMA which meant respondents did not have detectable levels for these analytes to calculate an average concentration. Average values are not calculated for the analyte unless there is more than 60% of the population with urine concentrations greater than the LOD.

Any data presented as significant or as significantly different refers to data that have been tested via significance testing such as a t-test and have a p-value of less than 0.05.

Notes

1. World Health Organization. 2001. *Environmental Health Criteria 224: Arsenic and arsenic compounds*. http://www.inchem.org/documents/ehc/ehc/ehc224.htm. Accessed July, 2017.
2. ATSDR (Agency for Toxic Substances and Disease Registry) (2007a). *Toxicological profile for arsenic*. U.S. Department of Health and Human Services, Atlanta, GA. Accessed September, 2017.
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4. Navas-Acien, A. et al. 2011. *Seafood intake and urine concentrations of total arsenic, dimethylarsinate and arsenobetaine in the US population*. Environmental Research. 111, (1). 110-118.
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7. Molin, M. et al. 2012. *Humans seem to produce arsenobetaine and dimethylarsinate after a bolus dose of seafood. Environmental Research*. 112. 28-39.
8. World Health Organization Media Centre. 2017. Arsenic. http://www.who.int/mediacentre/factsheets/fs372/en/. Accessed, November 2017.

For more information on the Canadian Community Health Survey, please contact Statistics Canada's Statistical Information Service (toll-free 1-800-263-1136; 613-951-8116; STATCAN.infostats-infostats.STATCAN@canada.ca).