Cadmium

Environmental estimates (circa 2011): Supplemental data

Table of Contents

1. Data for lifetime excess cancer risk estimates 2

Overview 2

i. Environmental Concentrations 2

ii. Calculated Lifetime Daily Intake 2

iii. Cancer Potency Factors 2

iv. Lifetime Excess Cancer Risk (per million people) 3

Supporting data by exposure pathway 3

i. Outdoor air 3

ii. Indoor air 3

iii. Dust 5

iv. Drinking water 5

v. Food and Beverages 5

2. Data quality for lifetime excess cancer risk estimates 5

3. Data for mapping concentrations 6

Estimates by health region 6

Estimates by census block 6

1. Data for lifetime excess cancer risk estimates

Overview

The summary data used to calculate lifetime excess cancer risk and the results for cadmium are provided in the tables below. For more detailed information on supporting data and sources, see below for each exposure pathway.

i. Environmental Concentrations

Exposure pathway	Units	Average	Maximum	Notes
Outdoor air	µg/m³	0.00011	0.00058	
Indoor air	µg/m³	Insufficient data		
Dust	µg/g	6.0	223.0	

ii. Calculated Lifetime Daily Intake

Exposure pathway	Average intake (mg/kg bodyweight per day)	Maximum intake (mg/kg bodyweight per day)
Outdoor air	0.000000003	0.000000013
Indoor air	Insufficient data	
Dust	0.000004	0.00015

iii. Cancer Potency Factors

Exposure route	Health Canada	US EPA	CA OEHHA
Inhalation	42.0	6.3	15.0

Sources for Cancer Potency Factors:

- Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part I: Guidance on Human Health Preliminary Quantitative Risk Assessment. Version 2.0.
- Health Canada, 2010. Federal Contaminated Site Risk Assessment in Canada, Part II: Health Canada Toxicological Reference Values (TRVs) and Chemical-Specific Factors. Version 2.0.
- United States Environmental Protection Agency Integrated Risk Information System
- California Office of Environmental Health Hazard Assessment, 2009. Air Toxics Hot Spots Risk Assessment Guidelines Part II: Technical Support Document for Cancer Potency Factors, Appendix A. (Updated 2011)

iv. Lifetime Excess Cancer Risk (per million people)

	Average[1]			Maximum[2]
Exposure pathway	Health Canada	US EPA	CA OEHHA[3]	
Outdoor air	0.11	0.016	0.038	0.56
Indoor air	Insufficient data			
Dust	Insufficient data			

[1]Lifetime excess cancer risk based on average intake x cancer potency factor from each agency
[2]Lifetime excess cancer risk based on maximum intake x highest cancer potency factor
[3]California Office of Environmental Health Hazard Assessment

Supporting data by exposure pathway

i. Outdoor air

Outdoor air concentrations are from the National Air Pollution Surveillance monitoring network operated by Environment Canada, for the year 2010.

Source	Stations (n)	Min	Max	Mean	DF
NAPS 2010 (µg/m³)	15	0.000013	0.00058	0.00011	1.0

DF = Detection frequency

We assume cadmium is present at these levels in all outdoor air, although concentrations may vary from one location to another.

ii. Indoor air

Indoor air concentrations are based on data published in peer-reviewed literature since 2000. A ranking system was used to select data most representative of Canadian conditions circa 2011:

1. Canadian data collected in 2000 or more recently, sample duration of 24 hours or longer;
2. US studies of similar currency and sample duration;
3. Studies from northern European countries of similar currency and sample duration;
4. Canadian, US or European studies with data collected prior to 2000 and similar sample duration; and
5. Studies with sample duration of less than 24 hours regardless of country or collection date, or studies from countries not comparable to Canada.

Rank: 2	Author:	Na (2004)					Location:	USA, Riverside CA			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
20			2001-2002	µg/m³	6 days						
12								0.039			
7								0.045			
1								0.050			

Notes: Values listed in the following order: ALL, Non-Smoking, Occasional Smoking, Frequent Smoking. Analyzed using XRF (less accurate technique).
*DF = Detection frequency
**DL = Detection limit

Rank: 4	Author:	Adgate (2007)					Location:	USA, Minneapolis			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
235	1.0		1999	µg/m³	48 hr			0.0003	0.00012		10th 0.00004 90th 0.00033

Notes: Analyzed using ICP-MX (most accurate method).
*DF = Detection frequency
**DL = Detection limit

Rank: 4	Author:	Lai (2004)					Location:	England, Oxford			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
50	0.71		1998-2000	µg/m³	48 hr			0.022		0.019	

Notes: Analyzed using XRF (less accurate technique).
*DF = Detection frequency
**DL = Detection limit

Rank: 4	Author:	Sax (2006)					Location:	New York City, Los Angeles			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
79	1.0		1999-2000	µg/m³	48 hr		0.00077	0.00017	0.15		
75	1.0						0.00172	0.00029	0.24		

Notes: Values listed in the following order: New York City, Los Angeles. Analyzed using ICP-MX (most accurate method).
*DF = Detection frequency
**DL = Detection limit

Rank: 5	Author:	Dermentzoglou (2003)					Location:	Greece			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
6				µg/m³	2 hrs			0.00015			
6								0.00077			
6								0.00246			
6								0.00291			

Notes: Values listed in the following order: Central Heating Central, Wood Burning Central, Cigarette Central, Cooking
*DF = Detection frequency
**DL = Detection limit

Sources for indoor air data:

- Adgate JL, Mongin SJ, Pratt GC, Zhang J, Field MP, Ramachandran G, et al. 2007. Relationship between personal, indoor, and outdoor exposures to trace elements in PM2.5. Science of the Total Environment 386: 21-32.
- Dermentzoglou M, Manoli E, Samara C. 2003. Sources and patterns of polycyclic aromatic hydrocarbons and heavy metals in fine indoor particulate matter of Greek houses. Fresenius Environmental Bulletin 12: 1511-1519.
- Lai HK, Kendall M, Ferrier H, Lindup I, Alm S, Hanninen O, et al. 2004. Personal exposures and microenvironment concentrations of PM2.5, VOC, NO2 and CO in Oxford, UK. Atmospheric Environment 38: 6399-6410.
- Na K, Sawant AA, Cocker III DR. 2004. Trace elements in fine particulate matter within a community in western Riverside Country, CA: focus on residential sites and a local high school. Atmospheric Environment 38: 2867-2877.
- Sax SN, Bennett DH, Chillrud SN, Ross J, Kinney PL, Spengler JD. 2006. A cancer risk assessment of inner-city teenagers living in New York City and Los Angeles. Environmental Health Perspectives 114: 1558-1566.

iii. Dust

Cadmium is not expected to be carcinogenic via ingestion.

iv. Drinking water

Cadmium is not expected to be carcinogenic via ingestion.

v. Food and Beverages

Cadmium is not expected to be carcinogenic via ingestion.

2. Data quality for lifetime excess cancer risk estimates

Only publicly available data were used to calculate these indicators. Data that are not publicly available may produce different results.

No systematic method for measuring data quality was possible, so we provide the following assessments of how well the data used may represent the actual Canadian average levels. Quality is rated higher when there are data from a number of Canadian monitors, or from Canadian studies that show results similar to other comparable studies. Quality is rated lower when data from few monitors or studies were available, and lowest when estimates are based on non-Canadian data. Others may rate data quality differently.

Exposure Pathway	Data Quality	Notes
Outdoor air	Moderate	• Cadmium is regularly measured in outdoor air at 15 monitoring stations across Canada using accepted protocols.
Indoor air	Gap	• No recent data or studies identified using appropriately accurate analytical methods.

3. Data for mapping concentrations

The maps use geographic coordinates at the census block level to represent residential locations. Concentration estimates are mapped at the health region level, which are created with aggregated census block data.

We used a model to predict annual average concentrations of cadmium in outdoor air at residential locations for 2011. These are predicted using levels measured from the National Air Pollution Surveillance (NAPS) monitors and estimated concentrations from known emitters. For more information on how these estimates were created, please see the Mapping Methods document on the Environmental Approach section of our website.

Estimates by health region

The table below shows predicted cadmium concentrations by province based on data at the health region level. The median concentration of cadmium measured in outdoor air in 2011 at the health region level was 0.00020 µg/m^3, while the mean concentration was 0.00026µg/m^3. Concentrations of cadmium can be higher or lower than average in many locations.

i. Provincial averages of predicted cadmium concentrations (µg/m^3) in outdoor air in 2011 based on health regions

Province	Median	Mean
BC	0.00024	0.00042
AB	0.00017	0.00024
SK	0.00015	0.00017
MB	0.00020	0.00024
ON	0.00019	0.00025
QC	0.00024	0.00025
NB	0.00021	0.00023
PE	0.00018	0.00018
NS	0.00017	0.00017
NL	0.00020	0.00021
YK	0.00035	0.00035
NT	0.00031	0.00031
NU	0.00032	0.00032
Canada	**0.00020**	**0.00026**

Estimates by census block

The table below shows provincial populations by concentration levels (either annual average or number of times above/below the national average) based on the census block data and the associated potential lifetime excess risk given different cancer potency factors.

i. Provincial population distribution by estimated average concentration (µg/m³) of cadmium in outdoor air in 2011 based on NAPS data at the census block

Estimated annual average concentration (µg/m³)	Less than 0.000037	0.000037 to 0.000044	0.000044 to 0.000055	0.000055 to 0.000073	0.000073 to 0.00011	0.00011 to 0.00017	0.00017 to 0.00022	0.00022to 0.00028	0.00028 to 0.00033	More than 0.00033
Compared to national average (0.00011µg/m³)*	> 3x lower	2.5 to 3x lower	2 to 2.5x lower	1.5 to 2x lower	1 to 1.5x lower	1 to 1.5x higher	1.5 to 2x higher	2 to 2.5x higher	2.5 to 3x higher	> 3.0x higher
	← Below Average					Above Average →				
BC	25,365 (0.6%)	1,134 (<0.1%)	855 (<0.1%)	1,215,949 (27.6%)	1,084,024 (24.6%)	687,844 (15.6%)	444,972 (10.1%)	118,003 (2.7%)	99,405 (2.3%)	722,506 (16.4%)
AB	--	--	--	--	1,179,500 (32.4%)	1,678,934 (46.1%)	310,747 (8.5%)	96,943 (2.7%)	63,040 (1.7%)	316,093 (8.7%)
SK	--	--	--	--	280,845 (27.2%)	458,879 (44.4%)	76,844 (7.4%)	45m254 (4.4%)	32,994 (3.2%)	138,565 (13.4%)
MB	--	--	--	--	422,400 (35.0%)	539,808 (44.7%)	92,553 (7.7%)	23,895 (1.7%)	11,680 (1.0%)	117,932 (9.8%)
ON	283,721 (2.2%)	451 (<0.1%)	15 (<0.1%)	848,048 (6.6%)	6,132,572 (47.7%)	3,412,054 (26.5%)	659,415 (5.1%)	146,773 (1.1%)	124,679 (1.0%)	1,244,093 (9.7%)
QC	--	--	--	194,026 (2.6%)	1,282,624 (16.2%)	3,218,870 (40.7%)	1,171,371 (14.8%)	574,347 (7.3%)	475,840 (76.0%)	985,923 (12.5%)
NB	--	--	--	--	269,336 (35.9%)	310,540 (41.3%)	38,942 (5.2%)	27,198 (3.6%)	16,641 (2.2%)	88,514 (11.8%)
NS	279,984 (30.4%)	26,764 (2.9%)	27,286 (3.0%)	40,558 (4.4%)	162,246 (17.6%)	314,886 (34.2%)	23,943 (2.6%)	23,759 (2.6%)	16,085 (1.7%)	6,216 (0.7%)
PE	--	--	--	--	41,611 (29.7%)	61,349 (43.8%)	12,859 (9.2%)	8,868 (6.3%)	5,164 (3.7%)	10,353 (7.4%)
NL	--	--	--	--	148,167 (28.8%)	238,128 (46.3%)	35,849 (7.0%)	28,362 (5.5%)	18,006 (3.5%)	46,024 (8.9%)
NU	--	--	--	--	--	23,292 (73.0%)	103 (0.3%)	481 (1.5%)	663 (2.1%)	7,367 (23.1%)
NT	--	--	--	--	811 (2.0%)	16,838 (40.6%)	376 0.9%)	3,382 (8.2%)	2,812 (6.8%)	17,243 (41.6%)
YT	--	--	--	--	7,951 (23.5%)	8,024 (23.7%)	1,495 (4.4%)	555 (1.6%)	1,076 (3.2%)	14,796 (43.6%)
CANADA	589,070	28,349	28,156	2,298,581	11,012,087	10,969,446	2,869,469	1,097,820	868,085	3,715,625
% of pop.	(1.8%)	(0.1%)	(0.1%)	(6.9%)	(32.9%)	(32.8%)	(8.6%)	(3.3%)	(2.6%)	(11.1%)

ASSOCIATED LIFETIME EXCESS CANCER RISK (per million people):
RED = POTENTIAL LIFETIME EXCESS RISK IS GREATER THAN 1 PER MILLION PEOPLE

Health Canada CPF: 42.0	< 0.036	0.036 to < 0.044	0.044 to < 0.055	0.055 to < 0.073	0.073 to < 0.11	0.11 to < 0.17	0.17 to < 0.22	0.22 to < 0.28	0.28 to < 0.33	> 0.33
California OEHHA CPF: 15.0	< 0.013	0.013 to < 0.015	0.015 to < 0.019	0.019 to < 0.025	0.025 to < 0.038	0.038 to < 0.057	0.057 to < 0.076	0.076 to < 0.095	0.095 to < 0.114	> 0.114
US EPA CPF: 6.3	< 0.005	0.005 to < 0.006	0.006 to < 0.008	0.008to < 0.011	0.011 to < 0.016	0.016 to < 0.024	0.024 to < 0.032	0.032 to < 0.04	0.04 to < 0.05	> 0.05

* measured at National Air Pollution Surveillance (NAPS) monitors in 2011
CPF: Cancer Potency Factor