Chrysene
Environmental estimates (circa 2011): Supplemental data

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1. Data for lifetime excess cancer risk estimates

Overview

The summary data used to calculate lifetime excess cancer risk and the results for chrysene 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	0.0002	0.0013	
Indoor air	µg/m³	0.00012	0.0014	
Dust	µg/g	3.29	35.1	
Drinking water	µg/L	Insufficient data		
Foods and beverages		See detailed data	Not estimated	

ii. Calculated Lifetime Daily Intake

Exposure pathway	Average intake (mg/kg bodyweight per day)	Maximum intake (mg/kg bodyweight per day)
Outdoor air	0.000000005	0.00000003
Indoor air	0.000000039	0.00000045
Dust	0.0000022	0.000023
Drinking water	Insufficient data	
Foods and beverages	0.000000035	Not estimated

iii. Cancer Potency Factors

Exposure route	Health Canada	US EPA	CA OEHHA
Inhalation	--	--	0.039
Ingestion	--	--	0.12

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	--	--	0.00018	0.0012
Indoor air	--	--	0.0015	0.018
Dust	--	--	0.259	2.77
Drinking water		Insufficient data		
Foods and beverages	--	--	0.00416	Not estimated

[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)	17	0.00002	0.0013	0.0002	1.0

DF = Detection frequency

We assume chrysene 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:	Jung (2010)						Location:	New York City		
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
203			2005 -	µg/m³	14 days	0.00002	0.001405	0.000115	0.0001	0.00008	
98			2010				0.00069	0.00009	0.00006		

Notes: Values listed in the following order: heating season (Oct-Apr), non-heating season (May-Sept)
*DF = Detection frequency
**DL = Detection limit

Rank: 2	Author:	Li (2005)						Location:	Chicago		
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
10	~0.95		2000 - 2001	µg/m³	48h x 14 months	0.000001	0.0013		0.0002		10th 0.00008 25th 0.0001 75th 0.0003 90th 0.0005

Notes: non-smoking homes, (sampled once a month for 14 months) total n = 115
*DF = Detection frequency
**DL = Detection limit

Rank: 3	Author:	Halsall (2008)						Location:	Lancaster UK		
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
7	1.0	0.00001 to 0.0015	Summer 2003	µg/m³	6 to 24 hours	0.00003	0.00228	0.00063	0.00028		

Notes: 3 locations
*DF = Detection frequency
**DL = Detection limit

Sources for indoor air data:

- Halsall CJ, Maher BA, Karloukovski VV, Shah P, Watkins SJ. 2008. A novel approach to investigating indoor/outdoor pollution links: Combined magnetic and PAH measurements. Atmospheric Environment 42: 8902-8909.
- Jung K, Patel MM, Kinney PL, Chillrud SN, Whyatt R, Hoepner L, et al. 2010. 1. Effects of Season and Indoor Heating on Indoor and Outdoor Residential Levels of Airborne Polycyclic Aromatic Hydrocarbons, Absorbance and Particulate Matter 2.5 in an Inner City Cohort of Young Children. Journal of Allergy and Clinical Immunology 125: AB81.
- Li A, Schoonover TM, Zou QM, Norlock F, Conroy LM, Scheff PA, et al. 2005. Polycyclic aromatic hydrocarbons in residential air of ten Chicago area homes: Concentrations and influencing factors. Atmospheric Environment 39: 3491-3501.

iii. Dust

Indoor dust 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: 1 Author: Maertens (2008) Location: Ottawa, Canada

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
51	1.0	0.025	2002 - 2003	µg/g		0.15	35.1	3.29	1.19	1.46	

Notes: Analyzed using GC/MS
*DF = Detection frequency
**DL = Detection limit

Rank: 2 Author: Whitehead (2011) Location: California, USA

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
583	1.0	0.002	2001-2007	µg/g		0.007	1.547		0.073		

Notes: Analyzed using GC/MS
*DF = Detection frequency
**DL = Detection limit

Rank: 2 Author: Hoh (2012) Location: San Diego County, CA, USA

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
43	1.0		2005-2007	µg/g		0.00730	0.226		0.0457		25^{th} 0.0355 75^{th} 0.0800
89	1.0					0.00670	0.380		0.0753		25^{th} 0.0412 75^{th} 0.0128

Notes: Analyzed using GC/MS
*DF = Detection frequency
**DL = Detection limit

Sources for dust data:

- Hoh E, Hunt RN, Quintana PJE, Zakarian JM, Chatfield DA, Wittry BC, Rodriguez E, Matt GE. 2012. Environmental tobacco smoke as a source of polycyclic aromatic hydrocarbons in settled house dust. Environ Sci Technol 46: 4174-4183.
- Maertens RM, Yang XF, Zhu JP, Gagne RW, Douglas GR, White PA. 2008. Mutagenic and carcinogenic hazards of settled house dust I: Polycyclic aromatic hydrocarbon content and excess lifetime cancer risk from preschool exposure. Environmental Science & Technology 42: 1747-1753.

- Whitehead T, Metayer C, Gunier RB, Ward MH, Nishioka MG, Buffler P, Rappaport SM. 2011. Determinants of polycyclic aromatic hydrocarbon levels in house dust. J Expo Sci Environ Epidemiol 21(2): 123-132.

iv. Drinking water

No recent data or studies were identified.

v. Food and Beverages

Food consumption data are from the Statistics Canada Food Survey (2006) - Food available, adjusted for losses tables, and from the Nutrition Canada Survey (1970-1972).

Food concentration data are primarily from the US-FDA Total Diet Study (2003-2004), with additional data on metals and several PAHs from the Canadian Food Inspection Agency (CFIA) - National Chemical Residue Monitoring Program: 2009-2010 Annual Report and the US-FDA (TDS Statistics on Element Results - 2008).

In order to better represent actual intake, we incorporated data for cooked and/or processed foods, as in some cases, this can either add to or diminish the amount measured in raw food.

Concentration data were obtained for 42% of total meat consumed, and 1% of total fruit consumed.

Food or Beverage	Concentration (µg/g)	DF
Beef	0.00033	0.15400
Chicken	0.00021	0.07700
Mutton and lamb		
Offal		
Oils and fats		
Pork	0.00022	0.08300
Salad oils		
Shortening and shortening oils		
Stewing hen		
Turkey		
Veal		
Fish fresh and frozen seafish		
Fish freshwater		
Fish processed seafish		
Apple pie filling		
Apple sauce		
Apples canned		
Apples dried		
Apples fresh		
Apples frozen		
Apricots canned		
Apricots fresh		
Bananas fresh		
Berries other fresh		
Blueberries canned		
Blueberries fresh		
Blueberries frozen		
Cherries fresh		
Cherries frozen		
Citrus other fresh		
Coconut fresh		
Cranberries fresh		
Dates fresh		
Figs fresh		
Fruit dried		
Grapefruit fresh		
Grapes fresh		
Guava and mangoes fresh		
Kiwi fresh		
Lemons fresh		
Limes fresh		
Mandarins fresh		
Melons musk, cantaloupe fresh		
Melons other fresh		
Melons watermelons fresh		
Melons, winter melons fresh		
Nectarines fresh		
Oranges fresh		
Papayas fresh		
Peaches canned		

Food or Beverage	Concentration (µg/g)	DF
Peaches fresh		
Pears canned		
Pears fresh		
Pineapples canned		
Pineapples fresh		
Plums total fresh		
Quinces fresh		
Raspberries frozen		
Strawberries canned		
Strawberries fresh		
Strawberries frozen		
Sugar maple		
Sugar refined		
Honey	0.00036	0.01400
Artichokes fresh		
Asparagus canned		
Asparagus fresh		
Avocados fresh		
Beans baked and canned		
Beans dry		
Beans green and wax canned		
Beans green and wax fresh		
Beans green and wax frozen		
Beets canned		
Beets fresh		
Broccoli fresh		
Broccoli frozen		
Brussels sprouts fresh		
Brussels sprouts frozen		
Cabbage Chinese fresh		
Cabbage fresh		
Carrots canned		
Carrots fresh		
Carrots frozen		
Cauliflower fresh		
Cauliflower frozen		
Celery fresh		
Corn canned		
Corn flour and meal		
Corn fresh		
Corn frozen		
Cucumbers fresh		
Eggplant fresh		
Garlic fresh		
Kohlrabi fresh		
Leeks fresh		
Lettuce fresh		
Lima beans frozen		
Manioc fresh		
Mushrooms canned		

Food or Beverage	Concentration (µg/g)	DF
Mushrooms fresh		
Okra fresh		
Olives fresh		
Onions and shallots fresh		
Parsley fresh		
Parsnips fresh		
Peas canned		
Peas dry		
Peas fresh		
Peas frozen		
Peppers fresh		
Potatoes chips		
Potatoes frozen		
Potatoes other processed		
Potatoes sweet fresh		
Potatoes white fresh		
Potatoes white fresh and processed		
Pumpkins and squash fresh		
Radishes fresh		
Rappini fresh		
Rutabagas and turnip fresh		
Spinach fresh		
Spinach frozen		
Tomatoes canned		
Tomatoes fresh		
Tomatoes pulp, paste and puree		
Vegetables other edible root fresh		
Vegetables other leguminous fresh		
Vegetables unspecified canned		
Vegetables unspecified fresh		
Vegetables unspecified frozen		
Butter		
Cheese cheddar		
Cheese cottage		
Cheese processed		
Cheese variety		
Cream cereal 10%		
Cream sour		
Cream table 18%		
Cream whipping 32% or 35%		
Eggs		
Ice cream		
Ice milk		
Margarine		

Food or Beverage	Concentration (µg/g)	DF
Milk buttermilk		
Milk chocolate drink		
Milk concentrated skim		
Milk concentrated whole		
Milk other whole milk products		
Milk partly skimmed 2%		
Milk skim		
Milk standard		
Milk sweetened concentrated skim		
Milkshake		
Powder buttermilk		
Powder skim milk		
Powder whey		
Sherbet		
Yogurt		
Cereal products		
Oatmeal and rolled oats		
Peanuts		
Pot and pearl barley		
Pulses and nuts		
Rice		
Rye flour		
Tree nuts		
Wheat flour		
Ale, beer, stout and porter		
Beverages alcoholic		
Coffee		
Distilled spirits		
Juice apple		
Juice grape		
Juice tomato		
Juice fruit		
Juice grapefruit		
Juice lemon		
Juice orange		
Juice pineapple		
Juice vegetable		
Soft drinks		
Tea		
Water bottled		
Wines		
Cocoa		

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	Low	• Chrysene is regularly measured in outdoor air at 17 monitoring stations across Canada using accepted protocols.
Indoor air	Very Low	• One recent US study identified (New York City). Some agreement with a smaller US study in Chicago.
Indoor dust	Low	• Measured levels from one recent Canadian study (Ottawa, ON) are considerably higher than 2 recent studies conducted in California, USA using the same analytical methods.
Drinking water	Gap	• Only 1 sample was analyzed for chrysene in Ontario in 2009. No recent data or studies were identified.
Foods and beverages	Very Low	• Very limited data from CFIA (National Chemical Residue Monitoring Program: 2009-2010 Annual Report) for chrysene in foods and beverages were identified.

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 chrysene 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 chrysene concentrations by province based on data at the health region level. The median concentration of chrysene measured in outdoor air in 2011 at the health region level was 0.00035 µg/m^3, while the mean concentration was 0.00041 µg/m^3. Concentrations of chrysene can be higher or lower than average in many locations.

i. Provincial averages of predicted chrysene concentrations (µg/m3) in outdoor air in 2011 based on health regions

Province	Median	Mean
BC	0.00047	0.00047
AB	0.00024	0.00026
SK	0.00022	0.00025
MB	0.00024	0.00022
ON	0.00038	0.00045
QC	0.00041	0.00057
NB	0.00036	0.00037
PE	0.00034	0.00034
NS	0.00043	0.00045
NL	0.00021	0.00024
YK	0.00035	0.00035
NT	0.00024	0.00024
NU	0.00034	0.00034
Canada	**0.00035**	**0.00041**

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 chrysene in outdoor air in 2011 based on NAPS data at the census block

Estimated annual average concentration (µg/m³)	Less than 0.000067	0.000067 to 0.00008	0.00008 to 0.0001	0.0001 to 0.00013	0.00013 to 0.0002	0.0002 to 0.0003	0.0003 to 0.0004	0.0004 to 0.0005	0.0005 to 0.0006	More than 0.0006
Compared to national average (0.0002 µg/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	--	--	--	458,741 (10.4%)	25,920 (0.6%)	2,311,420 (52.5%)	360,743 (8.2%)	322,842 (7.3%)	305,207 (6.9%)	615,184 (14.0%)
AB	--	447,239 (12.3%)	1,244,789 (34.1%)	751,420 (20.6%)	377,314 (10.4%)	604,876 (16.6%)	84,723 (2.3%)	47,545 (1.3%)	30,301 (0.8%)	57,050 (1.6%)
SK	--	--	--	344,879 (33.4%)	14,648 (1.4%)	430,319 (41.6%)	64,695 (6.3%)	46,272 (4.5%)	44,459 (4.3%)	88,109 (8.5%)
MB	--	477,902 (39.6%)	89,956 (7.4%)	355,906 (29.5%)	128,922 (10.7%)	110,967 (9.2%)	20,564 (1.7%)	5,762 (0.5%)	4,660 (0.4%)	13,629 (1.1%)
ON	693,395 (5.4%)	216,372 (1.7%)	1,686,331 (13.1%)	1,355,912 (10.5%)	2,452,759 (19.1%)	3,432,493 (26.7%)	628,740 (4.9%)	379,403 (3.0%)	318,518 (2.5%)	1,687,898 (13.1%)
QC	--	--	--	1,049,121 (13.3%)	63,427 (0.8%)	1,460,341 (18.5%)	2,506,384 (31.7%)	463,993 (5.9%)	432,171 (5.5%)	1,927,564 (24.4%)
NB	84,156 (11.2%)	3,380 (0.4%)	2,472 (0.3%)	243,283 (32.4%)	13,057 (1.7%)	262,417 (34.9%)	43,383 (5.8%)	28,992 (3.9%)	20,386 (2.7%)	49,645 (6.6%)
NS	--	--	--	272,832 (29.6%)	14,014 (1.5%)	406,075 (44.1%)	41,705 (4.5%)	36,847 (4.0%)	41,001 (4.4%)	109,253 (11.9%)
PE	--	--	--	50,081 (35.7%)	2,662 (1.9%)	64,934 (46.3%)	5,346 (3.8%)	2,576 (1.8%)	3,473 (2.5%)	11,132 (7.9%)
NL	--	--	--	204,231 (39.7%)	13,805 (2.7%)	196,348 (38.2%)	36,792 (7.2%)	21,073 (4.1%)	16,095 (3.1%)	26,192 (5.1%)
NU	--	--	--	31,906 (100.0%)	--	--	--	--	--	--
NT	--	--	--	20,350 (49.1%)	618 (1.5%)	15,696 (37.9%)	2,665 (6.4%)	821 (2.0%)	714 (1.7%)	598 (1.4%)
YT	--	--	--	7,021 (20.7%)	238 (0.7%)	17,566 (51.8%)	1,962 (5.8%)	2,173 (6.4%)	1,219 (3.6%)	3,718 (11.0%)
CANADA % of pop.	777,551 (2.3%)	1,144,893 (3.4%)	3,023,548 (9.0%)	5,145,683 (15.4%)	3,107,384 (9.3%)	9,313,452 (27.8%)	3,797,702 (11.3%)	1,358,299 (4.1%)	1,218,204 (3.6%)	4,589,972 (13.7%)

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

Health Canada CPF: No CPF										
California OEHHA CPF: 0.039	< 0.00006	0.00006 to < 0.00007	0.00007 to < 0.00009	0.00009 to < 0.00012	0.00012 to < 0.00018	0.00018 to < 0.00027	0.00027 to < 0.00036	0.00036 to < 0.00045	0.00045 to < 0.00054	> 0.00054
US EPA CPF: No CPF										

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