Polychlorinated Biphenyls

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 PCB's 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	0.0000000025	0.000000006	Total toxic equivalent PCBs
Indoor air	µg/m³	0.0069	0.014	Total PCBs with 3 to 7 chlorines
Dust	µg/g	0.29	0.82	Total with 3 to 7 chlorines
Drinking water				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	--	--
Indoor air	0.0000022	0.0000045
Dust	0.00000019	0.00000054
Drinking water	Insufficient data	
Foods and beverages	0.0000028	Not estimated

iii. Cancer Potency Factors

Exposure route	Health Canada	US EPA	CA OEHHA
Inhalation	--	0.4	2.0
Ingestion	--	2.0	2.0

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	--	--	--	--
Indoor air	--	0.896	4.48	9.096
Dust	--	0.38	0.38	1.077
Drinking water		Insufficient data		
Foods and beverages	--	5.61	5.61	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 2009.

Source	PCB	Stations (n)	Min	Max	Mean	DF
NAPS 2009 (µg/m³)	Average Total TEQ	10	0.0000000007	0.000000006	0.0000000025	1.0

DF = Detection frequency

We assume PCB's are present at these levels in all outdoor air, although concentrations may vary from one location to another. Available data were insufficient to estimate concentrations at residential locations.

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: 1	Author:	Harrad (2009)					Location:	Toronto			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
10	1.0 assumed		2006	µg/m³	28 days	0.0011	0.0144	0.0069	0.0049		5th 0.0014 95th 0.0142

*DF = Detection frequency
**DL = Detection limit

Rank: 3	Author:	Bohlin (2008)					Location:	Gothenburg Sweden, Lancaster UK			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
5	1.0	0.025 to 0.41	2006	µg/m³	6-7 weeks	0.0003	0.0016	0.0009	0.0005		
17		ng/m³				0.0002	0.0021	0.0009	0.0006		

Notes: Values listed in the following order: Gothenburg, Lancaster
*DF = Detection frequency
**DL = Detection limit

Rank: 3	Author:	Harrad (2006)					Location:	West Midlands, UK			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
31		~ 0.1 pg/m3	2003-2005	µg/m³	28 days	0.0005	0.0098	0.0028	0.0018		5th 0.0006 95th 0.00089

*DF = Detection frequency
**DL = Detection limit

Rank: 4	Author:	Rudel (2003)					Location:	Cape Cod, MA			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
120	0.31 0.3 0.6		1999-2001	µg/m³	24h		0.025 0.0036 0.0067	0.0013 0.00006 0.00018	< DL	0.0007 0.0009 0.0003	90th 0.003

Notes: Values presented in the following order: PCB 52, PCB 105, PCB 153.
*DF = Detection frequency
**DL = Detection limit

Rank: 5	Author:	Bohlin (2008)					Location:	Mexico City			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
13	1	0.00025 to	2006	µg/m³	6-7 weeks	0.0002	0.0008	0.0005	0.0005		
13		0.00041				0.0001	0.0003	0.000290	0.0016		

Notes: Values listed in the following order: urban, semi-rural
*DF = Detection frequency
**DL = Detection limit

Sources for indoor air data:

- Bohlin P, Jones KC, Tovalin H, Strandberg B. 2008. Observations on persistent organic pollutants in indoor and outdoor air using passive polyurethane foam samplers. Atmospheric Environment 42: 7234-7241.

- Harrad S, Hazrati S, Ibarra C. 2006. Concentrations of polychlorinated biphenyls in indoor air and polybrominated diphenyl ethers in indoor air and dust in Birmingham, United Kingdom: implications for human exposure. Environ Sci Technol 40: 4633-4638.
- Harrad S, Ibarra C, Robson M, Melymuk L, Zhang X, Diamond M, et al. 2009. Polychlorinated biphenyls in domestic dust from Canada, New Zealand, United Kingdom and United States: Implications for human exposure. Chemosphere 76: 232-238.
- Rudel RA, Camann DE, Spengler JD, Korn LR, Brody JG. 2003. Phthalates, alkylphenols, pesticides, polybrominated diphenyl ethers, and other endocrine-disrupting compounds in indoor air and dust. Environmental Science & Technology 37: 4543-4553.

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:	Harrad (2009)					Location:	Toronto, Texas, UK, New Zealand			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
10	100% assumed		2006	µg/g		0.056	0.82	0.29	0.26		5th 0.065 95th 0.72
20						0.047	0.62	0.22			5th 0.067 95th 0.52
20						0.0057	0.86	0.11	0.048		5th 0.009 95th 0.27
20						0.011	0.26	0.067	0.046		5th 0.013 95th 0.154

Notes: Values are the sum of all PCBs with 3 to 7 chlorines, reported in the following order: Toronto Canada, Texas, UK, and New Zealand
*DF = Detection frequency
**DL = Detection limit

Sources for dust:

- Harrad S, Ibarra C, Robson M, Melymuk L, Zhang X, Diamond M, et al. 2009. Polychlorinated biphenyls in domestic dust from Canada, New Zealand, United Kingdom and United States: Implications for human exposure. Chemosphere 76: 232-238.

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 23% of total meat consumed, 48% of total seafood consumed, 2% of total fruit consumed, and 4% of total dairy and eggs consumed.

Food or Beverage	Concentration (µg/g)	DF
Beef	0.01000	0.02273
Chicken	0.03000	0.0455
Mutton and lamb	0.01000	0.0227
Offal		
Oils and fats		
Pork	0.01000	0.0227
Salad oils		
Shortening and shortening oils		
Stewing hen		
Turkey		
Veal	0.01000	0.025
Fish fresh and frozen seafish	0.02438	0.9167
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	0.00023	0.02273
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		
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	0.00318	0.02273
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	Very Low	• Polychlorinated biphenyls are measured in outdoor air at 10 monitoring stations in Southern Ontario using accepted protocols, and reported as either total PCBs (including all congeners) or as total toxic equivalent PCBs. Total toxic equivalent levels were used for this estimate.
Indoor air	Very Low	• One recent Canadian study was identified (ON), but does not report total toxic equivalent PCBs in indoor air (only congeners with 3 to 7 chlorines).
Indoor dust	Very Low	• One recent Canadian study was identified (ON), but does not report total toxic equivalent PCBs in indoor dust (only congeners with 3 to 7 chlorines).
Drinking water	Gap	• Only one sample was noted as being tested for polychlorinated biphenyls in the Ontario Drinking Water Surveillance Program in 2009. No other data were identified.
Foods and beverages	Very Low	• No Canadian data on concentrations of polychlorinated biphenyls in foods and beverages were identified. Data from the US-FDA (TDS-2003-2004) were used for this estimate.