Acetaldehyde

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 acetaldehyde 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	0.81	1.8	
Indoor air	µg/m³	22	400.0	

ii. Calculated Lifetime Daily Intake

Exposure pathway	Average intake (mg/kg bodyweight per day)	Maximum intake (mg/kg bodyweight per day)
Outdoor air	0.000019	0.000042
Indoor air	0.00715	0.130

iii. Cancer Potency Factors

Exposure route	Health Canada	US EPA	CA OEHHA
Inhalation	--	0.0077	0.01

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	--	0.14	0.19	0.42
Indoor air	--	55.03	71.47	1299.48

[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

Source	Stations (n)	Min	Max	Mean	DF
NAPS 2010 (µg/m³)	11	0.34	1.8	0.81	1.0

DF = Detection frequency

We assume acetaldehyde 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: 1	Author:	Health Canada (2012)					Location:	Halifax, NS			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
331	1	0.171	2009 summer	µg/m³	24h	1.142	681.0	19.04	13.14	13.89	25th 8.808 75th 21.57 90th 32.79 95th 48.20
312	1		winter			2.133	143.2	15.45	10.53	11.06	25th 6.184 75th 17.95 90th 32.67 95th 45.73

*DF = Detection frequency
**DL = Detection limit

Rank: 1	Author:	Health Canada (2010)					Location:	Windsor, ON			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
217	0.995	0.019	2005 summer	µg/m³	24h	0.009	185.670	48.159	45.040	38.997	25th 29.660 75th 63.130 90th 86.030 95th 95.740
232	1		winter			4.352	509.647	26.437	16.302	18.514	25th 11.272 75th 26.605 90th 51.484 95th 62.900
211	1	0.019	2006 summer		24h	5.655	128.355	42.874	40.200	35.899	25th 24.190 75th 53.735 90th 73.890 95th 90.700
224	1		winter			3.960	78.435	15.334	12.603	12.992	25th 8.545 75th 19.435 90th 27.070 95th 35.605

*DF = Detection frequency
**DL = Detection limit

Rank: 1	Author:	Gilbert (2005)					Location:	Prince Edward Island			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
26.12.59	1.0 assumed		2002 (winter)	µg/m³	24h	4.4	79.1	26.4	18.9	20.2	

*DF = Detection frequency
**DL = Detection limit

Rank: 1 Author: Héroux (2010) Location: Regina, SK

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
111			2007	µg/m³	24h	0.49	48.8	12.69		10.1	
104						0.49	94.2	12.58 (avg 12.64)		9.74	

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

Rank: 1 Author: Stocco (2008) Location: Windsor, ON

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
48	0.99 to 1.0	0.009	2005	µg/m³	24h, 5 repeated measures					18.44 39.63	

Notes: 48 non-smokers, Values listed in the following order: Winter, Summer
*DF = Detection frequency
**DL = Detection limit

Rank: 2 Author: Liu (2007) Location: RIOPA – 3 US cities

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
353	>0.95		1999 - 2000	µg/m³	48h			22.9	18.6		5th 7.5 95th 50.2

Notes: Samples from 234 homes
*DF = Detection frequency
**DL = Detection limit

Rank: 2 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
46	1.0	<1	1999-	µg/m³	48h	91.8	16.7	13.1			
41			2000		weekday	35.9	13	11.7			

Notes: Values listed in the following order: NYC non-smoking homes, LA non-smoking homes
*DF = Detection frequency
**DL = Detection limit

Rank: 3 Author: Clarisse (2003) Location: Paris, France

Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
61	1.0 assumed	1.8	2001	µg/m³	72 h					10.1 10.0 10.2	

Notes: Values presented in the following order: Kitchen, living room, bedroom
*DF = Detection frequency
**DL = Detection limit

Rank: 3	Author:	Ohura (2006)					Location:	Shimuzu, Japan			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
25	1.0	0.14 pg	2000-2001	µg/m³	24h					9.39	10th 3.59 90th 24.1
21										16.7	10th 8.35 90th 36.7

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

Rank: 5	Author:	Feng (2004)					Location:	Ottawa, ON			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
30		1	unknown	µg/m³	100 minutes	4.4	38	18			

*DF = Detection frequency
**DL = Detection limit

Rank: 5	Author:	Marchand (2008)					Location:	Strasbourg, France			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
138			2004-2005	µg/m³	30 to 95 minutes	<dl	62	14.3	12		

Notes: Feb-May 2004 (24 homes) Oct 2004 – May 2005 (138 homes)
*DF = Detection frequency
**DL = Detection limit

Rank: 5	Author:	Marchand (2006)					Location:	Strasbourg, France			
Samples (n)	DF*	DL**	Sample Date	Units	Sample Duration	Min	Max	Mean (AM)	Med	Geomean (GM)	Percentile
16 16	1.0 assumed	0.32	2004-2005	µg/m³	20 to 90 minutes			18.1 18.2			

Notes: Values presented in the following order: Living room, bedroom.
*DF = Detection frequency
**DL = Detection limit

Sources for indoor air data:

- Clarisse B, Laurent AM, Seta N, Le Moullec Y, El Hasnaoui A, Momas I. 2003. Indoor aldehydes: measurement of contamination levels and identification of their determinants in Paris dwellings. Environmental Research 92: 245-253.
- Feng YL, Zhu JP. 2004. Separation and determination of carbonyl compounds in indoor air using two-step gradient capillary electrochromatography. Analytical Sciences 20: 1691-1695.
- Gilbert NL, Guay M, David MJ, Judek S, Chan CC, Dales RE. 2005. Levels and determinants of formaldehyde, acetaldehyde, and acrolein in residential indoor air in Prince Edward Island, Canada. Environ Res 99: 11-17.
- Health Canada. 2012. Halifax Indoor Air Quality Study (2009) – Volitile Organic Compounds (VOC) Data Summary.
- Health Canada . 2010. Windsor Exposure Assessment Study (2005-2006) : Data Summary for Volatile Organic Compound Sampling.

- Héroux ME, Clark N, Van Ryswyk K, Mallick R, Gilbert NL, Harrison I, et al. 2010. Predictors of Indoor Air Concentrations in Smoking and Non-Smoking Residences. International Journal of Environmental Research and Public Health 7: 3080-3099.
- Liu W, Zhang JJ, Korn LR, Zhang L, Weisel CP, Turpin B, et al. 2007. Predicting personal exposure to airborne carbonyls using residential measurements and time/activity data. Atmospheric Environment 41: 5280-5288.
- Marchand C, Bulliot B, Le Calve S, Mirabel P. 2006. Aldehyde measurements in indoor environments in Strasbourg (France). Atmospheric Environment 40: 1336-1345.
- Marchand C, Le Calve S, Mirabel P, Glasser N, Casset A, Schneider N, et al. 2008. Concentrations and determinants of gaseous aldehydes in 162 homes in Strasbourg (France). Atmospheric Environment 42: 505-516.
- Ohura T, Amagai T, Senga Y, Fusaya M. 2006. Organic air pollutants inside and outside residences in Shimizu, Japan: Levels, sources and risks. Science of the Total Environment 366: 485-499.
- 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.
- Stocco C, MacNeill M, Wang D, Xu X, Guay M, Brook J, et al. 2008. Predicting personal exposure of Windsor, Ontario residents to volatile organic compounds using indoor measurements and survey data. Atmospheric Environment 42: 5905-5912.

iii. Dust

Acetaldehyde is not expected to be present in dust in significant amounts, and is not expected to be carcinogenic via ingestion.

iv. Drinking water

There is no evidence that acetaldehyde is carcinogenic via ingestion at levels present in foods and beverages, including drinking water, and is recognized as a safe food additive in the US.

v. Food and Beverages

There is no evidence that acetaldehyde is carcinogenic via ingestion at levels present in foods and beverages, and is recognized as a safe food additive in the US. Acetaldehyde is a by-product of the metabolism of alcohol in the human body.

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	• Acetaldehyde is regularly measured in outdoor air at 11 monitoring stations across Canada using accepted protocols.
Indoor air	Moderate	• Recent studies were available for four locations in Canada (Halifax NS, Windsor ON, PEI, and Regina SK). Mean represents an average of means reported in the Canadian studies, and are relatively similar to means reported in studies conducted in the US.

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 from aggregated census block data.

We used a model to predict annual average concentrations of acetaldehyde 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 acetaldehyde concentrations by province based on data at the health region level. The median concentration of acetaldehyde measured in outdoor air in 2011 at the health region level was 1.294 µg/m^3, while the mean concentration was 1.349 µg/m^3. Concentrations of acetaldehyde can be higher or lower than average in many locations.

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

Province	Median	Mean
BC	1.360	1.469
AB	1.216	1.287
SK	0.938	0.962
MB	1.034	1.091
ON	1.385	1.411
QC	1.390	1.486
NB	1.391	1.509
PE	1.223	1.223
NS	1.432	1.409
NL	1.075	1.063
YK	1.261	1.261
NT	1.053	1.053
NU	1.799	1.799
Canada	**1.294**	**1.349**

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

Estimated annual average concentration (µg/m³)	Less than 0.27	0.27 to 0.32	0.32 to 0.41	0.41 to 0.54	0.54 to 0.81	0.81 to 1.22	1.22 to 1.62	1.62 to 2.03	2.03 to 2.43	More than 2.43
Compared to national average (0.81µg/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	--	--	184,951 (4.2%)	46,170 (1.0%)	487,050 (11.1%)	722,077 (16.4%)	175,111 (4.0%)	1,283,614 (2.9%)	251,189 (5.7%)	1,249,895 (28.4%)
AB	--	--	--	--	598,488 (16.4%)	1,898,203 (52.1%)	284,642 (7.8%)	300,391 (8.2%)	249,763 (6.9%)	313,770 (8.6%)
SK	--	--	--	--	438,251 (42.4%)	350,297 (33.9%)	98,013 (9.5%)	66,516 (6.4%)	40,206 (3.9%)	40,098 (3.9%)
MB	--	--	--	--	761,094 (63.0%)	226,137 (18.7%)	124,321 (10.3%)	47,513 (3.9%)	27,859 (2.3%)	21,344 (1.8%)
ON	--	--	--	279,196 (2.1%)	1,939,292 (15.1%)	6,196,397 48.2%)	1,328,978 (10.3%)	1,298,513 (10.1%)	1,084,024 (8.4%)	725,421 (5.6%)
QC	--	--	--	--	1,394,127 (17.6%)	3,225,144 (41.0%)	721,575 (9.1%)	703,500 8.9%)	683,437 (8.6%)	1,175,218 (14.9%)
NB	--	--	--	--	336,248 (44.8%)	245,395 (32.7%)	56,609 (7.5%)	41,368 (5.5%)	23,248 (3.1%)	48,303 (6.4%)
NS	--	--	--	--	272,832 (3.0%)	441,152 (47.90%)	54,361 (5.9%)	49,866 (5.4%)	44,644 (4.8%)	58,872 (6.4%)
PE	--	--	--	--	50,081 (35.7%)	58,927 (42.0%)	10,993 (7.8%)	6,137 (4.3%)	4,365 (3.1%)	9,701 (6.9%)
NL	--	--	--	--	213,062 (41.1%)	169,159 (32.9%)	42,996 (8.4%)	47,319 (9.2%)	20,222 (3.9%)	21,778 (4.2%)
NU	--	--	--	--	25,101 (78.7%)	4,932 (15.5%)	1,288 (4.0%)	535 (1.7%)	15 (<0.1%)	35 (0.1%)
NT	--	--	--	--	16,868 (4.1%)	10,694 (25.8%)	7,529 (18.2%)	4,525 (10.9%)	789 (1.9%)	1,057 (2.5%)
YT	--	--	--	--	7,021 (20.7%)	11,254 (33.2%)	5,702 (16.8%	2,856 (8.4%)	2,691 (7.9%)	4,373 (12.9%)
CANADA	--	--	184,951	325,366	6,539,515	13,559,768	2,912,118	3,852,653	2,432,452	3,669,865
% of pop.			(0.6%)	(1.0%)	(19.5%)	(40.5%)	(8.7%)	(11.5%)	(7.3%)	(11.0%)

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: 0.01	< 0.06	0.06 to < 0.08	0.08 to < 0.1	0.1 to < 0.13	0.13 to < 0.19	0.19 to < 0.29	0.29 to < 0.38	0.38 to < 0.48	0.48 to < 0.57	> 0.57
US EPA CPF: 0.0077	< 0.05	0.05 to < 0.06	0.06 to < 0.07	0.07 to < 0.09	0.09 to < 0.14	0.14 to < 0.21	0.21 to < 0.28	0.28 to < 0.35	0.35 to < 0.42	> 0.42

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