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BIOMONITORING CONTENT SUMMARY FOR THE **CANADIAN HEALTH MEASURES SURVEY**

Cycles 1–4 (2007–2015)

August 2017



Canada 

Health Canada is the federal department responsible for helping the people of Canada maintain and improve their health. We assess the safety of drugs and many consumer products, help improve the safety of food, and provide information to Canadians to help them make healthy decisions. We provide health services to First Nations people and to Inuit communities. We work with the provinces to ensure our health care system serves the needs of Canadians.

Biomonitoring Content Summary for the Canadian Health Measures Survey
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*Résumé du contenu de la biosurveillance de l'Enquête canadienne sur les mesures de la santé :
Cycles 1 à 4 (2007 à 2015)*

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BIOMONITORING CONTENT SUMMARY FOR THE CANADIAN HEALTH MEASURES SURVEY: CYCLES 1–4 (2007–2015)

These chemicals have been measured or are planned for measurement in blood and/or urine samples collected as part of the Canadian Health Measures Survey (CHMS) from 2007 to 2015. The chemicals were selected based on known or suspected health effects resulting from exposure, level of public concern, evidence of exposure in the Canadian population, and technical feasibility and cost of measurement. In addition, factors such as

emerging Health Canada priorities are considered while selecting chemicals for inclusion in the CHMS. Summary data for these chemicals have been published in Health Canada's reports on human biomonitoring of environmental chemicals in Canada and scientific articles. The primary source of summary data for each chemical, when available, is provided in the table below.

Summary of chemicals measured in cycles 1 to 4 of the Canadian Health Measures Survey including data sources.

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Acrylamide				
Acrylamide haemoglobin adduct			HC, 2015	HC, 2017
Glycidamide haemoglobin adduct			HC, 2015	HC, 2017
Chlorophenols				
2,4-Dichlorophenol	HC, 2010	HC, 2013		
2,5-Dichlorophenol		HC, 2013		
2,4,5-Trichlorophenol		HC, 2013		
2,4,6-Trichlorophenol		HC, 2013		
Pentachlorophenol		HC, 2013		
Dioxin				
2,3,7,8-Tetrachlorodibenzo- <i>p</i> -dioxin (TCDD)	Rawn et al., 2012			
1,2,3,7,8-Pentachlorodibenzo- <i>p</i> -dioxin (PeCDD)	Rawn et al., 2012			
1,2,3,4,7,8-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	Rawn et al., 2012			
1,2,3,6,7,8-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	Rawn et al., 2012			
1,2,3,7,8,9-Hexachlorodibenzo- <i>p</i> -dioxin (HxCDD)	Rawn et al., 2012			
1,2,3,4,6,7,8-Heptachlorodibenzo- <i>p</i> -dioxin (HpCDD)	Rawn et al., 2012			
1,2,3,4,6,7,8,9-Octachlorodibenzo- <i>p</i> -dioxin (OCDD)	Rawn et al., 2012			

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Environmental phenols and triclocarban				
Bisphenol A	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Triclocarban		HC, 2013		
Triclosan		HC, 2013	HC, 2015	HC, 2017
Furans				
2,3,7,8-Tetrachlorodibenzofuran (TCDF)	Rawn et al., 2012			
1,2,3,7,8-Pentachlorodibenzofuran (PeCDF)	Rawn et al., 2012			
2,3,4,7,8-Pentachlorodibenzofuran (PeCDF)	Rawn et al., 2012			
1,2,3,4,7,8-Hexachlorodibenzofuran (HxCDF)	Rawn et al., 2012			
1,2,3,6,7,8-Hexachlorodibenzofuran (HxCDF)	Rawn et al., 2012			
2,3,4,6,7,8-Hexachlorodibenzofuran (HxCDF)	Rawn et al., 2012			
1,2,3,7,8,9-Hexachlorodibenzofuran (HxCDF)	Rawn et al., 2012			
1,2,3,4,6,7,8-Heptachlorodibenzofuran (HpCDF)	Rawn et al., 2012			
1,2,3,4,7,8,9-Heptachlorodibenzofuran (HpCDF)	Rawn et al., 2012			
1,2,3,4,6,7,8,9-Octachlorodibenzofuran (OCDF)	Rawn et al., 2012			
Metals and trace elements				
Antimony	HC, 2010	HC, 2013		
Arsenic				
Arsenic (total)	HC, 2010	HC, 2013		
Arsenate		HC, 2013	HC, 2015	HC, 2017
Arsenite		HC, 2013	HC, 2015	HC, 2017
Arsenobetaine and arsenocholine		HC, 2013	HC, 2015	HC, 2017
Arsenocholine			HC, 2015	HC, 2017
Dimethylarsinic acid		HC, 2013	HC, 2015	HC, 2017
Monomethylarsonic acid		HC, 2013	HC, 2015	HC, 2017
Cadmium	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Cesium		HC, 2013		
Cobalt		HC, 2013		
Copper	HC, 2010	HC, 2013		
Fluoride		HC, 2013	HC, 2015	HC, 2017
Lead	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Manganese	HC, 2010	HC, 2013		
Mercury				
Mercury (inorganic)	HC, 2010		HC, 2015	HC, 2017
Mercury (total)	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Methylmercury			HC, 2015 ^a	HC, 2017
Molybdenum	HC, 2010	HC, 2013		
Nickel	HC, 2010	HC, 2013		
Selenium	HC, 2010	HC, 2013		
Silver		HC, 2013		

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Thallium		HC, 2013		
Tungsten		HC, 2013		
Uranium	HC, 2010	HC, 2013		
Vanadium	HC, 2010	HC, 2013		
Zinc	HC, 2010	HC, 2013		
Organochlorines				
Aldrin	HC, 2010 ^a			
α -Chlordane	HC, 2010 ^a			
γ -Chlordane	HC, 2010 ^a			
<i>p,p'</i> -Dichlorodiphenyldichloroethylene (<i>p,p'</i> -DDE)	HC, 2010 ^a			
<i>p,p'</i> -Dichlorodiphenyltrichloroethane (<i>p,p'</i> -DDT)	HC, 2010 ^a			
Endosulfan				
Hexachlorobenzene	HC, 2010 ^a			
β -Hexachlorocyclohexane	HC, 2010 ^a			
γ -Hexachlorocyclohexane	HC, 2010 ^a			
<i>cis</i> -Nonachlor	HC, 2010 ^a			
<i>trans</i> -Nonachlor	HC, 2010 ^a			
Oxychlordane	HC, 2010 ^a			
Mirex	HC, 2010 ^a			
Toxaphene parlar 26	HC, 2010 ^a			
Toxaphene parlar 50	HC, 2010 ^a			
Parabens				
Methyl paraben				HC, 2017
Ethyl paraben				HC, 2017
Propyl paraben				HC, 2017
Butyl paraben				HC, 2017
Perfluoroalkyl substances				
Perfluorobutanoic acid (PFBA)		HC, 2013 ^b		
Perfluorohexanoic acid (PFHxA)		HC, 2013 ^b		
Perfluorooctanoic acid (PFOA)	HC, 2010 ^a	HC, 2013 ^b		
Perfluorononanoic acid (PFNA)		HC, 2013 ^b		
Perfluorodecanoic acid (PFDA)		HC, 2013 ^b		
Perfluoroundecanoic acid (PFUnDA)		HC, 2013 ^b		
Perfluorobutane sulfonate (PFBS)		HC, 2013 ^b		
Perfluorohexane sulfonate (PFHxS)	HC, 2010 ^a	HC, 2013 ^b		
Perfluorooctane sulfonate (PFOS)	HC, 2010 ^a	HC, 2013 ^b		
Pesticides				
Carbamate insecticide metabolites				
Carbofuranphenol		HC, 2013		
2-Isopropoxyphenol		HC, 2013		

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Organophosphate insecticides and metabolites				
Acephate				
Diethylphosphate (DEP)	HC, 2010	HC, 2013		
Diethylthiophosphate (DETP)	HC, 2010	HC, 2013		
Diethyldithiophosphate (DEDTP)	HC, 2010	HC, 2013		
Dimethylphosphate (DMP)	HC, 2010	HC, 2013		
Dimethylthiophosphate (DMTP)	HC, 2010	HC, 2013		
Dimethyldithiophosphate (DMDTP)	HC, 2010	HC, 2013		
Malathion dicarboxylic acid				HC, 2017
Methamidophos				
3,5,6 Trichloro-2-pyridinol				HC, 2017
Phenoxy herbicide				
2,4-Dichlorophenoxyacetic acid (2,4-D)	HC, 2010	HC, 2013		
Pyrethroid insecticide metabolites				
<i>cis</i> -3-(2,2-Dibromovinyl)-2,2-dimethylcyclopropane carboxylic acid (<i>cis</i> -DBCA)	HC, 2010	HC, 2013		
<i>cis</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (<i>cis</i> -DCCA)	HC, 2010	HC, 2013		
<i>trans</i> -3-(2,2-Dichlorovinyl)-2,2-dimethylcyclopropane carboxylic acid (<i>trans</i> -DCCA)	HC, 2010	HC, 2013		
4-Fluoro-3-phenoxybenzoic acid (4-F-3-PBA)	HC, 2010	HC, 2013		
3-Phenoxybenzoic acid (3-PBA)	HC, 2010	HC, 2013		
Triazine herbicide metabolites				
Atrazine mercapturate		HC, 2013		
Desethylatrazine		HC, 2013		
Diaminochlorotriazine		HC, 2013		
Phthalate metabolites				
Mono benzyl phthalate (MBzP)	HC, 2013 ^c	HC, 2013		
Mono-3-carboxypropyl phthalate (MCPP)	HC, 2013 ^c	HC, 2013		
Mono cyclohexyl phthalate (MCHP)	HC, 2013 ^c	HC, 2013		
Mono-2-ethylhexyl phthalate (MEHP)	HC, 2013 ^c	HC, 2013		
Mono-(2-ethyl-5-hydroxyhexyl) phthalate (MEHHP)	HC, 2013 ^c	HC, 2013		
Mono-(2-ethyl-5-oxohexyl) phthalate (MEOHP)	HC, 2013 ^c	HC, 2013		
Mono ethyl phthalate (MEP)	HC, 2013 ^c	HC, 2013		
Mono-iso-butyl phthalate (MiBP)		HC, 2013		
Mono-isononyl phthalate (MiNP)	HC, 2013 ^c	HC, 2013		
Mono-methyl phthalate (MMP)	HC, 2013 ^c	HC, 2013		
Mono- <i>n</i> -butyl phthalate (MnBP)	HC, 2013 ^c	HC, 2013		
Mono- <i>n</i> -octyl phthalate (MnOP)	HC, 2013 ^c	HC, 2013		

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Polybrominated flame retardants				
2,2',4,4',5,5'-Hexabromobiphenyl (PBB 153)	HC, 2010 ^a			
4,4'-Dibromodiphenyl ether (PBDE 15)	HC, 2010 ^a , Rawn et al., 2014			
2,2',4-Tribromodiphenyl ether (PBDE 17)	HC, 2010 ^a , Rawn et al., 2014			
2,3',4-Tribromodiphenyl ether (PBDE 25)	HC, 2010 ^a			
2,4,4'-Tribromodiphenyl ether (PBDE 28)	HC, 2010 ^a , Rawn et al., 2014			
2',3,4'-Tribromodiphenyl ether (PBDE 33)	HC, 2010 ^a			
3,4,4'-Tribromodiphenyl ether (PBDE 37)	Rawn et al., 2014			
2,2',4,4'-Tetrabromodiphenyl ether (PBDE 47)	HC, 2010a, Rawn et al., 2014			
2,3',4,4'-Tetrabromodiphenyl ether (PBDE 66)	Rawn et al., 2014			
2,3',4',6-Tetrabromodiphenyl ether (PBDE 71)	Rawn et al., 2014			
2,4,4',6-Tetrabromodiphenyl ether (PBDE 75)	Rawn et al., 2014			
3,3',4,4'-Tetrabromodiphenyl ether (PBDE 77)	Rawn et al., 2014			
2,2',3,4,4'-Pentabromodiphenyl ether (PBDE 85)	Rawn et al., 2014			
2,2',4,4',5-Pentabromodiphenyl ether (PBDE 99)	HC, 2010 ^a , Rawn et al., 2014			
2,2',4,4',6-Pentabromodiphenyl ether (PBDE 100)	HC, 2010 ^a , Rawn et al., 2014			
2,3',4,4',6-Pentabromodiphenyl ether (PBDE 119)	Rawn et al., 2014			
3,3',4,4',5-Pentabromodiphenyl ether (PBDE 126)	Rawn et al., 2014			
2,2',3,4,4',5'-Hexabromodiphenyl ether (PBDE 138)	Rawn et al., 2014			
2,2',4,4',5,5'-Hexabromodiphenyl ether (PBDE 153)	HC, 2010 ^a , Rawn et al., 2014			
2,2',4,4',5,6'-Hexabromodiphenyl ether (PBDE 154)	Rawn et al., 2014			
2,3,3',4,5,6-Hexabromodiphenyl ether (PBDE 160)	Rawn et al., 2014			
2,2',3,4,4',5,6-Heptabromodiphenyl ether (PBDE 181)	Rawn et al., 2014			
2,2',3,4,4',5',6-Heptabromodiphenyl ether (PBDE 183)	Rawn et al., 2014			
2,3,3',4,4',5,6-Heptabromodiphenyl ether (PBDE 190)	Rawn et al., 2014			
2,3,3',4,4',5,5',6-Octabromodiphenyl ether (PBDE 205)	Rawn et al., 2014			
2,2',3,3',4,4',5,5',6,6'-Decabromodiphenyl ether (PBDE 209)	Rawn et al., 2014			
Hexabromocyclododecane α (HBCD α)	Rawn et al., 2014			
Hexabromocyclododecane β (HBCD β)	Rawn et al., 2014			
Hexabromocyclododecane γ (HBCD γ)	Rawn et al., 2014			
Tetrabromobisphenol A (TBBPA)				
Polychlorinated biphenyls (PCBs)				
Aroclor 1260	HC, 2010 ^a			
2,2',5-Trichlorobiphenyl (PCB 18)	Rawn et al., 2012			
2,4,4'-Trichlorobiphenyl (PCB 28)	HC, 2010 ^a , Rawn et al., 2012			
2,2',4,5'-Tetrachlorobiphenyl (PCB 49)	Rawn et al., 2012			
2,2',5,5'-Tetrachlorobiphenyl (PCB 52)	HC, 2010 ^a , Rawn et al., 2012			
2,3',4,4'-Tetrachlorobiphenyl (PCB 66)	HC, 2010 ^a , Rawn et al., 2012			
2,4,4',5-Tetrachlorobiphenyl (PCB 74)	HC, 2010 ^a , Rawn et al., 2012			

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
3,3',4,4'-Tetrachlorobiphenyl (PCB 77)	Rawn et al., 2012			
3,4,4',5-Tetrachlorobiphenyl (PCB 81)	Rawn et al., 2012			
2,2',4,4',5-Pentachlorobiphenyl (PCB 99)	HC, 2010 ^a , Rawn et al., 2012			
2,2',4,5,5'-Pentachlorobiphenyl (PCB 101)	HC, 2010 ^a , Rawn et al., 2012			
2,3,3',4,4'-Pentachlorobiphenyl (PCB 105)	HC, 2010 ^a , Rawn et al., 2012			
2,3,3',4',6-Pentachlorobiphenyl (PCB 110)	Rawn et al., 2012			
2,3,3',4,4'-Pentachlorobiphenyl (PCB 114)	Rawn et al., 2012			
2,3',4,4',5-Pentachlorobiphenyl (PCB 118)	HC, 2010 ^a , Rawn et al., 2012			
2',3,4,4',5-Pentachlorobiphenyl (PCB 123)	Rawn et al., 2012			
3,3',4,4',5-Pentachlorobiphenyl (PCB 126)	Rawn et al., 2012			
2,2',3,3',4,4'-Hexachlorobiphenyl (PCB 128)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4,4',5'-Hexachlorobiphenyl (PCB 138)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4,5,5'-Hexachlorobiphenyl (PCB 141)	Rawn et al., 2012			
2,2',3,4',5,5'-Hexachlorobiphenyl (PCB 146)	HC, 2010 ^a			
2,2',4,4',5,5'-Hexachlorobiphenyl (PCB 153)	HC, 2010 ^a , Rawn et al., 2012			
2,3,3',4,4',5-Hexachlorobiphenyl (PCB 156)	HC, 2010 ^a , Rawn et al., 2012			
2,3,3',4,4',5'-Hexachlorobiphenyl (PCB 157)	Rawn et al., 2012			
2,3,3',4',5,6-Hexachlorobiphenyl (PCB 163)	HC, 2010 ^a			
2,3',4,4',5,5'-Hexachlorobiphenyl (PCB 167)	HC, 2010 ^a , Rawn et al., 2012			
3,3',4,4',5,5'-Hexachlorobiphenyl (PCB 169)	Rawn et al., 2012			
2,2',3,3',4,4',5-Heptachlorobiphenyl (PCB 170)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,3',5,5',6-Heptachlorobiphenyl (PCB 178)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4,4',5,5'-Heptachlorobiphenyl (PCB 180)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4,4',5',6-Heptachlorobiphenyl (PCB 183)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4',5,5',6-Heptachlorobiphenyl (PCB 187)	HC, 2010 ^a , Rawn et al., 2012			
2,3,3',4,4',5,5'-Heptachlorobiphenyl (PCB 189)	Rawn et al., 2012			
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (PCB 194)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,3',4,4',5,6-Octachlorobiphenyl (PCB 195)	Rawn et al., 2012			
2,2',3,3',4,5,5',6-Octachlorobiphenyl (PCB 201)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,4,4',5,5',6-Octachlorobiphenyl (PCB 203)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (PCB 206)	HC, 2010 ^a , Rawn et al., 2012			
2,2',3,3',4,4',5,5',6,6'-Decachlorobiphenyl (PCB 209)	Rawn et al., 2012			

Polycyclic aromatic hydrocarbon metabolites

Benzo[a]pyrene metabolite

3-Hydroxybenzo[a]pyrene	HC, 2013	HC, 2015	HC, 2017
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Chrysene metabolites

2-Hydroxychrysene	HC, 2013	HC, 2015	HC, 2017
3-Hydroxychrysene	HC, 2013	HC, 2015	HC, 2017
4-Hydroxychrysene	HC, 2013	HC, 2015	HC, 2017
6-Hydroxychrysene	HC, 2013	HC, 2015	HC, 2017

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Fluoranthene metabolite				
3-Hydroxyfluoranthene		HC, 2013	HC, 2015	HC, 2017
Fluorene metabolites				
2-Hydroxyfluorene		HC, 2013	HC, 2015	HC, 2017
3-Hydroxyfluorene		HC, 2013	HC, 2015	HC, 2017
9-Hydroxyfluorene		HC, 2013	HC, 2015	HC, 2017
Napthalene metabolites				
1-Hydroxynapthalene		HC, 2013	HC, 2015	HC, 2017
2-Hydroxynapthalene		HC, 2013	HC, 2015	HC, 2017
Phenanthrene metabolites				
1-Hydroxyphenanthrene		HC, 2013	HC, 2015	HC, 2017
2-Hydroxyphenanthrene		HC, 2013	HC, 2015	HC, 2017
3-Hydroxyphenanthrene		HC, 2013	HC, 2015	HC, 2017
4-Hydroxyphenanthrene		HC, 2013	HC, 2015	HC, 2017
9-Hydroxyphenanthrene		HC, 2013	HC, 2015	HC, 2017
Pyrene metabolite				
1-Hydroxypyrene		HC, 2013	HC, 2015	HC, 2017
Tobacco biomarkers				
Nicotine and metabolites				
Anabasine (free)				
Anabasine (total)				
Cotinine (free)	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Cotinine (total)				
Cotinine- <i>n</i> -glucuronide				
Nicotine (free)				
Nicotine (total)				
Nicotine- <i>n</i> -glucuronide				
<i>trans</i> -3-Hydroxycotinine (free)				
<i>trans</i> -3-Hydroxycotinine (total)				
<i>trans</i> -3-Hydroxycotinine-glucuronide				
4-(Methylnitrosamino)-1-(3-pyridyl)-1-butanol (NNAL)				
NNAL (free)				
NNAL (total)				
Volatile organic compounds				
Ethylbenzene			HC, 2015 ^b	HC, 2017 ^b
Styrene			HC, 2015 ^b	HC, 2017 ^b
Toluene			HC, 2015 ^b	HC, 2017 ^b
<i>m</i> - and <i>p</i> -Xylenes			HC, 2015 ^b	HC, 2017 ^b
<i>o</i> -Xylene			HC, 2015 ^b	HC, 2017 ^b

Chemical	Cycle 1 2007–09 (6–79 years)	Cycle 2 2009–11 (3–79 years)	Cycle 3 2012–13 (3–79 years)	Cycle 4 2014–15 (3–79 years)
Benzene and metabolites				
Benzene			HC, 2015 ^b	HC, 2017 ^b
<i>trans, trans</i> -Muconic acid		HC, 2013	HC, 2015	HC, 2017 ^b
Phenol		HC, 2013		
S-Phenylmercapturic acid		HC, 2013	HC, 2015	HC, 2017 ^b
Chlorinated hydrocarbons				
1,1,2-Trichloroethylene			HC, 2015 ^b	HC, 2017 ^b
1,1,1,2-Tetrachloroethylene			HC, 2015 ^b	HC, 2017 ^b
Trihalomethanes				
Bromodichloromethane			HC, 2015 ^b	HC, 2017 ^b
Dibromochloromethane			HC, 2015 ^b	HC, 2017 ^b
Tribromomethane			HC, 2015 ^b	HC, 2017 ^b
Trichloromethane			HC, 2015 ^b	HC, 2017 ^b
General characterization				
Creatinine	HC, 2010	HC, 2013	HC, 2015	HC, 2017
Specific gravity				

a 20–79 years

b 12–79 years

c 6–49 years

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