Cadmium Exposures in Maternal Health

In this guide

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Sources of cadmium exposure

Human breast milk

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34. Human breast milk has previously been discussed in the COT statement on cadmium in the infant diet (COT, 2018). Cadmium intake in the average and high level exclusively breast-fed UK infants from 0 to 6 months ranged between 11 – 68% of the EFSA TWI of 2.5 µg/kg bw/week. The highest total exposure to cadmium in the infant diet was found in solid food for 12 - 60 month old children which constituted up to 260% of the EFSA TWI of 2.5 µg/kg

bw/week (0.36 µg/kg bw/day). Although there was an exceedance, it was not expected to remain at this level over the decades of bioaccumulative exposure considered by EFSA in setting the HBGV. The Committee concluded that there was no major concern, however efforts to minimise the levels of cadmium in the environment should continue.

Food

35. Cadmium levels have been measured in the composite food samples of The Total Diet Study (TDS) (Bates et al. 2014, 2016; Roberts et al. 2018). The highest exposure to cadmium came from the food groups miscellaneous cereals, potatoes, and bread.

36. In a Swedish birth cohort study, the maternal diets with high intakes of vegetables, root vegetables, nuts, grains and rice were significantly associated with higher erythrocyte and urinary cadmium levels, whereas red meat consumption had an inverse association (Gustin et al. 2020). High accumulation of cadmium has also been reported in rice where it is a staple food in Asia and it was shown that females had a higher elevated body burden of cadmium (Simmons et al. 2005; Kippler et al. 2007; Geng and Wang, 2019).

Drinking water

37. Drinking water can be contaminated with cadmium due to leaching from corroded/galvanized pipes or solder used within taps and water heaters (WHO, 2011). In areas with high cadmium pollution, well water may also be affected, with cadmium levels in excess of 25 µg/L (WHO, 2000; Lauwerys et al. 1990) being reported.

38. Directive 2003/40/EC specifies a maximum level of cadmium in natural mineral waters of 3.0 µg/L and equivalent UK legislation. The EU adopted the revised Drinking Water Directive ((EU) 2020/2184) which came into force at the start of 2021, which upheld the set value of 5.0 µg/L of Directive 98/83/EC on the quality of water intended for human consumption.

39. Levels of cadmium in drinking water in 2020 were published for England and Wales (99th percentile 0.23 µg/L, no mean data available), Scotland (mean and 97.5th percentile 0.02 and 0.06 µg/L respectively) and Northern Ireland (mean and 97th percentile 0.038 and 0.04 µg/L respectively) by the Drinking Water Inspectorate and the Drinking Water Quality Regulator (DWQR) for Scotland and Northern Ireland Water respectively.

Environmental

Dust

40. Cadmium dust includes various cadmium compounds including cadmium chloride and cadmium oxide which is formed when moist air oxidises the cadmium (Pohanish 2017; IPCS,1992). The cadmium levels in dust were determined by ICP-OES with a median concentration of 0.30 µg/g. Although the concentrations were low in environmental samples, urine samples in a study conducted in Western Australia by Hinwood et al. (2013) showed elevated levels. It was suggested that these higher levels of cadmium were linked to the participants eating fish and not taking iron/folic acid supplements, while those participants who used iron and folic acid supplements showed an association with decreased cadmium levels. Other factors that could affect the levels of cadmium were economic status and the geographical location in Western Australia.

Soil

41. Cadmium occurs naturally in the Earth's crust, is commonly found in association with zinc ores and is is also associated with atmospheric pollution (e.g., volcanic eruptions and emissions from smelting) and phosphate fertilisers. The Soil Guideline Value for residential soils adopted a total concentration of 10 mg/kg for cadmium which is above the concentration found in most soils (Rawlins et al. 2012; Environment Agency, 2009).The summary statistics reported for the principal domain for England and Wales were a normal background concentration (NBC) of 1.0 mg/kg (n = 4418) and 1.4 mg/kg (n = 681) respectively.

Air

42. Cadmium can be released into the atmosphere by anthropogenic sources and occurs mainly as fine respirable particles in particulate matter (10 µm). The Fourth Daughter Directive (2004/107/EC) set the target value for cadmium as 5 ng/m^3. Using the data collated by the UK Air Information Resource for 2020 the air exposure measurements of cadmium for England and Wales ranged from 0.062 to 0.725 ng/m^3 and 0.057 to 1.382 ng/m^3 respectively (Home - Defra, UK)

43. It has been estimated that one cigarette contains between 0.2 and 1.0 µg of cadmium and although advised not to smoke tobacco products while pregnant, those mothers that continue to smoke during their pregnancy have

been shown to have higher cadmium levels in comparison to non-smoking mothers (Ebrahim and Ashtarinezhad, 2015). Chao et al. (2014) sampled human milk samples during the four stages of lactation and found that the highest levels were found in colostrum, thus infants of smoking mothers were exposed to more cadmium than those with non-smoking mothers. Second-hand smoke can also lead to a 2-fold higher exposure to cadmium in comparison to unexposed women (Stone et al. 2021).

44. The COT have previously considered the potential toxicological risks from electronic cigarettes (E(N)NDS) and the effects on bystanders of secondary emissions (COT, 2018; 2019). The emissions from the electronic cigarettes differ from cigarette smoke (which is a well-known health hazard), with those from the electronic cigarette comprising the residual particulates/vapour exhaled from the user. The aerosols from these devices were evaluated for metals (including cadmium) by liquid phase extraction and ICP-MS.