Introduction and Background

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This is a paper for discussion. This does not represent the views of the Committee and should not be cited.

Introduction

1. The Scientific Advisory Committee on Nutrition (SACN) last considered maternal diet and nutrition in relation to offspring health in its reports on ‘The influence of maternal, fetal and child nutrition on the development of chronic disease in later life’ (SACN, 2011) and on ‘Feeding in the first year of life’ (SACN, 2018). The latter report also considered the impact of breastfeeding on maternal health.

2. In 2019, SACN agreed to conduct a risk assessment on nutrition and maternal health focusing on maternal outcomes during pregnancy, childbirth and up to 24 months after delivery; this would include the effects of chemical contaminants and excess nutrients in the diet.

3. SACN agreed that, where appropriate, other expert Committees would be consulted and asked to complete relevant risk assessments e.g., in the area of food safety advice. This subject was initially discussed by COT at its January 2020 meeting and a scoping paper was presented to the Committee in July 2020. This included background information on a provisional list of chemicals proposed by SACN. The list was brought back to the COT with additional information in September 2020. The COT agreed, at its meeting in September 2020, that papers on a number of components should be prioritised. To this end, papers on iodine, vitamin D and dietary supplements have been or will be presented to the Committee. The remaining list of compounds were to be triaged on the basis of toxicity and exposure.

4. Following discussion of the first prioritisation paper on substances to be considered for risk assessment, the Committee decided that each of the heavy metals (lead, mercury, cadmium, and arsenic) should be considered in separate papers. The following statement discusses the risks posed to maternal health by mercury in the diet and the environment.

Background

5. Mercury (Hg) is the only metallic element known to be liquid at standard temperature and pressure. Mercury is a group 12 metal, with atomic number 80 and a relative atomic mass of 200.592; its most abundant isotope is 202Hg with atomic mass 201.970 (Laeter et al., 2003). Mercury occurs naturally in the earth's crust at an abundance of 0.0000085%, chiefly as mercury (II) sulfide, also known as cinnabar, cinnabarite or mercurblende (Haynes, Lide and Bruno., 2016). Mercury has been used in thermometers, barometers, manometers, sphygmomanometers, float valves, mercury switches, mercury relays, fluorescent lamps, and other devices; however, its toxicity has led to phasing out of such mercury-containing instruments. Mercury remains in use for scientific research purposes, fluorescent lighting and in amalgam for dental restoration.

6. The three chemical forms of mercury are (i) elemental or metallic mercury (Hg^0), (ii) inorganic mercury (mercurous (Hg22+) and mercuric (Hg^{2+}) cations) and (iii) organic mercury.

7. Inorganic mercury exists as mercurous (Hg22+) and mercuric (Hg^{2+}) salts, which are used in several industrial processes and found in batteries, fungicides, antiseptics and disinfectants (EFSA., 2008).

8. Organic mercury compounds have at least one carbon atom covalently bound to the mercury atom (FAO/WHO., 2011). Methylmercury (MeHg) is by far the most common form in the food chain (FAO/WHO., 2011). Other organic mercury compounds such as phenylmercury, thiomersal and merbromin (also known as Mercurochrome) have been used as fungicides and in pharmaceutical products (EFSA., 2008).

9. Mercury is released into the environment from both natural and anthropogenic sources. After release into the environment, it undergoes complex transformations and cycles between atmosphere, land, and aquatic systems. Mercury ultimately settles in the sediment of lakes, rivers or bays, where it is transformed into MeHg, absorbed by phytoplankton, ingested by zooplankton and fish, and accumulates especially in long-lived predatory. Such species include sharks, swordfish, and tuna in the ocean and trout, pike, walleye, and bass in freshwater systems (WHO/IPCS., 1990). Because many of these species are food sources, populations that predominately depend on foods derived from fish or other aquatic environments are more vulnerable to MeHg exposure.

10. Food sources other than fish and seafood products may contain mercury, but mostly in the form of inorganic mercury. The available data indicates that the contribution to MeHg exposure from non-seafood sources is insignificant (EFSA., 2012).

11. The main adverse effect associated with MeHg exposure is toxicity to the central and peripheral nervous systems (WHO., 2017). Due to its ability to cross the placenta and the blood-brain barrier (BBB), MeHg exposure is of particular concern during embryonic neurodevelopment and in young children (COT., 2004). Pregnant and breastfeeding women are identified as sensitive sub-populations because maternal exposure can lead to exposure of the infant via breast milk or the unborn child via the placenta. The bioaccumulative properties and long half-life of MeHg mean that the blood concentration of MeHg at the time of becoming pregnant depends on the exposure to MeHg during the preceding year.

12. MeHg can also affect the kidneys. Acute neuro- and nephrotoxicity have been reported in cases of human MeHg poisoning, whereas neurotoxicity is usually associated with lower-level chronic exposures, especially in the developing fetus (COT., 2004).

13. Inorganic mercury in food is considerably less toxic than MeHg (EFSA., 2004). This is attributed to the lower absorption of inorganic mercury. In addition,

due to its limited lipophilicity, mercuric mercury does not readily cross the placental, blood-brain or blood-cerebrospinal fluid barriers (EFSA., 2012).

14. Animal studies have shown that the critical target for inorganic mercury toxicity is the kidney (NTP., 1993) but other targets include the liver, nervous system, immune system, reproductive and developmental systems (EFSA., 2012).