PREVENTING DENTAL CARIES WITH FLUORIDE: THE RISKS AND BENEFITS

SUMMARY: A recent Cochrane review on water fluoridation found that the initiation of water fluoridation resulted in reductions in dmft of 1.81 (35%) and in DMFT of 1.16 (26%). There were also increases in the percentage of caries-free children (deciduous dentition: 15%, permanent dentition: 14%). However, the majority of the studies were conducted prior to 1975, and the widespread use of fluoride toothpaste, and the authors found very little contemporary evidence on the efficacy of water fluoridation. They estimated that for a fluoride level of 0.7 ppm the percentage of participants with some degree of fluorosis was 40% and that in 12.5% this was of aesthetic concern. In the following editorial in *Fluoride*, this editor noted that the ability of fluoride to adversely cellular metabolism in cariogenic bacteria was its Achilles' heel for being a useful systemic therapeutic agent as it could also disrupt the ultrastructure of mitochondria and endoplasmic reticulum, and alter enzyme and gene expression levels in humans. The *Fluoride* editorial noted that, as well as contributing to dental fluorosis, systemic fluoride intake may be a possible aetiological factor in a number of significant health problems and concluded that an objective assessment of the risks and benefits of water fluoridation, together with taking account of the precautionary principle, indicated that systemic fluoride ingestion for preventing dental caries was a flawed concept.

Keywords: Cochrane review; Dental fluorosis; Risks and benefits; Water fluoridation.

A Cochrane review on water fluoridation for the prevention of dental caries, published online on 18 June 2015 and abstracted in this issue of *Fluoride* on pages 269–70, noted that dental caries pose a major public health problem in most industrialised countries, affecting 60% to 90% of school children, and that community water fluoridation is considered by health authorities to be a key strategy in the prevention of dental caries.[1] From the 107 studies that met the inclusion criteria and provided sufficient data for quantitative synthesis, they found that the initiation of water fluoridation resulted in reductions in dmft of 1.81 (a 35% reduction) and in DMFT of 1.16 (a 26% reduction) compared to the median control group mean values. There were also increases in the percentage of caries-free children of 15% for the deciduous dentition and 14% for the permanent dentition. The majority of studies (71%) were conducted prior to 1975 and the widespread introduction of the use of fluoride toothpaste. There was insufficient information to determine the effect of stopping water fluoridation programmes on caries levels, the effectiveness of water fluoridation for preventing caries in adults, and whether the initiation of a water fluoridation programme resulted in a change in disparities in caries across socioeconomic status (SES) levels. With regard to dental fluorosis, they estimated that for a fluoride level of 0.7 ppm the percentage of participants with some degree of fluorosis was 40% and that in 12.5% this was of aesthetic concern. Thus, the authors found very little contemporary evidence on the efficacy of water fluoridation and that the evidence was limited due to a high risk of bias within the studies and substantial between-study variation.

The finding in the Cochrane review of very little contemporary evidence on the efficacy of water fluoridation is similar to the conclusion of the 2011 study by the

Scientific Committee on Health and Environment Risks (SCHER) of the European Commission that while the evidence that topical fluoride has a protective effect against dental caries is considered to be strong, the scientific evidence that the systemic application of fluoride via drinking water is beneficial is less convincing.[2]

Two reviews on the topical use of fluoride in dentistry in this issue of *Fluoride* note that, in addition to hindering demineralization and increasing remineralization, the therapeutic action of fluoride may come from inhibiting bacterial growth and metabolism such as by reducing bacterial IgA protease synthesis by enzyme inhibition.[3,4] Although the beneficial topical effect of fluoride may be related more to the raised pH of the environment of the regrowing fluoroapatite crystals, formed after the hydroxyapatite is dissolved by bacterial lactic acid, than to an antibacterial action, as fluoride has to be at mM concentrations to significantly inhibit Streptococcus mutans and has no effect on lactobacilli,[5] the ability of fluoride to adversely effect cellular metabolism in bacteria is its Achilles' heel for being a useful systemic therapeutic agent in humans. Fluoride is able to disrupt the ultrastructure of mitochondria and endoplasmic reticulum in many organ systems in many mammalian species as well as altering enzyme and gene expression levels.[6] The present issue of *Fluoride* contains reports of fluoride reducing the viability of cardiomyocytes,[7] testicular Sertoli cells,[8] and adrenal medulla pheochromocytoma cells[9] as well as promoting dyslipidemia in castrated rats.[10]

The lack of clear evidence in the Cochrane review that water fluoridation reduces dental caries independently of socioeconomic status (SES) levels is consistent with a report on the confounding effect of SES which found that 82% of the wealthy, but only 55% of the poor, reported very good to excellent teeth regardless of fluoridation.[11] Teeth affected by systemic fluoride ingestion may also have other damage in addition to dental fluorosis, including the "fluoride bomb" and increased fractures.[11]

As noted, dental caries are a major health problem in many societies. Their increase since the early decades of the twentieth century has been linked to a change from traditional diets to modern ones, with refined foods such as white sugar and flour, and fewer vitamins and minerals, rather than to a lack of systemically ingested fluoride.[12]

As well as contributing to dental fluorosis, systemic fluoride intake may be a possible aetiological factor in a number of significant health problems including some forms of anaemia, arthritis, asthma, atherosclerosis, chronic fatigue syndrome, dermatitis, diabetes mellitus, Down syndrome, dyspepsia, hip fracture, hypothyroidism, infertility, osteosarcoma, prematurity, and various neurological impairments including some neurodevelopmental disorders, chemical brain drain, and reduced IQ. Although it is commonly stated that whether a substance is poisonous or not is determined by the dose, for some agents, such as lead and mercury, there does not appear to be any safe dose, and empirical evidence

suggests that to prevent nervous system impairment and reduced IQ in children the concentration of fluoride in drinking water should not exceed 0.1 mg/L.[13]

An objective assessment of the risks and benefits of water fluoridation, together with taking account of the precautionary principle, indicates that systemic fluoride ingestion for preventing dental caries is a flawed concept. However, such is the nature of "tardive photopsia,"[14] that the time required for the complete cessation of the practice may end up being on a par with the six decades needed for stopping the use of asbestos as a building material after its aetiological role in mesothelioma was discovered.

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