

Fluoride supplementation during pregnancy does not reduce caries in offspring

Roxana Elena Bohiltea^{1,2}, Corina Grigoriu^{1,3}, Valentin Varlas^{1,2}, Vlad Dima², Ioanina Parlatescu⁴, Dragos Epistatu⁵, Bianca Margareta Mihai², Teodor Salmen^{6,7}, Emilia Maria Vladareanu⁸, Marina Cristina Giurgiu⁹

¹ Department of Obstetrics and Gynecology, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

² Filantropia Clinical Hospital, Bucharest, Romania

³ University Emergency Hospital, Bucharest, Romania

⁴ Department of Oral Pathology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

⁵ Department of Radiology, Faculty of Dental Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

⁶ Doctoral School, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

⁷ "N.C. Paulescu" National Institute of Diabetes, Nutrition and Metabolic Disorders, Bucharest, Romania

⁸ Faculty of Medicine, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

⁹ Department of Periodontology, "Carol Davila" University of Medicine and Pharmacy, Bucharest, Romania

ABSTRACT

Fluoride represents an essential element in dental development and safety. Fluoride deficiency is associated with dental cavities. The main dietary source of fluoride is in water, followed by fluoridated toothpaste, tea, seafood, canned sardines or shells as well as medicinal supplements. The adequate intake ranges from 0.7 mg/day for toddlers, to 3 mg/day for adult females and 4 mg/day for adult males. The fluoride intake can present a difficulty in assessment, especially during pregnancy, so the question remains: is fluoride supplementation recommended during pregnancy to prevent dental cavities in the offspring? The correct answer is 'No'. Fluoride supplementation during pregnancy does not reduce the incidence of caries in offspring. Centers for Disease Control and Prevention (CDC) does not recommend fluoride supplementation due to its action mechanism; fluoride has beneficial effects only after the tooth eruption takes place through a topical mechanism. Fluorosis (fluoride toxicity) in offspring has not been described secondary to excessive ingestion of fluoride of the mother during pregnancy, but there are studies correlating neurotoxic effects in the infants from mothers who received fluoride supplementation.

Keywords: fluoride, pregnancy, neurotoxicity in infants, ADHD, low IQ scores

INTRODUCTION

Fluoride, along with copper, iodine, manganese and zinc, belongs to the trace elements group that are defined as minerals which are required in quantities between 1 to 100 mg/day in the adult population.

Water is the most important dietary source, due to the origin of fluoride that is the earth's crust, but the concentration of this mineral in water has a

wide variability, a fact that explains the large variability in the adults total fluoride intake [1]. Fluoride is contained in the ground water in proportions that vary between 0 and 40 mg/l [2]. Other significant fluoride sources are the artificial fluoridated water, fluoridated toothpastes, tea, seafood that contains comestible bones like canned sardines or shells and medicinal supplements [3].

Fluoride is a trace element that is considered beneficial, because it has an important role in pre-

venting dental caries, a fact that was well described in the literature, respectively, the inverse relationship between fluoride intake and dental caries, but this is insufficiently understood by the general public, leading to its inappropriate use [3]. For the beneficial effect of caries incidence reduction, many domestic water supplies are fluoridated, although the custom has raised many controversies [4,5].

DIETARY RECOMANDATIONS

The Food and Nutrition Board of the Institute of Medicine has developed the dietary reference intakes (DRIs) in order to guide the nutrient intake in variable sites. Moreover, for certain age groups, the recommended dietary allowance (RDA) is defined as the dietary intake that is sufficient to meet the daily necessities of nutrients for 97% of the individuals in that specific age group. Dietary guidelines that include the RDAs have a continuous update process, in order to be consistent with the new information that appears. In order to maintain an adequate nutrient intake and, also, a healthy status, there was established the adequate intake (AI), that consists in an estimation of the nutrient intake. On the other hand, the tolerable upper intake level (UL) is the maximum daily intake of a nutrient that is likely not to present any risk of adverse effects. A nutrient intake that exceeds severely over the recommended dietary allowance is called a „pharmacologic” dosing.

Dietary reference intake – adequate intake preset the recommended intake for fluoride; through RDA the available data are limited and it's hard to determine the population needs. Fluoride has an AI that ranges from 0.7 mg/day for toddlers, to 3 mg/day for adult females and, respectively, 4 mg/day for adult males. The UL ranges from 0,7 mg/day for infants from 0 to 6 months, 0,9 mg/day for infants between 7 and 12 months, 1,3 mg for children between 1 and 3 years, 2,2 mg/day for the age interval 4-8 years, not exceeding 10 mg/day for males and females, even during pregnancy and lactation.

METABOLISM, DEFICIENCY AND TOXICITY

Regarding the fluoride metabolism, the absorption of dietary fluoride occurs promptly in the stomach and small intestine; further, the absorbed fluoride is transported to calcified tissues summing 25%-33% of absorbed fluoride, while the remaining fluoride enters the urinary tract and is lost in the urine [2,6]. Bones and teeth contain approximately 99% of total body fluoride and the percentage has a tendency to steadily expand during life. Fluoride has the ability to produce fluorhydroxyapatite or fluorapatite by displacing hydroxyl ions from hy-

droxyapatite [2]. It is currently uncertain if fluoride has a fundamental biologic role, though fluoride may present some favorable effects [3]. There have been studies on rodents, which, once fed with fluoride-deficient meals, did not show any modifications that could indicate fluoride deficiency. On the other hand, after entering the bone, fluoride acts as a stimulus for the osteoblast activity as well as a positive factor for the bone density which appears to be maximum in the lumbar spine [7]. In the 1960s, fluoride was proposed as medical therapy for osteoporosis but with no success in diminishing the fracture risk although it promotes denser bones. In addition, there has been documented a potentially higher risk of nonvertebral fractures [8].

Fluoride deficiency is correlated dental cavities risk through pre-eruptive and post-eruptive mechanisms [5]. The fluoridation of public drinking water has been firmly supported by the American Dental Association (ADA) [4]; still, there are robust opinions in this direction [9].

The mechanisms described for fluoride toxicity are the ingestion of high amounts of fluoride, either from the drinking water, fluoride supplements or as fluorine-containing insecticides [5,10,11]. Also, inhalation or absorption through the skin (hydrofluoric acid spills or freon vapor) can induce toxicity in an industrial environment [1]. Fluoride toxicity occurs more frequently in children up to 6 years-old after fluoride-containing toothpaste ingestion or mouthwashes [12]; fluoride toxicity has a rare occurrence in the developed countries. Regarding acute toxicity, the symptoms include nausea, pain, diarrhea and vomiting [10,13]. Severe cases may present from renal dysfunction, cardiac dysfunction to coma and death [14]. The toxicity in children is 8.4mg/kg body weight, producing symptoms [10]. Fluorosis or chronic fluoride toxicity is due to elevated concentrations of fluoride in the drinking water or fluoride supplementation usage. Elevated concentrations of fluoride in groundwater have been found in regions adjacent to the Mediterranean sea, China and Northern Thailand; the World Health Organization (WHO) has named them in an overview of fluorosis. Dental fluorosis represents a disorder that influences the dental cosmetic and it is characterized by mottled teeth. Dental fluorosis is caused by chronic ingestion of elevated fluoride doses [1].

Fluoride is a trace element used widely in the primary prevention of dental caries; but it should be carefully dosed because an excess of the fluoride consumption (greater than 0.05 mg/kg per day) can cause fluorosis or hypomineralization of dental enamel [15], fact that determines the teeth to be more susceptible to wear and breakage [16]. The level of fluorosis may be observed as follows: a mild

form is suggested by a white flecked or lacy appearance of the enamel, while a severe form of fluorosis is suggested by a brown discoloration. The link between excessive fluoride consumption and fluorosis has an unknown mechanism that is probably complex, but that is not fully understood yet [17,18]. Prevention of fluorosis can be undergone by appropriate fluoride supplementation such as fluoride toothpaste or limitation of excessive fluoride consumption.

In more severe cases, skeletal fluorosis with bone that appears radiologically dense but fragile may be present, leading to fractures or, even to calcification of ligaments and tendons, resulting in reduced joint mobility [1]. In a more severe form of the syndrome, there may be present extensive calcification of ligaments and cartilage, or even bony outgrowths such as osteophytes and exostoses [19].

FLUORIDE IN PREVENTIVE DENTAL CARE

In children younger than two years, ADA recommends, in order to reduce dental fluorosis and systemic toxicity, brushing with water rather than fluoride toothpaste. In the case of children two to six years old, there is a benefit from the use of a small amount of fluoride toothpaste (approximately pea-sized) [20].

In nonpregnant, pregnant, and breastfeeding women, an adequate intake of fluoride is of 3 mg/day, a level that, theoretically, is hard to be achieved by the pregnant women who consume only unfluoridated bottled water or who live in areas with water that is not being fluoridated [21,22]. The assessment of fluoride intake is difficult to be achieved, given that fluoride may be present even in the process of preparing bottled drinks and prepared foods (eg, soups, canned vegetables) and is, also, contained in tea and seafood that contains edible bones or shells.

During pregnancy, the Centers for Disease Control and Prevention (CDC) does not recommend fluoride supplementation [23] because the primary tooth does not incorporate the prenatal fluoride supplementation [24] and, consecutively, they did not reduce the incidence of caries in offspring, fact that is emphasized in the randomized trial that evaluate this type of approach [25,26]. Fluoride has beneficial effects entirely only after the tooth eruption took place through a topical mechanism, making the old approach that ingestion of fluoride is beneficial because it is systemically incorporated into the developing tooth enamel desuete [27,28]. Moreover, the topical contact of fluoride from the water or dentifrice proved to be efficacious if it occurs as a postnatal exposure of the newly erupted teeth [27,28].

Fluorosis in offspring has not been described secondary to excessive ingestion of fluoride of the

mother during pregnancy [29]. Even though fluoride, usually, crosses the placenta, the placenta itself acts as a partial barrier to the excess of fluoride when maternal levels are higher than normal levels [30]. From ecological studies conducted in China, Mexico and in a multicenter birth cohort study from Canada, a possible association with neurodevelopmental effects. Chinese scientists have associated high levels of fluoride during pregnancy with developmental neurotoxicity in infants. Mexican scientists have linked high fluoride intake during pregnancy with ADHD and symptoms of inattention in infants and also with diminished scores on cognitive function tests in children from the age group 6-12. The Canadian study revealed lower IQ scores in infants from the age group 3-4 years-old whose mothers presented increased levels of fluoride during pregnancy [31-34]. In the Canadian and Mexican studies, the fluoride source of water was optimally fluoridated and was consumed in the form of tap water and other water-based beverages. What is more, in the Canadian study the consumption of tea, which has a high fluoride content, was adjusted. On the other hand, in the Chinese study, the source of fluoride was only from the water without any adjustments for tea consumption. A possible bias or unmeasured confounding, may be the observed association; a fact that emphasizes the importance for further investigation before stating that there is an association between fluoride and the propriety of being a neurodevelopmental toxicant [35].

In order to obtain a favourable outcome, it is important that dental care initiation be made at an early stage. A proof in sustaining the importance of the early care initiation is a randomized trial on pregnant aboriginal Australian females, which received preventive dental care with fluoride varnish application and anticipatory guidance, either initiated during pregnancy, either initiated at 24 months of age, which assessed in the first group a more effective prevention of dental decay at age 3 years and age 5 years than in the second group [36,37].

CONCLUSIONS

Fluoride is fundamental in the normal development and strength of the teeth and cavities prevention, but during pregnancy excess ingestion is not recommended due to its possible effects of the normal development of the central nervous system and its potential association with low scores on cognitive tests, low IQ score and ADHD. Furthermore, due to its topical action mechanism after the tooth erupts, there has not been demonstrated any benefit from fluoride supplementation during pregnancy.

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