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Fostering Good Oral Health Habits in Children *Before They are Born*

Inside: Employment Law Just Got More Complex

In Utero Programming of Fetuses for Good Oral Health in Children

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ABSTRACT

Dietary constituents ingested by the pregnant woman are found in amniotic fluid. Fetal swallowing of amniotic fluid triggers taste and smell sensory receptors that, when pleasurable, predispose the postnatal infant to crave specific food items. Newborns have an innate positive response to sweet tastes, which may be exacerbated by prenatal exposure to energy-dense, nutrient-poor foods. In utero predisposition to high-caloric foods may trigger a series of neurological programming events, leading to a child with a strong desire for sugar-rich foods. The worldwide epidemic of childhood obesity, with its associated poor oral health issues, suggests that dental care programs should start during pregnancy.

Dietary constituents ingested by a lactating woman are transmitted to her nursing infant. Recent studies also have shown that flavors from a pregnant mother's diet are transmitted to the amniotic fluid and are swallowed by the fetus. The types of food consumed by a woman during pregnancy are experienced by her fetus before its initial food exposure as an infant. Assuming that these same food experiences are continued during breastfeeding, some of these same flavors will be experienced by infants in breast milk.

Experience with a flavor in amniotic fluid or in breast milk has a domino effect to modify infants' acceptance and enjoyment of similarly flavored foods at weaning. Potentially, such food preferences could continue to childhood and thereafter to adulthood. This article will review the literature on fetal tastes acquired prenatally and will discuss the potential effects on the dental health of the child. The pediatric dentist and pediatrician may find this review helpful in guiding expectant and breastfeeding mothers to select the appropriate diet. Such knowledge may have an impact on the child's diet to help combat obesity, diabetes, dental caries and other weight-related issues.

Amniotic fluid contains many constituents, ranging from nutrients (e.g., glucose and amino acids) to flavors from the mother's dietary intake.[1] Recently, it has been shown that a fetus can taste and smell dietary constituents in the amniotic fluid. Olfactory receptors in the nasal cavity and in the nasal septum are present by the eighth week of gestation and have a mature appearance by termination of the second trimester. At seven to eight weeks of gestation, the taste receptors on the tongue and palate can detect the five tastes and flavors (i.e., bitter, sweet, salty, sour and umami). Fetal swallowing of small quantities of amniotic fluid commences at the termination of the first trimester and increases to 750 ml/day by 34 weeks of gestation.[2] Flavor perception, which results from the integration of smell and taste sensory systems, is accomplished in utero by the fetus sensing odors orthonasally and retronasally and tastes by receptors in the oral cavity.[1]

Remembering What We Ate

Fetal experiences to tastes and odors may generate long-term memory (i.e., programming) to influence food preferences later in life.[3] In one study, pregnant women consumed either carrot juice or water for four days/week for three consecutive weeks during the last trimester of pregnancy. Subsequently, their infants, at about six months of age, were fed plain cereal and cereal amended with carrot juice flavor. Approximately four weeks after supplementing the cereal with carrot juice flavor, the infants were videotaped as they were fed cereal with/without carrot juice flavor. Videotape analyses

were directed on the frequency of negative facial responses (e.g., gaping, head turning, nose wrinkling, upper lip raising, brow lowering) in response to each spoonful of ingested cereal. In addition, immediately after each videotape session, the mothers rated their infants' enjoyment of the food. As evaluated by their mothers, infants exposed prenatally to carrot juice appeared to enjoy the carrot juice-flavored cereal more than the plain cereal and exhibited fewer negative facial responses to the carrot juice-flavored cereal than did the control group not prenatally exposed to carrot juice.[4] Prenatal experiences with food flavors transmitted from the diet of the mother into the amniotic fluid led to greater acceptance and enjoyment of these foods during weaning. Apparently, the chemosensory prenatal experience was retained beyond the newborn period.

The chemical composition of amniotic fluid changes as a function of the dietary foods ingested by the pregnant mother, with some foods adding flavor to the amniotic fluid.[5] For example, amniotic fluid was obtained from pregnant women undergoing amniocentesis. Forty-five minutes prior to the procedure, five of the women ingested capsules of garlic and the other five women consumed placebo capsules. A distinct odor of garlic was detected in four of the five women who ingested garlic.[6]

Another study compared the dietary preferences to garlic in two groups of children, one whose pregnant mothers consumed garlic at 35 weeks gestation and the other whose mothers did not ingest garlic. On average, pregnant mothers in the experimental group ate 14 meals containing fresh garlic; the mothers in the control group did not consume garlic. Their children, aged 8 to 9 years old, were fed beef burgers, beans and potato gratin, with/without added garlic. Those children prenatally exposed to garlic ate substantially more garlic-flavored potatoes than did the controls, demonstrating that prenatal flavor experiences affected dietary behavior well into childhood.[7]

Establishing a Connection

Mother's milk consumed during breastfeeding serves as a connection between in utero experiences with flavors in the amniotic fluid to those dietary experiences with solid foods at weaning and thereafter. For example, the above-noted research on fetal in utero exposures to carrot flavor[4] was extended to a group of breastfeeding infants whose mothers consumed carrot juice during the first three months of the infants' life. Exposure to carrot flavors in breast milk enhanced the infants' responses to carrot flavor when tested at weaning. In a later study, breast-fed infants were more acceptable of peaches than were formula-fed infants. This enhanced acceptance of peaches, as determined by intake, rate of consumption and facial appearances, was attributed to the greater infant experience to fruit flavors, due to enhanced maternal consumption of fruits during lactation.[8]

Thus, early flavor experiences transmitted in amniotic fluid and in breast milk modify later flavor and food preferences, establish food likes and dislikes that establish lifelong food habits that have an impact on the health and wellness of the infant, the child and, possibly, the adult. If the mother eats the same types of foods during pregnancy and lactation, it is most probable that the amniotic fluid and breast milk have commonalities in food flavors, with breast milk serving as the connecting link between experiences with flavors in utero with flavors in solid foods during early childhood.[5,9] The pregnant mother is empowered to mediate the future health and wellness of her child.[10]

It was generally assumed that food preferences initially were formed during infancy, commencing with nursing. However, it is now known that flavors of foods in the diet of a pregnant woman are found in the amniotic fluid, which when swallowed by the fetus can promote food preferences in infancy. Such flavor likes/dislikes can persist to childhood and potentially to adult life. Children have inborn positive preferences for sugar and negative responses for bitter tastes. Soon after birth, young infants exhibit positive taste preferences towards sweet favors and negative taste responses to bitter tastes.[1] Repeated exposures to sugary flavors in amniotic fluid promote a pleasurable dependence on high-caloric tastes later in life.[11] Overconsumption by a pregnant woman of calorie-dense, nutrient-poor food rich in lipids and glucose may predispose her fetus and, hence, the infant, child and future adult to prefer high-fat and high-sugar foods. Potentially, this may exacerbate the worldwide epidemic of obesity and diabetes.[10-12]

The Case for Healthy Prenatal Diet

According to the Centers for Disease Control and Prevention growth charts, approximately 17% of children and adolescents aged 2 to 19 years in the United States are obese, and almost 32% of children and adolescents are overweight or obese.[13] The relationship between childhood obesity and dental caries[14] and periodontal disease[15] has been noted. A common risk factor for poor dental health and obesity in early childhood is the overconsumption of sugar.[16] However, the deleterious effects of a high-caloric diet during pregnancy and the development of dental caries in the offspring have only just begun to be appreciated. The European Society for Pediatric Gastroenterology, Hepatology, and Nutrition Committee on Nutrition formulated a position paper on the over-consumption of sugars, particularly of sugar-sweetened beverages, in European children. The committee recognized "that infants have an innate preference for sweet tastes, which may be modified and reinforced by pre- and postnatal exposures. Sugar-containing beverages/free sugars increase the risk for overweight/obesity and dental caries."[17]

There is a preponderance of evidence in the dental health literature that advocated healthy prenatal diets.[18] It seems to be intuitive that social habits of poor nutrition would be transmitted to the child by nurture. The preceding articles provided scientific evidence that, by nature, certain dietary proclivities of the child can be altered in the prenatal and in the postnatal breastfed infant via amniotic fluid and breast milk. Perhaps, we need to be changing children's taste preferences to healthier foods in utero, with the added bonus that the mother will benefit as well.

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