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Breast-feeding Lowers Childhood Obesity

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INTRODUCTION

The prevalence of overweight and obesity in children is increasing rapidly (1). This is alarming due to the increased risk of these children becoming obese adults (2), and due to several obesity-related morbid conditions. Obesity is associated with type 2 diabetes mellitus, orthopedic problems, respiratory problems, fertility problems, cardiovascular diseases and psychosocial consequences in the form of a negative self-image, emotional and behavioral problems, and depression (2). Children who develop these conditions track them into adulthood, thus increasing both their medical burden on society and their risk for early morbidity and mortality. Consequently, the prevention of overweight from childhood onwards is an important issue. Environmental and behavioral factors are regarded as the most important causes of the rapid increase in the prevalence of overweight and as the most important starting points for prevention (2). Prevention programs aimed at stimulating breast feeding and daily physical activity and the restriction of sweetened drinks and watching TV are very promising (3). The objective of this paper is to determine whether breastfeeding and its duration are associated with a reduced risk of being overweight among young children.

TRENDS IN BREASTFEEDING

The breastfeeding initiation rates in the United States have steadily fell since 1940s, which coincided with the increased industrialization and migration of the US workforce from rural to urban areas(4). The 1998 breastfeeding initiation rates (64%) and rate of infants being breastfed at 6 months (29%) are the highest recorded in 30 years (4). Despite these recent gains, the US Surgeon General's Healthy People 2000 goals for breastfeeding were not met, and targets of a "75% breastfeeding rate at hospital discharge with 50% of infants still breastfeeding at 6 months and 25% at 12 months have been reiterated for the year 2010" (4). Several socioeconomic, cultural, and personal factors are known to influence a woman's choice of infant feeding. Currently, breastfeeding is most common among women who are "college educated, white, married, older than 30 years, and of middle or higher income levels" (4).

IS BREASTFEEDING PROTECTIVE AGAINST CHILDHOOD OBESITY?

The hypothesis that breastfeeding has a protective effect against obesity is not recent. Nevertheless, controversial results have been found, and the issue is still up-to-date, especially because of the increase that has been observed in the prevalence of obesity. The first indication of a significant protective effect of breast-feeding against childhood obesity was published in 1981 by Kramer (5). In a review published in 2001, Butte (6) summarized the results of studies conducted up to 1999. She found that breastfeeding was associated with reduced risk of childhood overweight in only 4 of the 16 studies, and even in those 4 there were unresolved questions about confounding factors. Since 1999, however, several new large-scale studies have been published. These studies were narratively reviewed by Dewey (7). Most of the studies in his review demonstrated a link between breastfeeding and child overweight. Of the 11 studies that met the predefined criteria, 8 showed a lower risk of overweight in children who were breastfed. The significant adjusted odds ratios (AORs) were generally in the range of 0.66 to 0.79, indicating that the odds of being overweight were about 21% to 34% lower in children who had been breastfed. The dose-response relationship was observed in some, but not all, of the positive

studies. The findings suggest that if the association is causal, the effect of breastfeeding is relatively modest. This may explain why it is not detected when the sample sizes are relatively small. The first systemic review on this issue was published in August 2004 by Arenz et al. (8). The results from their meta-analysis of 9 studies with more than 69,000 participants also indicated that breastfeeding is associated with a “small but consistent protective effect” against childhood obesity. The AOR was very close to Dewey’s findings, which was 0.78.

SUGGESTED CONFOUNDING FACTORS

The strongest predictor of child overweight status is the mother’s concurrent weight. In the cross-sectional study of Heidger et al. (9), they found that the rate of children being overweight nearly tripled with maternal overweight status and more than quadrupled with maternal obesity status. Whitaker et al. (10) also found that parental obesity more than doubles the risk of adult obesity among both obese and nonobese children less than 10 years of age. Furthermore, maternal adiposity prevents successful initiation or maintenance of breastfeeding (11). The other relevant confounding factors are child’s gender, race/ethnicity, and birth weight, mother’s age, education, prepregnancy BMI, weight gain during pregnancy and postpartum smoking, dietary factors, physical activity, and socioeconomic status (12).

POSSIBLE MECHANISMS

Metabolic imprinting

Metabolic imprinting refers to “a phenomenon through which an early nutritional experience during a critical and specific period of development could result in a long-lasting effect that predisposes to certain diseases” (13). A classic epidemiological study is the historical cohort study carried out by Ravelli et al. (14) with 300,000 19-year-old men exposed to the Dutch famine of 1944-1945 and examined at military induction. Those individuals whose mothers were nutritionally deprived during the first half of pregnancy had a significantly higher obesity rates than those who had not been exposed to such conditions. The explanation for this, as the authors suggest, is that these individuals were nutritionally deprived during a critical period of hypothalamic differentiation, therefore modifying the development of hypothalamic centers in charge of appetite regulation.

Breastfeeding represents one of the earliest nutritional experiences of newborns. Its unique composition could be implicated in metabolic imprinting. For instance, there could be substances in breast milk that imprint the neuro-hormonal system controlling food intake. In 1980, Lucas et al. (15) studied the metabolic and endocrine responses to formula-feeding and breast-feeding in 77 six-day-old healthy term infants. Bottle-fed neonates were found to have significant changes in plasma-concentrations of insulin, motilin, enteroglucagon, neurotensin, and pancreatic polypeptide after feeding, whereas in breast-fed infants these changes were reduced or absent. Basal levels of gastric inhibitory polypeptide, motilin, neurotensin, and vasoactive intestinal peptide were also higher in the bottle-fed infants than in those who were breast-fed. These findings, as the authors suggest, may partly explain differences in the deposition of subcutaneous fat and in stool frequency between breast-fed and bottle-fed neonates. In 2002, Hirai et al. (16) studied the trophic effect of multiple growth factors in human

milk on cultured human fetal small intestinal cells. They concluded that many growth factors in human milk, such as EGF, IGF-1, FGF, HGF, and TGF- α , have a strong trophic effect on immature intestinal cells and may be involved in perinatal gastrointestinal adaptation. These growth factors were found to inhibit adipocyte differentiation *in vitro* by Hauner et al. (17) and Petruschke et al. (18). Leptin was also detected in breast-milk by Casabiel et al. (19), which may have a regulatory role in infants since this hormone inhibits appetite and anabolic pathways, and stimulates catabolic pathways. Furthermore, protein intake and amount of energy metabolization is lower in breastfed than in formula-fed infants (20). The high protein intake leads to an increased secretion of IGF-1 (insulin-like growth factor type 1), which in its turn stimulates the multiplication of adipocytes (21). Rolland-Cahera et al. (22) also showed a significant association between early protein intake and later BMI in their longitudinal study, suggesting that a higher protein intake early in life might increase the risk of later obesity.

Behavioral aspects

Breast-fed infants regulate their food intake quite precisely according to their needs for growth and maintenance. In addition, they control the breast milk production of their mother. In contrast, satiety can be challenged by bottle-feeding, when the saturated infant is encouraged to empty the bottle, and by feeding formulas more concentrated in energy and nutrients than breast milk. If this occurs early and goes on, the infant's development of self-regulating mechanisms may be impaired, since external control mechanisms may subdue internal hunger and satiety signals. Therefore, bottle-feeding could favor the development of overweight by stimulating an excessive milk intake or by harming the development of self-regulating mechanisms.

Breast-feeding could also be part of a lifestyle running in families and may contribute to the formation of healthier eating habits in the infant. It is common knowledge that the maternal diet affects the flavor of breast milk and that different tastes interfere with milk intake. There is evidence that experience with several flavors (tastes) during breastfeeding facilitates the acceptance of new and varied foods by the child in the future (23).

CONCLUSION

The hypothesis that breast-feeding could have a protective effect against obesity is supported by epidemiological evidence, being biological plausible, but literature data are still controversial. Since breastfeeding has many benefits, no adverse effects, and low cost, it may represent a new and effective weapon to attenuate the dramatically rising prevalence of obesity in the United States and elsewhere. However, its protective effects against childhood obesity still have to be confirmed and the potentially implicated mechanisms still have to be clarified.

Since randomized controlled trials on breastfeeding is not ethical, only cohort, cross-sectional and case-control studies have been performed on this issue so far. However, trials with randomized intervention on hospital level as recently published by Kramer et al (24) might provide data that will allow for better assessment of the effects of breastfeeding on obesity.

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