Early Life Nutrition and Bone Development in Children

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Fetal and early life may be a critical period for the development and/or programming of metabolic systems, including the skeleton. There is increasing human data from cohort studies on the association between early life nutrition and bone development in children [1]. This presentation will summarize these studies. Breastfed children initially have lower bone mass than bottle-fed children, but longer term studies suggest that they have higher bone mass (size adjusted) by age 8 especially in children born at term. By the time of peak bone mass, both preterm and term children have higher bone mass, and the difference is larger than at age 8 in the same children, indicating a different bone accrual trajectory curve (table 1). This appears to be due to altered tracking of bone accrual, with breastfeed children more likely to deviate positively and less likely to deviate negatively from usual accrual curves. These children also have a 30–60% lower fracture risk at both age 8 and during puberty, which is largely mediated by higher bone mass. These associations appear dependent on the duration of breastfeeding or the percentage of breast milk in the diet, suggesting a biologic association rather than one mediated by socioeconomic status. Indeed, intention to breastfeed at birth was less strongly associated than actual breastfeeding supporting this concept. Diet in utero has also been prospectively associated with subsequent bone mass from ages 6 to 16 years [1, 2]. This has been demonstrated in both well-nourished western populations and those with less than optimal intake in India. Positive associations include milk, phosphorus, magnesium, potassium, protein, calcium and vitamin D while fat intake is negative. The most consistent were phosphorus, magnesium and fat. Maternal cord vitamin D levels predict bone mass in the children at age 9, and bone mass was also higher in the children of mothers taking vitamin D supplements during pregnancy. In comparison to breastfeeding, these associations were modest but significant, which may, in part, reflect the limitations of dietary food frequency questionnaires or may reflect...
their relative importance. In addition, no association with fracture has been observed. There have been no randomized trials of diet during pregnancy with a subsequent bone outcome, but these associations are independent of important confounders and later environmental exposures, suggesting they are real. Smoking also interferes with bone mineralization possibly due to impaired placental function, suggesting a direct effect on in utero nutrition [1]. This is most marked in the early years in children born at term but appears to diminish over time so that there is no effect on bone mass by age 16 even though the children are smaller. Only a small amount of bone is laid down during pregnancy, so it seems unlikely that these factors influence this to any major extent. The data as a whole are more strongly in support of programming, which still has an impact up to the age of peak bone mass, suggesting that osteoporosis prevention should start very early in the life cycle.

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References
