Milk Intake, Calcium and Vitamin D in Pregnancy and Lactation: Effects on Maternal, Fetal and Infant Bone in Low- and High-Income Countries

Ann Prentice

Calcium and vitamin D are essential for bone growth and maintenance. Among the bone-forming minerals (Ca, P, Mg, Zn), dietary calcium supply is close to biological requirements and may be limiting in some parts of the world where there are few rich dietary sources of calcium, particularly for children and women during pregnancy and lactation [1]. Similarly, the vitamin D status of many women and young children is compromised by low UVB skin exposure and by factors that increase vitamin D usage, even in tropical countries with abundant sunshine [2]. Milk from domesticated ruminants, primarily cow, sheep, goat, camel and buffalo, are major sources of dietary calcium and, in countries where commercially available milk is fortified, of dietary vitamin D. This short review summarizes the data on calcium and vitamin D supply for mothers and young children in low- and high-income countries and considers the evidence on the implications for maternal, fetal and infant bone health.

The skeleton of a neonate contains about 25 g of calcium, and that of an adult woman contains about 800–1,000 g of calcium. The accretion of calcium by the fetus occurs predominantly in the second half of pregnancy, with the highest rates of 200–300 mg/day occurring in the last trimester. Similar daily accretion rates occur in the first weeks of life and gradually decrease during infancy. These are mirrored by the calcium supply from breastmilk which averages around 200–300 mg Ca/day during exclusive breastfeeding [1]. Dietary calcium intakes vary widely between individuals in the same population and between different populations, generally reflecting the consumption of animal milks: a typical adult range is 300–1,500 mg Ca/day and is proportionately lower for children. Population average intakes of calcium are generally high in the countries of North America, Europe and Australasia.
and low in those of Africa and Asia. Intakes at the low end of the range are well below international recommendations and are close to the biological calcium requirement for pregnant and lactating mothers and their offspring [1, 3].

Vitamin D is a prohormone which is converted in the body to an active metabolite, 1,25-dihydroxyvitamin D \([1,25(\text{OH})_2\text{D}]\) that is essential for maintaining calcium homeostasis by the orchestration of intestinal calcium absorption, bone mineral turnover and renal calcium reabsorption [2, 4, 5]. For those individuals that have regular exposure to adventitious UVB sunlight exposure, endogenous synthesis of vitamin \(\text{D}_3\) is the primary source of vitamin D [2, 5]. Dietary sources of vitamin D, present as either vitamin \(\text{D}_3\) (cholecalciferol) or vitamin \(\text{D}_2\) (ergocalciferol), are important providers of the prohormone when skin exposure to UVB sunlight is limited [5].

Current evidence indicates that, in the human, there are physiological mechanisms that support the necessary calcium fluxes across the placenta and mammary gland and that are unresponsive to increases in calcium intake. This applies across the range of dietary calcium intakes recorded in healthy individuals. In contrast, although there is unlikely to be an additional requirement for vitamin D during pregnancy and lactation, many women have poor vitamin D status. This places them at risk of osteomalacia and their infants at risk of rickets, osteomalacia, compromised skeletal growth and other outcomes. There needs to be increased awareness among policy makers, health professionals and the public about the importance of safe UVB sunshine exposure and consumption of dietary vitamin D by women of reproductive age at risk of vitamin D deficiency.

References

1 Prentice A: Micronutrients and the bone mineral content of the mother, fetus and newborn. J Nutr 2003;133:1693S–1699S.