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Vitamin D content of human milk and associations with milk fat content and maternal serum 25-hydroxyvitamin D concentrations

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Vitamin D requirements during the first year are unknown and an adequate intake (AI) value of 10 μg/d[(1)] has been recommended for infants in the absence of sufficient data to establish an estimated average requirement. Data on the vitamin D content of human milk are variable and maternal factors that influence milk vitamin D levels are poorly described. The objectives of this analysis were to measure total vitamin D content in human milk, to investigate the impact of adjusting for fat content on composition estimates and to evaluate the association between maternal serum 25-hydroxyvitamin D [s25(OH)D] concentration and milk vitamin D content.

In a sample of 108 women, 98% of whom were of European origin, expressed breast milk samples were collected at 2–3 weeks postpartum using a standardised procedure, i.e. in the afternoon once baby had completed a feed, and were frozen immediately. Vitamin D_2, D_3 and 25(OH)D were quantified using HPLC. Fat creamatocrit (v/v, %) of human milk was measured using a micro-haematocrit centrifuge. Fat content (g/L) was calculated using the formula: [(creamatocrit-0.59)/0.146][(2)]. Maternal serum 25(OH)D_2, 25(OH)D_3 and 3-epi-25(OH)D_3 were measured by LC-MS/MS.

Vitamin D and Fat content* in human milk		**Maternal s 25(OH)D (nmol/L)**	
Vitamin D_2 (μg/L)	0.11 (0.0–0.51)	25(OH)D_2	1.9 (1.4–3)
Vitamin D_3 (μg/L)	1.52 (0.65–3.25)	25(OH)D_3	35.8 (22–54)
25(OH)D (μg/L)	0.09 (0.09–0.09)	3 epi-25(OH)D_3	1.7 (1.1–2.4)
Total Vitamin D (μg/L)∞	2.2 (1.57–4.4)	Total s25(OH)D†	37.8 (25–58)
Fat content (g/L)	0.4 (34.6–62.9)		

*Values are median (interquartile range); ∞ Total vitamin D = (D_2 + D_3) + 25(OH)D*5; †Total s25(OH)D = 25(OH)D_2 + 25(OH)D_3.

The total vitamin D content of milk was associated with milk fat ($R^2 = 0.036$; $\beta = 0.19$; $P = 0.05$), but not with maternal s25(OH)D, days post-partum or maternal BMI. Vitamin D_3 was significantly associated with fat content ($\beta = 0.254$; $P = 0.008$) and maternal s25(OH)D ($\beta = 0.215$; $P = 0.044$) and negatively associated with number of days post-partum ($\beta = -0.174$; $P = 0.05$) [total adjusted $R^2 = 0.122$, $P =$].

In summary, the total vitamin D content in human milk is largely determined by the vitamin D_3 content, which is associated with milk fat composition and maternal s25(OH)D concentrations, and negatively associated with the duration of lactation. Assuming an average consumption of milk of 600–800 ml/day (up to ∼6 month)[(3)], an exclusively breastfed infant in this sample would receive 1.3–1.8 μg vitamin D/day, which is substantially lower than the adequate intake (AI) of 10 μg[(1)]. First stage infant formula would provide ∼7 μg of vitamin D/day in 700 ml formula. Further research to define the vitamin D requirement in infants is required.

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1. Institute of Medicine (2011) Dietary Reference Intakes for Calcium and Vitamin D. Washington, DC: The National Academies Press.
2. Lucas A, Gibbs J, Lyster R *et al. BMJ.* 1978;1(6119): 1018–20.
3. da Costa THM, Haisma H, Wells JCK *et al. J Nutr.* 2010;140(12): 2227–32.