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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 D₂, D₃ and 25(OH)D were quantified using HPLC. Fat creatocrit (v/v, %) of human milk was measured using a micro-haematocrit centrifuge. Fat content (g/L) was calculated using the formula: [(crematocrit-0.59)/0.146]⁽²⁾. Maternal serum 25(OH)D₂, 25(OH)D₃ and 3-epi-25(OH)D₃ 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 = (D₂ + D₃) + 25(OH)D*5; [†]Total s25(OH)D = 25(OH)D₂ + 25(OH)D₃.

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 D₃ 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 D₃ 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.