Response of serum 25-hydroxyvitamin D concentrations to vitamin D supplementation during lactation

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Pregnancy, lactation and early childhood are life stages when the risk of low vitamin D status is high and the knowledge basis for determining nutritional requirements for vitamin D is weak. The current dietary reference intervals (DRI) for vitamin D in pregnant and lactating women are the same as those in non-pregnant adult females below 70 years (600 IU/15 µg/d)(1). The aim of the current study was to investigate vitamin D requirements during lactation. We conducted a double-blind randomised placebo-controlled trial across three intervention groups using 20 µg/d of vitamin D₃ (to achieve a total vitamin D intake of ~25 µg/d), with or without 500 mg Ca, or placebo, over 12 weeks of lactation. The study protocol was implemented across a calendar year to account for seasonal effects.

Concentrations of serum 25-hydroxyvitamin D (s25(OH)D) were measured at baseline (BL) and endpoint (EP) in mothers and in umbilical cord blood using ELISA. Vitamin D metabolites (D₃, D₂ and 25(OH)D) were quantified in expressed breast milk at four time points during the intervention study using HPLC. Dietary intakes of vitamin D and Ca, anthropometric data, socio-demographic and lifestyle data were collected, as well as antenatal supplement use and habitual sunshine exposure. The s25(OH)D data are described here.

<table>
<thead>
<tr>
<th>25(OH)D (nmol/L)</th>
<th>Total (n 100)</th>
<th>Placebo (n 27)</th>
<th>Vitamin D (n 36)</th>
<th>D and Ca (n 37)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline*</td>
<td>43.4 (31.5–60.1)</td>
<td>45.2 (29.2–64.9)</td>
<td>45.4 (38.1–54.2)</td>
<td>39.5 (30.1–62.6)</td>
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<tr>
<td>Endpoint†</td>
<td>71.8 (58.6–88.7)</td>
<td>48.3 (36.7–65.6)</td>
<td>78.4 (67.9–94.1)</td>
<td>75.9 (67.7–98.0)</td>
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</tbody>
</table>

Median; interquartile range in parentheses; *One-way ANOVA followed by Tukey’s test. †ANCOVA adjusting for BL s25(OH)D, dietary intake of vitamin D and season of EP blood sampling.

At BL, 21 and 63% had a s25(OH)D level below the thresholds for vitamin D deficiency and sufficiency of 30 and 50 nmol/l, respectively. Season of blood sampling was the main determinant of BL s25(OH)D (adj. R² = 0.338; β = 0.571; P < 0.001), as expected. Other determinants were parity and total vitamin D intake (β = 0.157 and 0.150, respectively; P < 0.05). Mean (sd) cord s25(OH)D levels were 33.8 (14.8) nmol/l (n 92) and were 78% of maternal levels on average (R² = 0.7; P < 0.001). Season of birth (adj. R² = 0.274; β = 0.137) and antenatal vitamin D supplement use (adj. R² = 0.004; β = 0.140) were independent predictors of cord s25(OH)D levels (both P < 0.05).

A final sample of 100 women completed the intervention protocol, of which ninety were more than 80% compliant. The intervention considerably increased s25(OH)D levels in the treatment groups by ~30 nmol/l (see Table) with no difference in the EP concentrations between women who received vitamin D only and those who received vitamin D + Ca. Given that the average habitual vitamin D intake in the group was 4.3 µg/d, supplementation with 20 µg/d vitamin D₃ to achieve a total intake of ~25 µg/d, maintained s25(OH)D levels >30 nmol/l in all lactating women and brought 96% above the desirable threshold of 50 nmol/l.

In conclusion, the current DRI of 15 µg/d is inadequate to achieve a target s25(OH)D of 50 nmol/l in 97.5% of lactating women at a latitude of 51°N.

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