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Efficacy of food fortification for the prevention of vitamin D deficiency – results of a systematic review and meta-analysis

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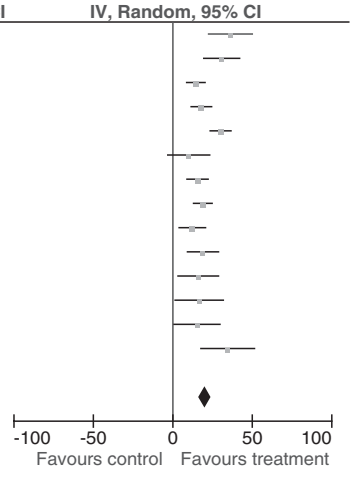
Food fortification with vitamin D is a potentially effective public health strategy to address vitamin D deficiency. The aim of this systematic review was to evaluate the current evidence that food fortification can improve vitamin D status in the population by increasing circulating 25-hydroxyvitamin D (25(OH)D) concentrations in excess of the cut-off levels representing deficient or desirable status.

Five medical and health databases (Medline OVID, PubMed, CINAHL, Embase, Cochrane Central Register of Controlled Trials) were searched for randomised controlled trials in free-living adults that used vitamin D-fortified foods and reported circulating 25(OH)D concentrations. A total of 440 abstracts were retrieved. Two reviewers independently screened papers for eligibility and extracted relevant data. Meta-analysis of the absolute mean change in circulating 25(OH)D concentrations was conducted using a random-effects model. Dose, latitude and baseline 25(OH)D were identified *a priori* as probable sources of heterogeneity. Fourteen trials were included (*n* 936; 483 treated and 453 controls), derived from eleven published studies[1–11], all of which showed a statistically significant beneficial effect of food fortification on circulating 25(OH)D concentrations. Individual treatment effects ranged from 10.00 (95% CI −3.20, 23.20) to 36.25 (22.47, 50.03) nmol/l. There was moderate statistical heterogeneity across the fourteen trials ($P = 0.002$, $I^2 = 60\%$) which was not explained by subgroup analyses of dose, latitude and baseline 25(OH)D concentrations.

Study or Subgroup	Experimental Mean	SD	Total	Control Mean	SD	Total	Weight	Mean Difference IV, Random, 95% CI
Biancuzzo et al 2010a	32	25.25	18	-4.25	14.5	15	5.0%	36.25 [22.47, 50.03]
Biancuzzo et al 2010b	26.5	18	17	-4.25	14.5	15	6.3%	30.75 [19.48, 42.02]
Chee et al 2003	17.3	19.72	91	2.8	19.41	82	10.2%	14.50 [8.66, 20.34]
Daly et al 2006	4.27	19.47	75	-13.69	20.46	72	9.7%	17.96 [11.50, 24.42]
de Jong et al 1999	35	18	37	5	9	34	9.7%	30.00 [23.46, 36.54]
Green et al 2010	-11	27.42	32	-21	27.26	34	5.3%	10.00 [-3.20, 23.20]
Keane et al 1998	22.28	10.9	24	6.75	10.92	18	9.6%	15.53 [8.86, 22.20]
Kruger et al 2010a	12.69	10.95	27	-6.17	11.24	29	10.3%	18.86 [13.05, 24.67]
Kruger et al 2010b	24.07	16.4	30	11.8	16.4	30	8.3%	12.27 [3.97, 20.57]
Kukuljan et al 2009	12.79	27.18	45	-6.17	19.41	44	7.2%	18.96 [9.16, 28.76]
McKenna et al 1995	-15	31.48	52	-31	34.22	50	5.5%	16.00 [3.23, 28.77]
Natri et al 2006a	16.3	21.89	11	-0.3	12	9	4.4%	16.60 [1.47, 31.73]
Natri et al 2006b	14.9	19.61	10	-0.3	12	9	4.7%	15.20 [0.74, 29.66]
Trangpricha et al 2003	57	26.19	14	22.5	17.32	12	3.8%	34.50 [17.64, 51.36]
Total (95% CI)			**483**			**453**	**100.0%**	**19.86 [15.97, 23.76]**

Heterogeneity: Tau² = 29.75; Chi² = 32.54, df = 13 (P = 0.002); I² = 60%
Test for overall effect: Z = 9.99 (P < 0.00001)



These data suggest a beneficial effect of vitamin D-fortified food on circulating 25(OH)D concentrations. However, the treatment effect is influenced by a variety of factors, such as dose, latitude, baseline 25(OH)D concentrations, sun exposure, dietary vitamin D intake and age. Investigators did not typically report the change in prevalence of individuals with 25(OH)D concentrations below cut-off levels indicating deficiency, so it was not possible to evaluate the effectiveness of fortification in preventing vitamin D deficiency. There is a need for stronger data on the effect of vitamin D-fortified food on vitamin D status using controlled intervention studies and transparent reporting.

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