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Efficacy of fortification of cow's milk as a dietary strategy to increase dietary vitamin D intakes

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The majority of vitamin D required by humans is derived by ultraviolet (UV) radiation of the 7-dehydrocholesterol in the skin[(1)]. Vitamin D can also be obtained from the diet, and these sources of vitamin D are of particular importance here in the UK and Ireland as a number of factors, including age, skin pigmentation, clothing and the use of sun protection, and geographical location, negatively influence the skin's ability to synthesise the vitamin[(2)]. Milk is a source of naturally occurring vitamin D (albeit providing a small contribution); the vitamin D content of whole, semi-skimmed and skimmed milk is currently listed as 0.03 μg, 0.01 μg and trace per 100 g, respectively[(1)]. Numerous studies have reported the effectiveness of dairy fortification as a strategy to increase dietary vitamin D intakes at the population level[(3,4)]. The aim of this study was to use population level dietary data to simulate how fortified cow's milk could contribute to total dietary vitamin D intake using a dietary modelling approach.

Data from the National Diet and Nutrition Survey (NDNS) rolling programme (2008–2011) were obtained from the UK Data Service[(5)]. A total of 12,239 recorded diary days (*n*3,073) were available for analysis. The vitamin D content of whole, semi-skimmed, skimmed and 1% fat milk was then manipulated to apply three incremental levels of fortification (1 μg, 1.5 μg and 2 μg per 100 ml), and the effect on total vitamin D intake was investigated in all milk consumers.

A total of 82.5% diary days reported an intake of cow's milk, with intakes of consumption ranging from 2–1,764 ml with a mean intake of 202 (SD 180) ml/d. While semi-skimmed milk proved the most popular type of milk among consumers (51% of diary days), the mean volume of whole milk consumed was higher, compared to that of semi-skimmed milk (249.7(SD 207) vs.187(SD 162.1 ml/d; $P < 0.001$). As a result, the simulated fortification of whole milk showed the greatest increase in total vitamin D intake.

	Total vitamin D intake (μg/d)							
	Fortification levels of milk							
	0 μg/100 ml*		1 μg/100 ml		1.5 μg/100 ml		2 μg/100 ml	
	Median	Percentiles	Median	Percentiles	Median	Percentiles	Median	Percentiles
Whole milk	1.86[a]	0.91–3.39	4.46[b]	2.72–6.84	5.63[c]	3.37–8.52	6.73[d]	4.02–10.39
Semi-skimmed milk	2.13[a]	1.08–4.03	4.06[b]	2.59–6.44	4.91[c]	3.14–7.74	5.75[d]	3.68–9.04
Skimmed milk	2.61[a]	1.12–5.11	4.32[b]	2.48–7.06	5.20[c]	2.94–8.28	5.98[d]	3.37–9.47
1% fat milk	4.12[a]	2.69–7.18	2.69[b]	4.12–7.18	5.25[c]	3.14–7.94	6.47[d]	3.55–9.07

* Vitamin D content of milk as listed in the McCance and Widdowson[(1)].
Percentiles (25^{th}, 75^{th}).
[a,b,c,d] values within a row with different superscript letters represent significance ($P < 0.001$, Friedman Test and Wilcoxon Signed Rank Test).

Results show that fortification of UK cow's milk with vitamin D, at concentrations similar to that applied in the US/Canada (approximately 1 μg/100 ml), would significantly increase consumer's vitamin D intake. Such fortification would therefore be an effective strategy to increase vitamin D intakes, and subsequently improve the vitamin D status at the population level. While this study has focused solely on the effect of vitamin D fortification of cow's milk, more research is needed to investigate the impact of such fortification on the vitamin D content of other dairy products and their contributions to consumer's dietary vitamin D intakes.

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5. UK Data Service http://discover.ukdataservice.ac.uk/