Impact of dairy products and dietary calcium on bone-mineral content in children: results of a meta-analysis

Huncharek M, Muscat J, Kupelnick B

CRD summary

This review evaluated the impact of calcium and dairy product supplementation on bone mineral content in children. It concluded that calcium and dairy products, with or without vitamin D, significantly increase bone mineral content in children with low base-line calcium intakes. Given a number of limitations in the review process, the conclusions of this review should be interpreted with caution.

Authors' objectives

To determine the impact of dietary calcium and dairy derived nutrients on bone mineral content in children.

Searching

MEDLINE (1966 to 2006), Current Contents (up to March 2003) and the Cochrane Library (no dates given) were searched for publications in English language only. Search terms were reported. The reference lists of retrieved articles and relevant reviews were checked for additional studies.

Study selection

Randomised controlled trials (RCTs) or observational studies of children aged ≤18 years were eligible for inclusion. Only RCTs with a sample size of ≥50 patients and specified selection criteria for comparison groups and randomisation procedures were considered. Inclusion criteria for interventions were not explicitly stated but most included RCTs evaluated calcium with or without vitamin D and some evaluated vitamin D supplementation alone. The outcome of interest was bone mineral content (definition not reported). Studies of children with chronic diseases were excluded.

The mean age of participants ranged from 4 to 17.3 years and most were female. Different methods and sites were used to measure bone mineral content and to assess dietary intake in observation studies.

One reviewer screened abstracts to eliminate those not meeting inclusion criteria. The number of reviewers involved in the final selection of studies was not reported.

Assessment of study quality

The authors did not state that they assessed validity.

Data extraction

Data on the mean and standard deviation of bone mineral content in the experimental and control arms were extracted in order to calculate the mean difference in bone mineral content between groups.

Two reviewers independently extracted data using a standardised form. Disagreements were resolved by consensus.

Methods of synthesis

RCTs were pooled by meta-analysis using a modified Mantel-Haenszel method to calculate a pooled mean difference of bone mineral content between groups. The χ^2 test for homogeneity (Q-statistic) was used to test for similarity in mean differences across included RCTs ($p<0.05$ was taken to indicate significant heterogeneity).

Sensitivity analysis was used to explore the effect of differences in baseline calcium intake and types of supplements on study results. Publication bias was not formally assessed.

Results of the review

Thirty four studies were included (n=6,815): 21 RCTs (n=3,821), 10 cross-sectional studies (n=2,486) and three cohort studies (n=508). The duration of follow-ups in the RCTs ranged from 12 to 48 months.

RCTs: Data from all RCTs showed that dietary calcium supplementation was associated with a non-statistically significant increase in total body/bone mineral content (mean difference (in grams) 2.05g, 95% CI (Confidence Interval): -3.26, 7.36, 12 RCTs). There was evidence of statistically significant heterogeneity (p<0.04). Dietary calcium supplementation was associated with a significantly higher bone mineral content among children with low base-line calcium intakes (mean difference 49.9 g, 95% CI: 24.0, 76.6, three RCTs).

There was no significant difference in lumbar spine bone mineral content between calcium/dairy supplement plus vitamin D groups and controls (mean difference 35 g, 95% CI: -6.8, 41.8, two RCTs). There was no evidence of statistical heterogeneity (p=0.47). There was no significant difference in lumbar spine bone mineral content between vitamin D groups and controls (mean difference 1.41 g, 95% CI: -0.3, 3.12, two RCTs).

Cross-sectional and cohort studies: Overall, data from these sources were limited in quantity and quality, so no meaningful interpretation was possible.

Authors' conclusions

Dietary calcium and dairy products, with or without vitamin D, significantly increased total body and lumbar spine bone mineral content in children with low base-line calcium intakes.

CRD commentary

The review question was clear and inclusion criteria were specified for participants, outcomes and study design. Relevant databases were searched. Only papers published in English were considered, so it is possible that relevant papers may have been missed. No efforts were made to search for unpublished literature and publication bias was not assessed. Consequently, there is potential for publication bias (with consequent over-estimation of supplementation effects). Reviewer error and bias may have been introduced into the review process as only one reviewer assessed studies for inclusion. The quality of included studies is unclear as validity was not assessed. The statistical methods used in the meta-analysis were appropriate and justified. Sensitivity analyses were conducted to evaluate statistical heterogeneity and the influence of specific study characteristics on the study results. The basis of reported increased lumbar spine bone mineral content following supplementation is unclear. The authors' conclusions were mainly derived from subgroup analyses. Given the above weaknesses in the review process, the authors' conclusions should be interpreted with caution.

Implications of the review for practice and research

Practice: The authors stated that current recommendations on calcium/dairy products for children and adolescents appear justified and should not be revised.

Research: The authors stated that further research is needed to evaluate the association between calcium/dairy intake and risk of fracture and osteoporosis in later life. They recommended that future studies should tackle a number of current design challenges (such as wide variations in anatomic sites for bone mineral content) and investigate the effect of puberty on calcium requirements.

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