

Citation:

Rajpathak SN, Rimm EB, Rosner B, Willett WC, Hu FB. Calcium and dairy intakes in relation to long-term weight gain in US men. *Am J Clin Nutr.* 2006 Mar; 83 (3): 559-566.

PubMed ID: [16522901](#)

Study Design:

Prospective Cohort Study

Class:

B - [Click here](#) for explanation of classification scheme.

Research Design and Implementation Rating:

POSITIVE: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To evaluate the association between calcium and dairy intakes and 12-year weight change in US men.

Inclusion Criteria:

Not described.

Exclusion Criteria:

- Men without a completed food-frequency questionnaire (FFQ) at baseline
- Those with unreasonable caloric intakes (>4,200 or <800kcal per day)
- Those who had left a large number of items blank (>70 items) were excluded from the study.

Description of Study Protocol:**Recruitment**

Mailing of validated FFQs to male health professionals.

Design

Prospective cohort study with multivariate linear analysis.

Dietary Intake/Dietary Assessment Methodology

- Information on the average frequency of consumption of selected foods and beverages during the preceding year were obtained through semi-quantitative FFQs. Nutrient intake was calculated by multiplying the frequency of consumption with the nutrient content and then adding the contributions from all foods and beverages
- The food-composition database used was based primarily on the USDA data, supplemented

with the manufacturers' data

- This questionnaire also collected additional information on the use of calcium and multivitamin supplements. Total calcium intake was calculated as the sum of dietary and all supplemental intakes. To determine dairy calcium intake, we summed the calcium intake from whole milk, skim milk, low-fat milk, ice cream, cheese, yogurt and cream consumption.

Blinding Used

Not described.

Statistical Analysis

- Age-adjusted and multivariate linear regression were used to examine the association between 12-year weight change (in kg) and baseline and change in calcium intake
- In all analyses, the main exposure variable in quintiles was modeled to avoid a linearity assumption and to reduce the effect of outliers
- To evaluate the association of dairy and dietary calcium intake with weight change, men were excluded who reported the use of calcium supplements anytime during the 12-year period (N=6,255)
- Least-squares means were calculated for changes in body weight across quintiles of baseline calcium intake or change in calcium intake after adjustment for age (<50, 50-54, 55-59, 60-64 or >65 years), smoking (past, current or never), alcohol consumption (non-drinker, 0.1-4.9, 5.0-9.9, 10.0-14.9 or >15.0g per day), physical activity (MET-hours per day), caloric intake (kcal per day), GL and intakes of caffeine (mg per day), cereal fiber (g per day), whole grains (g per day), fruit and vegetables (servings per day), soft drinks (servings per day) and trans fat (percent of calories). These nutrients and food variables were included in the multivariate models either because they are likely to be associated with a healthy lifestyle or because they were shown to predict weight gain in the present cohort or in other cohorts
- In the analysis of change in calcium intake, both change and baseline levels of covariates, including baseline calcium intake, were controlled because it was a potential confounder
- We conducted stratified analyses to evaluate a potential effect modification by age (<65 or >65 years) and intakes of vitamin D and protein using median intake as the cutoffs. Because the predominant source of dietary calcium intake was from dairy product consumption, we conducted similar analyses to evaluate whether baseline or change in dairy product intake (servings per day) was associated with weight change. For all analyses of dietary and dairy intake, we excluded the men who reported calcium supplement use to avoid confounding by supplement use
- Tests of linear trend across quintiles of calcium or dairy intake were performed by assigning the median values for the categories and fitting this continuous variable in the model
- All statistical tests conducted were two-sided with a type I error (alpha) of 0.05 and P-values <0.05 were considered statistically significant
- All statistical analyses were performed with SAS software version 8.

Data Collection Summary:

Timing of Measurements

FFQs obtained for baseline in 1986 and change in variables was followed in 1998.

Variables

- Total calcium intake was calculated as the sum of dietary and all supplemental intakes.
- Glycemic load (GL) was calculated by:
 - Multiplying the carbohydrate content of each food by its glycemic index
 - Multiplying this value by the frequency of consumption
 - Summing the values from all foods
- Intake of trans-fat was estimated from the FFQ with the use of composition values
- Weight change was defined as the difference between the 1986 and 1998 self-reported body weights.

Control Variables

- Age (<50, 50-54, 55-59, 60-64 or >65 years)
- Smoking (past, current or never)
- Alcohol consumption (non-drinker, 0.1-4.9, 5.0-9.9, 10.0-14.9 or >15.0g per day)
- Physical activity (MET-hours per day), caloric intake (kcal per day)
- Glycemic load
- Consumption of caffeine (mg per day), cereal fiber (g per day), whole grains (g per day), fruit and vegetables (servings per day), soft drinks (servings per day) and trans fat (percent of calories).

Description of Actual Data Sample:

- *Initial N*: 51,529 men
- *Attrition (final N)*:
 - For baseline analysis =23,504
 - For prospective analysis =19,615
- *Age*: 40-75 years
- *Ethnicity*: Not reported
- *Other relevant demographics*: Not reported
- *Anthropometrics*: BMI =25.2kg/m²
- *Location*: United States.

Summary of Results:

- In a multivariate analysis with adjustment for potential confounders, neither baseline nor change in intake of total calcium was significantly associated with weight change
- There was no significant (NS) associations between weight and dietary, dairy or supplemental calcium intake when evaluated separately
- The men with the largest increase in total dairy intake gained slightly more weight than did the men who decreased intake the most (3.14 compared with 2.57kg; P for trend =0.001) This association was primarily due to an increase in high-fat dairy intake. Low-fat dairy intake was NS associated with weight change
- Mean weight gain did not differ significantly by quintile of total, dietary, dairy or supplemental calcium intake assessed at baseline in 1986
- NS association was found between total dairy intake and weight gain
- In the multivariate model, the difference in mean weight gain between extreme quintiles of high-fat dairy intake was small (3.24kg for the highest quintile compared with 2.86kg for the lowest quintile; P for trend =0.03), which indicated that the participants who consumed more

high-fat dairy at baseline had a slightly lower 12-year weight gain than the participants who consumed less high-fat dairy

- The difference for low-fat dairy intake between extreme quintiles was similar (2.83 compared with 3.18kg), but a reverse trend that was not significant (P =0.17)
- In age-adjusted analyses, the men who increased their intake of total calcium the most (quintile 5) had slightly less weight gain than those who most decreased their calcium intake (quintile 1; 2.53 compared with 2.94kg, respectively; P for trend <0.001)
- The difference between the two groups disappeared after adjustment for potential confounders (2.75 compared with 2.70kg; P for trend =0.93). Similarly, dietary, dairy and supplemental calcium intakes were not significantly associated with weight change in multivariate analyses. The men with the largest increase in total dairy intake gained more weight than did the men who decreased intake the most (3.14 compared with 2.57kg; P for trend <0.001), which was primarily attributable to an increase in high-fat dairy intake (3.27 compared with 2.70kg; P for trend <0.001).

Author Conclusion:

- In conclusion, this study does not support the hypothesis that increasing calcium or dairy consumption is associated with lower long-term weight gain in men
- Whether calcium supplementation or increased dairy intake is beneficial in preventing weight gain needs to be further studied in long-term randomized trials.

Reviewer Comments:

From the Research Design and Implementation Criteria Checklist

- 8.4 Unclear. Intent to treat was not described in this article
- 8.7 Unclear. Type II analysis was not reported. Error could be reduced due to sample size
- 2.2 Unclear. Authors did not address the demographics of the studied population. Nonetheless, this information was collected and reported elsewhere and probably was not used in the multivariate analyses.

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

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|----|---|-----|
| 1. | Would implementing the studied intervention or procedure (if found successful) result in improved outcomes for the patients/clients/population group? (Not Applicable for some epidemiological studies) | N/A |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | Yes |
| 3. | Is the focus of the intervention or procedure (independent variable) or topic of study a common issue of concern to nutrition or dietetics practice? | Yes |

4.	Is the intervention or procedure feasible? (NA for some epidemiological studies)	N/A
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Validity Questions

1.	Was the research question clearly stated?	Yes
1.1.	Was (were) the specific intervention(s) or procedure(s) [independent variable(s)] identified?	Yes
1.2.	Was (were) the outcome(s) [dependent variable(s)] clearly indicated?	Yes
1.3.	Were the target population and setting specified?	Yes
2.	Was the selection of study subjects/patients free from bias?	Yes
2.1.	Were inclusion/exclusion criteria specified (e.g., risk, point in disease progression, diagnostic or prognosis criteria), and with sufficient detail and without omitting criteria critical to the study?	Yes
2.2.	Were criteria applied equally to all study groups?	Yes
2.3.	Were health, demographics, and other characteristics of subjects described?	No
2.4.	Were the subjects/patients a representative sample of the relevant population?	Yes
3.	Were study groups comparable?	Yes
3.1.	Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)	N/A
3.2.	Were distribution of disease status, prognostic factors, and other factors (e.g., demographics) similar across study groups at baseline?	Yes
3.3.	Were concurrent controls used? (Concurrent preferred over historical controls.)	N/A
3.4.	If cohort study or cross-sectional study, were groups comparable on important confounding factors and/or were preexisting differences accounted for by using appropriate adjustments in statistical analysis?	Yes
3.5.	If case control or cross-sectional study, were potential confounding factors comparable for cases and controls? (If case series or trial with subjects serving as own control, this criterion is not applicable. Criterion may not be applicable in some cross-sectional studies.)	N/A
3.6.	If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?	N/A
4.	Was method of handling withdrawals described?	Yes

4.1.	Were follow-up methods described and the same for all groups?	Yes
4.2.	Was the number, characteristics of withdrawals (i.e., dropouts, lost to follow up, attrition rate) and/or response rate (cross-sectional studies) described for each group? (Follow up goal for a strong study is 80%.)	Yes
4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	Yes
4.4.	Were reasons for withdrawals similar across groups?	Yes
4.5.	If diagnostic test, was decision to perform reference test not dependent on results of test under study?	N/A
5.	Was blinding used to prevent introduction of bias?	Yes
5.1.	In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?	N/A
5.2.	Were data collectors blinded for outcomes assessment? (If outcome is measured using an objective test, such as a lab value, this criterion is assumed to be met.)	N/A
5.3.	In cohort study or cross-sectional study, were measurements of outcomes and risk factors blinded?	Yes
5.4.	In case control study, was case definition explicit and case ascertainment not influenced by exposure status?	N/A
5.5.	In diagnostic study, were test results blinded to patient history and other test results?	N/A
6.	Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?	Yes
6.1.	In RCT or other intervention trial, were protocols described for all regimens studied?	N/A
6.2.	In observational study, were interventions, study settings, and clinicians/provider described?	N/A
6.3.	Was the intensity and duration of the intervention or exposure factor sufficient to produce a meaningful effect?	Yes
6.4.	Was the amount of exposure and, if relevant, subject/patient compliance measured?	N/A
6.5.	Were co-interventions (e.g., ancillary treatments, other therapies) described?	N/A
6.6.	Were extra or unplanned treatments described?	N/A
6.7.	Was the information for 6.4, 6.5, and 6.6 assessed the same way for all groups?	N/A
6.8.	In diagnostic study, were details of test administration and replication sufficient?	N/A

7.	Were outcomes clearly defined and the measurements valid and reliable?	Yes
7.1.	Were primary and secondary endpoints described and relevant to the question?	Yes
7.2.	Were nutrition measures appropriate to question and outcomes of concern?	Yes
7.3.	Was the period of follow-up long enough for important outcome(s) to occur?	Yes
7.4.	Were the observations and measurements based on standard, valid, and reliable data collection instruments/tests/procedures?	Yes
7.5.	Was the measurement of effect at an appropriate level of precision?	Yes
7.6.	Were other factors accounted for (measured) that could affect outcomes?	Yes
7.7.	Were the measurements conducted consistently across groups?	Yes
8.	Was the statistical analysis appropriate for the study design and type of outcome indicators?	Yes
8.1.	Were statistical analyses adequately described and the results reported appropriately?	Yes
8.2.	Were correct statistical tests used and assumptions of test not violated?	Yes
8.3.	Were statistics reported with levels of significance and/or confidence intervals?	Yes
8.4.	Was "intent to treat" analysis of outcomes done (and as appropriate, was there an analysis of outcomes for those maximally exposed or a dose-response analysis)?	???
8.5.	Were adequate adjustments made for effects of confounding factors that might have affected the outcomes (e.g., multivariate analyses)?	Yes
8.6.	Was clinical significance as well as statistical significance reported?	Yes
8.7.	If negative findings, was a power calculation reported to address type 2 error?	???
9.	Are conclusions supported by results with biases and limitations taken into consideration?	Yes
9.1.	Is there a discussion of findings?	Yes
9.2.	Are biases and study limitations identified and discussed?	Yes
10.	Is bias due to study's funding or sponsorship unlikely?	Yes
10.1.	Were sources of funding and investigators' affiliations described?	Yes
10.2.	Was the study free from apparent conflict of interest?	Yes

