Citation:

Mirmiran P, Esmaillzadeh A, Azizi F. Dairy consumption and body mass index: An inverse relationship. *Int J Obes* (Lond). 2005 Jan; 29 (1): 115-121.

PubMed ID: 15534616

Study Design:

Cross sectional study

Class:

D - Click here for explanation of classification scheme.

Research Design and Implementation Rating:

NEUTRAL: See Research Design and Implementation Criteria Checklist below.

Research Purpose:

To assess the relationship between consumption of dairy products and body mass index (BMI) in Tehranian adults.

Inclusion Criteria:

- Men and women
- Previously selected to participate in a prospective study conducted within the framework of Tehran Lipid and Glucose Study (TLGS), which was aimed at determining the prevalence of non-communicable disease risk factors, developing healthy lifestyles to curtail these risk factors and inhibiting the rising trend of chronic diseases in Tehran
- Under coverage of primary health care systems.

Exclusion Criteria:

Subjects who:

- Had unusually high or low dietary intake values. Less than 800 and more than 8,000kcal per day for men, or less than 600 and more than 6,000kcal per day for women
- Were smokers
- Suffered from chronic diseases (based on their verbal responses to the related questionnaire)
- Were on a weight-reduction diet.

Description of Study Protocol:

Recruitment

Described in the Tehran Lipid and Glucose prospective Study (reference 13).

Design

Cross sectional study.

Dietary Intake/Dietary Assessment Methodology

- One food frequency questionnaire
- Two, 24-hour food recalls collected by trained dietitians. One completed by the subjects at their homes and the second on a weekend at the Research Unit
- The questionnaires were validated in the Nationwide Household Food Consumption Survey Project
- Portion sizes of consumed foods were converted to grams using household measures
- Dairy products were defined according to the US Food Guide Pyramid. The amounts of yogurt, milk and cheese that count as a serving were considered as eight ounces, one cup and 1.5 ounces, respectively
- Analyses for content of energy and the other nutrients using Nutritionist III software program designed for Iranian foods.

Statistical Analysis

- Cut-points for quartiles of dairy consumption were calculated and subjects were categorized based on quartile cut-points
- These cut-points were the same for men and women: first, less than 1.6 servings per day; second, 1.6 to less than 2.2 servings per day; third, 2.2 to less than three servings per day; fourth, greater than three servings per day.
- Quantitative variables were compared using the Student t-test and one-way analysis of variance (ANOVA) with the Bonferroni correction
- Age- and energy-adjusted means for dietary variables were determined across quartile categories of dairy consumption by using GLM. Analysis of covariance (ANCOVA) with the correction of Bonferroni was used to compare these means.
- BMIs in various dairy consumption categories were compared by ANCOVA after controlling for the effect of age, physical activity, energy intake, carbohydrate, dietary fiber, fat and protein intake
- Subjects were divided into three categories based on their BMI: normal-weight (BMI less than 25kg/m^2), overweight (BMI=25 to 29.9kg/m^2) and obese (BMI greater than 30kg/m^2), and the variables were tested.
- Chi-square test was used to detect any significant differences in the distribution of subjects across quartile categories of dairy consumption. Correlation of dairy consumption to body weight and BMI was determined using partial correlation that was controlled for age, physical activity, energy intake, carbohydrate intake, dietary fiber, fat and protein intake.
- To determine the association of dairy consumption with BMI, we used multivariate logistic regression models controlled for age (year), energy intake (kcal per day), carbohydrate intake (grams per day), fat intake (grams per day), protein intake (grams per day), dietary fiber intake (grams per day) and physical activity level (light, moderate or heavy)
- In all multivariate models, the first quartile of dairy consumption was considered as a reference
- Statistical significance (P-value) was considered at less than 0.05 in all analyses
- Statistical Package for Social Sciences (SPSS, Inc., Version 9.05) was used for analyses.

Blinding Used

Not reported.

Data Collection Summary:

Dependent Variables

- BMI and weight were measured using scales and tape measures
- All measures were taken by the same person to minimize bias.

Independent Variables

Daily dairy consumption per serving, stratified in four quartiles (determined using 24-hour dietary recall and food frequency questionnaire):

- Less than 1.6
- 1.6 to less than 2.2
- 2.2 to less than three
- More than three servings per day.

Control Variables

- Age
- Physical activity
- Energy
- Carbohydrate
- Dietary fiber
- Protein
- Fat intake.

Description of Actual Data Sample:

- *Initial N:* 462 healthy subjects (223 men and 239 women)
- *Attrition (final N):* Not described
- *Age:*
  - Men: 38±15 years
  - Women: 32±13 years.
- *Ethnicity:* Not described
- *Other relevant demographics:* Not described.
- *Anthropometrics:*
  - BMI of men: 24.8±4.6kg/m^2
  - BMI of women: 25.3±5.3kg/m^2.
- *Location:* Endocrine Research Center of the Shaheed Beheshti University of Medical Sciences.

Summary of Results:

- Higher intakes of energy, carbohydrate, protein, fat and calcium were seen in men than

women (P<0.01 for all)
- Consumption of dairy products was 3.7±1.0 and 2.9±1.2 servings per day in men and women, respectively
- As the servings of dairy consumption increased per day, the proportion of normal-weight subjects rose and that of obese ones declined
- As BMI increased, the proportion of subjects with lower consumption of dairy products increased, whereas that of those with higher consumption decreased
- There was a significant inverse correlation between the servings of dairy consumption per day and BMI after controlling for the effect of age, physical activity, energy, carbohydrate, dietary fiber, protein and fat intake (r=-0.38, P<0.05)
- After adjustment for potential confounding variables, men and women in the top quartile of dairy consumption had lower chances for being overweight (OR=0.78, 95% CI=0.43–0.92 for men and OR=0.89, 95% CI=0.53–0.95 for women) and obese (OR=0.73, 95% CI=0.40–0.83 for men and OR=0.69, 95% CI=0.34–0.80 for women) compared to those in the first quartile.

Other Findings

Table 1: Dietary Variables of Subjects by Sex

Variable	Men (N=223)	Women (N=239)
Dairy products consumption (servings per day)	3.7±1.0	2.9±1.2
Energy intake (kcal per day)	2,998±558	2,353±374*
Carbohydrate intake (g per day)	442±83	335±62*
(Percentage of energy)	59±10	57±9
Protein intake (g per day)	85±8	62±9*
(Percentage of energy)	11±2	11±2
Fat intake (g per day)	99±33	85±27*
(Percentage of energy)	30±6	32±5
Calcium intake (mg per day)	785±131	668±127*

*P<0.01, compared to men.

Table 2. Dietary Data and Physical Activity Status Across Quartile Categories of Dairy Consumption

	Quartile Categories of Dairy Consumption[a]							
	Men				Women			
	1	2	3	4	1	2	3	4
Dairy intake[b]								
Energy intake (kcal per day)	2,905	2,990	2,914	3,037	2,323	2,384	2,401	2,378
Carbohydrate intake (g per day)	445	432	426	438	339	344	335	335
(Percentage of energy)	60	58	58	58	58	58	56	56
Fat intake (g per day)	93	104	100	99	83	84	89	86

(Percentage of energy)	29	31	30	30	32	32	33	33
Protein intake (g per day)	83	83	86	88	62	63	65	66
(Percentage of energy)	11	11	12	12	10	10	11	11
SFA intake (g per day)	17	18	19	19	17	15	16	15
Calcium intake (mg per day)	669	683	743*	883*	605	609	648	766*
Dietary fiber intake (g per day)	12	10	12	11	9	11	10	12

Author Conclusion:

The results suggest an inverse relationship between dairy consumption and BMI.

Reviewer Comments:

- *This was a well-designed and implemented cross sectional study with a significant sample size*
- *Some comments on the data presented:*
  - *There was no description of the actual amount of subjects in each of the four quartiles of dairy consumption*
  - *Comparisons may have been unbalanced and probably the number of people in the first quartile had the lowest number of subjects as this was a group with a higher proportion (percentage) of healthy obese individuals.*

Research Design and Implementation Criteria Checklist: Primary Research

Relevance Questions

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

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?	Yes
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?**	No
4.1.	Were follow-up methods described and the same for all groups?	???
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%.)	???

4.3.	Were all enrolled subjects/patients (in the original sample) accounted for?	???
4.4.	Were reasons for withdrawals similar across groups?	N/A
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?**	???
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?	???
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 interveningfactors described?**	N/A
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?	Yes
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?	Yes
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?	Yes
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?	N/A
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?	N/A
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?	Yes
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?	No
10.2.	Was the study free from apparent conflict of interest?	Yes