Citation:

Bes-Rastrollo M, Wedick NM, Martinez-Gonzalez MA, Li TY, Sampson L, Hu FB. Prospective study of nut consumption, long-term weight change, and obesity risk in women. *Am J Clin Nutr*. 2009 Jun;89(6):1913-9. Epub 2009 Apr 29.

PubMed ID: 1940363

Study Design:

Prospective Cohort Study

Class:

B - 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 long term relation between nut or peanut butter consumption and weight change in a large prospective cohort of young and middle aged women.

Inclusion Criteria:

Had to be one of the 116,671 participants of the Nurses' Health Study II that looked at female US nurses aged 24-44 at study initiation in 1989 and they had to complete the biennial mail questionnaires.

Exclusion Criteria:

Excluded if:

- did not complete dietary questionnaires (Food Frequency Questionnaires) in 1991
- left >70 items blank
- reported extreme caloric intakes (<500 or >3500 kcal/d)
- had a history of diabetes or cardiovascular disease before 1999
- reported a diagnosis of cancer (except melanoma skin cancer) before 1999
- had no data on physical activity assessed in 1991 or 1997
- were pregnant at the time of the 1991, 1995, or 1999 questionnaire administrations
- they did not provide any information on weight at any time period

Description of Study Protocol:

Recruitment

Participants were part of the Nurses' Health Study II that looked at female US nurses aged 24-44 at study initiation in 1989 and they had to complete the biennial mail questionnaires.

Design: Prospective Cohort Study

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis

- Least-squares means for change in body weight in kilograms were calculated from 1991 to 1999 across the categories for baseline nut consumption
- Multivariate models were adjusted for age, BMI, alcohol intake, physical activity, smoking, postmenopausal hormone use, oral contraceptive use and potential dietary confounders, including soft drink consumption during follow-up
- Tests for linear trend across increasing categories of peanut butter, peanut, and other nut consumption were performed by assigning the median value of nut consumption to the respective categories of exposure and entering this continuous variable into models
- To assess potential effect modification by baseline BMI, associations were analyzed between total nut consumption and weight gain after stratifying by baseline BMI
- After excluding obese participants at baseline, the hazard ratio (HR) was used to assess the incidence of obesity (BMI≥30) for each category of consumption compared with the lowest category using Cox proportional hazards analysis stratified by 5 year age categories and 2 year intervals.
- Statistical significance was defined at an alpha level of 0.05, including the assessment of significant interaction terms

Data Collection Summary:

Timing of Measurements

- The cohort was followed using biennial mailed questionnaires

- Self administered food frequency questionnaires were given in 1991, 1995, and 1999
- Physical activity was assessed in the 1991 and 1997 questionnaires
- Participants provided information on their body weight and height for each of the biennial questionnaires

Dependent Variables

- Weight change based on self-report, and determined by subtracting the participant's weight at baseline from weight at the follow-up assessment

Independent Variables

- Diet assessment conducted by food frequency questionnaires
- Physical activity was assessed in the 1991 and 1997 questionnaires

Control Variables

Description of Actual Data Sample:

Initial N: 116,671 female US nurses

Attrition (final N): 51,188 female US nurses

Age:24-44 years of age at study initiation in 1989

Ethnicity: not described

Other relevant demographics:

	Never/Almost Never	1-3 times/month	1 time/week	≥2 times/week	P for trend
Subjects [n (%)]	30,102(58.8)	9,961(19.5)	7,575 (14.8)	3,550(6.9)	<0.001
Age (y)	36.31 ± 4.60[2]	36.53 ±4.57	36.69 ± 4.53	37.22±4.94	<0.001
Physical Activity (METs[3] -h/wk)	20.33± 26.03	19.38±24.78	21.19± 26.63	23.24±31.85	<0.001
Currently Smoking (%)	10.68	11.12	12.02	13.19	<0.001
Currently using oral contraceptives	11.28	10.48	10.38	9.19	<0.001
Currently receiving hormone replacements (%)	2.30	2.36	2.40	2.12	0.92
Total Caloric intake (kcal/d)	1673.01±499.38	1818.71±503.63	1939.33± 523.23	2082.92±544.83	<0.001

Anthropometrics:

	Never/Almost Never	1-3 times/month	1 time/week	≥2 times/week	P for trend
Subjects [n (%)]	30,102(58.8)	9,961(19.5)	7,575 (14.8)	3,550(6.9)	<0.001
Weight (kg)	66.14 ± 14.41	65.51±14.15	66.03± 14.38	64.97±14.35	<0.001
BMI (kg/m[2])	24.37 ± 5.02	24.06±4.94	24.24± 5.03	23.77±4.94	<0.001

Location: United States

Summary of Results:

Key Findings

- The mean (±SD) 8-year weight change was a weight gain from baseline of 5 ± 7kg among this cohort of 51,188 women (mean ± SD age: 37 ± 5 years).
- In 1991, ~15% of women reported eating 1 serving/week [equivalent to 1 oz, or 28.35g, nuts (peanuts + tree nuts)], and 7% reported eating ≥2 servings/week of peanuts plus tree nuts
- Peanut butter was more frequently consumed than plain nuts; 10,968 (21%) and 11,083 (22%) women consumed peanut butter once per week and at least twice per week, respectively.
- Women who reported eating nuts >2 times per week had slightly less mean weight gain (5.04 ± 0.12 kg) than did women who rarely ate nuts (5.55 ± 0.04 kg, P for trend < 0.001).
- Although, on average, participants increased their body weight, women with higher dietary intakes of total nuts (ie ≥2 servings/week)

after a mean 8 year follow-up experienced 0.51kg less weight gain (95% CI: -0.82, -0.20) compared with those who rarely ate nuts, after adjustment for potential confounders (P for trend < 0.001)
- For the same comparison but with total nut consumption subdivided into peanuts and tree nuts, an inverse association with a higher magnitude was shown for tree nuts (-1.01-kg difference; 95% CI: -1.67, -0.36; P for trend < 0.001) and a marginally significant inverse association was shown for peanut consumption (-0.37-kg difference; 95% CI: -0.98, 0.23; P for trend = 0.011).
- In multivariate analyses in which lifestyle and other dietary factors were controlled for, we found that greater nut consumption (>2 times per week compared with never/almost never) was associated with a slightly lower risk of obesity (hazard ratio = 0.77, 95% confidence interval: 0.57, 1.02, P for trend = 0.003).

	Frequency of Consumption				
	Never/almost never	1-3 times/month	1 time/wk	≥2 times/wk	P for trend[t]
Total nuts (peanuts + tree nuts)					
Subjects [n(%)]	30,102(58.8)	9961(19.5)	7575 (14.8)	3550 (6.9)	
Median consumption of total nuts (servings/d)	0	0.07	0.14	0.28	
Crude body weight change (kg)	5.55±0.04[2]	5.26±0.07	5.27±0.08	4.91±0.12	<0.001
Multivariate-adjusted body weight change (kg)[3]	5.55±0.04	5.35±0.07	5.29±0.08	4.98±0.12	<0.001
Multivariate-adjusted body weight change (kg)[4]	5.55±0.04	5.31±0.07	5.30±0.08	5.04±0.12	<0.001
Multivariate-adjusted body weight change (kg)[5]	5.53±0.04	5.32±0.07	5.33±0.08	5.15±0.12	<0.001
Peanuts					
Subjects [n(%)]	34,089 (66.6)	13,266(25.9)	3017(5.9)	816(1.6)	
Median consumption of peanuts (servings/d)	0	0.07	0.14	0.43	
Crude body weight change (kg)	5.50±0.04	5.34±0.06	5.16±0.13	5.08±0.26	0.003
Multivariate-adjusted body weight change (kg)[3]	5.48±0.04	5.38±0.06	5.20±0.13	5.04±0.26	0.003
Multivariate-adjusted body weight change (kg)[4]	5.49±0.04	5.36±0.06	5.20±0.13	5.12±0.25	0.011
Multivariate-adjusted body weight change (kg)[5]	5.47±0.04	5.39±0.06	5.26±0.13	5.28±0.25	0.120
Tree Nuts					
subjects [n(%)]	38,297 (74.8)	10,192(19.9)	2014 (3.9)	685(1.3)	
Median consumption of other nuts (servings/d)	0	0.07	0.14	0.43	
Crude body weight change (kg)	5.56±0.04	5.13±0.07	5.00±0.16	4.17±0.28	<0.001
Multivariate-adjusted body weight change (kg)[3]	5.53±0.04	5.21±0.07	5.12±0.16	4.33±0.28	<0.001
Multivariate-adjusted body weight change (kg)[4]	5.52±0.04	5.21±0.07	5.22±0.16	4.51±0.27	<0.001
Multivariate-adjusted body weight change (kg)[5]	5.50±0.04	5.25±0.07	5.32±0.16	4.65±0.27	<0.001

- 3 Multivariate model adjusted for age (continuous), baseline alcohol intake, physical activity, smoking, postmenopausal hormone use, oral contraceptive use, baseline BMI (continuous), glycemic load, and intakes of certain dietary intakes at baseline
- 4 Multivariate model adjusted for multivariate model 2 + changes in confounders between time periods (except BMI)
- 5 Multivariate model adjusted for multivariate model 3 + changes in the adherence of prudent and Western dietary patterns

Other Findings

- Women with more frequent total nut consumption in 1991 tended to be older, to consume more calories, be more physically active, and smoke more than women who rarely consumed nuts.
- Assessment of peanut butter consumption showed no evidence of an association with obesity.
- The multivariate-adjusted HR of obesity for those participants who consumed peanut butter ≥2 times/week compared with those who rarely consumed peanut butter was 0.97 (95% CI: 0.87, 1.07; P for trend = 0.219).

Author Conclusion:

- Higher nut consumption was not associated with greater body weight gain during 8 year follow-up in healthy middle-aged women.
- Instead, it was associated with a slightly lower risk of weight gain and obesity
- The results of this study suggest that incorporating nuts into diets does not lead to greater weight gain and may help control weight

Reviewer Comments:

Weight based on self-report. Limitations mentioned in discussion:

- *large cohort of female nurses*
- *low percentage of women in the cohort with high levels of nut consumption*
- *potential measurement error in the assessment of dietary nut consumption based on semiquantitative FFQs inherent to the nutritional epidemiology field*

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?**	???
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?	???
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)	Yes
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.)	Yes
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?**	???

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.)	???
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?**	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?	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?	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?**	???
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?	???
7.5.	Was the measurement of effect at an appropriate level of precision?	???
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)?	N/A
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?	N/A
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