

Citation:

Bes-Rastrollo M, Martinez-Gonzalez MA, Sanchez-Villegas A, de la Fuente Arrillaga C, Martinez JA. Association of fiber intake and fruit/vegetable consumption with weight gain in a Mediterranean population. *Nutrition* 2006;22(5):504-11.

PubMed ID: [16500082](#)

Study Design:

Cross-sectional Analysis of Prospective Cohort 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:

The purpose of this study was to determine the association between fiber intake and fruit/vegetable consumption with the likelihood of weight gain in the previous 5 years in a Mediterranean population.

Inclusion Criteria:

- Participants in the Seguimiento Universidad de Navarra (SUN) Project

Exclusion Criteria:

- Subjects who reported excessively high or low values for total energy intake (< 800 kcal/day in men and <600 kcal/day for women or >4200 kcal/d in men and > 3500 kcal/d in women)
- Subjects with missing values in other variables of interest were excluded from analysis.

Description of Study Protocol:**Recruitment**

- Subjects were recruited starting in January 2000.
- Baseline dataset of the Seguimiento Universidad de Navarra (SUN) Project. The SUN Project was designed in collaboration with the Harvard School of Public Health Study during 1998 and the methodology is similar to that used in large American cohorts such as the Nurses' Health Study and the Health Professionals Follow-up Study. All participants were university graduates.
- The dataset of the SUN Project incorporated 17,170 participants up to December 2004.

Design: Cross-Sectional Analysis of the Seguimiento Universidad de Navarra (SUN) study.

Blinding used (if applicable): not applicable

Intervention (if applicable): not applicable

Statistical Analysis

- Logistic regression models were fitted to assess the relationship between fiber intake or fruit/vegetable consumption and the probability of weight gain and to identify the main variability sources concerning fiber intake in the SUN cohort participants.
- The sample was stratified by gender because we detected an interaction (effect modification) between gender and fiber intake using a product term. We also detected an interaction between gender and fruit/vegetable consumption.
- An adjusted model according to the joint exposure to energy-adjusted tertiles of fiber intake and fruits and vegetables consumption was fitted in the overall sample.
- The lowest tertile for both exposures was considered the reference category.
- Quintiles of fiber intake or quintiles of fruit/vegetable consumption as the exposure and a weight gain of at least 3 kg in the previous 5 y as the outcome because our information came from a categorical variable and this value corresponded to approximately 1 U of body mass index (BMI; kilograms per squaremeter) in our participants.
- Odds ratios (ORs) and 95% confidence intervals were calculated by considering the lowest quintile of fiber intake or fruit/vegetable consumption as the reference category.
- Fiber intake and fruit/vegetable consumption were also analyzed as continuous variables in the multivariate models.
- Stepwise multiple regression was utilized.

Data Collection Summary:

Timing of Measurements

- Dietary and non-dietary exposures were assessed through a baseline self-administered questionnaire, which included different questions related to lifestyles, with 46 items for men and 54 items for women.

Dependent Variables

- Weight change in the previous 5 years, based on self-report
- This variable had 10 different values (no change, weight loss 1 to 2 kg, weight loss 3 to 4 kg, weight loss 5 to 10 kg, weight loss, weight gain 1 to 2 kg, weight gain 3 to 4 kg, weight gain 5 to 10 kg, weight gain > 10 kg, weight gain because of pregnancy), was grouped in two categories: weight gain of at least 3 kg (unless due to pregnancy) or not.

Independent Variables

- Dietary exposure was ascertained through a semiquantitative food-frequency questionnaire (136 food items) previously validated in Spain for different fruits and 11 items for vegetable consumption.
- Nutrient intake scores were computed with an ad hoc computer program that was specifically developed for this purpose. A dietitian updated the nutrient databank by using the latest available information included in the food composition table for Spain as frequency multiplied by nutrient composition of specified portion size, where frequencies were measured in nine frequency categories (6+/d, 4 to 6/d, 2 to 3/d, 1/d, 5 to 6/wk, 2 to 4/wk, 1/wk, 1 to 3/mo, never or almost never) for each food item. The overall glycemic load for each participant was calculated as the glycemic index multiplied by carbohydrate content multiplied by consumption frequency for each food item.
- Data of food intake were transformed into grams of fruits and vegetables and grams of fiber and used as continuous variables.

Control Variables

- Sociodemographic (sex, age, marital status, university degree, or employment)
- Anthropometric (weight, height, body image, or weight change),
- Health-related habits (smoking status, alcohol consumption, use of seatbelt, use of sunscreen, or physical activity)
- Medical history variables (medication use, cholesterol level, blood pressure, or family history of several diseases).

Description of Actual Data Sample:

Initial N: 5094 men and 6613 women

Attrition (final N): same

Age: median age range of subjects divided into quintiles was 35 - 51 years for men and 40 - 48 years for women

Ethnicity: Spanish

Other relevant demographics: not stated

Anthropometrics: not stated

Location: Spain

Summary of Results:

Key Findings:

- Multivariate-adjusted odds ratios for weight gain across quintiles 1 to 5 of fiber intake were 1.00 (reference), 0.86, 0.86, 0.70, and 0.52 (P for trend < 0.001) among men and 1.00 (reference), 0.99, 1.08, 1.05, and 0.72 (P for trend = 0.005) among women.
- There was a significant inverse association between total fruit/vegetable consumption and weight gain, but only among men (adjusted odds ratios, 0.78, 0.89, 0.70 and 0.54 for quintiles 2 to 5, P for trend < 0.001).
- The inverse association between fruit/vegetable consumption and weight gain in the previous 5 years was more evident among those with a high intake of total fiber, and the benefit of total fiber was more evident among those with a high consumption of fruits and vegetables.

Fiber	Fruits and vegetables	Fruits and vegetables	Fruits and vegetables
	Low	Medium	High
Low	1.00 (reference) (3036)	1.00 (827)	0.87 (39)
Medium	0.96 (720)	1.07 (2361)	0.94 (822)

High 0.96 (146) 0.80 (715)§ 0.69 (3041)*

Adjusted* odds ratios† for weight gain (> 3 kg in previous 5 y) according to joint exposure to energy-adjusted tertiles of fiber intake and tertiles of fruit/vegetable consumption‡

*Adjusted for gender, total energy intake, leisure-time physical activity (metabolic equivalents per hour per week), smoking status (never smoker, former smoker, and current smoker), snacking, watching television, and energy-adjusted total fat intake.

† Statistical test: non-conditional logistic regression.

‡ Men and women are analyzed together, the reference category is the lower tertile for both exposures. Number of participants for each category in parentheses.

§ p <0.05, * p<0.001

Other Findings

Among a study population of 5094 men and 6613 women, 38% of men and 29% of women reported a weight gain of at least 3 kg in the previous 5 y.

Author Conclusion:

This study provides additional support to the inverse association between fiber or fruit/vegetable consumption and weight gain, thus emphasizing the importance of replacing some dietary compounds by such foods and fiber-rich products, which may help to avoid weight gain.

Reviewer Comments:

Large sample size but did not appear to account for medical history variables in the analysis. Study population was said to be all university graduates, question representativeness of the general population. Weight gain based on self-report.

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) | <input checked="" type="checkbox"/> Yes |
| 2. | Did the authors study an outcome (dependent variable) or topic that the patients/clients/population group would care about? | <input checked="" type="checkbox"/> 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? | <input checked="" type="checkbox"/> Yes |
| 4. | Is the intervention or procedure feasible? (NA for some epidemiological studies) | <input checked="" type="checkbox"/> Yes |

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?	???
2.4.	Were the subjects/patients a representative sample of the relevant population?	???
3.	Were study groups comparable?	N/A
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?	N/A
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?	N/A
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.)	Yes
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?	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?	N/A
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?	N/A
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?	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?	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?	N/A
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

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