

## Citation:

Due A, Larsen TM, Mu H, Hermansen K, Stender S, Astrup A. Comparison of 3 ad libitum diets for weight-loss maintenance, risk of cardiovascular disease, and diabetes: a 6-mo randomized, controlled trial. *Am J Clin Nutr*. 2008 Nov;88(5):1232-41.

**PubMed ID:** [18996857](#)

## Study Design:

Randomized Controlled Trial

## Class:

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

## Research Design and Implementation Rating:



POSITIVE: See Research Design and Implementation Criteria Checklist below.

## Research Purpose:

The purpose was to compare the effect on weight-loss maintenance and change in cardiovascular disease and diabetic risk factors of 3 diets (Willett's new Healthy Eating Pyramid, the Official Nordic Dietary Guidelines, and the average Danish diet) in a 6-month controlled dietary maintenance program.

## Inclusion Criteria:

- Nondiabetic overweight and obese men and women
- Inclusion criteria were specified in the following study: Rasmussen LG, Larsen TM, Mortensen PK, Due A, Astrup A. Effect on 24-h energy expenditure of a moderate-fat diet high in monounsaturated fatty acids compared with that of a low-fat, carbohydrate-rich diet: a 6-mo controlled dietary intervention trial. *Am J Clin Nutr* 2007; 85:1014-22.

## Exclusion Criteria:

None specifically mentioned.

## Description of Study Protocol:

**Recruitment** - subjects recruited from the Copenhagen area.

**Design** - Parallel, randomized, controlled trial

**Blinding used** - implied with measurements

### Intervention (if applicable)

- The first dietary intervention contained moderate fat and > 20% of monounsaturated fats (MUFA diet, n = 54), low glycemic index, and 10-20% protein.
- The second dietary intervention had 20-30% of calories from fat and was considered to be low-fat (LF diet, n = 51), moderate glycemic index, and 10-20% protein.
- The control diet was made up of 35% of calories from fat (n = 26), high glycemic index, and 10-20% protein. This was the diet from the 3-week standardization period.

- Subjects were allowed to choose foods free of charge from the grocery store during a 3-week standardization period and in the 6-month dietary intervention. The subjects' shopping cart items had to match the prescribed diet or were to keep shopping until it matched.
- Participants had to eat the food themselves, and they were allowed to eat foods ad libitum.
- A 21-day break was allowed for subjects not to shop or record dietary intake, but they were instructed to continue following the diet.
- One nutrition counseling session was provided during the shopping period. Two additional private sessions were conducted during the 6 month period. Recipes were made available to subjects.

### Statistical Analysis

- About 15% were expected to drop out during the low calorie intervention and 20% during maintenance, so sample size estimation was raised to 50 in the MUFA and low-fat groups, with 25 subjects in the control group.
- One-factor analysis of variance was used to assess differences between groups before dietary intervention.
- Analysis of covariance assessed between-group differences from baseline to 6 months for all variables, with baseline values as covariates.
- Repeated measures analyzed body weight over time and diet for one month with baselines values as covariates.
- Intent to treat analysis was done using multiple imputation (MI) via Markov chain Monte Carlo.
- The SAS software was used for ITT and SPSS for other statistical measures.
- Chi-square tests were used for the following variables: differences in gender, proportion of drop-outs, and participants who maintained > 10% weight loss or who lost additional weight.
- Results are mean values with 95% CI or means  $\pm$  SEMs.
- Insulin resistance score was obtained using a homeostasis model assessment of insulin resistance HOMA-IR).

## Data Collection Summary:

**Timing of Measurements** - baseline and 6 months

### Dependent Variables

- Weight loss maintenance: for repeated-measures analyses, monthly weights were obtained on a single calibrated scale.
- Body composition was measured with dual-energy X-ray absorptiometry.
- Waist and hip circumference measurements were obtained.
- Diabetes and cardiovascular risk factors were assessed using a fat biopsy from the buttock area and the venous blood samples from baseline and 6 months.

### Independent Variables

- The first dietary intervention contained moderate fat and > 20% of monounsaturated fats (MUFA diet, n = 54), low glycemic index, and 10-20% protein.
- The second dietary intervention had 20-30% of calories from fat and was considered to be low-fat (LF diet, n = 51), moderate glycemic index, and 10-20% protein.
- The control diet was made up of 35% of calories from fat (n = 26), high glycemic index, and 10-20% protein. This was the diet from the 3-week standardization period.
- Dietary compliance was measured from the buttock fat biopsies.

### Control Variables

## Description of Actual Data Sample:

**Initial N:** 169

**Attrition (final N):** 131 (55 males, 76 women), with 25 not completing the 6-month intervention

**Age:** 18 - 35 years old (28.2  $\pm$  4.8 years)

**Ethnicity:** not reported

**Other relevant demographics:** see table

**Anthropometrics:** body mass index 28 - 36. No significant differences existed between groups at study entry.

## Participants' characteristics by diet group at screening<sup>1</sup>

|                          | MUFA diet (n = 54)      | Low-Fat (n = 51) | Control (n = 26) |
|--------------------------|-------------------------|------------------|------------------|
| Age (years)              | 29.2 ± 4.5 <sup>2</sup> | 27.3 ± 4.9       | 27.6 ± 5.1       |
| Gender (M/F)             | 22/32                   | 22/29            | 11/15            |
| BMI (kg/m <sup>2</sup> ) | 31.4 ± 2.7              | 31.6 ± 2.7       | 31.3 ± 2.5       |
| Height (m)               | 1.74 ± 0.1              | 1.75 ± 0.1       | 1.73 ± 0.1       |
| Body weight (kg)         | 95.4 ± 12.8             | 96.9 ± 13.5      | 93.9 ± 13.8      |
| Weight loss (kg)         | 11.8 ± 3.0              | 12.7 ± 4.0       | 12.9 ± 4.6       |
| Waist (cm)               | 102.9 ± 8.8             | 104.4 ± 8.9      | 103.8 ± 8.7      |
| Hip (cm)                 | 115.6 ± 8.1             | 116.3 ± 7.0      | 114.4 ± 6.5      |

<sup>1</sup> Measurements at screening before diet comparisons.

<sup>2</sup> Mean ± SD (all such values).

**Location:** Copenhagen, Denmark

## Summary of Results:

### Key Findings

- Diet composition did not have major effects on maintenance of weight loss during the 6-month dietary intervention. The MUFA and LF diets had slower rates of weight gain when compared to a Western diet. The MUFA diet may have a positive impact on diabetes risk factors.
- The type of diet that is followed may not matter as it relates to weight loss maintenance. The type of dietary fat may affect body fat composition and satiety.
- The MUFA diet reduced fasting insulin and improved HOMA-IR. A diet that is high in unsaturated fat may improve insulin resistance.

### Dietary intake and compliance

- No differences were noted between groups.
- Significant differences were noted in type and quantity of fat ( $P < 0.001$ ) and carbohydrate ( $P < 0.001$ ) in all groups.
- Protein intake was slightly lower on MUFA when compared to LF diet.

### Body weight and body composition

- No between-group weight loss differences were noted.
- Mean weight loss (± SEM): 12.1 ± 0.5 kg in MUFA group, 13.1 ± 0.6 kg in LF group, and 13.2 ± 1.0 kg in the control group.
- Weight regain at 6 months: 2.5 ± 0.7 kg in MUFA group, 2.2 ± 0.7 kg in LF group, and 3.8 ± 0.8 kg in the control group. No significant weight regain was found between groups.
- Significantly lower body fat regain in LF (1.3 ± 0.6 kg) and MUFA groups (2.2 ± 0.7 kg) than in control group (3.5 ± 0.8 kg,  $P < 0.01$  and  $P < 0.05$ , respectively).

### Risk factors for cardiovascular disease and diabetes

- Fasting insulin of 2.6 ± 3.5 pmol/L on the MUFA diet, 4.3 ± 3.0 pmol/L on LF diet, and 14.0 ± 4.3 pmol/L in the control group.

## Author Conclusion:

Diet composition had no major effect on preventing weight regain. However, both the LF and MUFA diets produced less body fat regain than did the control diet, and the dropout rate was

lowest in the LF diet group, whereas fasting insulin decreased and the homeostasis model assessment of insulin resistance and ratio of LDL to HDL improved with the MUFA diet.

### Reviewer Comments:

*Authors note that the fatty acid composition in buttock fat was used as a dietary compliance marker, although this method has not yet been validated. More subjects dropped out of the MUFA group than the LF and control groups.*

### 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) | Yes |
| 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)  | Yes |

#### Validity Questions

- |      |   |     |
|------|---|-----|
| 1.   | <b>Was the research question clearly stated?</b>  | 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.   | <b>Was the selection of study subjects/patients free from bias?</b>   | 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 |

|           |  |     |
|-----------|--|-----|
| <b>3.</b> | <b>Were study groups comparable?</b>   | Yes |
| 3.1.      | Was the method of assigning subjects/patients to groups described and unbiased? (Method of randomization identified if RCT)  | ??? |
| 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?  | 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.) | N/A |
| 3.6.      | If diagnostic test, was there an independent blind comparison with an appropriate reference standard (e.g., "gold standard")?  | N/A |
| <b>4.</b> | <b>Was method of handling withdrawals described?</b>   | 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?  | ??? |
| 4.5.      | If diagnostic test, was decision to perform reference test not dependent on results of test under study?   | N/A |
| <b>5.</b> | <b>Was blinding used to prevent introduction of bias?</b>  | Yes |
| 5.1.      | In intervention study, were subjects, clinicians/practitioners, and investigators blinded to treatment group, as appropriate?  | Yes |
| 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.)  | Yes |
| 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        |
| <b>6.</b> | <b>Were intervention/therapeutic regimens/exposure factor or procedure and any comparison(s) described in detail? Were intervening factors described?</b> | <b>Yes</b> |
| 6.1.      | In RCT or other intervention trial, were protocols described for all regimens studied?  | Yes        |
| 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?   | Yes        |
| 6.5.      | Were co-interventions (e.g., ancillary treatments, other therapies) described?  | Yes        |
| 6.6.      | Were extra or unplanned treatments described?   | Yes        |
| 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        |
| <b>7.</b> | <b>Were outcomes clearly defined and the measurements valid and reliable?</b>   | <b>Yes</b> |
| 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        |
| <b>8.</b> | <b>Was the statistical analysis appropriate for the study design and type of outcome indicators?</b>  | <b>Yes</b> |
| 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)? | Yes        |
| 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        |
| <b>9.</b>  | <b>Are conclusions supported by results with biases and limitations taken into consideration?</b>  | <b>Yes</b> |
| 9.1.       | Is there a discussion of findings?   | Yes        |
| 9.2.       | Are biases and study limitations identified and discussed?   | Yes        |
| <b>10.</b> | <b>Is bias due to study's funding or sponsorship unlikely?</b>   | <b>Yes</b> |
| 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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