Incidence of obesity is lower in persons who consume olive oil

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SHORT COMMUNICATION

Incidence of obesity is lower in persons who consume olive oil

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We undertook a population-based cohort study in Pizarra (Spain). Anthropometric and nutritional variables were recorded for 613 persons. The type of fat used was determined by measurement of the fatty acids contained in cooking oil. Serum fatty acid was used as a biological marker of the type of fat consumed. Obesity incidence in persons who were not obese at baseline was greater in those who consumed sunflower oil (Group 1: 41.5 (95% CI, 25.4–67.8) cases per 1000 person-years) than in those who consumed olive oil or a mixture of oils (Group 2: 17.3 (95% CI, 11.6–25.8) cases per 1000 person-years). The risk of developing obesity over 6 years, adjusted for age, sex, physical activity, smoking, instruction level, energy intake and baseline BMI, was 2.3 (95% CI, 1.06–5.02) in group 1 compared with that in group 2. The increase in the prevalence of obesity in the free-living population is associated with the type of fatty acids in the diet.
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Keywords: olive oil; obesity incidence; population-based cohort study

Two of the most important factors contributing to the increased prevalence of obesity in the world are the reduction in physical exercise and an increased intake of energy. The importance of fats is more controversial. Studies examining the type of dietary fat have either found a weak positive association with intake of animal fats and a negative association with intake of vegetable fats (Colditz *et al*., 1990) or else no association between the type of dietary fat and prevalence of obesity (González *et al*., 2004). The role of mono-unsaturated fatty acid (MUFA) in the control of body weight has been poorly studied. We tested the hypothesis that the incidence of obesity in the population is associated with the type of fatty acids in the diet.

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The study was undertaken in Pizarra (southern Spain). Details of the design and sample have been reported previously (Soriguer *et al*., 2003, 2008). A total of 613 individuals, aged 18–65 years, were randomly selected for a dietary survey from the initial sample of 1226 individuals, who were also randomly selected from the population census (Figure 1). Written consent was obtained.

Measurements of weight, height and waist circumference were determined, and body mass index (BMI) was calculated.

The fatty acid composition of serum phospholipids was measured by gas chromatography in fasting venous blood samples, as reported (Soriguer *et al*., 2003).

A prospective, quantitative, 7-day food questionnaire was administered to all participants and a sample was taken of the cooking oil being used for analyzing fatty acids by gas chromatography (Soriguer *et al*., 2003). Oils having concentrations of linoleic acid higher than 50% were classified as sunflower oil, otherwise as olive oil or a mixture. The concordance between the type of oil declared in the questionnaire and that detected by chromatography was above 85%. Obesity was set at a BMI of 30 kg/m^2 or above. The cohort was reevaluated 6 years later (6.0 ± 1.3 years). The outcome variable was obesity.

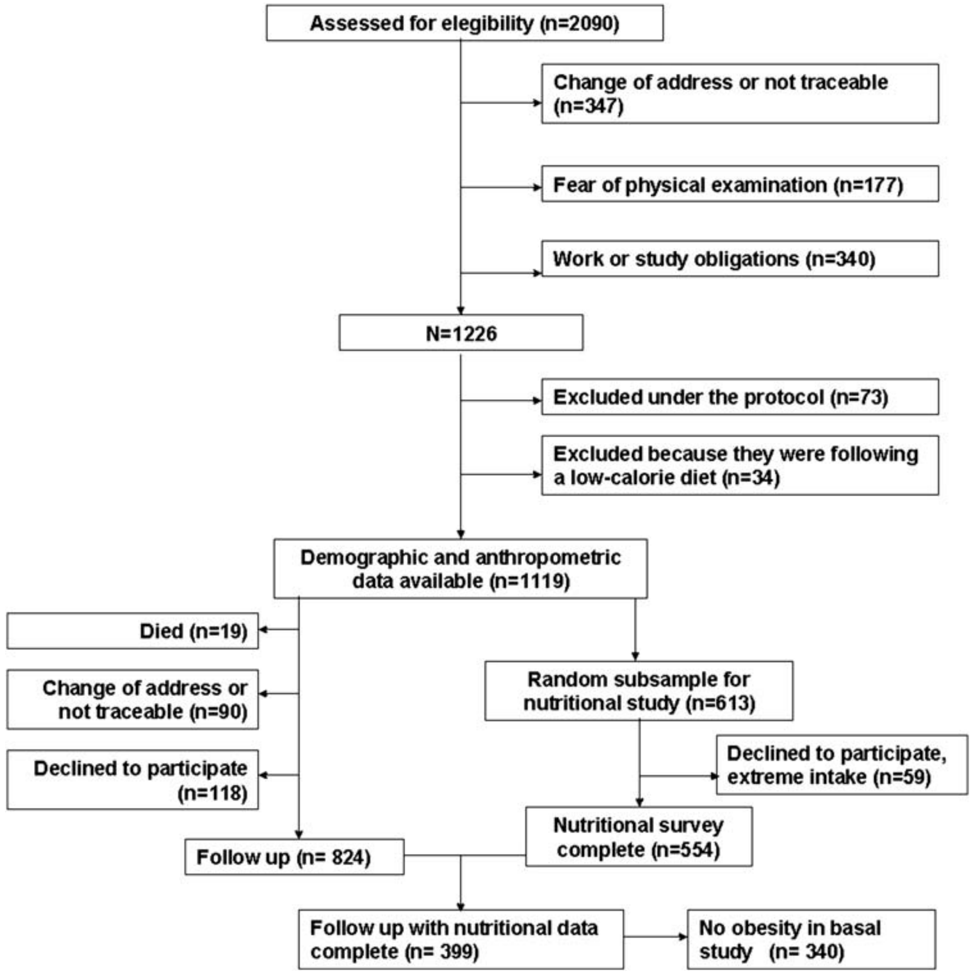

Figure 1 Pizarra study sampling.

Adjusted contrast hypothesis testing with continuous variables was carried out using ANOVA, and the χ^2-test was used for qualitative variables. Relative risk was calculated by logistic regression analysis.

Table 1 shows the characteristics of the individuals at risk (those with a BMI $<30\,kg/m^2$ in the baseline study) according to the type of oil consumed. No significant differences were found in the age (39.0 ± 13.3 years) or sex ratio (men = 37.1%). Baseline weight, BMI and waist circumference were higher in persons who consumed sunflower oil, although the differences were not significant when adjusted for age and sex. There were no differences with regard to physical activity, smoking or education level.

The fatty acids from serum phospholipids followed the expected pattern, with persons who consumed olive oil having a greater proportion of MUFA, a lower proportion of polyunsaturated fatty acids and a higher oleic acid:stearic acid ratio. Energy intake and macronutrient intake were similar in both groups, in baseline and follow-up studies, but as expected, the proportion of dietary fatty acids varies according to the type of oil consumed.

The incidence of obesity was significantly higher in those who consumed sunflower oil than in those who consumed olive oil or a mixture (Table 2). Persons who consumed olive oil had a lower risk of being obese at follow-up, adjusted for age, sex, physical activity, smoking, instruction level, energy intake and BMI in the baseline study (similar results are obtained in the function of basal weight).

The increase in BMI over the study period in persons who were not obese at baseline was significantly higher in those with a lower phospholipid oleic acid : stearic acid ratio: 8.3 ± 15.03% in the lowest tertile, 5.6 ± 9.1% in the highest tertile, $P = 0.009$ adjusted for age and sex.

The increased consumption of saturated fats has generally been considered to favor weight gain, whereas fats rich in n-6 or n-3 fatty acids may be associated with a reduced weight gain (González *et al*., 2004). Studies comparing MUFA with carbohydrate-rich diets show that weight loss is

Table 1 Characteristics of the study population (only those with BMI < 30 in the baseline study) according to the type of oil consumed

	Olive oil or mixture (n = 261)	*Sunflower oil (n = 79)*	*P-value adjusted for age and sex*
Baseline weight (kg)	65.9 ± 9.4	67.3 ± 9.5	0.6
Follow-up weight (kg)	68.8 ± 10.8	71.6 ± 10.4	0.02
Baseline BMI (kg/m^2)	25.1 ± 2.8	25.7 ± 3.2	0.07
Follow-up BMI (kg/m^2)	26.3 ± 3.3	27.6 ± 3.7	0.01
Baseline waist circumference (cm)	86.2 ± 10.2	87.1 ± 10.1	0.5
Follow-up waist circumference (cm)	94.5 ± 10.4	97.1 ± 9.8	0.02
% of smokers (at least 1 cigarette/day)	41.4	36.3	0.4
% of sedentary people (light daily activity)	87.0	91.1	0.4
Instruction level			
Person with no studies (%)	25.1	21.3	0.3
Person with primary studies (%)	50.6	61.3	
Person with secondary (high school) studies (%)	15.2	12.5	
Person with university studies (%)	9.1	5.0	
Baseline serum phospholipid fatty acid composition			
Saturated FA (%)	45.6 ± 6.6	46.5 ± 6.3	0.5
MUFA (%)	12.5 ± 2.6	11.0 ± 2.1	0.0001
PUFA n-6 (%)	36.4 ± 5.3	37.1 ± 5.5	0.02
PUFA n-3 (%)	5.4 ± 1.8	5.2 ± 1.8	0.5
Oleic acid : stearic acid ratio	0.88 ± 0.24	0.73 ± 0.21	0.0001
Basal study intake			
Daily energy intake (kJ × 1000)	9.8 ± 2.9	9.6 ± 2.7	0.3
Proteins (% energy intake)	15.2 ± 2.6	15.0 ± 2.8	0.1
Glucids (% energy intake)	45.1 ± 6.8	45.6 ± 7.0	0.5
Fats (% energy intake)	41.0 ± 5.9	40.8 ± 5.6	0.2
Saturated fatty acid (% fat intake)	29.4 ± 0.1	29.6 ± 4.6	0.8
MUFA (% fat intake)	53.4 ± 5.1	51.2 ± 5.2	0.003
PUFA (% fat intake)	17.1 ± 4.5	19.1 ± 5.8	0.004
Follow-up study intake			
Daily energy intake (kJ × 1000)	8.6 ± 3.0	9.1 ± 3.8	0.2
Proteins (% energy intake)	14.8 ± 3.8	14.8 ± 4.1	0.6
Glucids (% energy intake)	43.2 ± 9.8	41.2 ± 11.1	0.1
Fats (% energy intake)	42.2 ± 10.2	44.3 ± 11.7	0.1
Saturated fatty acid (% fat intake)	29.8 ± 8.1	28.7 ± 7.2	0.2
MUFA (% fat intake)	54.9 ± 8.4	53.2 ± 8.6	0.04
PUFA (% fat intake)	15.3 ± 8.1	17.9 ± 10.2	0.03

Abbreviations: FA, fatty acid; MUFA, mono-unsaturated fatty acid; PUFA, polyunsaturated fatty acid.

Table 2 Risk of obesity at follow-up

	Olive oil or mixture (n = 261)	*Sunflower oil (n = 79)*	*P-value*
Obesity prevalence (95% CI) in follow-up adjusted for age and sex	11.0 (7.3–14.7)	25.8 (20.7–30.9)	0.005
Obesity incidence rate (95% CI) per 1000 person-years	17.3 (11.6–25.8)	41.5 (25.4–67.8)	0.006
Relative risk (95% CI)	1	2.4 (1.3–4.5)	0.007
Relative risk (95% CI) adjusted for sex, age, physical activity, smoking, instruction level, energy intake and baseline BMI.	1	2.3 (1.06–5.02)	0.03

Abbreviation: 95% CI, 95% confidence interval.

determined more by energy restriction than by diet composition (Golay *et al*., 1996). The SUN prospective cohort study found no significant association between consumption of olive oil and weight gain, possibly because of a short follow-up time (Bes-Rastrollo *et al*., 2006). Schröder *et al*. (2004), in a cross-sectional survey, found that the traditional Mediterranean dietary pattern was inversely associated with BMI and obesity. Trichopoulou *et al*. (2002), in another cross-sectional study, found a weak, inconclusive negative association between MUFA and BMI.

The MUFA could act selectively on satiety, increasing the rate of postprandial oxidization, increasing adipocyte lipolytic activity or having a thermogenic effect. MUFA could also affect body weight by modulating levels of cytokines.

Most industrialized countries have experienced a continuous increase in the amount of linoleic acid in the diet. Ailhaud and Guesnet (2004) have proposed that an increase in the consumption of n-6 polyunsaturated fatty acids may favor the continuous development of adipose tissue during pregnancy and lactation. This early stimulation of adipocytes and preadipocytes could be the onset of adult obesity, especially if diets rich in n-6 polyunsaturated fatty acids continue throughout life.

Persons who consume more olive oil may have a different dietary behavior and may consume more dietary calories (Serra-Majem *et al.*, 2003). This observation would strengthen the results of our study as, if true, the higher intake of calories would not favor the lower weight gain seen in persons who habitually consumed olive oil. In our study, the persons who consumed mainly sunflower oil had a similar intake of energy and macronutrients to those who consumed olive oil. The association between the increase in BMI and the oleic:stearic acid ratio in the serum phospholipids followed the same trend as the association between weight, BMI and waist circumference and the type of oil collected, suggesting that the association is not due to a confounding environmental or cultural variable, but rather to the biological effect of MUFA measured by their uptake into serum phospholipids.

Conflict of interest

The authors declare no conflict of interest.

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