Dietary fat intake and body mass index in Spanish children[1–4]

Luis A Moreno, Antonio Sarría, Aurora Lázaro, and Manuel Bueno

ABSTRACT Our objectives were to describe the pattern of dietary fat intake and to present data on trends of growth in Spanish children in past decades. In 1984 a nationwide nutritional survey was conducted in Spain. The average nationwide fat intake was 42% of energy. Across different regions, saturated fat intakes ranged from 13% to 15% of energy and monounsaturated fat intakes ranged from 18% to 19% of energy. More recently, some surveys were conducted at a regional or local level. In children aged 6–10 y, total fat intake ranged from 38% to 48% of energy, of which saturated fat intake ranged from 16% to 18% and monounsaturated fat ranged from 19% to 20%. In children aged 11–14 y, total fat intake ranged from 41% to 51% of energy, of which saturated fat intake ranged from 12% to 18% and monounsaturated fat intake accounted for 20%. In our region of Aragón, we observed a significant trend in children's growth, especially when we accounted for body mass index. The results reflect an increasing total fat consumption in Spain, especially of saturated and monounsaturated fat. The following question remains unanswered: what percentage of fat intake should be recommended when monounsaturated fat is the principal source of fat? Trends on body mass index values in children of our region during the past decades could be related to the amount of fat intake in our population. To confirm these findings we must measure dietary fat intake and nutritional status in the same population of children and adolescents. *Am J Clin Nutr* 2000;72(suppl):1399S–403S.

KEY WORDS Dietary fat, nutritional intake, dietary surveys, olive oil, growth, body mass index, obesity, vitamins, minerals, children, Spain, monounsaturated fat

INTRODUCTION

Excessive intake of dietary fat has been related to the main causes of mortality in developed countries, ie, cardiovascular diseases and cancer, but the epidemiologic evidence is not very relevant (1–3). However, epidemiologic data are compatible with the hypothesis that dietary fat intake affects the risk of coronary heart disease and cancer by its effect on other risk factors, ie, serum cholesterol concentrations and obesity (4, 5). Dietary fat intake, fat quality, and cholesterol intake markedly regulate serum lipid concentrations in childhood as in adulthood (6, 7). Dietary fat seems also to be associated with the occurrence of obesity (5).

The main goal of recommendations aimed at decreasing the risk of coronary heart disease in children is the reduction of dietary fat intake, specifically a reduced intake of saturated fat and cholesterol (8, 9). Fears of low intakes of energy, essential fatty acids, and fat-soluble vitamins with possible deleterious effects on growth and development have hampered efforts to reduce dietary fat intake in childhood (10, 11). Therefore, our objectives were to describe the pattern of dietary fat intake in Spanish children, present data on trends of growth, and comment about the adequacy of micronutrient intakes in children consuming a low-fat diet.

DIETARY FAT INTAKE

Household dietary information

To estimate the pattern of dietary intake in a population, household budget surveys represent a valuable resource that has been long overlooked (12). Studies based on individuals and analytic epidemiologic investigations are superior in many ways (13), but they are costly, usually cover a limited time period, and do not use standard protocols to ensure comparability. Household dietary information in Spain was obtained from 3 household budget surveys conducted by the National Institute of Statistics in 1964–1965, 1980–1981, and 1990–1991 (14). The study sample of those surveys was selected by a 2-stage stratified sampling scheme and included 20 800 households in 1964–1965, 24 000 in 1980–1981, and 28 000 in 1990–1991. Trained interviewers visited the household every day (1964–1965 survey) or every other day (1980–1981 and 1990–1991 surveys) for a week.

These surveys showed a rise in the energy supplied by fat from 30% in 1964–1965 to 40% in 1980–1981 and to 41.5% in 1990–1991. In the latter survey, saturated fat represented 11.9%, monounsaturated fat 18.8%, and polyunsaturated fat 6.8% of total energy intake. In our region of Aragón, fat intake represents 44.3% of total energy intake: 12.4% saturated fat, 20.8% monounsaturated fat, and 7.0% polyunsaturated fat.

We think these data could be extrapolated to children because in the aforementioned surveys there were no significant differences between households with or without children. Moreover,

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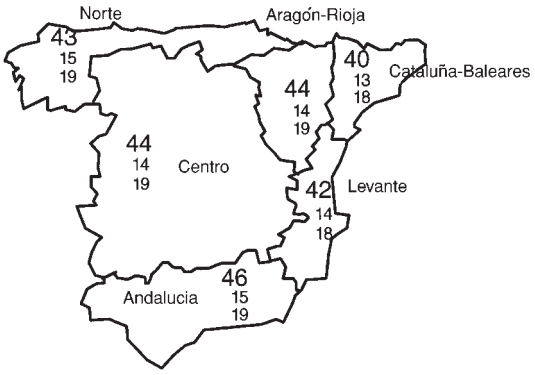

FIGURE 1. Dietary fat intake in Spanish children, by region, on the basis of the Paidos '84 survey. In each region, the first number represents the percentage of energy from total fat, the second number represents the percentage of energy from saturated fat, and the third number represents the percentage of energy from monounsaturated fat.

the Framingham Study showed that husbands and wives tend to consume fairly similar amounts of all nutrients except potassium and sodium; the degree of similarity between parents (especially the mother) and children was high for all nutrients, particularly for total fat, saturated fat, unsaturated fat, cholesterol, and carbohydrates (15).

Individual dietary surveys

Evaluation of energy and nutrient intakes present major problems, especially in childhood, and comparison between studies is particularly difficult. Some methods involve recording food intake on certain days of the week (sometimes including a Saturday or Sunday), whereas other methods include recording food intake for all days of the week. Data recording may be the responsibility of the parents, of the parents and the child, or of the child alone. Mothers tend to have little information about what their children eat at school and away from home in general and the reports of the children themselves tend to be unreliable.

In 1984 a nationwide nutritional survey was conducted in Spain (16). The study sample of this survey included 4231 children (2271 boys and 1960 girls) aged 6–14 y. The average fat intake nationwide was 42% of energy. Dietary fat intakes by region and by type of fatty acid are shown in **Figure 1**. Saturated fat intake ranged from 13% to 15% and monounsaturated fat intake ranged from 18% to 19% of energy.

The cost of setting up these surveys has prevented the establishment of more individual surveys in Spain; more recently, surveys have only been conducted at a regional or local level and the methodology used has not always been the same. Despite the problems of among-study comparisons, we reviewed recent studies of the dietary habits of children in Spain. In **Table 1** and **Table 2**, we present data on fat intake in the best designed surveys (17–21). In children aged 6–10 y, total fat intake ranged from 38% to 48% of energy, of which saturated fat ranged from 16% to 18% and monounsaturated fat ranged from 19% to 20%. In children aged 11–14 y, total fat intake ranged from 41% to 51% of energy, saturated fat from 12% to 18%, and monounsaturated fat accounted for 20%.

Comments

A common finding of the individual surveys reviewed in the past is the high intake of total fat due to an elevated intake of saturated and monounsaturated fat. We expected this finding because olive oil is Spain's principal source of fat and characteristically is used in the place of animal fats typical of northern European diets. Olive oil contains a large proportion of monounsaturated fat (oleic acid), is relatively low in saturated fat, and is a source of the antioxidant vitamin E.

Studies have shown that olive oil increases HDL cholesterol and reduces LDL cholesterol, promoting in a balanced way a desirable blood lipid profile. Oleic acid is also considered to be antithrombotic compared with saturated fatty acids (22). Moreover, diets high in monounsaturated fat are less likely than those diets high in polyunsaturated fat to be involved in the oxidation of LDL, a process thought to increase the risk of atherogenesis and coronary heart disease (23). Furthermore, epidemiologic studies have repeatedly indicated that olive oil may have beneficial effects, not only on cardiovascular health but also on the incidence of cancer (3).

Mediterranean people have used olive oil as their major dietary fat for a few thousand years with no evidence of harm. The following question remains unanswered: what percentage of total fat from energy should be recommended when olive oil is the principal source of fat? Evidence suggests that the proportion of energy from total fat in Mediterranean diets varies widely throughout the region, from 28% to 40%. Proportions of energy from fat across this range appear to have been compatible with excellent adult health with diets in which most of the fat was derived from olive oil (24).

DIETARY FAT INTAKE AND CHILDREN'S GROWTH

A healthy diet in children is one that permits optimum growth, development, and health. Some concerns have been raised about the safety of reduced-fat diets in growing children. Case studies of poor growth from reduced-fat diets have been reported (25).

In some well-controlled studies (26, 27), lower fat intakes seem to be nutritionally adequate for growth and fat intake as a

TABLE 1
Dietary fat intake in Spanish children aged 6–10 y

	Galicia (17)		Madrid (18)		Reus (19)		
	Boys	Girls	Boys	Girls	Boys	Girls	Granada (20)
Energy (kJ/d)	8209	7719	10506	9573	8071	7753	10125
Fat (% of energy)							
Total	43	44	44	44	40	38	48
Saturated	16	16	18	18	—	—	—
Monounsaturated	19	20	20	20	—	—	—
Polyunsaturated	6	6	6	6	—	—	—

TABLE 2
Dietary fat intake in Spanish children aged 11–14 y

	Galicia (17)		Madrid (18)		Reus (19)		Zaragoza (21)		Granada (20)	
	Males	Females	Males	Females	Males	Females	Males	Females	Males	Females
Energy (kJ/d)	9017	8364	11 502	10 724	10 334	9004	12 243	10 205	9874	9309
Fat (% of energy)										
Total	45	45	43	43	41	41	42	40	47	51
Saturated	17	16	17	18	—	—	12	12	—	—
Monounsaturated	20	20	20	20	—	—	20	20	—	—
Polyunsaturated	7	6	5	5	—	—	6	7	—	—

percentage of energy seems not to be associated significantly with the growth of these children. In our lipid's clinic, we did not observe growth retardation in hypercholesterolemic children who consumed a low-fat, low-cholesterol diet (28).

On the other hand, recent studies conducted in adults seem to confirm the notion that high-fat diets might, over time, lead to excess body fat deposition. Saturated and monounsaturated fat intakes also seem to be predictors of actual adiposity markers, whereas high polyunsaturated fat intake seems to exert no effect on these markers (29). Some longitudinal studies determined that the fat content of a diet is a significant predictor of body weight gain (30). Moreover, consumption of a diet restricted in total fat, saturated fat, and cholesterol, under weight-maintenance and ad libitum conditions, was accompanied by significant weight loss (5).

In children, high fat intakes are associated with obesity even when controlling for potential confounders (ie, sex, total energy intake, physical fitness, and parental body mass) (31, 32) and greater weight gain (33) are controlled for. In Spanish adolescents, obese subjects derived a greater proportion of their energy from fat when compared with normal-weight individuals (34). Moreover, overweight in children has been increasing in prevalence (35).

In our region of Aragón, we observed a significant trend in children's growth, especially when we accounted for body mass index (BMI; in kg/m^2) (36). We assessed the growth of 3 similar school-age populations of Zaragoza, Spain, whose heights and weights were measured during the years 1972, 1982, and 1990. In 1972 the sample included 4375 children; in 1982, 3082; and in 1990, 3199 (36). As recommended by a World Health Organization Expert Committee (37), BMI values were compared with US reference standards (38) and we have calculated SD scores or *z* scores. There was a significant increasing trend in BMI, especially in boys (**Figure 2** and **Figure 3**). The increase was observed in the 1982–1990 period. This change may have been due to an increase in fat intake over the period (14) and to the sedentary habits of these children; however, physical activity seems not to be a major determinant of BMI (39).

One explanation for the association between dietary fat and adiposity could be that excess dietary fat leads to greater fat accumulation than does excess dietary carbohydrate (40). At least part of the increased efficiency of gaining weight by eating too much fat is the experimental demonstration of a theoretical consideration. Less energy is expended to store fat in the body from dietary fat than from dietary carbohydrate. Dietary fat is stored as triacylglycerol in the body at a metabolic cost of 3% of ingested energy, whereas dietary carbohydrate is stored in fat at the metabolic cost of 23% of the ingested energy (41).

In the past years, research has focused on central or abdominal adipose tissue distribution that is already present in children (42, 43). However, dietary fat seems to not specifically influence fat accretion in the intraabdominal region (4).

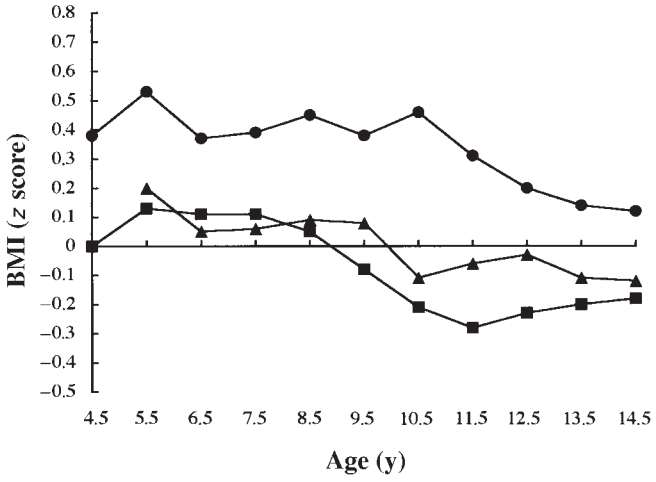

FIGURE 2. Body mass index (BMI), expressed as *z* scores, in boys in 3 cross-sectional studies (■, 1972; ▲, 1982; ●, 1990) conducted in Zaragoza, Spain.

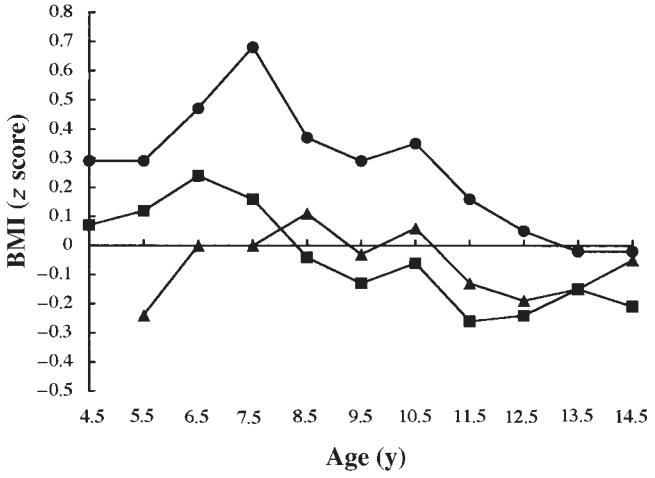

FIGURE 3. Body mass index (BMI), expressed as *z* scores, in girls in 3 cross-sectional studies (■, 1972; ▲, 1982; ●, 1990) conducted in Zaragoza, Spain.

DIETARY FAT INTAKE AND NUTRITIONAL ADEQUACY

Reductions in fat intake lead to an organoleptically monotonous diet and at the same time necessitate an increase in the amount of food ingested. This increase in the amount of food eaten is often difficult for the subject to achieve. In addition, and even if energy intake is maintained, a reduction in fat intake may increase the risk of micronutrient deficiency. In the Bogalusa Heart Study, children in whom fat accounted for <30% of total energy intake ingested significantly less vitamin B-1, B-2, B-6, B-12, and E than did children in whom the corresponding figure was >40% (44). In other countries, a self-selected low-fat intake among children from average to high socioeconomic backgrounds does not compromise their intake of nutrients (45).

In children of different ages, there was no significant differences in vitamin, mineral, and trace element intakes between those who reduced their fat intakes and those who did not (46–48). In adolescents, lower-fat diets were related to lower self-reported intakes of several nutrients; however, no adverse effects were observed on blood biochemical measures of nutritional status (27). Therefore, it seems that, at least under well-controlled conditions, it is possible for young children to lower their fat intake safely to reduce their risk of heart disease (28).

CONCLUSIONS

Results from family and individual dietary surveys indicate increasing total fat consumption in Spain over recent decades, especially of saturated and monounsaturated fat, as was shown also for other Mediterranean countries (49, 50). The following question remains unanswered: what percentage of fat intake should be recommended when monounsaturated fat is the principal source of fat? Trends in BMI values in children in our region of Aragón during recent decades could be related to the amount of fat intake in our population. To confirm these findings we must design studies that measure dietary fat intake and nutritional status in the same population of children and adolescents.

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