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Fatty Acid Composition of Plasma Lipids in Healthy Portuguese Children: Is the Mediterranean Diet Disappearing?

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Key Words

Atherosclerosis · Children · Dietary fat · Germany · Heart disease prevention · Mediterranean diet · Monounsaturated fatty acids · Oleic acid · Portugal · Trans fatty acids

Abstract

Background: Adults and children in Mediterranean countries are believed to consume a Mediterranean-type diet which is higher in monounsaturated and n–3 polyunsaturated fatty acids than compared to central and northern parts of Europe and has preventive effects for cardiovascular risks. ***Subjects and Methods:*** In preschool children from Porto, Portugal (n = 35) and Munich, Germany (n = 18) we determined the plasma phospholipid fatty acid composition considered as a biomarker for dietary fat intake. ***Results:*** The plasma phospholipid contents of total saturated fatty acids are similar in both groups, but the Portuguese children have lower values of monounsaturated and n–3 polyunsaturated fatty acids. The results indicate that the food habits of Portuguese children are even less close to the traditional Mediterranean diet than those of German children. ***Conclusions:*** Efforts should be made to encourage young families as well as manufacturers and distributors of food products in Portugal to emphasize traditional Mediterranean food habits, especially in young children.

Introduction

Primary prevention of cardiovascular disease, which remains a major health threat in European populations, should begin in children because early vascular lesions start to develop already in the first years of life [1, 2]. Therefore, a diet rich in monounsaturated fatty acids (MUFA) but with a limited intake of saturated and trans fatty acids has been recommended as a healthy diet for children from the age of 2–3 years onwards to reduce the risk of later heart disease [3], i.e. a dietary fat intake provided by the traditional Mediterranean diet [4, 5]. However, recent studies from southern Italy using dietary records to record food habits reported a change away from the traditional Mediterranean diet towards a more Western-type diet, with increasing intakes of saturated fats, both in urban adults [6] and in young children aged 6–32 months [7]. Thus, it appears questionable to which extent the dietary fat quality of children in southern and central

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Europe still differs. Therefore, we tried to compare the quality of dietary fat intake in a sample of preschool children from the city of Porto, Portugal, and German children from the city of Munich by analysis of the plasma phospholipid fatty acid composition which is considered a reliable biomarker of dietary fatty acid intake [8, 9].

Subjects and Methods

Children aged 12–48 months were considered eligible for enrollment into the study if they were generally healthy, free from acute infections or other acute diseases, and well-nourished with weight and height within normal ranges.

The 35 children enrolled at Porto were participating in a longitudinal study on health risks and had been enrolled after birth. All had been born at term with birth weights appropriate for gestational age. Blood samples for this study were obtained at the age of 24 months, together with samples used for a scheduled preventive health check. Eighteen German children of the same age group who attended the pediatric outpatient department for elective diagnostic procedures involving diagnostic venipuncture (e.g. intravenous urography, blood sampling prior to elective surgery) participated in the study. The study protocol was reviewed by the local ethical committees, and informed consent of the patients' parents was obtained.

Venous blood samples were obtained from an antecubital vein with sodium EDTA (1 mg/ml) as the anticoagulant. After centrifugation the plasma was immediately frozen in plastic vials with a snap-on lid and stored at –18 °C until analysis. The samples from the Portuguese children were transported to Munich on dry ice. Plasma lipids were extracted into methanol/chloroform, plasma lipid classes separated by thin layer chromatography, fatty acid methyl esters prepared by transesterification with methanolic HCl were analyzed by high-resolution capillary gas chromatography using a Hewlett-Packard Series II 5890 gas chromatography as previously described [10]. Results are expressed as percentage (wt/wt) of all fatty acids detected with a chain length between 12 and 22 carbon atoms. The data are presented as means and standard deviations. A two-tailed t test was used to compare the results of the Portuguese and German children. Differences were regarded as statistically significant at $p < 0.05$.

Results

The proportion of total saturated fatty acids in plasma phospholipids was similar in Portuguese and German children (table 1). However, the intermediate chain saturated fatty acids, lauric (C12:0) and myristic (C14:0) fatty acids, were markedly higher in the German children, which may reflect a higher intake of foods containing tropical oils such as coconut oil. Total trans fatty acids as well as the major trans isomers contributed significantly lower proportions to plasma phospholipids of the Portuguese than the German children. Contrary to expectations, total MUFA as well as oleic acid, the predominant fatty acid found in olive oil, were found at markedly lower percentage values in the Portuguese children. Total n–6 polyunsaturated fatty acids (PUFA) and the long-chain metabolites (n–6 LC-PUFA) were not different between the 2 groups. In contrast, both the n–3 fatty acid precursor (18:3n–3) and the total n–3 LC-PUFA metabolites were

Table 1. Major fatty acids in plasma phospholipids of 35 Portuguese and 18 German children aged 12–48 months (% wt/wt, mean and standard deviation)

Fatty acid	Portugal (n = 35)	Germany (n = 18)	p
C12:0	0.01 (0.02)	0.07 (0.11)	0.026
C14:0	0.35 (0.19)	0.62 (0.43)	0.02
C14:1t	0.01 (0.02)	0.08 (0.11)	0.013
C14:1n–5	0.01 (0.02)	0.69 (0.33)	<0.0001
C16:0	27.70 (6.50)	29.25 (3.06)	n.s.
C16:1t	0.081 (0.037)	0.321 (0.161)	<0.0001
C16:1n–7	0.288 (0.126)	0.821 (0.511)	0.0004
C18:0	15.73 (3.76)	14.5 (1.59)	n.s.
C18:1t	0.095 (0.17)	1.128 (0.351)	<0.0001
C18:1n–9	9.26 (2.63)	14.33 (2.45)	<0.0001
C18:2t	0.06 (0.04)	0.02 (0.03)	<0.0001
C18:2n–6	18.80 (4.90)	20.10 (2.99)	n.s.
C18:3n–6	0.08 (0.05)	0.07 (0.07)	n.s.
C20:0	0.66 (0.21)	0.17 (0.16)	<0.0001
C18:3n–3	0.10 (0.04)	0.21 (0.11)	0.0013
C20:1n–9	0.16 (0.10)	0.18 (0.11)	n.s.
C20:2n–6	0.33 (0.09)	0.36 (0.07)	n.s.
C20:3n–9	0.23 (0.12)	0.48 (0.38)	0.014
C20:3n–6	2.52 (0.76)	2.92 (0.65)	n.s.
C22:0	1.68 (0.55)	0.27 (0.21)	<0.0001
C20:4n–6	7.22 (1.99)	8.22 (1.82)	n.s.
C22:2n–6	0.96 (0.31)	0.034 (0.05)	<0.0001
C20:5n–3	0.40 (0.17)	0.18 (0.21)	0.0006
C22:4n–6	0.39 (0.16)	0.43 (0.15)	n.s.
C22:5n–3	0.49 (0.15)	0.94 (0.45)	0.0006
C22:6n–3	2.29 (0.77)	2.55 (0.87)	n.s.
Total saturated	48.1 (11.3)	44.88 (2.97)	n.s.
Total trans	0.28 (0.19)	1.63 (0.50)	<0.0001
MUFA	12.97 (3.37)	16.02 (3.02)	0.0016
Total n–6 PUFA	30.23 (7.24)	32.11 (4.03)	n.s.
Total n–3 PUFA	3.28 (1.04)	4.23 (1.3)	0.011
Total LC-PUFA	14.57 (3.73)	16.63 (3.63)	n.s.
Total n–6 LC-PUFA	11.39 (2.93)	11.94 (2.45)	n.s.
Total n–3 LC-PUFA	3.28 (1.04)	4.03 (1.30)	0.04

MUFA = Monounsaturated fatty acids; PUFA = polyunsaturated fatty acids; LC-PUFA = long-chain PUFA with 20 and 22 carbon atoms. Sums of fatty acid groups also include minor fatty acids not listed here and therefore are not always identical to the sum of listed fatty acids of the respective group.

found at significantly lower levels in the Portuguese group, even though eicosapentaenoic acid (C20:5n–3) provided higher proportions.

Discussion

The results of this study indicate that the dietary fat intake of the Portuguese preschool children studied here is not any closer to the traditional Mediterranean diet than that of central European children from southern Germany. In a previous study using 3-day weighed dietary records, we have shown that primary school children from the Munich area consume a diet rich in fat, comprising about 40% of the dietary energy intake, with about half of the dietary fat contributed by saturated fats [11]. The present study suggests that the dietary fat quality of the Portuguese children is rather similar.

There were only relatively minor differences in the plasma phospholipid fatty acid composition between the 2 groups studied here. The lower values for lauric (C12:0) and myristic (C14:0) fatty acids in the Portuguese group may be due to a lower consumption of coconut oil which is widely used in Germany in the preparation of baked goods as well as shortenings and frying fats. Markedly lower values of trans fatty acids in children from Portugal could partly be a consequence of a lower milk fat consumption, but in view of the size of the difference we consider it highly likely that there was a markedly lower consumption of partially hydrogenated fats. In contrast to our expectations, the Portuguese children did not show indications of higher but instead rather of lower intakes of oleic acid (C18:1n–9), which is indicative of olive oil consumption. Also, the Porto children had lower values of α-linolenic acid (18:3n–3) found in many plants and seeds, and of n–3 LC-PUFA provided by sea fish. Obviously, the dietary habits of the Portuguese children were even less close to the concept of a Mediterranean-type diet than those of the German children. These developments appear to be due to an increasing disappearance of regional foods, which are being substituted by foods manufactured to similar concepts and with similar ingredients throughout the European Union, including specially prepared foods offered to preschool children.

These developments are unfortunate since the Mediterranean diet is favored not only in adult populations but also in young children for a variety of reasons [3, 12]. A diet with relatively high proportions of the dietary fat intake provided by MUFA can effectively improve plasma lipid and lipoprotein levels, with a favorable effect on the HDL/LDL cholesterol ratio [13, 14]. Moreover, a high intake of MUFA also reduces the oxidizability of LDLs [13, 15, 16] regarded as a key factor in the initiation of vascular lesions. High MUFA diets also exert preventive effects by modulation of endothelial function inducing decreased plasma levels of endothelium-derived factors involved in vascular disease progression, such as von Willebrand factor, tissue factor pathway inhibitor, plasminogen activator inhibitor type-1, vascular cell adhesion molecule-1 and other mediators [13, 17]. Studies in diabetic subjects have also documented an enhancement of insulin sensitivity and improved glucose levels [18]. High intakes of n–3 fatty acids from plants and particularly from sea fish that are also found in the typical Mediterranean diet [5] contribute further to the prevention of atherosclerosis and coronary heart disease [19].

Benefits on clinical outcome have been documented in controlled, randomized trials in post-infarction patients in whom a Mediterranean-type diet resulted in markedly reduced risk for coronary heart disease and prolonged survival as compared to a prudent Western-type diet [20]. The Mediterranean-type diet with high MUFA intakes has also been proposed to have protective effects against cancer [20, 21] and the cognitive decline associated with aging [22].

We consider it most unfortunate that the traditional food habits of the Mediterranean countries, with their multiple reported benefits, are apparently disappearing at least in young children. Pediatricians and other health care professionals should encourage young families, manufacturers and distributors of foods to return to the traditional concepts of a Mediterranean diet for young children aiming at long-term health.

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