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Dietary intervention in a hypercholesterolemic school-aged population from Northern Spain

A. García, J. M. Gutiérrez, S. Fernández, J. Aparicio and A. Menéndez-Patterson

Departmento de Biología Funcional, Area Fisiología, Facultad de Medicina, Universidad de Oviedo, 33006 Oviedo (Spain)

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A "before and after" intervention study, over a five year period, was done in order to find the degree of compliance to dietary recommendations and their effects on serum lipids in a hypercholesterolemic school-aged population. 383 children between 6 and 13 years of age, were identified with hypercholesterolemia (total serum levels above 4.8 mmol/l), in a previous randomized mass screening of 1095 individuals. Some dietary guidelines aimed at decreasing fat consumption and increasing fiber and carbohydrate ingestion were given to the families, and 226 of the children participated in the follow-up. Changes of address and/or school-center was the main cause of non-participation. The follow-up examination consisted in the evaluation of serum lipids and actual diet. Cholesterol serum levels decreased from a mean value of 5.4 mmol/l to 4.8 mmol/l. 59.3 % of the sample had reached serum cholesterol levels below the risk threshold. Fat ingestion diminished significantly (40.3 % of calories to 36.7 %, $p < 0.001$), saturated fatty acids decreased from 15.3 % of calories to 13.5 % ($p < 0.001$), monounsaturated fatty acids decreased from 17.1 % to 15.4 % ($p < 0.001$) and polyunsaturated fatty acids remained unchanged. Carbohydrate consumption increased from 45 % of the calories to 47.38 % ($p < 0.001$). Dietary changes were greater in individuals out of risk than those who still had high cholesterol levels. These data indicate a good family compliance to the recommendations and that changes in food habits seem to be effective in controlling hyperlipidemia. Dietary changes are better accepted by younger children.

Key words: Serum cholesterol, Diet, Follow-up, Childhood.

According to the hypothesis that atherosclerosis originates in childhood, it is important to identify and correct its risk factors as early in life as possible for preventive purposes (2, 16). Hypercholesterolemia is a major risk factor for the development of coronary heart disease.

Correspondence to A. Menéndez-Patterson (Tel.: 34-8-504209; Fax: 34-8-103072).

Thus its early detection and management could retard the atherosclerotic process (47). Controversy exists about whether the detection of children at risk should be done by mass screening or only in children with a family history of cardiovascular disease (8, 18). Some studies show a significant degree of correlation, r = 0.44 (9), r = 0.8 (40), between serum lipid levels in childhood and those in adulthood. Whether this degree of tracking is sufficient to warrant testing of the whole childhood population is a matter of opinion. For some authors the strategy to screen only those children from high risk families is clearly ineffective (8, 33, 36). Other investigators warn of the danger of unnecessary diet management in "false-positive" children when they are screened universally (18) and think that further studies are needed to indicate the best age at which the initial estimation should be made and to define the most appropriate cut-off point for diagnosis of hypercholesterolemia (23, 26). Nevertheless, it seems clear that the estimations need to be repeated, at least in those children whose levels are in the upper values, at 3 to 5 year intervals.

Diet affects blood lipids in children as well as in adults. Various studies have shown that serum cholesterol levels increase with higher intake of saturated fatty acids (SFA) and cholesterol, decrease with the consumption of polyunsaturated fatty acids (PUFA) and are not influenced by monounsaturated fatty acids (MUFA). Recently high-density-lipoprotein cholesterol (HDL) has been shown to be strongly and inversely related to cardiovascular heart disease risk (6). The substitution of SFA for MUFA or PUFA reduces low-density-lipoprotein cholesterol (LDL) without lowering HDL levels and thus increases the prevention of atherogenesis (4, 25). Thus, the potential food atherogenicity depends on its content of cholesterol, SFA and, more recently described, its proportion of cholesterol oxides (cholesterol oxide products and lipid oxide product), which have high angiotoxicity (1, 17). The PUFA/SFA ratio, Connor Index or Keys index have been proposed to evaluate the atherogenic capacity of diets (3). Existing studies show the actual tendency of children and adolescents to eat foods with high atherogenic potential (5, 28). Although some authors think that dietary intervention may carry certain risks for children, e.g. growth failure (20), it seems widely accepted that modifying children's diets in order to lower the total fat content to about 30 - 35 % of total calories and increasing the consumption of PUFA while reducing SFA and cholesterol would have no deleterious effects and could be effective for primary prevention (23, 26).

In a study carried out during the period 1987-1989 (15) it was found that 36 % of a sample of 1095 school-aged children from our area (Asturias, Northern Spain) had serum cholesterol levels above cardiovascular risk threshold (4.8 mmol/l). Their diet was hypercaloric, hyperlipidic and too rich in SFA. At the end of the first study, some guidelines were given to families. As there are very few studies on intervention and follow-up in Spain, we carried out the present work after a 5-year period in order to discover the degree of compliance to the recommendations and the possible effects on serum lipids.

Materials and Methods

From 1987-1989 randomized mass screening for cardiovascular risk factors in children was carried out in our region. After classifying all school-centers into two environmental groups (rural and urban), three centers from each group were randomly selected. All students attending those centers were invited to participate in the screening, but measures were performed only on those whose parent consent was obtained. The final sample was composed of 1095 boys and girls aged 6 to 13. Thirty-six percent of the 383 children studied presented hypercholesterolemia (serum cholesterol above 4.8 mmol/l, measured by an enzymatic method, in a blood sample after an 8 h fast). Details of the screening method have been previously described elsewhere in detail (15).

Counseling was given to each family whose children had high levels of blood lipids at the end of the screening period. There was a meeting at the school centers with the study team members, parents and children to explain the main points of the intervention and its importance. A short brochure with the guidelines to be followed was given to each family and they all had a telephone number to contact the study team members in order to clarify any possible future doubts. The follow-up of the intervention was entrusted to the children's pediatricians, whose reports were obtained by the study team members at the second contact.

The main points of the dietary intervention were: 1) Intake decrease of factory produced pastry and cakes, pork and their derivatives, viscera and eggs; 2) Consumption increase of fish, fruits and vegetables; and 3) Change whole milk and its derivatives for semi-skimmed products when the cholesterol levels were above 5.2 mmol/l.

These children were contacted 5 years later, at ages between 11 and 18 and invited to participate in the present follow-up study. The informed consent by the parents and/or the children was obtained from those who had previously participated in the study (113 boys and 113 girls). Change of address and/or school was the most common cause of non-participation in the study, followed by the fear of blood sampling. None of the children was, or had been, under pharmacologic treatment.

The follow-up examination was carried out as follows: *Blood samples*: Venous blood was collected, in EDTA-coated tubes, in the morning after overnight fasting, with the subject in recumbent position. Plasma was separated and frozen for later analysis in the same series. Plasma cholesterol (C), triglycerides (T) and HDL were determined using enzymatic methods with reagents from Boehringer in a Hitachi 717 Analyzer.

LDL was calculated according to FRIEDEWALD *et al.* (14). The C/HDL and LDL/HDL indexes were also determined. Cardiovascular risk thresholds were established as follows: for children 11 to 13 years of age, C $\geq$ 4.8 mmol/L (32); and for those 14 to 18 years of age, C $\geq$ 5.2 mmol/L (37); C/HDL $\geq$ 2.2 (10); LDL/HDL $\geq$ 3.5 (10).

Assessment of dietary intake.– Diet was assessed using three nonconsecutive 24 hour recall-questionnaires, including one weekend day. Interviews were done by a trained nutritionist, on an individual basis with the children in school. Portion size was determined by household measures and models and the results of the three days were averaged. Nutrient intake was calculated for 25 nutrients in terms of density. The proportion of calories delivered by proteins, carbohydrates, total fat, SFA, MUFA and PUFA and ingestion of cholesterol (DO) was also analyzed.

In order to know the influence of the different fatty acids of the diet in serum lipids the PUFA/SFA ratio and two atherogenic indexes: the Connor index (7) [(0.01 SFA) + (0.05 DC)] and the Keys index [1.35 [(2 SFA) - PUFA] + 1.5√(1000 DC)/Kcal)] (11) were calculated. For the transformation of food into nutrients the Wander-Sandoz program (41) was used.

Food habits.– A food frequency questionnaire (30 food items) was submitted to families to find out possible changes in food consumption habits, with special attention being paid to important cholesterol source foods, SFA, MUFA and PUFA.

Family history of diabetes, hypertension, hyperlipemias, atherosclerosis and heart attack was registered as well as certain socioeconomic characteristics.

Statistical Analysis.– Conventional statistical paired methods were used for the comparisons of parameters between both studies, and non-parametric methods were used when needed. Results were considered significant when $p \leq 0.05$. The analysis was done with the SPSS/PC program for Windows v.6.0.1

The study design was approved by the Committee on Ethical Research of the Oviedo University Hospital.

Results

At baseline no significant changes were seen between the hyperlipidemic children who were studied and those who refused to participate in the second part of the study either in serum lipid levels (mean difference, -1.58 ± 0.11, SD) or in the analysis of the diet: proportion of proteins (17.6 % in the followed-up children vs 16.5 % in the lost children), of fats (39.7 % vs 37 %), proportion of carbohydrates (43 % vs 46 %), of SFA (14.6 % vs 14.5 %), proportion of MUFA (15.8 % vs 16.6 %), of PUFA (4 % vs 4.1 %), Connor index (43 vs 46.2) and Keys index (100 vs 105).

In the second study, when total serum cholesterolemia was taken into account, only 40.7 % of the sample still maintained a level above the risk threshold for total cholesterol. The LDL/HDL ratio was below 2.2 in 72 % of the population and the C/HDL was lower than 3.5 in 80 % of the cases. No statistical differences between girls and boys were observed.

Cholesterol serum levels decreased from a mean value of 5.4 mmol/l to 4.8 mmol/l (10 %). In the group of children with cholesterolemia levels under thresholds there was a reduction of 16 %, while this amounted to only 2 % in the children still above risk thresholds. As table I shows, the decreased in serum cholesterol was maximum in 13-14 and 15 to 16 year-old groups (12-13 %), diminishing by 8 % in the 11-12 year-old group and not significant in the 17-18 year-old group.

From the time of the first study to the second one, the proportion of calories delivered by total fat diminished statistically while the proportion of proteins and carbohydrates increased significantly (table II), these being closer to the Recommended Dietary Goals than those in the first study (46).

Table I. *Serum lipids (mmol/e) and serum lipid ratios in both studies in the different groups of age at the moment of the follow-up.*
Mean ± SD. In parenthesis the number of participants. $^{a}p \leq 0.001$, $^{b}p \leq 0.01$.

	11-12 years (94)		13-14 years (70)		15-16 years (47)		17-18 years (15)	
Study:	1st	2nd	1st	2nd	1st	2nd	1st	2nd
Cholesterol	5.34±0.54	4.90±0.81[a]	5.34±0.51	4.66±0.61[a]	5.33±0.47	4.71±0.73[b]	5.37±1.07	5.04±0.93
HDL	1.90±0.34	1.72±0.33	1.92±0.41	1.60±0.36[a]	1.66±0.33	1.43±0.37[a]	1.64±0.43	1.51±0.42[b]
Cholesterol/HDL	2.91±0.66	2.06±0.56	2.92±0.70	2.07±0.52	3.52±1.03	3.42±0.69	3.30±1.10	3.02±1.27
LDL/HDL	1.73±0.62	1.85±0.47	1.69±0.55	1.82±0.47	2.23±0.90	1.88±0.50[b]	2.21±1.20	2.34±0.94

Table II. *Proportion of energy delivered by macronutrients and fatty acids, and intake of cholesterol, fiber, some fatty acids and indexes of atherogeneity.* Mean ± SD. Number of participants, 226. [a]$p \leq 0.001$, [b]$p \leq 0.01$, [c]$p < 0.05$. SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids. CH = Carbohydrates.

	1st Study	2nd Study
Calories	2318.60 ± 402.2	2251.54 ± 637.24
Proteins (%)	13.72 ± 2.60	14.93 ± 3.95[a]
CH (%)	45.11 ± 5.37	47.38 ± 6.34[a]
Fat (%)	40.35 ± 5.28	36.75 ± 6.74[a]
SFA (%)	15.31 ± 3.22	13.57 ± 3.64[a]
MUFA (%)	17.12 ± 4.17	15.42 ± 3.75[a]
PUFA (%)	4.04 ± 1.56	4.02 ± 2.53
Oleic (mg/Kcal)	16.00 ± 4.00	14.00 ± 6.00[b]
Myristic+Palmitic (mg/Kcal)	12.00 ± 4.00	10.00 ± 5.00[c]
Cholesterol (mg/1000Kcal)	181.80 ± 52.46	166.42 ± 68.71[c]
Fiber (mg/Kcal)	6.00 ± 0.30	6.00 ± 0.20
PUFA/SFA	0.27 ± 0.84	0.32 ± 0.26[b]
Connor Index	21.00 ± 5.65	18.23 ± 7.64
Keys Index	111.28 ± 27.54	97.19 ± 35.04[a]

Ingestion of SFA and MUFA decreased significantly while the consumption of PUFA remained unchanged.

Cholesterol ingestion, intake of myristic plus palmitic fatty acids, in terms of density of nutrients, decreased statistically and no changes were seen in fiber consumption (table II). The PUFA/SFA ratio increased and Connor and Keys indixes decreased significantly in the second study.

Only caloric differences were seen between diets of males and females, but no changes were observed in the content of fat and its composition.

Table III shows separated results for the group of individuals who reached serum cholesterol values under thresholds and those who could still be considered at risk. Generally, changes have a greater significance in the first group where the proportion of carbohydrates and MUFA in the caloric intake, the ingestion of cholesterol, PUFA/SFA ratio, Connor and Keys indexes are significantly diminished.

With the exception of the Keys index (table IV), changes in the diet of the older girls and boys were not significant. The ingestion of cholesterol and the Connor index decreased statistically in 13 to 14 year-old children and 11-12 year olds. Both parameters increased in 15 to 18 year-old boys and girls, although not statistically. Keys Index diminished significantly also in 11 to 12 year-old children and in children aged 15 to 16. The PUFA/SFA ratio increased statistically between 13 and 16 years of age, and no variation was seen in the youngest and oldest individuals. If the ingestion of fatty acids is examined, the consumption of oleic decreased in children from 11 to 16, but only statistically in the children aged 15 to 16. The oleic intake did not diminish statistically in older boys and girls. The myristic plus palmitic acid ingestion was lower in the second study in all age groups, but significance was only seen in ages 13-14 and 15-16. Fiber ingestion only increased statistically in the 15 to 16 year-old children.

Energy intake diminished statistically only in older children (2419.22 ± 491.59 Kcal to 1936.23 ± 419.30 Kcal, $p \leq 0.05$). The proportion of proteins increased in all age groups but only signifincantly in chil-

Table III. *Proportion of energy delivered by macronutrients and fatty acids and intake of fiber, cholesterol, some fatty acids and atherogenic indexes of the diets in both risk groups of hypercholesterolemia.*
Mean ± SD. In parenthesis the number of participants. $^a p \leq 0.001$, $^b p \leq 0.01$, $^c p \leq 0.05$. CH = carbohydrates; SFA = saturated fatty acids; MUFA = monounsaturated fatty acids; PUFA = polyunsaturated fatty acids.

	Under risk threshold (N = 132)		Above risk threshold (N = 92)	
	1st Study	2nd Study	1st Study	2nd Study
Calories	2326.49 ± 394.4	2280.21 ± 600.8	2312.26 ± 401.7	2227.36 ± 684.7
Proteins (%)	13.87 ± 2.40	15.08 ± 3.51^b	13.50 ± 2.80	14.70 ± 3.02^c
CH (%)	44.74 ± 4.29	48.68 ± 6.81^a	45.76 ± 6.48	46.82 ± 5.18
Fat (%)	40.47 ± 5.23	36.11 ± 6.47^a	40.00 ± 5.37	37.22 ± 6.85^b
SFA (%)	15.32 ± 3.38	13.34 ± 3.72^a	14.94 ± 2.83	13.90 ± 3.59^c
MUFA (%)	17.26 ± 4.64	15.17 ± 3.99^b	16.52 ± 3.07	15.85 ± 3.43
PUFA (%)	4.20 ± 1.12	4.27 ± 3.23	3.86 ± 0.98	3.82 ± 1.51
Cholesterol (mg/1000Kcal)	189.11 ± 59.6	164.02 ± 71.2^b	174.40 ± 44.21	164.13 ± 62.00
Fiber (mg/Kal)	5.98 ± 1.19	6.40 ± 0.60	5.90 ± 0.10	5.90 ± 0.20
Oleic (mg/Kcal)	12.00 ± 3.00	10.00 ± 5.00^b	16.00 ± 4.00	15.03 ± 5.87
Myristic+Palmitic (mg/Kcal)	11.69 ± 3.50	10.37 ± 3.94^c	11.95 ± 3.31	10.00 ± 4.00^b
PUFA/SFA	0.26 ± 0.07	0.35 ± 0.04^c	0.26 ± 0.08	0.29 ± 0.14
Connor Index	21.46 ± 6.07	17.89 ± 7.65^b	20.47 ± 5.11	18.63 ± 7.67
Keys Index	112.49 ± 27.5	92.61 ± 35.83^a	109.87 ± 27.20	102.49 ± 33.60

Table IV. *Intake of cholesterol, fiber, some fatty acids and atherogenic indexes of the diet in different age groups (age at the follow-up).*
Mean ± SD. In parenthesis the number of participants. $^a p \leq 0.001$, $^b p \leq 0.01$, $^c p \leq 0.05$. PUFA = polyunsaturated fatty acids; SFA = saturated fattyacids.

Actual Age (years)		Cholesterol (mg/1000Kcal)	Fiber (mg/Kcal)	Oleic (mg/Kcal)	Myi.+Palm. (mg/Kcal)	PUFA/SFA	Connor Index	Keys Index
11-12	First Study	192.87 ± 46.00	6.10 ± 1.00	16.00 ± 4.00	12.00 ± 4.00	0.25 ± 0.80	21.73 ± 5.26	114.29 ± 26.70
(N=94)	Second Study	160.62 ± 64.62^b	5.90 ± 1.00	14.00 ± 7.00	11.00 ± 5.00	0.27 ± 0.09	18.35 ± 7.50^b	104.22 ± 34.64^c
13-14	First Study	187.48 ± 55.43	7.00 ± 0.60	15.00 ± 4.00	11.19 ± 3.27	0.27 ± 0.08	22.31 ± 6.56	109.68 ± 30.58
(N=70)	Second Study	154.28 ± 62.77^c	6.70 ± 2.00	14.00 ± 4.00	9.65 ± 3.71^c	0.32 ± 0.13^c	17.56 ± 7.42^c	99.44 ± 37.64
15-16	First Study	168.08 ± 57.95	6.20 ± 1.00	18.00 ± 4.00	13.00 ± 3.00	0.29 ± 0.10	19.33 ± 5.01	108.22 ± 23.24
(N=47)	Second Study	186.61 ± 80.71	7.00 ± 2.00^c	14.00 ± 3.00^a	10.00 ± 5.00^b	0.38 ± 0.06	19.41 ± 8.67	87.08 ± 34.34^c
17-18	First Study	145.07 ± 36.54	6.10 ± 1.00	16.00 ± 5.00	12.00 ± 3.00	0.29 ± 0.09	18.23 ± 5.11	108.69 ± 34.83
(N=15)	Second Study	174.92 ± 63.76	5.80 ± 2.00	18.00 ± 8.00	11.00 ± 5.00	0.35 ± 0.27	16.41 ± 6.31	34.83 ± 22.57^c

dren aged 11-12 ($p \leq 0.05$) and in 15 to 16 ($p \leq 0.001$). Proportion of carbohydrates significantly increased in children aged 13-14 ($p \leq 0.001$) and 15 to 16 ($p > 0.05$). The contribution of fat to energy was lower in the second study in all ages, although it was not significant in the older boys and girls. Results in the other age groups were: 11-12 years, 39.28±5.68 % to 36.95 ± 6.59 %, $p \leq 0.05$; 13-14 years, 40.17 ± 5.01 % to 35.85 ± 6.31 %, $p \leq 0.001$); 15-16 years, 42.51±4.46 % to 36.52 ± 7.61 %, $p \leq 0.001$. About the proportion of energy delivered by the different fatty acids in the diets analyzed in the first and second study, significant results were only found in the proportion of SFA in the first age group (15.63 ± 2.96 % to 13.91 ± 3.78, $p \leq 0.01$) and the proportion of MUFA in the 15-16 year-old children's diets (18.16 ± 4.12 % to 15.42 ± 3.67 %, $p \leq 0.01$).

Discussion

Our data show a reduction in serum lipids in the study group for a 5 year period. According to the conclusion of the Lipid Research Clinics' Program, -a reduction of 1 % in plasma cholesterol levels lowers cardiovascular risk by 2 % (21)-, a risk reduction of about 20 % in the whole population under study could have been obtained. This reduction would have been around 32 % in 59 % of the sample, who had reached cholesterol levels under risk thresholds, and 4 % in the rest, who still have high cholesterolemia.

Only 36 % of the studied individuals had a positive family history of cardiovascular risk factors. This means, that selective screening would have failed to identify 64 % of the hypercholesterolemic children who would not have received the benefits of the intervention program, which indicates that mass screening is the basis of good primary prevention (8, 36, 40).

To assess diet the 24-hour recall method was used, whose accuracy in evaluating children's ingestion has been proven (34, 43). Anthropometric measures (data not presented) showed normal growth and development in all the children studied.

An important decrease in fat ingestion was found with a significant decrease in SFA and MUFA intake and no changes in PUFA ingestion. More relevant than the average changes in the whole sample are the changes in each individual which were analyzed by the Keys and the Connor indexes (28). High index values would indicate an atherogenic diet because of its inadequate composition in fatty acids and cholesterol. These indexes changed statistically from the first study only in the population out of risk at the moment.

High serum cholesterol levels observed in Finnish children have been attributed to the typical Finnish diet extremely rich in saturated fat (44). Some epidemiological studies have shown that dietary intake of saturated fat has a determining role for plasma cholesterol level (19), although other authors found a weak correlation between fat intake and cholesterol level within the same population (39). FOMON *et al.* (12) consider that human studies have failed to demonstrate that dietary factors operating during infancy influence subsequent serum lipid concentrations. Furthermore, for other investigators, the high individual variation in serum lipid responses to dietary components (27) and the great difficulties in obtaining reliable information by the usual methods of nutritional assessment (31) make it difficult to determine whether there is a relationship between diet and cholesterolemia.

The benefits in the whole pediatric population of some good dietary recommendations about fat ingestion, especially because they may influence on long-term health are accepted (5, 23, 30).

The effects of dietary restriction on hypercholesterolemic children have been widely analyzed in case/control, cohorts and pre-to-post studies. SANCHEZ-BAYLE *et al.* (38), in a group of over 450 boys and girls aged 2 to 18 with hypercholesterolemia, designed a prospective clinical trial. Their conclusion was that diet therapy is effective in the treatment of hypercholesterolemia in childhood and adolescence for reducing total serum lipids and apolipoproteins such as A-1 and B-100. POLONSKY *et al.* (35) in a pre-to-post study of over 182 children found a reduction in LDL and triglycerides as well as an increase in HDL, from the first follow-up visit after nutritional and risk-management counceling. In a study of the same characteristics in other 104 children with dyslipoproteinemia, it was found that diet counseling failed to decrease LDL but changes in dietary fat intake appeared to influence HDL levels (29). More recently the DISC Research Group (42) in a cohort study reported changes in LDL levels of about 0.40 mmol/l after a 3 year dietary intervention in children aged 8-10. Those changes were significantly higher ($p = 0.02$) in the group of children who had received dietary counseling.

We are not certain whether the improvements obtained in lipid values were entirely due to dietary changes or to some other factors. The absence of a "proper" control group in this study (not hypercholesterolemic) does not permit to reach conclusive statements. Nevertheless the significant decrease in the proportion of children above risk thresholds together with a lower ingestion of fats, especially in the case of saturated fats and cholesterol, and the fact that the children who were still hypercholesterolemic had weaker changes in their dietary habits, seem to confirm the benefits of dietary changes on serum lipid levels.

Lipid levels are known to decrease in puberty (13). This could potentially confound the improvement in lipid values in some of the children studied, but both groups (normal cholesterol levels and cholesterolemia above threshold) are similar in age distribution, the possible confounding physiologic effect of growth being minimized.

For MACHÍN *et al.* (24), diet is an effective treatment for hyperlipidemia but compliance for long periods is difficult, which does not agree with the present results, as dietary guidelines are still being followed some five years after the original diagnosis.

Our results seem to indicate that dietary recommendations were better followed by the youngest, whose meals are mostly prepared at home or at school. As the number of out of home meals increases and children have more freedom to choose the food they eat, compliance to recommendations diminishes. This confirms the idea that nutritional education should start as early as possible. On the other hand, it is known that the main sources of saturated fats in our culture are industrial pastries, snacks and typical American take-away foods (45), whose consumption has increased in children and, in particular, in adolescents (22). As it seems really difficult to persuade the children not to eat these kinds of foods, it is important to make Health Authorities aware of the problem and to try to regulate their composition in order to adjust them to the nutritional goals.

To sum up, the early identification of children who are at risk of cardiovascular disease is a matter of importance. Early dietary intervention, reducing fat intake, especially saturated fatty acids, and increasing the proportion of carbohydrates, PUFA, MUFA and fiber in the diet, seem to have a beneficial effect on serum lipids. Thus compliance to changes in dietary habits is good and it is better in younger children.

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A. GARCÍA, J. M. GUTIÉRREZ, S. FERNÁNDEZ, J. APARICIO y A. MENÉNDEZ-PATTERSON. *Intervención dietética en una población escolar hipercolesterolémica del norte de España.* J. Physiol. Biochem. (Rev. esp. Fisiol.), 52 (1), 49-58, 1996.

En una población de escolares de entre 6 y 13 años de edad se estudia la intervención y seguimiento durante 5 años, del efecto de la dieta sobre los lípidos séricos. Tras un cribado previo sobre 1095 niños se identifican 383 hipercolesterolémicos (colesterol sérico total > 4,8 mmol/l) a los que se les da una serie de normas dietéticas para disminuir el consumo de grasa y aumentar el de carbohidratos y fibra. En el estudio participan 226 niños, siendo la principal causa de pérdidas el cambio de domicilio y/o centro escolar. Se analizan: parámetros antropométricos, lípidos séricos y de la dieta actual. Los niveles medios de colesterol descienden de 5,4 a 4,8 mmol/l. El 59,3 % de la muestra alcanza colesterolemias inferiores al umbral de riesgo. La ingestión de grasas disminuye desde 40,35 % de las calorías al 36,75 % ($p \leq 0{,}001$); los ácidos grasos saturados descienden desde el 15,31 % de la ingesta calórica hasta el 13,57 % ($p \leq 0{,}001$), la proporción de monoinsaturados disminuye del 17,12 % al 15,42 % ($p \leq 0{,}001$) y la de poliinsaturados no varía. El consumo de carbohidratos aumenta del 45 % de las calorías al 47,38 % ($p \leq 0{,}001$). Los resultados indican una buena aceptación de las recomendaciones dietéticas y que estas son efectivas para el control de los lípidos séricos. Los cambios dietéticos son mejor admitidos por los niños de menor edad.

Palabras clave: Colesterol sérico, Dieta, Estudio de seguimiento, Edad escolar.

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