



Influence of the Mediterranean diet on carotid intima–media thickness in hypercholesterolaemic children: A 12-month intervention study

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KEYWORDS

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Pre-pubertal children;
Lipid profile

Abstract *Background and aims:* The Mediterranean diet has been recognised as having a protective role on the cardiovascular system due to its low lipid and high antioxidant content. Lipid profile and oxidant status represent two important risk factors related to endothelial dysfunction, even at early stages of cardiovascular diseases. The aim of the study was to evaluate the influence of a 12-month Mediterranean diet on the variation of lipid profile and carotid intima–media thickness (cIMT) in pre-pubertal hypercholesterolaemic children.

Methods and results: We performed a cross-sectional study comparing lipid profile and cIMT in a group of 68 pre-pubertal children (36 with hypercholesterolaemia and 32 controls). In addition, in the hypercholesterolaemic children a 12-month intervention programme with a Mediterranean diet was started to evaluate the variation of lipid profile and cIMT. At baseline, hypercholesterolaemic children showed a significantly higher cIMT (both right and left carotid artery) compared to controls (both $p < 0.05$). After 12 months of diet intervention, a significant reduction of total cholesterol, LDL-cholesterol and cIMT was documented (all $p < 0.05$). Furthermore, at the end of follow-up, delta body mass index-Standard Deviation score and delta LDL-cholesterol were significantly and independently related to the changes of cIMT (both $p < 0.05$).

Abbreviations: AHA, American Heart Association; BMI, body mass index; cIMT, carotid intima–media thickness; DBP, diastolic blood pressure; HDL-C, HDL-cholesterol; HOMA-IR, Homeostasis Model Assessment of Insulin Resistance; IR, insulin resistance; LDL-C, LDL-cholesterol; PUFAs, plant-derived n-3 polyunsaturated fatty acids; SDS, Standard Deviation score; SBP, systolic blood pressure; TC, total cholesterol; TG, triglycerides.

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Conclusion: The Mediterranean diet represents a valid approach in the treatment of hypercholesterolaemia even during childhood.

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Introduction

Hypercholesterolaemia is a key component of the development and progression of angiopathy. In fact, total cholesterol (TC) and LDL-cholesterol (LDL-C) seem to be the major determinants of the atherosclerotic process [1]. The chronic exposure to increased lipid levels induces anatomic arterial changes even in childhood [2], and autopsy studies showed the presence of fatty streaks in the aortas of 3-year-old children [3].

Over the last years, high-resolution B-mode ultrasound measurement of the carotid intima–media thickness (cIMT) has been developed as a reliable and non-invasive method to predict the development of atherosclerosis. It has to be acknowledged that to date no normal values of cIMT for age and sex in healthy children have been established yet. Nonetheless, data in children with familial hypercholesterolaemia [4], hypertension [5], type 1 diabetes [6], and severe obesity [7] have clearly shown that high values of cIMT are a strong predictor of development of atherosclerosis later on in life. These data suggest that early therapeutic approaches during childhood aimed to positively modify these vascular findings could play a major role in reducing the risk of cardiovascular diseases in adulthood. Although lifestyle changes, characterised by nutritional approach and physical activity, represent the main strategy for the prevention of cardiovascular diseases in the paediatric age group, the data are still controversial. In fact, an interventional study in a group of obese children documented a decreased cIMT after a weight loss programme [8], while another study showed a reduction of the oxidative and pro-inflammatory state after a 6-week diet without changes in terms of cIMT [9].

Among the nutritional approaches, the Mediterranean diet has been recognised as having a protective role on the cardiovascular system [10,11]. The Lyon Diet Heart Study, a randomised secondary prevention trial, reported a relevant decrease of the recurrence rate in survivors of myocardial infarction following the Mediterranean diet [12]. This dietary pattern represents one of the healthiest diets characterised by low intake of total and saturated fats and increased intake of marine or plant-derived n-3 polyunsaturated fatty acids (PUFAs), fresh fruits and vegetables, legumes, high-fibre cereals, antioxidants, vegetable proteins and B vitamins [13]. However, up to now only few studies demonstrated the beneficial effects of the Mediterranean diet in youths [14–16].

The aim of this study was to investigate whether the Mediterranean diet could influence the lipid profile in pre-pubertal children with hypercholesterolaemia during a 12-month interventional period. Furthermore, we evaluated the potential association between changes in cIMT and the main metabolic and anthropometric variables after the Mediterranean dietary intervention.

Methods

A total of 36 pre-pubertal hypercholesterolaemic children were recruited from the Department of Pediatrics, University of Chieti, Italy. Hypercholesterolaemia was defined according to TC or LDL-C level above the 75th percentile for age and sex found on two distinct occasions [17]. Children with familial lipid disorders or family history for dyslipidaemia were excluded. All subjects were otherwise in good health and were not affected by other diseases (renal dysfunctions, endocrine disorders, hereditary diseases and systemic inflammation) or were taking any medication. None of the children was involved in regular and programmed physical activity. As control group, we recruited 32 healthy normocholesterolaemic pre-pubertal children admitted to the Department of Paediatrics for minor diseases. A physical examination was performed including anthropometric parameters (height, height-Standard Deviation score (SDS), weight, body mass index (BMI), BMI-SDS) and bio-impedance to determine fat mass. Based on BMI-SDS, children with values between -2 and 2 were defined as normal-weight, whereas children with values >2 SD were defined as obese. The pubertal stage was defined based on the Tanner criteria (all children had pre-pubertal characteristics corresponding to stage 1 both at baseline and after 12 months of diet). Furthermore, basal blood pressure was measured.

Fasting blood samples were obtained to evaluate lipids (TC, triglycerides (TG), LDL-C and HDL-cholesterol (HDL-C)), and glucose and insulin for the assessment of insulin resistance (IR). cIMT was measured by high-resolution B-mode ultrasound.

Hypercholesterolaemic children were encouraged to follow a Mediterranean diet for 12 months. During this period, all subjects had a follow-up visit after 6 months to obtain anthropometric parameters and lipid profile. At the end of the intervention, anthropometric parameters, metabolic parameters and cIMT were obtained.

This study was approved by Ethical Committee of University of Chieti. Written informed consent was obtained from parents and oral consent from children.

Anthropometric measurements

Body weight was determined to the nearest 0.1 kg and height was measured in triplicate with the Harpenden stadiometer to the nearest 0.1 cm. BMI and BMI-SDS for age and sex were calculated [18].

Mediterranean dietary intervention

At the start of the study, a 3-day dietary recording was performed by one physician and two nutritionists to

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