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How Well Can We Control Dyslipidemias Through Lifestyle Modifications?

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Abstract The role for lifestyle modifications to correct dyslipidemia(s) is reviewed. Dietary composition is crucial. Replacing saturated fat with MUFA or n-6 PUFA lowers plasma low-density lipoproteins (LDL) cholesterol and ameliorates the LDL/HDL ratio. Replacing saturated fat with carbohydrates has diverging effects due to the heterogeneity of carbohydrate foods. Diets rich in refined carbohydrates increase fasting and postprandial triglycerides, whereas the consumption of fiber-rich, low GI foods lowers LDL cholesterol with no detrimental effects on triglycerides. The role of polyphenols is debated: available evidence suggests a lowering effect of polyphenol-rich foods on postprandial triglycerides. As for functional foods, health claims on a cholesterol lowering effect of psyllium, beta-glucans and phytosterols are accepted by regulatory agencies. The importance of alcohol intake, weight reduction, and physical activity is discussed. In conclusion, there is evidence that lifestyle affects plasma lipid. A multifactorial approach including multiple changes with additive effects is the best option. This may also ensure feasibility and durability. The traditional Mediterranean way of life can represent a useful model.

Keywords Dyslipidemias · LDL cholesterol · Cardiovascular diseases prevention · Lifestyle modifications · Dietary fat · Dietary carbohydrates

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Introduction

Lifestyle intervention plays an important role in the prevention of atherosclerotic cardiovascular diseases. It can influence atherogenesis directly or through effects on cardiovascular risk factors such as plasma lipids, blood pressure, or plasma glucose levels [1]. In particular, a large body of data has accumulated during the last 50 years on the impact of different dietary measures and regular physical activity on plasma lipoprotein metabolism. On the overall, the evidence supports the efficacy of lifestyle modifications in improving the plasma lipoprotein profile and reducing the incidence of cardiovascular diseases (CVD) [2, 3].

It is well established that low-density lipoproteins (LDL) contribute to the development of atherosclerosis over and above the influence of other known risk factors. Triglyceride-rich lipoproteins, particularly in diabetic patients and in people with metabolic syndrome, are also associated with an increased cardiovascular risk, while high-density lipoprotein (HDL) cholesterol levels are inversely associated with CVD in prospective studies [2]. A meta-analysis of intervention studies on the relationship between improvement of the plasma lipoprotein profile and incidence of cardiovascular events has demonstrated that lowering non-HDL cholesterol translates into reduction of CV incidence independently of the mechanisms involved (i.e., dietary interventions, use of statins, resins, or ileal bypass) [4]. This emphasizes the opportunity to implement lifestyle modifications aimed at reducing LDL and non-HDL cholesterol at the population level in people at moderate cardiovascular risk—as the only therapeutic intervention—and in people at high cardiovascular risk—in addition to the pharmacological treatment [2, 3].

Dietary Fat Composition

The impact of dietary fat modifications on the plasma lipoprotein profile is summarized in a meta-analysis of 27 well conducted, controlled dietary intervention trials lasting 3 to 8 weeks. The relationship between diet composition and changes in plasma concentrations of the major lipoprotein classes is consistent and reproducible to the point that from these data, a set of mathematical equations were derived to predict the magnitude of the change(s) in plasma lipoprotein levels in response to specific dietary fat change(s) [5]. According to these equations, the amount of saturated fat in the diet and, in particular, that of fatty acids with 12–16 carbon atoms has the strongest impact on plasma LDL cholesterol levels. The estimated increase in LDL cholesterol for each additional 1 % energy from saturated fat is 0.8–1.6 mg/dL (0.02–0.04 mmol/L). On the contrary, LDL cholesterol decreases by 2.0 mg/dL (0.051 mmol/L) for each 1 % of saturated fatty acid (SFA) intake replaced with n-6 polyunsaturated fat (PUFA), by 1.6 mg/dL (0.041 mmol/L) for the replacement with monounsaturated fatty acid (MUFA) and by 1.2 mg/dL (0.032 mmol/L) for the replacement with carbohydrate.

As for HDL cholesterol, substituting MUFA for SFA has a small or no effect, whereas n-6 PUFA induces a slight decrease of this lipoprotein class; however, both types of unsaturated fat reduce the LDL/HDL cholesterol ratio and lower plasma triglycerides, thus improving the overall cardiovascular risk associated with the plasma lipoprotein profile. The high quality and the large number of the individual studies reviewed make these predictions very reliable [5].

The high consistency of the evidence has prompted the European Food Safety Authority (EFSA)—an independent and authoritative body appointed by the European Community to issue opinions on the scientific substantiation of health claims—to state that "Consumption of saturated fat increases blood cholesterol concentrations; consumption of mono- and/or polyunsaturated fat in replacement of saturated fat has been shown to lower/reduce blood cholesterol. Blood cholesterol lowering may reduce the risk of (coronary) heart disease" [6].

Substitution of saturated fat with MUFA or n-6 PUFA improves also other cardiovascular risk factors (RF) in particular, insulin sensitivity, blood pressure, subclinical inflammation, and endothelial dysfunction [7, 8].

Trans-fatty acids in the diet are largely of industrial origin. They have quantitatively similar raising effects on LDL cholesterol as SFAs, but unlike SFAs, they also decrease HDL cholesterol levels, with an additional detrimental effect on the LDL/HDL ratio [5].

In most industrialized countries, the food industry has largely eliminated the trans-fatty acids from food production, thus greatly reducing their consumption at the population level. This measure may contribute to the improvement of the plasma lipid profile and the prevention of CVD. Unfortunately, the intake of trans-fatty acids remains too high in many developing countries and further actions are needed to restrict or completely eliminate their use. Several experimental studies in humans have evaluated the effects of dietary cholesterol on cholesterol absorption and lipid metabolism and have revealed a marked variability among individuals. This variability is influenced both by the genetic background—among other polymorphisms in the cholesterol transporters, ABCG5/8 and NPC1L1 play a significant role—and by the composition of diet. In particular, a highly saturated fat intake amplifies the ability of dietary cholesterol to increase LDL cholesterol levels. Within the context of a diet with a moderate content of saturated fat, the impact of dietary cholesterol on LDL cholesterol is small. A greater impact, however, is observed in people with marked hypercholesterolemia [9].

Amount and Type of Carbohydrate-Rich Foods

Replacement of foods high in saturated fat in the diet can be achieved either by unsaturated fat or by carbohydrate-rich foods. Carbohydrate intake represents a controversial issue in relation to the impact on plasma lipoprotein metabolism and on CVD prevention partly due to the heterogeneity of carbohydrate food sources. Carbohydrate foods may differ for their chemical composition (starch vs mono-disaccharides) but also for their physical form and for the amount and/or types of other bioactive food ingredients (i.e., fiber, polyphenols). Very often, this heterogeneity and the sometimes diverging metabolic effects of different carbohydrate-rich foods are not properly accounted for when evaluating the impact of carbohydrates on plasma lipid levels and other cardiovascular risk factors.

In fact, the influence of carbohydrate-rich foods on lipoprotein metabolism depends not only on their amount but also on specific food features that influence carbohydrate digestibility and the absorption of other nutrients. This has raised much interest in food properties able to retard the carbohydrate digestion and absorption in the intestine. In this context, not only the carbohydrate type (mono-disaccharides or polysaccharides) but also the content of fiber and other food constituents modulate the postprandial glucose rise. In particular, viscosity plays an important role, since it delays gastric emptying and hampers the mixing of the intestinal content, thus decreasing the rate of glucose transport to the enterocytes. All these different food features that influence carbohydrate digestibility and, hence, the postprandial metabolic response are somewhat accounted for by the measurement of the glycemic index (GI). This is conceptually the glycemic response elicited by a portion of food containing 50 g of available carbohydrate expressed as a percentage of the glucose response elicited by 50 g of glucose. The preferential

consumption of low glycemic index foods counteracts the possible untoward effects of a highly refined carbohydrate diet on fasting and postprandial plasma triglycerides and on HDL [10•, 11].

Dietary Fiber

Pioneer studies with diets rich in dietary fiber and composed only of natural foods clearly indicate that these diets, especially if rich in soluble fiber, significantly reduce LDL-cholesterol levels in hyperlipidemic and type 2 diabetic patients [12]. The net LDL-cholesterol reduction due to changes in fiber intake can be as high as 10 %. Furthermore it has to be considered that fiber rich foods are generally used as substitutes for food sources of saturated fat and this leads to an additional decrease in LDL cholesterol levels [13].

The beneficial effects of high-fiber diets on LDL cholesterol have been recently confirmed by a meta-analysis comparing the effects of low-GI vs high-GI diets. The significant decrease in LDL cholesterol observed with the low-GI diets was related to their fiber content and, in fact, it was not any more evident when studies with high-fiber diets were excluded from the analysis [14]. The hypocholesterolemic effect of dietary fiber has been mainly ascribed to soluble fiber such as pectin, guar gum, psyllium which are found in fruits, vegetables and legumes, or beta-glucans which are found in some cereals (oats and barley) [15, 16].

In particular, for pectin and psyllium, different meta-analyses show that an average intake of 7–10 g/day reduces total and LDL-cholesterol levels by 0.13 mmol/l [15]. In line with this observation, intervention studies with diets rich in pulses, foods with a high content of pectin, gum, and psyllium show a significant reduction of LDL cholesterol [16]. Of course, other components present in these foods (i.e., phytoestrogen, polyphenols) may also play a role.

Also for beta-glucans, a meta-analysis of intervention studies shows a significant reduction of LDL cholesterol by as much as 6 % with an average daily dosage of at least 3 g/day [17•].

The effect of dietary fiber on plasma triglyceride levels is less clear. Dietary fiber seems able to counteract the rising effect of carbohydrates on fasting triglycerides [13]. In the last years, much attention has been paid to postprandial lipemia as a cardiovascular risk factor and, indeed, large epidemiological studies suggest that postprandial triglycerides are a stronger CV risk factor than fasting triglyceride levels [18]. Different dietary components modulate the postprandial triglyceride response. Recently, much attention has been devoted to the effects of dietary fiber on postprandial triglycerides. Our group has shown that in people with type 2 diabetes, a fiber-rich diet (fruit, vegetable, legumes, whole grains) reduces the postprandial triglyceride response, mainly due to the reduction of lipoproteins carrying exogenous lipids [19]. On the same line, we have shown that in people with the metabolic syndrome a diet based on wholegrain cereals, as compared to a diet with refined cereals, reduces postprandial triglyceride levels by 40 % [20•]. In this study, the decrease in postprandial triglycerides was significantly and inversely correlated with the intake of cereal fiber, supporting the role of cereal fiber in the modulation of the postprandial metabolism.

The effects of dietary fiber on HDL are negligible. Together with the reduction of LDL cholesterol, a small decrease in HDL cholesterol has been reported with high-fiber diets in some studies; however, on the overall, the magnitude of this effect is much less relevant than that obtained on LDL cholesterol. In addition, dietary fiber is able to counteract to a variable extent the decrease in HDL cholesterol induced by high-carbohydrate foods [21].

Dietary fiber may act on lipid metabolism, in particular on LDL cholesterol, through different mechanisms: slowing cholesterol absorption in the intestine, increasing bile acid excretion, producing in the colon short-chain fatty acids that, in turn, inhibit hepatic cholesterol synthesis [15].

With respect to the effects on postprandial triglycerides, it has been suggested that dietary fiber slows down and reduce the absorption of fat in the small intestine, thus decreasing the production of chylomicrons [22].

Simple and Added Sugars

Within the carbohydrates, a particular attention has to be paid to simple sugars and, particularly, to fructose, which, although characterized by a low glycemic index, has many adverse effects on lipid metabolism. Prospective studies indicate that a high intake of sugar-sweetened beverages, containing either sucrose or fructose, is associated with an increased risk of metabolic and cardiovascular diseases (obesity, type 2 diabetes, hypertension, and coronary heart disease) [23, 24]. On the same line, observational and intervention studies show that while low-to-moderate doses of fructose (~10 % of total energy) have no major impact on carbohydrate and lipid metabolism, higher doses increase fasting and postprandial triglyceride levels, especially in subjects with obesity and hypertriglyceridemia [25, 26•].

In conclusion, the available evidence indicates that a high amount of refined carbohydrates in the habitual diet is generally associated with untoward effects on fasting and postprandial lipoprotein levels and ultimately on CVD risk. Therefore, dietary recommendations for the prevention of cardiovascular disease strongly suggest to increase the consumption of fiber-rich and low-GI foods such as vegetables, fruits, whole grains, and legumes, and to limit the intake of sugar-sweetened beverages, sweets, and other foods rich in added sugar [2, 3].

Other Bioactive Compounds Able to Influence Lipid Metabolism

In recent years, much attention has been paid to other food constituents that were neglected in the past since they are present in foods in very small amounts. Among them, the polyphenols have been extensively studied for their impact on cardiovascular diseases and, more in general, on human health.

These substances are mainly present in foods like vegetables, fruits, legumes, whole cereals, and nuts, all of which have been associated with a reduction in CVD risk. Polyphenols may contribute, at least in part, to the health benefits of these foods. They are a very large and complex family of compounds present in virtually all plant foods and in plant-derived beverages, particularly coffee and green tea, wine, and in cocoa/chocolate [27].

Polyphenols and foods rich in these substances may reduce cardiovascular risk by modulating lipid metabolism. In vitro and animal studies have shown that polyphenols decrease Apo B-containing lipoproteins and increase HDL cholesterol levels. This is particularly true for proanthocyanidins that represent one of the most abundant polyphenols in the human diet. However, intervention trials conducted in humans have produced inconsistent results. The differences in the study outcomes have been mainly ascribed to differences in the methodology (i.e., different compounds were tested at different doses) [28].

Dark chocolate and cocoa products, rich in polyphenols but containing also other substances able to influence lipid metabolism, seem to have a more evident hypocholesterolemic effect. A meta-analysis of intervention studies in humans shows a significant decrease in LDL cholesterol in short-term studies, whereas studies of longer duration do not confirm the effects of cocoa on LDL cholesterol and on other lipoprotein classes [29, 30].

Against this background, we tried a more comprehensive approach to evaluate the effects of polyphenol-rich foods on plasma lipoprotein metabolism. Therefore, rather than single molecules, we tested a whole diet that included foods rich in different types of polyphenols. The polyphenol-rich diet was evaluated in a controlled intervention study of medium term duration and was able to significantly reduce plasma triglycerides at fasting and in the postprandial period. No effects were observed on LDL and HDL cholesterol [31•].

In conclusion, data on polyphenols and cardiovascular risk are not at all conclusive and controlled intervention studies of long duration in humans are needed. At this stage, it is however reasonable to recommend the consumption of foods rich in polyphenols because they are associated with clinical benefits on many cardiovascular risk factors [32•].

The Role of Functional Foods

Emerging evidence supports the role for "functional foods" as part of the lifestyle intervention to treat dyslipidemias. Consumption of foods with added plant sterols/stanols, or soluble (viscous) fiber, such as those contained in oats or barley, is associated with a significant reduction in LDL cholesterol, and therefore may have a role in the management of patients whose absolute cardiovascular risk assessment does not justify the use of pharmacotherapy. Alternatively, it may be used on top of pharmacotherapy in people with a high cardiovascular risk and plasma lipid levels not at target. Unfortunately, none of these dietary supplements has been tested in formal RCT with CVD end points.

Phytosterols compete with cholesterol for the intestinal absorption, thus reducing LDL cholesterol levels. Phytosterols have been added to different foods (yogurt, spreads, and vegetable oils); however, the food matrix does not significantly influence the cholesterol-lowering efficacy of phytosterols at equivalent doses [33]. In order to achieve a clinically relevant hypocholesterolemic effect (i.e., 7–10 % reduction) a daily dose of 2 g consumed preferably with the main meal is needed. This dosage has little or no effect on HDL-C and TG levels.

A recent meta-analysis of intervention trials on the effects of fiber supplements on plasma cholesterol levels clearly demonstrates that pectin and psyllium as well as beta-glucans from either whole oats or barley induce a significant reduction of LDL cholesterol levels [34].

On the basis of the abovementioned evidence, health claims on a reduction of LDL cholesterol levels by nearly 5 % with the supplement of 7 g/day of psyllium or 3 g/day of beta-glucans have been accepted by FDA and EFSA [35, 36].

Weight Reduction, Alcohol and Habitual Physical Activity

Studies evaluating the effects of weight reduction on plasma lipoprotein metabolism indicate that weight loss is associated with a modest, but statistically significant, decrease in total and LDL cholesterol together with more pronounced effects on plasma triglyceride levels and HDL.

A meta-analysis of intervention studies [37] aiming at weight reduction showed that weight loss per se (average 16 kg or 16 % from baseline weight) is associated with a mean decrease in plasma total cholesterol of 30 mg/dL, due to the reduction of both LDL and VLDL cholesterol in equal proportions. Weight reduction is significantly correlated with the decrease of LDL and VLDL cholesterol and triglyceride concentrations. For each kilogram decrease in body weight, total and LDL cholesterol decrease by 2 and 0.8 mg/dL, respectively. Furthermore, a 0.3-mg/dL reduction in HDL cholesterol occurs for subjects who actively lose weight, whereas a 0.4-mg/dL increase occurs for subjects at a stabilized weight

reduction. Improvements in HDL cholesterol and in plasma triglycerides tend to be greater in overweight or obese subjects on low-carbohydrate diets, whereas changes in LDL cholesterol levels are more favorable in subjects on low-fat diets [38].

From a practical point of view, weight reduction may be achieved by reducing the consumption of energy-dense foods, especially those rich in fat, to achieve a caloric deficit of 300–500 kcal/day. To maintain its effectiveness on the long run, this intervention should be incorporated into structured, intensive lifestyle education programs. The prescription of a very low energy diet should be limited to cases with severe obesity (BMI >35 kg/m^2) and administered in specialized centers [2].

Alcohol consumption has a neutral effect on LDL cholesterol and a possible positive impact on HDL cholesterol levels [39] but is associated with untoward effects on triglycerides levels. The intake of 40–60 g/day of alcohol is associated with a significant increase in plasma triglycerides particularly in obese or hypertriglyceridemic people.

Moderate-to-heavy aerobic exercise is associated with an improvement in the plasma lipid profile. Both plasma triglyceride reductions and an increase of HDL cholesterol are observed after exercise training. An energy expenditure of 1200 to 2200 kcal/week is associated a with reduction of 5 to 38 mg/dL of plasma triglycerides and an increase of 2 to 8 mg/dL in HDL cholesterol. Evidence from cross-sectional studies indicates that greater changes in HDL cholesterol levels and plasma triglycerides can be expected with additional increases in exercise training volume. Exercise training seldom alters total cholesterol and LDL-cholesterol, unless weight loss is associated with the exercise training program [38].

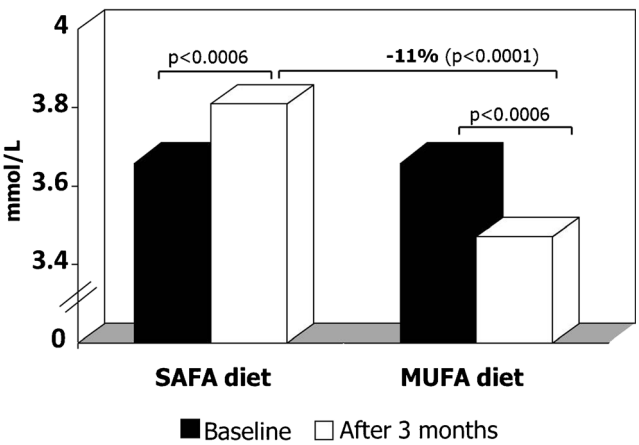

Fig. 1 Effects on LDL cholesterol levels of a 3-month dietary intervention based on the substitution of 10 % energy from saturated with monounsaturated fat in 162 healthy subjects. The KANWU study (modified from reference [43])

Implementation of Lifestyle Modification to Control Dyslipidemias

According to current dietary guidelines for CVD prevention, the most relevant dietary modification to improve the plasma lipoprotein profile is the reduction of trans- and saturated fat (SFA) (i.e., butter, cream, hard margarines, and tropical oils) that should be replaced, by monounsaturated (MUFA) and polyunsaturated fats (PUFA) from non-tropical vegetable oils. The target is to keep the energy intake from saturated fat to <10 % (<7 % in the presence of high plasma cholesterol values) and trans-fats to <1.0 % of total energy. In order to reach this goal, also fatty or processed meat, sweets, regular cheese should be limited while fruits, vegetables, legumes, nuts, and wholegrain cereal foods should be preferred. The latter ones represent an important source of dietary fiber and polyphenols that, as outlined above, have additional beneficial effects on plasma lipoproteins [2, 3].

Other features of the recommended diet for CVD prevention are a low salt intake (below 5 g/day), moderation in the consumption of alcoholic beverages (<10 g/day for women and <20 g/day for men) and limitation in the intake of beverages and foods with added sugars, particularly soft drinks. Moreover, special attention should be paid to the energy intake in order to reduce the occurrence of overweight and obesity [2, 3].

These recommendations are mostly based on solid evidence coming from prospective observational reports and clinical studies evaluating the impact of diet on cardiovascular risk factors [1, 39, 40]. However, also the few available randomized controlled clinical trials (RCT) with hard end points (i.e., CV events), although not always consistent, indicate that the so called healthy diet is effective in reducing the incidence of cardiovascular events [41]. In this respect, it is always important to consider that dietary intervention studies are much more complex than pharmacological trials, and failure to achieve substantial modifications in the habitual diet is often a plausible explanation for the lack of effects on the study outcomes. Moreover, dietary interventions are necessarily multifactorial since it is not possible to change a single dietary constituent without modifying at the same time other features of the diet. Therefore, the results of studies evaluating changes in the habitual diet need to be evaluated taking into account

Table 1 LDL-cholesterol reduction by multiple lifestyle modifications

Intervention	LDL cholesterol reduction
Saturated fat reduction (↓ 10 %)	10 %
Dietary fiber increase (15–20 g)	8 %
Weight reduction (5 kg)	−5 %
Foods enriched with phytosterols (2 g)	10 %
	30–35 %

Table 2 Foods available for consumption in Finland in the second half of the last century

g/day	1960	1970	1980	1990	2000
Animal fat	59	59	51	39	34
Vegetable oils	9	16	20	22	26
Vegetables	50	55	96	156	195
Fruit	114	141	243	216	225
Fish	47	61	77	88	86

FAO food balance sheets

the complexity of the intervention and the nature of all modifications of the food choices undertaken.

Despite these methodological difficulties, new evidence from RCT supports the concept that CVD can be effectively prevented by appropriate diet modifications [2]. Recently, the results of a randomized controlled trial conducted in high-risk individuals have clearly shown that a Mediterranean diet, resembling food choices highlighted in most recent recommendations for CVD prevention, lowers by 29 % (RR 0.71; 95 % CI 0.56–0.90) the incidence of cardiovascular disease over a 5-year period in comparison with a low-fat diet traditionally considered as the gold standard [42].

Criticisms to the use of lifestyle interventions for controlling dyslipidemias arise from the difficulty to achieve changes that may last in the long term and from doubts on the clinical relevance of the magnitude of the lipoprotein changes that can be achieved.

As for the last point, it is clear from the evidence reviewed here that although each single lifestyle modification has a rather modest impact on plasma lipoprotein levels and, in particular, on LDL cholesterol, the combination of different measures may have a clear clinical relevance. Reducing by 10 %, the amount of saturated fat in the diet leads to an LDL cholesterol reduction of around 10 % (Fig. 1) [43] and summing it up to the effect(s) of other diet modifications (i.e., increase of dietary fiber, weight reduction, and the daily consumption of phytosterol supplements), the impact on LDL cholesterol can be meaningful (Table 1). The additive effects of lifestyle changes have been clearly demonstrated by a study in which a so-called portfolio diet was tested. Indeed, adoption of this type of diet that included plant sterols, viscous fiber, soy proteins, and nuts had cumulative LDL cholesterol-lowering benefits reaching an overall reduction of 20–30 %, which represent a meaningful approach to the reduction of CVD risk [44•]. Appropriate food choices aiming at reducing simple sugar intake and at increasing food sources of polyphenols together with regular exercise of moderate intensity may also have a favorable impact on other lipoprotein classes, namely triglyceride-rich lipoproteins and HDL.

As for the feasibility of lifestyle changes in the long term, significant declines in saturated fat intake and reciprocal increases in polyunsaturated fat were implemented at the population level between 1990 and 2010 in many Eastern and Northern European countries. This demonstrates the feasibility at the level of the general population of lifestyle modifications aiming at reducing LDL cholesterol and at improving the overall lipoprotein profile. The decrease of the saturated fat consumption started in the second half of the last century in most European countries as indicated by crude national availability and production estimates. Finland constitutes one of the best documented examples of a community intervention that had most of its effect prior to 1990, with further (though smaller) declines

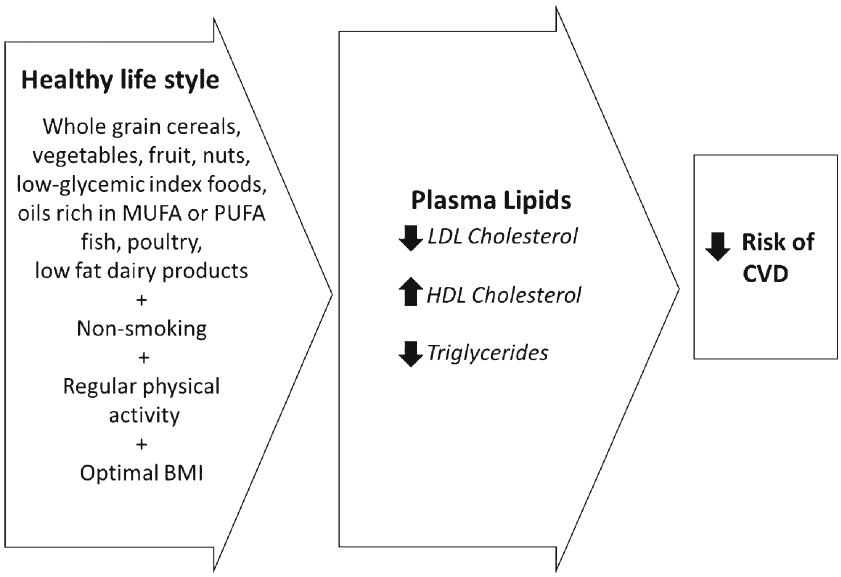

Fig. 2 The impact of lifestyle modifications on plasma lipids and CVD risk

seen after that [45]. The major pillars of this intervention included the transition from consumption of fatty milk to low fat and skimmed milk, a large reduction in butter consumption, and a marked increase in the use of vegetables and vegetable oils (Table 2). Dietary changes were paralleled by a constant decline of serum cholesterol levels; at the population level over 80 % of the cholesterol reduction was due to dietary changes, and only less than 20 % to the use of statins; these drugs become available only 10 years after the plasma cholesterol decline had started [46].

Additional key issues concerning the implementation of lifestyle modifications are (1) long-term adherence and (2) economical costs. Addressing the question of how to ensure sustainable dietary changes must be a priority for research. Furthermore, in the current austerity climate in Europe, cost may detrimentally influence the choice of a Mediterranean diet. Both challenges require the involvement of public health researchers and policy makers to ensure the benefits of dietary intervention are optimized.

Conclusions

Taking into consideration the whole available evidence, it is clear that lifestyle modifications can be very effective in controlling dyslipidemias. In this respect, a multifactorial approach seems the best option since it can combine multiple small variations in the habitual behaviors that are more feasible and durable than a single, more radical change and that in addition have additive effects on the amelioration of the plasma lipoprotein profile (Fig. 2). This approach is of major clinical relevance both for people who do not need pharmacological treatment—in view of their low/moderate absolute CVD risk—and for those who are on hypolipidemic drugs since they can get extra benefits from appropriate lifestyle changes. The traditional Mediterranean way of life can represent a useful model to implement dietary changes and other lifestyle modifications that are healthy and, at the same time, is based on a solid cultural and gastronomic background that facilitates its implementation on the basis not only of its health benefits but also in consideration of its palatability and appeal.

Compliance with Ethical Standards

Conflict of Interest Gabriele Riccardi, Olga Vaccaro, Giuseppina Costabile, and Angela A. Rivellese declare that they have no conflict of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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