

## Original Article

# Secondary prevention of coronary heart disease by diet

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Secondary prevention of coronary heart disease (CHD) usually focuses on risk reduction in patients with established CHD who are at high risk of recurrent cardiac events and death from cardiac causes. Because complications such as sudden cardiac death (SCD) and associated syndromes are often unpredictable, occur out of hospital and far from any potential therapeutic resources in the majority of cases, and account for more than 60% of total cardiac mortality in most countries, they should be the priority of any secondary prevention program. As a conclusion of this article, we propose a minimum clinical priority dietary program based on the idea that many patients (and their families) find it difficult to fully and immediately adopt a very effective cardioprotective diet. The clinical priority program provides a list of simple dietary recommendations that the patient and his/her attending physician will try to follow or not, according to their own choices and possibilities.

**Key words:** secondary prevention of heart disease, cardioprotective diet, plaque inflammation, heart failure, blood cholesterol

## Introduction

Secondary prevention of coronary heart disease (CHD) should be started immediately after the first clinical manifestation of CHD. In more general terms, secondary prevention usually focuses on risk reduction in patients with established CHD who are at high risk of recurrent cardiac events and death from cardiac causes. The two main causes of death in these patients are sudden cardiac death (SCD) and heart failure (HF), often resulting from myocardial ischemia and subsequent necrosis. The main mechanism underlying recurrent cardiac events is myocardial ischemia resulting from atherosclerotic plaque rupture or ulceration. Plaque rupture is usually the consequence of intraplaque inflammation in relation with a high lipid content of the lesion, high concentration of leukocytes and lipid peroxidation products. Thus, in patients with established CHD, the three main aims of the preventive strategy are to prevent malignant ventricular arrhythmia and the development of severe ventricular dysfunction (and heart failure) and to minimize the risk of plaque inflammation and ulceration. This means that the priority of secondary prevention is somewhat different from that of primary prevention. In the context of primary prevention, intervention focuses on traditional risk factors (e.g. blood cholesterol or blood pressure) and surrogate endpoints rather than on specific clinical complications such as SCD. This does not mean that traditional risk factors of CHD should not be measured and, if necessary, corrected in secondary prevention, because they also play a role in the occurrence of CHD complications. It simply means that because complications such as SCD and associated syndromes are often unpredictable, occur out of hospital and far from any potential therapeutic resources in the majority of cases, and account for more than 60% of cardiac mortality in secondary prevention, they should be the priority of any secondary prevention program.

As a conclusion of this article, we propose a minimum clinical priority dietary program based on the idea that many patients (and their families) find it difficult (for instance because they are not supported by a well-informed physician) to fully and immediately adopt a very effective cardioprotective diet. The clinical priority program provides a list of simple dietary recommendations that the patient and his/her attending physician will try to follow or not, according to their own choices and possibilities. Patients and physicians should know, however, that none of these minimum changes could replace the holistic approach described elsewhere.<sup>1</sup>

## Dietary prevention of sudden cardiac death

In the absence of a generally accepted definition, SCD is usually defined as death from a cardiac cause occurring within one hour from the onset of symptoms. The magnitude of the problem is considerable as SCD is a very common, and often the first, manifestation of CHD, and it accounts for about 50% of cardiovascular mortality in developed countries.<sup>2</sup> In most cases, SCD occurs without prodromal symptoms and out of hospital. As a matter of fact, this mode of death is a major public health issue. Since up to 80% of SCD patients had CHD,<sup>2</sup> the epidemiology and potential preventive approaches of SCD should, in theory, parallel those of CHD. In other words, any treatment aimed at reducing CHD should reduce the incidence of SCD.

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The hypothesis that eating fish may protect against SCD is derived from the results of a secondary prevention trial, the Diet And Reinfarction Trial (DART), which showed a significant reduction in total and cardiovascular mortality (both by about 30%) in patients who had at least 2 servings of fatty fish per week.<sup>3</sup> The authors suggested that the protective effect of fish might be explained by a preventive action on ventricular fibrillation (VF), since no benefit was observed on the incidence of nonfatal acute myocardial infarction (AMI). This hypothesis was consistent with experimental evidence suggesting that n-3 polyunsaturated fatty acids (PUFA), the dominant fatty acids in fish oil and fatty fish, have an important effect on the occurrence of VF in the setting of myocardial ischemia and reperfusion in various animal models, both in vivo and in vitro.<sup>4,5</sup> In the same studies, it was also apparent that saturated fatty acids are proarrhythmic as compared to unsaturated fatty acids. Using an elegant in vivo model of SCD in dogs, Billman and colleagues demonstrated a striking reduction of VF after intravenous administration of pure n-3 PUFA, including both the long chain fatty acids present in fish oil and alpha-linolenic acid, their parent n-3 PUFA occurring in some vegetable oils.<sup>6</sup>

Support for the hypothesis of a clinically significant antiarrhythmic effect of n-3 PUFA in the secondary prevention of CHD, as put forward in DART,<sup>3</sup> came from two randomized trials testing the effect of ethnic dietary patterns (instead of that a single food or nutrient), i.e a Mediterranean type of diet and an Asian vegetarian diet, in the secondary prevention of CHD.<sup>7,8</sup> The two experimental diets included a high intake of essential alpha-linolenic acid, the main vegetable n-3 PUFA. Whereas the incidence of SCD was markedly reduced in both trials, the number of cases was small and the antiarrhythmic effect cannot be entirely attributed to alpha-linolenic acid as these experimental diets were also high in other nutrients with potential antiarrhythmic properties, including various antioxidants. These findings were extended by the population-based case-control study conducted by Siscovick and colleagues on the intake of n-3 PUFA among patients with primary cardiac arrest, compared to that of age- and sex-matched controls.<sup>9</sup> Their data indicated that the intake of about 5 to 6g of n-3 PUFA per month (an amount provided by consuming fatty fish once or twice a week) was associated with a 50% reduction in the risk of cardiac arrest. In that study, the use of a biomarker, the red blood cell membrane level of n-3 PUFA, considerably enhanced the validity of the findings, which also were consistent with the results of many (but not all) cohort studies suggesting that consumption of one to two servings of fish per week is associated with a marked reduction in CHD mortality as compared to no fish intake.<sup>10,11</sup> In most studies, however, the SCD endpoint is not reported. Finally, in a large prospective study (more than 20,000 participants with a follow-up of 11 years), Albert *et al.*, examined the specific point that fish has antiarrhythmic properties and may prevent SCD.<sup>12</sup> They found that the risk of SCD was 50% lower for men who consumed fish at least once a week than for those who had fish less than once a month. Interestingly, the consumption of fish was not related to non-sudden cardiac death suggesting that the main

protective effect of fish (or n-3 PUFA) is related to an effect on arrhythmia. These results are consistent with those of DART.<sup>3</sup>

The GISSI-Prevenzione trial was aimed at helping in addressing the question of the health benefits of foods rich in n-3 PUFA (and also in vitamin E) and their pharmacological substitutes.<sup>13</sup> Patients (n=11,324) surviving a recent AMI (<3 months) and having received the prior advice to come back to a Mediterranean type of diet were randomly assigned supplements of n-3 PUFA (0.8g daily), vitamin E (300mg daily), both or none (control) for 3.5 years. The primary efficacy endpoint was the combination of death and non-fatal AMI and stroke. Secondary analyses included overall mortality, cardiovascular (CV) mortality and SCD. The clinical events were validated by an ad-hoc committee of expert cardiologists,<sup>13</sup> who presumably used the current definition of SCD. Treatment with n-3 PUFA significantly lowered the risk of the primary endpoint (the relative risk decreased by 15%). Secondary analyses provided a clearer profile of the clinical effects of n-3 PUFA. Overall mortality was reduced by 20% and CV mortality by 30%. However, it was the effect on SCD (45% lower) that accounted for most of the benefits seen in the primary combined endpoint and both overall and CV mortality. There was no difference across the treatment groups for nonfatal CV events, a result comparable to that of DART.<sup>3</sup> Thus, the results obtained in this randomised trial are consistent with previous controlled trials,<sup>3,7,8</sup> large-scale observational studies<sup>10-12</sup> and experimental studies,<sup>4,6</sup> which together strongly support an effect of n-3 PUFA in relation with SCD. An important point is that the protective effect of n-3 PUFA on SCD was greater in the groups of patients who complied more strictly with the Mediterranean diet. This suggests a positive interaction between n-3 PUFA and some components of the Mediterranean diet which is, by definition, not high in n-6 PUFA and low in saturated fats, but rich in oleic acid, various antioxidants and fibre, and associated with a moderate consumption of alcohol.

#### **Diet and the risk of heart failure following AMI**

The incidence of chronic heart failure (CHF), the common end-result of most cardiac diseases and the second cause of cardiac death, is increasing steadily in many countries despite (and probably because of) considerable improvements in the acute and chronic treatment of CHD, which is nowadays the main cause of CHF in most countries.<sup>14</sup> In the recent years, most research effort about CHF has been focused on drug treatment, and there has been little attention paid to non-pharmacological management. Some unidentified factors may indeed contribute to the rise in the prevalence of CHF and should be recognised and corrected if possible. For instance, CHF is now seen also as a metabolic problem with endocrine and immunological disturbances potentially contributing to the progression of the disease.<sup>15,16</sup> Only recently has it been also recognized that increased oxidative stress may contribute to the pathogenesis of CHF.<sup>17</sup> The intimate link between diet and oxidative stress is obvious, knowing that the major antioxidant defences of our body are derived from essential nutrients.<sup>18</sup> While it is generally considered

that a high sodium diet is detrimental (and may result in acute decompensation of heart failure through a volume over-load mechanism), little is known about other aspects of diet in CHF in terms of both general nutrition and micronutrients such as vitamins and minerals. In these patients, it is important not only to take care of the diagnosis and treatment of the CHF syndrome itself and for the identification and aggressive management of traditional risk factors of CHD such as high blood pressure and cholesterol (because they can aggravate the syndrome), but also for the recognition and correction of malnutrition and of deficiencies in specific micronutrients.

The vital importance of micronutrients for health and the fact that several micronutrients have antioxidant properties are now fully recognized. These may be as direct antioxidants such as vitamins C and E or as components of antioxidant enzymes: superoxide dismutase or glutathione peroxidase.<sup>18</sup> It is now widely believed (but still not causally demonstrated) that diet-derived antioxidants may play a role in the development (and thus in the prevention) of CHF. For instance, clinical and experimental studies have suggested that CHF may be associated with increased free radical formation<sup>19</sup> and reduced antioxidant defences<sup>20</sup> and that vitamin C may improve endothelial function in patients with CHF.<sup>21</sup>

Other nutrients, however, may be also involved in certain cases of CHF. While deficiency in certain micronutrients, whatever the reason, can actually cause CHF and should be corrected (see below), it is important to understand that patients suffering from CHF also have symptoms that can affect their food intake and result in deficiencies, for instance tiredness when strained, breathing difficulties and gastrointestinal symptoms like nausea, loss of appetite and early feeling of satiety. Drug therapy can lead to loss of appetite and excess urinary losses in case of diuretic use. All of these are mainly consequences, not causative factors, of CHF. Thus the basic treatment of CHF should, in theory, improve these nutritional anomalies. However, since they can contribute to the development and severity of CHF, they should be recognized and corrected as early as possible.

Finally, it has been shown that up to 50% of patients suffering from CHF are malnourished to some degree,<sup>22</sup> and CHF is often associated with weight loss. There may be multiple etiologies to the weight loss,<sup>23</sup> in particular lack of activity resulting in loss of muscle bulk and increased resting metabolic rate. There is also a shift towards catabolism with insulin resistance and increased catabolic relative to anabolic steroids.<sup>24</sup> TNF, sometimes called cachectin (see above), is higher in many patients with CHF,<sup>15,24</sup> which may explain weight loss in these patients. Finally, cardiac cachexia is a well-recognized complication of CHF, its prevalence increases as symptoms worsen<sup>25</sup> and it is an independent predictor of mortality in CHF patients. However, the pathophysiological alteration leading to cachexia remains unclear and at present, there is no specific treatment apart from the treatment of the basic illness and correction of the associated biological abnormalities.

As written above, an important practical point is that deficiencies in specific micronutrients can actually cause

CHF, or at least aggravate it. The prevalence of these deficiencies among patients with CHF (and post-infarction patients) is unknown. Whether we should systematically search for them also remains unclear. In particular, we do not know whether the association of several borderline deficiencies that do not individually result in CHF may result in CHF, especially in the elderly. For certain authors, however, there is sufficient evidence to support a large-scale trial of dietary micronutrient supplementation in CHF.<sup>26</sup>

There is no room here to fully expose the present knowledge in that field. We will just briefly discuss the selenium issue. Selenium deficiency has been identified as a major factor in the etiology of certain non-ischemic CHF syndromes, especially in low-selenium soil areas such as Eastern China and Western Africa.<sup>27</sup> In Western countries, cases of congestive cardiomyopathy associated with low antioxidant nutrients (vitamins and trace elements) have been reported in malnourished HIV-infected patients and in subjects on chronic parenteral nutrition.<sup>28</sup> Selenium deficiency is also a risk factor for peripartum cardiomyopathy.

In China, an endemic cardiomyopathy called Keshan disease seems to be a direct consequence of selenium deficiency. Whereas the question of the mechanism by which selenium deficiency results in CHF remains open, recent data suggest that selenium may be involved in skeletal (and cardiac) muscle deconditioning (and in CHF symptoms such as fatigue and low exercise tolerance) rather than in left ventricular dysfunction.<sup>20</sup> Actually, in the Keshan area, the selenium status coincides with the clinical severity rather than with the degree of left ventricular dysfunction as assessed by echocardiographic studies. When the selenium levels of residents were raised to the typical levels in the non-endemic areas, the mortality rate declined significantly but clinically latent cases were still found and the echocardiographic prevalence of the disease remained high.<sup>27</sup> What we learn from Keshan disease and other studies conducted elsewhere<sup>20</sup> is therefore that in patients with a known cause of CHF, even a mild deficiency in selenium may influence the clinical severity of the disease (for instance, the tolerance to exercise). Finally, recent experimental data suggest that the myocardium is extremely sensitive (at least in response to an ischemic stress) to selenium deficiency,<sup>29</sup> suggesting that cardiac selenium-dependent enzymes are very important for cardiac function. These data should serve as a strong incentive for the initiation of studies testing the effects of natural antioxidants on the clinical severity of CHF, in particular in the context of CHD and after an AMI. In the meantime, however, physicians would be well advised to measure selenium in CHD patients with an exercise inability disproportionate to their cardiac dysfunction.

### **Diet and the prevention of plaque inflammation and rupture**

For several decades, the prevention of CHD (including the prevention of ischemic recurrence after a prior AMI) has focused on the reduction of the traditional risk factors: smoking, HBP, hypercholesterolemia. Priority was given to the prevention (or reversion) of vascular

atherosclerotic stenosis. As discussed above, it has become clear in secondary prevention that clinical efficiency needs to primarily prevent the fatal complications of CHD such as SCD. This does not mean, however, that we should not try slowing down the atherosclerotic process, and in particular plaque inflammation and rupture. Indeed, it is critical to prevent the occurrence of new episodes of myocardial ischemia whose repetition in a recently injured heart can precipitate SCD or CHF. Myocardial ischemia is usually the consequence of coronary occlusion caused by plaque rupture and subsequent thrombotic obstruction of the artery. Recent progress in the understanding of the cellular and biochemical pathogenesis of atherosclerosis suggests that, in addition of the traditional risk factors of CHD, there are other very important targets of therapy to prevent plaque inflammation and rupture. In this regard, the most important question is: how and why does plaque rupture occur?

Most investigators agree that atherosclerosis is a chronic inflammatory disease.<sup>30</sup> Pro-inflammatory factors (free radicals produced by cigarette smoking, hyperhomocysteinemia, diabetes, peroxidized lipids, hypertension, elevated and modified blood lipids) contribute to injure the vascular endothelium, which results in alterations of its antiatherosclerotic and antithrombotic properties. This is thought to be a major step in the initiation and formation of arterial fibrostenotic lesions.<sup>30</sup> From a clinical point of view, however, an essential distinction should be made between unstable, lipid-rich and leukocyte-rich lesions and stable, acellular fibrotic lesions poor in lipids, as the propensity of these two types of lesion to rupture into the lumen of the artery, whatever the degree of stenosis and lumen obstruction, is totally different.

In 1987, we proposed that inflammation and leukocytes play a role in the onset of acute CHD events.<sup>31</sup> This has been confirmed.<sup>32-34</sup> It is now accepted that one of the main mechanisms underlying the sudden onset of acute CHD syndromes, including unstable angina, myocardial infarction and SCD, is the erosion or rupture of an atherosclerotic lesion,<sup>32,33</sup> which triggers thrombotic complications and considerably enhances the risk of malignant ventricular arrhythmias.<sup>34</sup> Leukocytes have been also implicated in the occurrence of ventricular arrhythmias in clinical and experimental settings,<sup>35</sup> and they contribute to myocardial damage during both ischemia and reperfusion.<sup>35</sup> Clinical and pathological studies showed the importance of inflammatory cells and immune mediators in the occurrence of acute CHD events,<sup>30,36</sup> and prospective epidemiological studies showed a strong and consistent association between acute CHD and systemic inflammation markers.<sup>37,38</sup> A major question is to know why there are macrophages and activated lymphocytes<sup>39</sup> in atherosclerotic lesions and how they get there. Issues such as local inflammation, plaque rupture and attendant acute CHD complications follow.

Steinberg *et al.*, proposed in 1989 that oxidation of lipoproteins causes accelerated atherogenesis.<sup>39</sup> Elevated plasma levels of low-density lipoproteins (LDL) are a major factor of CHD, and reduction of blood LDL levels (for instance by drugs) results in less CHD. However, the mechanism(s) behind the effect of high LDL levels is not

fully understood. The concept that LDL oxidation is a key characteristic of unstable lesions is supported by many reports.<sup>39</sup> Two processes have been proposed. First, when LDL particles become trapped in the artery wall, they undergo progressive oxidation and are internalized by macrophages, leading to the formation of typical atherosclerotic foam cells. Oxidized LDL is chemotactic for other immune and inflammatory cells and up-regulates the expression of monocyte and endothelial cell genes involved in the inflammatory reaction.<sup>30,39</sup> The inflammatory response itself can have a profound effect on LDL,<sup>30</sup> creating a vicious circle of LDL oxidation, inflammation and further LDL oxidation. Second, oxidized LDL circulates in the plasma for a period sufficiently long to enter and accumulate in the arterial intima, suggesting that the entry of oxidized lipoproteins within the intima may be another mechanism of lesion inflammation, in particular in patients without hyperlipidemia.<sup>40</sup> The oxidized LDL theory is not inconsistent with the well-established lipid-lowering treatment of CHD, as there is a positive correlation between plasma levels of LDL and markers of lipid peroxidation<sup>41,42</sup> and low absolute LDL level results in reduced amounts of LDL available for oxidative modification. LDL levels can be lowered by drugs or by reducing saturated fats in the diet. Reduction of the oxidative susceptibility of LDL was reported when replacing dietary fat with carbohydrates. Pharmacological (lowering of cholesterol) and nutritional (high antioxidant intake) approaches of the prevention of CHD are not mutually exclusive but additive and complementary.

An alternative way to reduce LDL concentrations is to replace saturated fats with polyunsaturated fats in the diet. However, diets high in polyunsaturated fatty acids increase the polyunsaturated fatty acid content of LDL particles and render them more susceptible to oxidation<sup>43</sup> which would argue against use of such diets (see above the section on SCD and n-6 PUFA). As a matter of fact, in the secondary prevention of CHD, such diets failed to improve the prognosis of the patients (for a review see ref 44). In that context, the traditional Mediterranean diet, with low saturated fat and polyunsaturated fat intakes, appears to be the best option. Diets rich in oleic acid increase the resistance of LDL to oxidation independent of the content in antioxidants<sup>45,46</sup> and results in leukocyte inhibition.<sup>47</sup> Thus, oleic acid-rich diets decrease the pro-inflammatory properties of oxidized LDL. Constituents of olive oil other than oleic acid may also inhibit LDL oxidation.<sup>48</sup> Various components of the Mediterranean diet may also affect LDL oxidation. For instance, alpha-tocopherol or vitamin C, or a diet combining reduced fat, low-fat dairy products and a high intake of fruits and vegetables were shown to favorably affect either LDL oxidation itself or/and the cellular consequences of LDL oxidation.<sup>49,50</sup>

Finally, significant correlation was found between certain dietary fatty acids and the fatty acid composition of human atherosclerotic plaques,<sup>51,52</sup> which suggests that dietary fatty acids are rapidly incorporated into the plaques. This implies a direct influence of dietary fatty acids on plaque formation and the process of plaque rupture. It is conceivable that fatty acids that stimulate oxidation of

LDL (n-6 fatty acids) induce plaque rupture whereas those that inhibit LDL oxidation (oleic acid), inhibit leukocyte function (n-3 fatty acids)<sup>53</sup> or prevent "endothelial activation" and the expression of pro-inflammatory proteins (oleic acid and n-3 fatty acids)<sup>54,55</sup> contribute to pacify and stabilize the dangerous lesions. In the same line, the potential of dietary n-3 fatty acids to reduce the production of inflammatory cytokines<sup>56,57</sup> by leukocytes should be underlined. As dietary n-3 fatty acids are major characteristics of the Mediterranean diet, it is not surprising to observe that this diet was associated with lower rate of new episodes of CHF in the Lyon Diet Heart Study.<sup>58</sup>

Thus, any dietary pattern combining a high intake of natural antioxidants, a low intake of saturated fatty acids, a high intake of oleic acid, a low intake of omega-6 fatty acids and a high intake of omega-3 fatty acids would logically produce a highly cardioprotective effect. This is consistent with what we know about the Mediterranean diet pattern,<sup>59,60</sup> with the results of the Lyon Diet Heart Study<sup>8,58,59</sup> and the Indo-Mediterranean diet trial.<sup>61</sup> These trial data were recently confirmed by concordant observational studies, those published by the GISSI investigators<sup>62</sup> and those of Greek epidemiologists.<sup>63</sup> As a matter of fact, experts of the American Heart Association now recognized the Mediterranean diet as the reference diet for the prevention of CHD.<sup>64</sup>

### The dietary approach to reduce blood cholesterol

Cholesterol is a determinant of CHD mortality, and its blood level is at least partly regulated by diet. However, few epidemiological studies have prospectively included analyses of the dietary habits of the studied populations in the evaluation of their risk.<sup>65</sup> In the Seven Countries Study, marked differences in CHD mortality, dietary habits and cholesterol distribution were observed in the different cohorts.<sup>66</sup> Cholesterol levels were high in Northern Europe and in the USA (an average level of 7 mmol/L), and low in rural Japan (an average of 4 mmol/L in average), and population cholesterol levels were positively associated with CHD mortality.

A major (and often underestimated) finding of the Seven Countries Study was the large difference in absolute risk of CHD death at the same level of serum cholesterol in the different cohorts. At cholesterol level of about 6 mmol/L, CHD mortality was 3 times as high in Northern Europe as in Mediterranean Europe (18% vs 6%). This suggested that factors other than cholesterol were playing an important role. Because of the similarity of the other traditional risk factors and the large differences in the dietary habits of the cohorts,<sup>67</sup> it was proposed that the difference in CHD mortality between populations was mainly related to their dietary habits, through biological effects independent of cholesterol.<sup>44,67</sup> This was the basis of a new "diet-heart hypothesis" in which cholesterol was not the central issue.<sup>44,67</sup> In fact, the first dietary trials designed for the secondary prevention of CHD were based on the hypothesis that a cardioprotective diet should primarily reduce cholesterol.<sup>44</sup> While the investigators succeeded in reducing cholesterol, they failed to reduce CHD mortality.<sup>44,68</sup> This was mainly attributed to an insufficient effect of the tested diets on

cholesterol, and the conclusion was that cholesterol-lowering drugs should be preferred. However, none of the diets tested in these old trials was patterned from the traditional diets of populations protected from CHD (e.g. vegetarian, Asian or Mediterranean), although these diets are associated with low cholesterol. Also, no trial was aimed at testing the cholesterol-lowering effect of a typical Mediterranean diet, probably because this diet was (and often still is) mistakenly regarded as a high fat diet, allegedly not appropriate to reduce cholesterol. Finally, as discussed in the different sections of this text, the Mediterranean diet was shown to strongly reduce the risk of CHD complications in secondary prevention<sup>8,58</sup> and should be one of the preferred dietary patterns adopted by post-infarct patients.<sup>64</sup> In the Lyon trial, the lipid-lowering effect of the Mediterranean diet was not different from that of the prudent Western diet followed by the control group, because lipid-lowering drugs were widely used in the two randomized groups. This nonetheless suggested that the Mediterranean diet was cardioprotective through biological effects independent of its effect on cholesterol. In particular, data from the Lyon trial suggested that the Mediterranean diet might prevent SCD (see above the section about the dietary prevention of SCD).

### A minimum clinical priority dietary program

Despite the increased evidence that dietary prevention is critical in the post-AMI patient, many physicians (and their patients) remain rather poorly informed about the potential of diet to reduce cardiac mortality, the risk of new CHD complications and the need for recurrent hospitalisation and investigation. There are many reasons for that, the main one probably being an insufficient knowledge of nutrition.<sup>69</sup> For that reason (and knowing the resistance of many physicians to accept the idea that diet is important in CHD), we propose in the following lines a *minimum dietary program* that every CHD patient, whatever his/her medical and familial environment, should know and follow. Based on the clinical priorities of secondary prevention discussed above, the "minimum Mediterranean dietary program" should include the following:

1. Reduced consumption of animal saturated fat (for instance, by totally excluding butter and cream from the daily diet and drastic reduction of fatty meat) and increased consumption of n-3 fatty acids through increased intake of fatty fish (about 200g, twice a week). For patients who cannot eat fish (for any reason), taking capsules of n-3 fatty acids (for instance, a mix of alpha-linolenic acid and long-chain n-3 fatty acids) is the best alternative option. With this comprehensive approach, some ways of presenting or cooking fish (salted, deeply fried with saturated or polyunsaturated fat) should be avoided. Very importantly, the patients (and their physicians) should be aware that n-3 fatty acid supplementation will be even more cardioprotective if associated with adequate dietary modifications discussed in the text above.<sup>70</sup>
2. Increased intake of anti-inflammatory fatty acids (oleic acid and n-3 fatty acids) and decreased intake of pro-

inflammatory fatty acids (n-6 fatty acids). The best way is to exclusively use olive oil and canola oil for cooking and salad dressing and canola oil-based margarine instead of butter and polyunsaturated oils and margarines.<sup>71,72</sup> Patients should also systematically reject convenience food prepared with fats rich in saturated, polyunsaturated and trans fatty acids.

3. Increased intake of natural antioxidants (vitamins and trace-elements) and folates through increased consumption of fresh fruits and vegetables, legumes and tree nuts.

4. Moderate intake of alcoholic beverages (1 or 2 drinks per day), preferably wine, preferably during the evening meal, and never before driving or making a dangerous technical manipulation.

5. Reduction of sodium intake (below 100mmol per day if possible) knowing that it is a very difficult task at the present time because of the high sodium content of many natural (including typical Mediterranean foods such as olives, bread and cheeses) and convenience food.

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