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Review

Contemporary issues regarding nutrition in cardiovascular rehabilitation

Sébastien Lacroix [a,b,c,d], Jennifer Cantin [b,c,d], Anil Nigam [b,c,d,e,f,*]

[a] The Microsoft Research, University of Trento Centre for Computational Systems Biology (COSBI), Piazza Manifattura 1, 38068 Rovereto, Italy
[b] Cardiovascular Prevention and Rehabilitation Centre, Montreal Heart Institute, Montreal, Quebec, Canada H1T 1C8
[c] Research Centre, Montreal Heart Institute, Canada
[d] Department of Nutrition, Faculty of Medicine, Université de Montréal, Montréal, Québec, Canada H3T 1A8
[e] Department of Medicine, Université de Montréal, Montréal, Québec, Canada H3T 1J4
[f] PERFORM Centre, Concordia University, Montreal, Quebec, Canada H4B 1R6

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ABSTRACT

In this article, we discuss certain contemporary and controversial topics in cardiovascular (CV) nutrition including recent data regarding the health benefits of the Mediterranean diet, the role of saturated fatty acids, red meat and the microbiome in CV disease and the current role of personalized CV nutrition. Findings from the PREDIMED study now demonstrate the health benefits of the Mediterranean diet even in the absence of heart disease. The study highlighted that even small, sustained and easily implementable changes to diet can provide significant health benefits even in Mediterranean regions. Likewise, observational data in secondary prevention show that increased adherence to the Mediterranean diet is associated with good long-term clinical outcomes among subjects with stable coronary heart disease. The role of saturated fats in the development of CV disease remains controversial, although data suggest that these fats are associated with modestly increased risk of CV events. In contrast, the obesity epidemic currently driving the CV risk worldwide is in large part due to excess consumption of refined carbohydrates. Furthermore, a growing body of evidence suggests that the intestinal microbiome is highly sensitive to lifestyle choices and may play a pivotal role in modulating CV disease development. For example, recent evidence linking processed and unprocessed meats to increased CV risk pointed to the gut microbial metabolite trimethylamine N-oxide as a potential culprit. Finally, given the high interindividual variability in response to interventions including diet, personalized nutrition has potential to play a major role in tailoring diets based on genetic make-up to maximize health benefits. This approach is still in its infancy but is highly promising.

1. Introduction

Cardiovascular (CV) nutrition remains a cornerstone of a complete cardiac rehabilitation program. According to the most recent data from the World Health Organization, hypertension, high blood sugar, excess weight and hypercholesterolemia represent 4 of the 10 greatest risk factors for all-cause mortality worldwide [1]. These risk factors highlight the vital role that nutrition plays in health and disease. The same can be said at the individual level. The contemporary patient with CV disease (CVD) not only has underlying heart disease but most often has multiple co-morbidities including obesity, diabetes, hypertension and dyslipidemia, all of which continue to play a role in long-term prognosis. Therefore, poor nutrition plays a major role in the initiation and maintenance of the atherosclerotic process, but diet has a major role in reversing heart disease.

In this article, we discuss several contemporary topics in CV nutrition, some of which are controversial, including recent findings regarding the Mediterranean diet (MED) and CV risk, the role of saturated fatty acids and red meat in CVD and personalized nutrition for CV prevention.

2. The Mediterranean diet: recent findings

Most dietary patterns that have been studied for their cardiometabolic properties (e.g. DASH, Mediterranean, Nordic diets) are based on similar principles, that natural, nutrient-rich

* Corresponding author at: Montreal Heart Institute and "Université de Montréal", 5000 Belanger Street, Montreal, Quebec, Canada, H1T 1C8.
Tel.: +1 514 376 3330x4033; fax: +1 514 376 1355.
E-mail address: anil.nigam@icm-mhi.org (A. Nigam).

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foods should be prioritized over highly processed foods [2]. The widely known MED has been largely investigated since its first description by Keys et al. [3]. Briefly, this dietary pattern is rich in fruits and vegetables, legumes and grains, with moderate consumption of fish, low-fat dairy products, and alcohol and relies on extra-virgin olive oil (EVOO) as its main source of dietary fat [4]. The nutritional composition of the MED is thus rich in monounsaturated fatty acids (MUFAs), primarily oleic acid, dietary fibers, and antioxidant compounds such as polyphenols, in addition to a high ratio of omega-3 to omega-6 polyunsaturated FAs. This dietary pattern is also characterized by low consumption of highly processed foods, red meats and vegetable oils other than EVOO, so it is poor in saturated FAs (SFAs), industrially produced *trans* fats and simple sugars.

Epidemiological and accumulating clinical studies have demonstrated the benefits of the MED and its constituents that act in synergy to prevent the development of CVD and its risk factors in the primary prevention setting. For example, a recent meta-analysis of epidemiological and prospective trials concluded that a two-point increase in adherence to the MED, measured by the MED score elaborated by Panagiotakos et al. [5] was associated with a 10% reduction in all-cause mortality in healthy people of all age groups and in CV risk [6]. On a practical level, a two-point increase in MED score requires a modest increase in consumption of beneficial foods including fruits, vegetables, legumes, grains and fish combined with a modest decrease in detrimental foods such as processed and unprocessed red meats. Such dietary modifications are thus attainable and implementable at the population level. As noted below, data regarding the benefits of the MED in secondary prevention are more limited [7,8] but are wholly consistent with primary prevention studies.

The largely covered PREDIMED intervention trial and the plethora of post hoc-related analyses have revealed for the first time in a randomized controlled trial (RCT) the CV and cardiometabolic benefits of the MED in people without overt CVD but at high risk. The study involved 7447 Spanish participants with type 2 diabetes mellitus (T2DM) or at least 3 traditional CV risk factors who were randomized to receive a low-fat control diet or 1 of 2 MEDs (supplemented with large quantities of EVOO or mixed nuts). Adherence to a MED decreased the incidence of stroke, myocardial infarction (MI) or CV death by 30% [9]. As well, adherence to a MED (particularly in the increased nut-consumption group) significantly reduced the prevalence of metabolic syndrome and diabetes in the context of an ad libitum diet [10–12]. PREDIMED interventions positively affected other intermediate CV endpoints: they normalized levels of B-type natriuretic peptide, oxidized LDL, and lipoprotein(a) [13]; improved plasma antioxidant status [14]; and decreased the prevalence of hypertension [15].

However, conclusions from the PREDIMED trial require interpretation with caution [16]. In reality, all 3 groups had similar baseline diets, which reflected a high degree of adherence, on average, to the MED [9,17]. At the end of the trial, the proportion of energy intake from total fat was only slightly lower in the low-fat control group (37%) relative to the MED groups (41%), whereas that from saturated fat was similar among the groups [16]. Although adherence to the MED was increased in the olive oil and nut groups, the major differences in terms of the control diet were the higher MUFA content (from increased EVOO consumption and nut consumption) and PUFA content (from nut consumption). Thus, correctly speaking, PREDIMED demonstrated that consumption of significant quantities of EVOO or nuts in addition to a MED reduced fatal and non-fatal CV endpoints relative to a MED alone. Nonetheless, PREDIMED demonstrated that minor and thus sustainable dietary modifications to already "healthy" habits can benefit CV health and lower event rates.

Since the publication of both the GISSI-Prevenzione [7] and Lyon Diet Heart studies [8], no additional prospective RCTs have evaluated the impact of the MED or its constituents on the secondary prevention of CVD. Briefly, GISSI-Prevenzione demonstrated in 11,324 Italian subjects with recent MI that supplementation with fish oil (1 g EPA + DHA) reduced the risk of CV death relative to placebo by 17–30% after a mean follow-up of 3.5 years [7]. In contrast, in the Lyon Diet Heart study, 423 patients with recent acute MI were randomized to a control diet (prudent Western diet) or a MED and followed for 45 months, on average [8]. Similar to PREDIMED, the MED group received canola oil as a supplement to increase dietary content of alpha-linolenic acid. The study demonstrated that adherence to the MED reduced the composite endpoint of cardiac death and non-fatal MI by 72% ($P = 0.0001$) and risk of cardiac death alone by 65% ($P = 0.01$). Taken together, the results of PREDIMED, GISSI-Prevenzione and the Lyon Diet Heart studies demonstrate that as one moves from primary to secondary prevention of CVD and from targeted supplementation of a specific constituent to a holistic MED pattern, the benefits of a MED on hard clinical endpoints are even greater. Recent data from an observational study support this view. In a substudy of the STABILITY trial, which included over 15,000 patients with stable coronary heart disease (CHD), adherence to a MED was associated with reduced risk of major adverse cardiac events including CV death, non-fatal MI and non-fatal stroke in the context of optimal contemporary medical management [18]. In contrast, adherence to a Western-type diet rich in refined grains, carbohydrates and deep-fried foods was not associated with poorer outcomes. As noted by the authors, these data suggest that consumption of healthy foods is more important than avoidance of less healthy foods for secondary prevention of CV events [18].

3. Controversies in cardiovascular nutrition

3.1. Saturated fatty acids

In the past 2 years, much confusion has surrounded the role of SFAs in the pathogenesis of CHD because of the publication of meta-analyses that have suggested deleterious effects on CV health falsely attributed to these fats over the past 40 years [19,20]. The first meta-analysis of Chowdhury et al. concluded that their findings "did not yield clearly supportive evidence for current cardiovascular guidelines that encourage high consumption of polyunsaturated fatty acids and low consumption of saturated fats" [19]. However, many experts in the field have criticized the authors' methodology, notably, that one study in particular, the Sydney Diet Heart Study [21], should not have been included in the meta-analysis because the supplemented source of w-6 PUFAS was a *trans* fat-based margarine [22]. Moreover, according to Dawczynski et al., in the analyses of circulating blood fatty acid composition, 2 studies [23,24] finding negative associations between SFAs from dairy products (pentadecanoic acid (15:0) and heptadecanoic acid (17:0)) and MI should not have been included because dairy sources of SFAs do not reflect total SFA intake [25]. By eliminating the 2 studies, Dawczynski et al. found a harmful association between SFA blood levels and coronary outcomes.

The meta-analysis by de Souza et al. also found no association between SFA intake and CV mortality or total CHD [20]. However, a positive trend association between SFA intake and CHD mortality was found. The methodology of this meta-analysis is arguable. Indeed, the study included observational studies, conducted over a very broad time range, from 1981 to 2014, and in very heterogeneous populations. Moreover, the studies included did not all consider which macronutrient replaced the SFAs [26]. In one