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The cardiometabolic consequences of replacing saturated fats with carbohydrates or Ω-6 polyunsaturated fats: Do the dietary guidelines have it wrong?

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INTRODUCTION

A recent publication by Malhotra[1] was refreshing, inspiring and hit on an important topic that has been heavily debated for over 50 years, that is, are saturated fats as bad as we have been led to believe?

HISTORY OF THE LOW-FAT 'DIET-HEART' HYPOTHESIS

The vilification of saturated fat by Keys[2] began two decades before the seven countries study, where Keys showed a curvilinear association between fat calories as a percentage of total calories and death from degenerative heart disease from six countries. However, he excluded data from 16 countries that did not fit his hypothesis. Indeed, data were available at the time from 22 countries, and when all countries were looked at the association was greatly diminished.[3] Furthermore, no association existed between dietary fat and mortality from all causes of death.[3] Thus, past data promoted by Keys showing that an increased percentage of fat calories consumed increases the risk of death are not valid (and certainly could never have proved causation). These data seemingly lead us down the wrong "dietary-road" for decades to follow, as pointed out by others.[4 5]

THE CONSEQUENCES OF REPLACING SATURATED FATS WITH CARBOHYDRATES

The initial Dietary Goals for Americans, published in 1977, proposed increasing carbohydrates and decreasing saturated fat and cholesterol in the diet.[6 7] This stemmed from the belief that since saturated fats increase total cholesterol (a flawed theory to begin with) they must increase the risk of heart disease. Moreover, it was believed that since fat is the most "calorie-dense" of the macronutrients, a reduction in its consumption would lead to a reduction in calories and a subsequent decrease in the incidence of obesity, as well as diabetes and the metabolic syndrome. However, the advice to increase carbohydrate intake seemingly made things worse, with an increase in its consumption (mainly corn syrup) paralleling the increased incidence of diabetes and obesity in the USA.[8] In this analysis, fat was not associated with type 2 diabetes when total energy intake was accounted for,[8] and the intake of saturated fat in the USA during this time was also not on the rise.[9] These data provide a strong argument that the increase in the consumption of refined carbohydrates was the causative dietary factor for the diabetes and obesity epidemic in the USA.

These data are further strengthened by a randomised, controlled, dietary intervention trial comparing a low-fat (<10% saturated fat) versus a low-carbohydrate (12% of total calories from carbohydrates) diet.[10 11] While both diets were low in calories (1500 kcal/day), the low-carbohydrate diet showed greater improvements on numerous endpoints such as (1) *body fatness* (abdominal fat, body mass), (2) *lipids* (triglycerides, apolipoprotein B (ApoB)), (3) *glucose tolerance* (glucose, insulin and insulin resistance—measured via homoeostasis model assessment), (4) *inflammation* (tumour necrosis factor α, interleukin (IL) 6, IL-8, monocyte chemotactic protein 1, E-selectin, intercellular adhesion molecule 1) and (5) *thrombogenic markers* (plasminogen activator inhibitor 1).[10 11] Additionally, the low-carbohydrate diet provided (1) an increase in high-density lipoprotein cholesterol (HDL-C), (2) a reduction

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in the ApoB/ApoA-1 ratio and (3) a reduction in small, dense low-density lipoprotein (sdLDL), whereas all of these parameters were worsened on a low-fat diet.[10 11] Thus, overall cardiometabolic health seems to improve to a greater extent when carbohydrate is restricted rather than fat.

The assumption that a low-fat diet reduces the 'bad' cholesterol (ie, LDL) is an imprecise notion. While total LDL may be lowered with a reduced intake of dietary fat, if replaced with carbohydrate, this may increase sdLDL particles (ie, pattern B),[10 11] which are more atherogenic than large buoyant LDL particles (ie, pattern A).[12] Additionally, data indicate that a high saturated fat intake lowers sdLDL particles and raises large buoyant LDL particles.[13] Thus, replacing carbohydrate with fat may improve the LDL particle size distribution (eg, pattern B shifted to pattern A). Lastly, if fat is replaced with carbohydrate, this may worsen the overall lipid profile (decrease in HDL-C, increase in triglycerides and increase in sdLDL particles).[10 11]

Several other randomised trials indicate that a low-carbohydrate diet reduces weight and improves lipids more than a low-fat diet.[14–18] Thus, reducing carbohydrates, as opposed to fat, seems to have more favourable effects on atherogenic dyslipidaemia, inflammation, thrombogenic and atherosclerotic surrogate markers.[10–18] From these data, it is easy to comprehend that the global epidemic of atherosclerosis, heart disease, diabetes, obesity and the metabolic syndrome is being driven by a diet high in carbohydrate/sugar as opposed to fat, a revelation that we are just starting to accept.

THE CONSEQUENCES OF REPLACING SATURATED FATS WITH POLYUNSATURATED (Ω-6) FATS

Not only has the condemnation of saturated fats led to an increased consumption of carbohydrates, it has also led to several dietary guidelines recommending replacement of saturated fats with polyunsaturated fats, without specifying which polyunsaturated fatty acid (ie, Ω-3 vs Ω-6). The recommendation for increasing polyunsaturated fat stems from pooled analyses of data looking at increasing Ω-3 and Ω-6 polyunsaturated fatty acids.[19 20] However, a meta-analysis of randomised controlled trials showed that replacing a combination of trans-fats and saturated fats with Ω-6 polyunsaturated fats (without simultaneously increasing Ω-3 fatty acids) leads to an increased risk of death.[21] These results were corroborated when data were recovered from the Sydney Diet Heart Study and included in an updated meta-analysis.[22]

Other human trials, not included in the aforementioned meta-analysis, include the Anti-Coronary Club trial, which showed that more people died (overall (26 vs 6) and due to coronary heart disease (8 vs 0)) when saturated fat was replaced with polyunsatured fat.[23] The National Diet Heart Trial, a randomised, double-blind study, also showed a higher number of cardiovascular events (n=4) on a diet that was high in the polyunsaturated(P)/saturated(S) fat ratio (2:1), than on a diet high in saturated fat (n=1, P/S=0.4).[24] Thus, advice to replace saturated fats with polyunsaturated fats (ie, Ω-6) may increase the risk of coronary heart disease, cardiovascular events, death due to coronary heart disease and overall mortality.[21–24]

Reasons for the potential harmful effects of Ω-6 fatty acids may be due to their promotion of cancer, suppression of the immune system, lowering of HDL-C and increasing the susceptibility of LDL to oxidation.[25] Further evidence indicates a role of Ω-6 in promoting prostate[26–28] and breast cancer.[29] This is supported by the Anti-Coronary Club study, where there was 71% increased risk of death from causes other than coronary heart disease among individuals who were placed on a diet designed to increase the P/S ratio in those who had not experienced a new coronary event.[30] Moreover, in a controlled clinical trial by Dayton *et al*,[31] there was a greater than threefold increased risk of death due to carcinoma when saturated fat (mainly of animal origin) was substituted for Ω-6 polyunsaturated fat (including corn, soybean, safflower and cottonseed). The potential harms of replacing saturated fat with carbohydrates or Ω-6 polyunsaturated fats are summarised in box 1.

LACK OF EVIDENCE FOR A LOW-FAT DIET

Data are lacking in the support of a low-fat diet. In the low-fat diet in myocardial infarction trial, a controlled trial was performed to test if a low-fat diet would improve outcomes in 264 men who had recently recovered from a first myocardial infarction.[32] Despite the fact that patients in the low-fat diet group ate significantly less fat (45 g/day vs 110–130 g/day), consumed less calories (approximately 1950 calories vs 2450 calories), obtained a lower cholesterol level and achieved a greater fall in body weight than those in the control group, there was no difference in definite reinfarction or death.

Box 1 The potential harms of replacing saturated fat with carbohydrates or Ω-6 polyunsaturated fats

The potential harms of replacing saturated fat with carbohydrates
- Increase in small, dense LDL particles.
- Shift to an overall atherogenic lipid profile (lower HDL-C, increase in triglycerides and an increase in the ApoB/ApoA-1 ratio).
- Smaller improvements in glucose tolerance, body fatness, weight, inflammation and thrombogenic markers.
- Increased incidence of diabetes and obesity.

The potential harms of replacing saturated fat with omega-6 polyunsaturated fats
- Increased risk of cancer.
- Increased risk of coronary heart disease, cardiovascular events, death due to heart disease and overall mortality.
- Increased oxidised LDL-C.
- Reduction in HDL-C.

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In the Women's Health Initiative (WHI), a randomised controlled trial including 48 835 postmenopausal women, a low-fat diet was not shown to reduce coronary heart disease, stroke or cardiovascular disease,[33] despite a significant reduction in LDL-C, nor was there a reduction in cancer.[34 35] A meta-analysis by Siri-tarino *et al*[36] consisting of 21 prospective epidemiological studies, derived from 347 747 participants, indicated that the intake of saturated fat does not increase coronary heart disease or cardiovascular disease. Moreover, a recent Cochrane meta-analysis indicated that changing dietary fat intake does not affect total mortality or cardiovascular mortality.[37] Although reducing saturated fat was associated with a reduced risk of cardiovascular events by 14%, this was not shown with reducing total fat consumption.[37] While the WHI study and the Siri-tarino and Cochrane meta-analyses cannot be taken at face value, taken together with "the low-fat diet in myocardial infarction trial", a compelling argument can be made for the general lack of evidence in support of a low-fat diet. Dietary recommendations based on evidence from the literature are summarised in box 2.

The final nail in the low-fat diet coffin is two randomised trials, one for the primary prevention of cardiovascular disease, PREDIMED[38] (Prevención con Dieta Mediterránea), indicating a reduction in the incidence of major cardiovascular events with a Mediterranean diet compared with a low-fat diet, and the other for the secondary prevention of cardiovascular disease, the Lyon Diet Heart Study[39] showing that a Mediterranean diet reduces all-cause and cardiovascular mortality as well as non-fatal myocardial infarction compared with a prudent diet.

CONCLUSIONS

In summary, the benefits of a low-fat diet (particularly a diet replacing saturated fats with carbohydrates or Ω-6 polyunsaturated fatty acids) are severely challenged. Dietary guidelines should assess the totality of the evidence and strongly reconsider their recommendations for replacing saturated fats with carbohydrates or Ω-6 polyunsaturated fats.

Box 2 Dietary recommendations based on evidence from the literature

- Dietary guideline recommendations suggesting the replacement of saturated fat with carbohydrates/Ω-6 polyunsaturated fats do not reflect the current evidence in the literature.
- A change in these recommendations is drastically needed as public health could be at risk.
- The increase in the prevalence of diabetes and obesity in the USA occurred with an increase in the consumption of carbohydrate not saturated fat.
- There is no conclusive proof that a low-fat diet has any positive effects on health. Indeed, the literature indicates a general lack of any effect (good or bad) from a reduction in fat intake.
- The public fear that saturated fat raises cholesterol is completely unfounded as the low-density lipoprotein particle size distribution is worsened when fat is replaced with carbohydrate.
- A public health campaign is drastically needed to educate on the harms of a diet high in carbohydrate/sugar.
- It would be naive to assume that any recommendations related to carbohydrate or fat intake would apply to processed foods, which undoubtedly should be avoided if possible.

Competing interests None.

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