Editorial

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Are refined carbohydrates worse than saturated fat?[1–3]

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For several decades, the diet-heart paradigm that high intake of saturated fat and cholesterol increases the risk of atherosclerosis and ischemic heart disease (IHD) has been the driving force behind national and international dietary recommendations for prevention of IHD (1). This model, which promotes diets that are typically low in fat (particularly saturated fat) and high in complex carbohydrates, has led to substantial decline in the percentage of energy intake from total and saturated fats in the United States. At the same time, it has spurred a compensatory increase in consumption of refined carbohydrates and added sugars—a dietary shift that may be contributing to the current twin epidemics of obesity and diabetes.

The changed landscape in obesity and dietary patterns suggests a need to reassess the dominant diet-heart paradigm and related dietary recommendations, ie, the strategy of replacing total and saturated fats with carbohydrates. A recent pooled analysis of 11 American and European cohort studies ($n = 344{,}696$ persons) found no association between decreased risk of IHD and replacement of saturated fat with carbohydrates; indeed, the approach was associated with a slightly increased risk (2). Similarly, a meta-analysis of 21 cohort studies ($n = 347{,}747$ subjects) found no significant association between intake of saturated fat compared with carbohydrates and risk of IHD, stroke, and total cardiovascular events (3). Conversely, observational studies as well as randomized clinical trials show that substitution of polyunsaturated for saturated fat has a beneficial effect IHD (4).

Until recently, the role of carbohydrates in cardiovascular disease risk has received scant attention. Depending on chemical structure, carbohydrates are traditionally classified as simple or complex (polysaccharide). The latter are considered to be a healthy alternative to dietary fats. However, many complex carbohydrates (eg, baked potatoes and white bread) produce even higher glycemic responses than do simple sugars (5). Thus, the term *complex carbohydrates* is not useful in characterizing the quality of carbohydrates. More useful indicators of carbohydrate quality include the amount and type of fiber, the extent of processing, and glycemic index (GI) and glycemic load (GL). Each of these characteristics represents partially overlapping but physiologically independent aspects of carbohydrate quality. The GI, which compares blood glucose concentrations after ingestion of a test food and a standard weight (50 g) of a reference carbohydrate (glucose or white bread), provides a biologically meaningful ranking of carbohydrate-containing foods on the basis of an increase in blood glucose (area under the curve). GI values of individual foods largely depend on rate of digestion and speed of carbohydrate absorption, making their physical form an important factor. Typically, foods with more compact granules (low-starch gelatinization) and high amounts of viscose soluble fiber (eg, barley, oats, and rye) are digested at a slower rate and have lower GI values than do highly processed refined carbohydrates (eg, white bread). These refined carbohydrates are more rapidly attacked by digestive enzymes due to grinding or milling that reduces particle size and removes most of the bran and the germ. Numerous epidemiologic studies have found that higher intake of refined carbohydrates (reflected by increased dietary GL) is associated with greater risk of type 2 diabetes and IHD, whereas higher consumption of whole grains protects against these conditions (1).

In this issue of the Journal, Jakobsen et al (6) compared the association between saturated fats and carbohydrates with IHD risk among 53,644 men and women in a Danish cohort of the Diet, Cancer, and Health Study. During 12 y of follow-up, 1943 incident cases of myocardial infarction (MI) were diagnosed. Multivariate analyses showed that saturated fat intake was not associated with risk of MI compared with carbohydrate consumption—a finding consistent with the results from a recent pooled analysis and a meta-analysis (2, 3). However, replacement of saturated fat with high-GI-value carbohydrates significantly increased the risk of MI (relative risk per 5% increment of energy from carbohydrates: 1.33; 95% CI: 1.08, 1.64), whereas replacement with low-GI-value carbohydrates showed a nonsignificant inverse association with IHD risk (relative risk per 5% increment of energy from carbohydrates: 0.88; 95% CI: 0.72–1.07).

This study is notable for its large size, long duration of follow-up, and detailed assessment of dietary and lifestyle factors. It is the first epidemiologic study to specifically examine the effects of replacing saturated fats with either high- or low-quality carbohydrates, and it provides direct evidence that substituting high-GI-value carbohydrates for saturated fat actually increases IHD risk.

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Unfortunately, most carbohydrates in Western diets are highly processed, including bread, rolls, pizza, white rice, and most ready-to-eat cold cereals and sugar. Prior studies show that these types of carbohydrates are particularly harmful for overweight and obese individuals, suggesting that adverse effects of carbohydrates are aggravated by underlying insulin resistance (7).

The obesity epidemic and growing intake of refined carbohydrates have created a ''perfect storm'' for the development of cardiometabolic disorders. For this reason, reduction of refined carbohydrate intake should be a top public health priority. Several dietary strategies can be used to achieve this goal. These include replacing carbohydrates (especially refined grains and sugar) with unsaturated fats and/or healthy sources of protein and exchanging whole grains for refined ones. A combination of these approaches can increase flexibility in macronutrient composition and thus long-term adherence. In addition, limiting sugar-sweetened beverage consumption, a major source of dietary GL and excess calories, has been associated with lower risk of obesity, type 2 diabetes, and IHD (8).

A very-low-fat, high-carbohydrate diet (eg, percentage of energy $< 20\%$ from fat and $>70\%$ from carbohydrates), once typical in traditional Asian populations, has the potential to be cardioprotective if most of the carbohydrates come from minimally processed grains, legumes, and vegetables and if the population is lean and active (and thus has low insulin resistance). However, such a diet is difficult to maintain long term. A very-low-fat diet may also increase risk of hemorrhagic stroke (9). On the other hand, recent clinical trial and epidemiologic evidence suggests that a diet with moderately restricted carbohydrate intake but rich in vegetable fat and vegetable protein improves blood lipid profile (10) and is associated with lower risk of IHD in the long term (11). Benefits of the plant-based, low-carbohydrate diet are likely to stem from higher intake of polyunsaturated fats, fiber, and micronutrients as well as the reduced GL in the dietary pattern.

Clearly, diets high in either saturated fats or refined carbohydrates are not suitable for IHD prevention. However, refined carbohydrates are likely to cause even greater metabolic damage than saturated fat in a predominantly sedentary and overweight population. Although intake of saturated fat should remain at a relatively low amount and partially hydrogenated fats should be eliminated, a singular focus on reduction of total and saturated fat can be counterproductive because dietary fat is typically replaced by refined carbohydrate, as has been seen over the past several decades. In this era of widespread obesity and insulin resistance, the time has come to shift the focus of the diet-heart paradigm away from restricted fat intake and toward reduced consumption of refined carbohydrates.

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REFERENCES

1. Hu FB, Willett WC. Optimal diets for prevention of coronary heart disease. JAMA 2002;288:2569–78. doi:10.1001/jama.288.20.2569
2. Jakobsen MU, O'Reilly EJ, Heitmann BL, et al. Major types of dietary fat and risk of coronary heart disease: a pooled analysis of 11 cohort studies. Am J Clin Nutr 2009;89:1425–32. doi:10.3945/ajcn.2008.27124
3. Siri-Tarino PW, Sun Q, Hu FB, Krauss RM. Meta-analysis of prospective cohort studies evaluating the association of saturated fat with cardiovascular disease. Am J Clin Nutr 2010;91:535–46. doi:10.3945/ajcn.2009.27725
4. Mozaffarian D, Micha R, Wallace S. Effects on coronary heart disease of increasing polyunsaturated fat in place of saturated fat: a systematic review and meta-analysis of randomized controlled trials. PLoS Med 2010;7:e1000252.
5. Ludwig DS. The glycemic index: physiological mechanisms relating to obesity, diabetes, and cardiovascular disease. JAMA 2002;287:2414–23. doi:10.1001/jama.287.18.2414
6. Jakobsen MU, Dethlefsen C, Joensen AM, et al. Intake of carbohydrates compared with intake of saturated fatty acids and risk of myocardial infarction: importance of the glycemic index. Am J Clin Nutr 2010; 91:■■–■■.
7. Liu S, Willett WC, Stampfer MJ, et al. A prospective study of dietary glycemic load, carbohydrate intake, and risk of coronary heart disease in US women. Am J Clin Nutr 2000;71:1455–617.
8. Malik VS, Popkin BM, Bray GA, Despres JP, Hu FB. Sugar-sweetened beverages, obesity, type 2 diabetes mellitus, and cardiovascular disease risk. Circulation 2010;121:1356–648. doi:10.1161/CIRCULATIONAHA.109.876185
9. Iso H, Sato S, Kitamura A, Naito Y, Shimamoto T, Komachi Y. Fat and protein intakes and risk of intraparenchymal hemorrhage among middle-aged Japanese. Am J Epidemiol 2003;157:32–99. doi:10.1093/aje/kwf166
10. Jenkins DJ, Wong JM, Kendall CW, et al. The effect of a plant-based low-carbohydrate (''Eco-Atkins'') diet on body weight and blood lipid concentrations in hyperlipidemic subjects. Arch Intern Med 2009; 169:1046–5410. doi:10.1001/archinternmed.2009.115
11. Halton TL, Willett WC, Liu S, et al. Low-carbohydrate-diet score and the risk of coronary heart disease in women. N Engl J Med 2006; 355:1991–2002. doi:10.1056/NEJMoa055317