

## The Questionable Benefits of Exchanging Saturated Fat With Polyunsaturated Fat

Uffe Ravnskov, MD, PhD; James J. DiNicolantonio, PharmD; Zoë Harcombe, MA; Fred A. Kummerow, PhD; Harumi Okuyama, MD, PhD; and Nicolai Worm, MD, PhD

For many years we have been told that to prevent cardiovascular disease (CVD), we must lower our intake of saturated fatty acids (SFAs) and instead eat more carbohydrates and polyunsaturated fatty acids (PUFAs). Backed up by the National Cholesterol Education Program, the National Institutes of Health, and the American Heart Association, the medical profession has promoted this idea eagerly, although the number of contradictory scientific reports is almost endless. There is in fact much evidence that doing the opposite is more relevant.

### The Contradictions

The main argument for using this diet has been that it lowers the concentration of cholesterol in the blood and thus prevents CVD. This idea was proposed for the first time by Keys,<sup>1</sup> and as support, he presented data from 16 cohorts in 7 countries in an article that has been used as an argument till today. However, although there was a weak association between the intake of SFAs and heart mortality when all cohorts were analyzed together, there were substantial differences within each country in spite of similar intakes of SFAs. Most contradictory was the observation that coronary heart disease (CHD) mortality on the Greek island Corfu was 16 to 17 times higher than that on Crete, although the intake of SFAs was the same on both the islands. Furthermore, in a recent analysis of the data from this study, the authors found that processed foods, primarily carbohydrates, were classified as saturated fats.<sup>2</sup> The UK government and the National Institute of Clinical Excellence have also inappropriately listed biscuits, cakes, pastries, and savory snacks as saturated fats.<sup>2</sup>

The diet-heart recommendations of the American Heart Association, published in 1982 and based mainly on Keys' hypothesis, were already questioned a year later,<sup>3</sup> and since

then, many more objections have been presented.<sup>4-8</sup> The main arguments are as follows:

1. In clinical experiments, the effect of a high intake of SFAs on serum cholesterol is weak and transient,<sup>5</sup> and 10 randomized controlled or crossover trials have found that a high intake of SFAs, even up to 50% of the total caloric intake, has little effect or none at all on total or low-density lipoprotein (LDL) cholesterol.<sup>7</sup>
2. Two meta-analyses of prospective epidemiologic studies found lack of an association between CVD mortality and SFA intake.<sup>5,9</sup> Even more contradictory were the results from 10 cohort studies of patients with stroke. In 3 of them, no difference in SFA intake was seen between patients with stroke and healthy people; in 7 studies, patients with stroke had eaten significantly less SFAs.<sup>7</sup>
3. A meta-analysis of 16 long-term cohort studies found a reduction in risk in individuals with the highest dairy consumption relative to those with the lowest intake: risk ratio (RR) 0.87 (0.77, 0.98) for all-cause deaths, RR 0.92 (0.80, 0.99) for ischemic heart disease, RR 0.79 (0.68, 0.91) for stroke, and RR 0.85 (0.75, 0.96) for incident diabetes.<sup>10</sup>
4. A meta-analysis of 16 observational studies found that a high-fat dairy intake was inversely associated with adiposity and was unassociated with diabetes and CVD.<sup>11</sup>
5. Meta-analyses of the dietary trials have found only trivial or no benefit at all from decreasing the intake of SFAs and/or increasing the intake of PUFAs.<sup>5,12</sup> In accordance, a high concentration of small dense LDL and a low concentration of large buoyant LDL are associated with CHD,<sup>13</sup> and the intake of SFAs lowers the former and raises the latter.<sup>14</sup>

Studies of people whose diet data are based on interviews are of course inaccurate. A more



From the Magle Stora Kyrkogata 9, Lund, Sweden (U.R.); Saint Luke's Mid America Heart Institute, Kansas City, MO (J.J.D.); Faculty of Science and Technology, Institute of Clinical Exercise and Health Science, University of the West of Scotland, Hamilton, Lanarkshire, United Kingdom (Z.H.); Department of Comparative Biosciences, University of Illinois at Urbana-Champaign, Urbana (F.A.K.); Institute for Consumer Science and Human Life, Kinjo Gakuin University, Mori Yamaku, Nagoya, Japan (H.O.); and German University for Prevention and Health Care Management, Saarbrücken, Germany (N.W.).

reliable way is to analyze the concentration of short-chain SFAs (12:0–15:0) in fat cells because their concentrations reflect the intake of saturated fat during the past weeks or months.<sup>7</sup> In 3 case-control studies of patients with myocardial infarction and healthy control individuals, no difference was found with regard to the content of short-chain SFAs; in 2 studies, it was even significantly lower in the patients.<sup>7</sup> These studies concerned only patients with first myocardial infarction or patients who were not on a diet, and a diet bias was therefore unlikely.

### The Irrational Advice Continues

These facts have had no effect on the official guidelines. Although the authors of the recent World Health Organization/Food and Agriculture Organization of the United Nations guidelines stated that “the available evidence from cohort and randomised controlled trials is unsatisfactory and unreliable to make judgement about and substantiate the effects of dietary fat on risk of CHD,” they found no reason to change the advice regarding the intake of SFAs.<sup>15</sup>

At a recent international invitation-only symposium, a panel of dietary experts concluded that “the evidence from epidemiologic, clinical, and mechanistic studies is consistent in finding that the risk of CHD is reduced when SFAs are replaced with polyunsaturated fatty acids” without specifying which types of PUFAs.<sup>16</sup> Their main arguments were as follows:

1. A pooled analysis of 11 cohort studies established that for a 5% lower energy intake from SFAs and a concomitant higher energy intake from PUFAs, there was a significant inverse association between the intake of PUFAs and the risk of coronary events.<sup>17</sup> However, the authors had excluded more than a dozen cohort studies included in the above-mentioned meta-analyses,<sup>5,9</sup> which reported no difference in SFA intake between people with and without CHD, and they had ignored the above-mentioned cohort studies of patients with stroke.<sup>7</sup>
2. A meta-analysis of 7 dietary trials established a significantly lower number of coronary events in the treatment groups.<sup>18</sup> However, the authors of this analysis had excluded the trial of Rose et al and the Sydney trial, both of which resulted in a higher mortality in the treatment group.<sup>12</sup> The meta-analysis is

also in conflict with the results from a recent report of 4 unsuccessful trials in which SFAs were exchanged with omega-6 PUFAs only.<sup>12</sup>

3. Another argument was that before 1990, the decreasing CHD rates in the United States and Poland correlated with a decreasing intake of SFAs and an increasing intake of PUFAs. However, similar dietary changes were seen during the CHD epidemic in the United States between 1909 and the earlier 1960s.<sup>19</sup>
4. A lower risk of CVD was said to be associated with lower intakes of full-fat dairy products. The authors had ignored the meta-analysis by Elwood et al.<sup>11</sup> Instead, they referred to the Nurses' Health Study, but according to a multivariable analysis in that study, the multivariate risk ratio difference between the first and the fifth quintile, both of high-fat and low-fat dairy intake, was trivial (high fat, 1.00 vs 1.09; low fat, 1.00 vs 0.90).<sup>20</sup>

### The Consequences

The dietary recommendations, according to which SFAs should be exchanged with carbohydrates, were introduced more than 30 years ago for the US population and have been followed in many countries. In retrospect, the current epidemics of obesity, metabolic syndrome, and type 2 diabetes that started shortly afterward may be an effect of this diet.

To exchange SFAs with PUFAs is not a wise decision either. Today, food rich in PUFAs is dominated by vegetable oils from soybeans, corn, and sunflower, all of which are rich in linoleic acid.

Already in 1991 Scott Grundy warned against eating too much omega-6 PUFAs.<sup>21</sup> According to Grundy, there was no epidemiological support for this advice; it suppressed the immune system; it lowered HDL, it promoted LDL oxidation, it increased the risk of cholesterol gallstones, and it promoted cancer in laboratory animals.<sup>22</sup>

Since then, many studies have confirmed his warnings. Associations have been found between omega-6 PUFAs and prostate, pancreas, colon, and in particular breast cancer. In an *in vitro* study, the growth of human breast cancer cells was stimulated by linoleic acid<sup>23</sup>; several cohort studies have found that women with a high intake of omega-6 PUFAs run a higher risk of breast cancer,<sup>24</sup> and several studies have also

found that women with a low omega-3/omega-6 ratio in their adipose tissue have the highest risk of breast cancer.<sup>25</sup> The outcome of the hitherto longest dietary trial, in which SFAs were exchanged with PUFA oils, is in accordance. Coronary heart disease mortality was lowest in the treatment group, but total mortality was the same because more died from cancer in the experimental group.<sup>26</sup> The benefit with regard to CHD mortality in that trial can also be questioned because there were significantly more smokers in the control group and the degree of atherosclerosis in those who died during the trial was highest in the treatment group.

### Conclusion

The benefits of replacing SFAs with PUFAs are questionable. There is no evidence that a lower intake of SFA can prevent CVD and a high intake of PUFAs without specification may result in a high intake of omega-6, which is associated with many adverse health effects. Because there is much evidence that saturated fat may even be beneficial, we urge the American Heart Association, the American Diabetes Association, and the National Institute of Clinical Excellence to consider the aforementioned evidence when updating their future guidelines.

Correspondence: Address to Uffe Ravnskov, Magle Stora Kyrkogata 9, 22350 Lund, Sweden (ravnskov@tele2.se).

### REFERENCES

1. Keys A. Coronary heart disease in seven countries. *Circulation*. 1970;41(Suppl 1):1-211.
2. Harcombe Z, Baker JS, Davies B. Food for thought: have we been giving the wrong dietary advice? *Food Nutr Sci*. 2013;4(3):240-244.
3. Temple NJ. Coronary heart disease—dietary lipids or refined carbohydrates? *Med Hypotheses*. 1983;10(4):425-435.
4. Reiser R. A commentary on the rationale of the diet-heart statement of the American Heart Association. *Am J Clin Nutr*. 1984;40(3):654-658.
5. Ravnskov U. The questionable role of saturated and polyunsaturated fatty acids in cardiovascular disease. *J Clin Epidemiol*. 1998;51(6):443-460.
6. Okuyama H, Ichikawa Y, Sun Y, Hamazaki T, Lands WE. The cholesterol hypothesis—its basis and its faults. *World Rev Nutr Diet*. 2007;96:1-17.
7. Ravnskov U. Is saturated fat bad? In: De Meester F, Zibadi S, Watson RR, eds. *Modern Dietary Fat Intakes in Disease Promotion (Nutrition and Health, Part 2)*. New York, NY: Humana Press; 2010:109-119.
8. Lawrence GD. Dietary fats and health: dietary recommendations in the context of scientific evidence. *Adv Nutr*. 2013;4(3):294-302.
9. 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(3):535-546.
10. Kratz M, Baars T, Guyenet S. The relationship between high-fat dairy consumption and obesity, cardiovascular, and metabolic disease. *Eur J Nutr*. 2013;52(1):1-24.
11. Elwood PC, Pickering JE, Givens DJ, Gallacher JE. The consumption of milk and dairy foods and the incidence of vascular disease and diabetes: an overview of the evidence. *Lipids*. 2010;45(10):925-939.
12. Ramsden CE, Zamora D, Leelarthaepin B, et al. Use of dietary linoleic acid for secondary prevention of coronary heart disease and death: evaluation of recovered data from the Sydney Diet Heart Study and updated meta-analysis [corrections published in *BMJ*. 2013;346:f903]. *BMJ*. 2013;346:e8707.
13. Griffin BA, Freeman DJ, Tait GW, et al. Role of plasma triglyceride in the regulation of plasma low density lipoprotein (LDL) subfractions: relative contribution of small, dense LDL to coronary heart disease risk. *Atherosclerosis*. 1994;106(2):241-253.
14. Dreon DM, Fernstrom HA, Campos H, Blanche P, Williams PT, Krauss RM. Change in dietary saturated fat intake is correlated with change in mass of large low-density-lipoprotein particles in men. *Am J Clin Nutr*. 1998;67(5):828-836.
15. Skeaff CM, Miller J. Fat and coronary heart disease: summary of evidence from prospective cohort and randomised controlled trials. *Ann Nutr Metab*. 2009;55(1-3):173-201.
16. Astrup A, Dyerberg J, Elwood P, et al. The role of reducing intakes of saturated fat in the prevention of cardiovascular disease: where does the evidence stand in 2010? *Am J Clin Nutr*. 2011;93(4):684-688.
17. 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(5):1425-1432.
18. 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(3):e1000252.
19. Antar MA, Ohlson MA, Hodges RE. Changes in retail market food supplies in the United States in the last seventy years in relation to the incidence of coronary heart disease with special reference to dietary carbohydrates and essential fatty acids. *Am J Clin Nutr*. 1964;14(3):169-178.
20. Bernstein AM, Sun Q, Hu FB, Stampfer MJ, Manson JE, Willett WC. Major dietary protein sources and risk of coronary heart disease in women. *Circulation*. 2010;122(9):876-883.
21. Grundy SM. Multifactorial etiology of hypercholesterolemia: implications for prevention of coronary heart disease. *Arterioscler Thromb*. 1991;11(6):1619-1635.
22. Carroll KK, Khor HT. Effects of level and type of dietary fat on incidence of mammary tumors induced in female Sprague-Dawley rats by 7,12-dimethylbenz(a)anthracene. *Lipids*. 1971;6(6):415-420.
23. Earashi M, Endo Y, Obata T, et al. Effects of linoleic acid and eicosanoid synthesis inhibitors on the growth and c-myc oncogene expression of human breast cancer cells. *Int J Oncol*. 1996;8(1):145-151.
24. Thiébaud AC, Chajès V, Gerber M, et al. Dietary intakes of omega-6 and omega-3 polyunsaturated fatty acids and the risk of breast cancer. *Int J Cancer*. 2009;124(4):924-931.
25. Murff HJ, Shu XO, Li H, et al. Dietary polyunsaturated fatty acids and breast cancer risk in Chinese women: a prospective cohort study. *Int J Cancer*. 2011;128(6):1434-1441.
26. Dayton S, Pearce ML, Hashimoto S, Dixon WJ, Tomiyasu U. A controlled clinical trial of a diet high in unsaturated fat in preventing complications of atherosclerosis. *Circulation*. 1969;40(Suppl 2):1-63.