

## Review Article

# Overview and perspective in human nutrition

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For the last decade, the focus of nutritional advice for prevention of chronic disease has been to limit or reduce total fat intake and to consume large amounts of carbohydrate. However, this advice is inconsistent with many lines of evidence indicating that unsaturated fats have beneficial metabolic effects and reduce risk of coronary heart disease. More recent evidence has also shown that the large majority of carbohydrates in Western diets, consisting of refined starches and sugars, have adverse metabolic effects and increase risks of coronary heart disease and type 2 diabetes. Unfortunately, a major opportunity for health improvement has been lost by failing to distinguish healthy from unhealthy forms of carbohydrates and fats. Recent analyses indicate that moderate changes in diet, together with regular physical activity and not smoking, can prevent the large majority of heart disease, type 2 diabetes, and some forms of cancer. These findings have substantial relevance for many populations in Asia, where incidence of type 2 diabetes is rising rapidly.

**Key Words:** diet, nutrition, cardiovascular disease, cancer, diabetes

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## INTRODUCTION

The last century was a time of enormous progress in human nutrition. Essential minerals, vitamins, amino acids, and fatty acids were identified, metabolic pathways were described, and the cataloguing of genetic variants that affect metabolism was begun. Also, clinical deficiencies were nearly eliminated in many parts of the world, and improvements in nutrition contributed importantly to major extensions of life expectancy in almost all countries. Still, large numbers of children remain undernourished, mainly in Africa and Asia; this unfinished agenda, which is tightly linked to poverty, must continue to receive our attention, but the solutions will mainly require political willpower of both the affluent and developing countries. Nevertheless, the dominant nutrition-related problem in most countries, including many poor developing countries, will be the rise in chronic disease, including cardiovascular disease, diabetes, and some cancers. This shift in disease patterns, the epidemiologic transition, is partly the result of success in reducing infectious disease and childhood undernutrition, but it has been strongly accelerated by changes in diet, physical activity, and smoking.

During the last several decades, we have learned much about the influences of diet and lifestyle on the risks of chronic diseases. While many details are yet to be learned, we have now shown that the large majority of cardiovascular disease, diabetes, and some cancers can be prevented by modifications of nutritional and lifestyle factors that are modest and do not require a return to poverty and deprivation. Yet, relatively few individuals are practicing these healthy behaviors, disease-promoting foods and beverages are aggressively marketed to vulnerable individuals, and governmental policies often encourage unhealthy options. The result is that rates of obesity and diabetes are increas-

ing in most countries, and large parts of the populations of both affluent and developing countries may experience a reversal of the gains in life expectancy that have been achieved. The economic costs of managing diabetes and its complications medically can be enormous and undermine progress in other areas.

Because a looming epidemic of chronic disease is already affecting large parts of Asia, I will take this opportunity to review briefly what I consider to be some of the most important aspects of diet for the prevention of this epidemic. Because these diseases have been dominant in western countries for decades, much of this evidence is from these populations, but available data suggest this evidence is also relevant to Asian populations.

### *Dietary Fat*

During the 1980s and 90s the major emphasis in prevention of chronic disease by diet was to limit intake of total fat; recommendations for low fat intake were the primary focus of guidelines developed by the WHO and many countries. The concept that fat intake should be low derives largely from observations that affluent Western countries have had high intakes of fat and also high rates of coronary heart disease, diabetes, and some cancers.<sup>1,2</sup> However, these correlations are limited to saturated fat, and countries with high intake of monounsaturated fat tend to have lower rates of heart disease and many of these same cancers. The two

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regions with the lowest rates of heart disease were those following the traditional diet of Japan, with about 8-10% of calories from fat, and the traditional diet of Crete, with approximately 40% of calories from fat. International comparisons need to be interpreted cautiously, nevertheless, because many factors, such as smoking rates, physical inactivity, and adiposity, are also correlated with western affluence.

Evidence from early controlled feeding studies in the 1960s substantiated the adverse effects of saturated fat on total serum cholesterol levels, which are associated with higher risk of coronary heart disease, but also documented that polyunsaturated fat reduces serum cholesterol. Thus, dietary advice during the 1960s and 70s emphasized replacement of saturated fat with polyunsaturated fat, not total fat reduction. The subsequent doubling of polyunsaturated fat consumption probably contributed greatly to the halving of coronary heart disease rates in the US. However, in the 1980s dietary advice subtly shifted to replacing fat in general with carbohydrate. The wisdom of this direction became questionable with the appreciation that total serum cholesterol can be subdivided: the LDL fraction increases but the HDL fraction reduces risk of coronary disease. More recently, serum triglyceride levels have also been associated with higher risk. Controlled feeding studies have shown that when saturated fat is replaced by carbohydrate, total and LDL cholesterol levels do fall, but HDL also falls proportionally, and triglyceride levels rise.<sup>3</sup> Thus, the ratio of LDL or total cholesterol to HDL does not change, which would predict little reduction in heart disease risk. Replacing either poly- or monounsaturated fat with carbohydrate would actually make the serum cholesterol ratio worse, but replacing saturated fat with either poly- or monounsaturated fat improves this ratio and would be expected to reduce heart disease. The relation of dietary fat to heart disease has become more complicated with the appreciation that trans-unsaturated fatty acids (produced by the partial hydrogenation of liquid vegetable oils) have important biological effects. Trans fats have uniquely adverse characteristics because they raise serum LDL and triglycerides and reduce HDL.

Although the effects of diet on blood cholesterol fractions and triglycerides are important, we now know that dietary factors can influence many other pathways that are important in the cause and prevention of coronary heart disease. For example, omega-3 fatty acids (from fish and some plant oils) can reduce the likelihood of ventricular fibrillation, the heart rhythm disturbance that causes sudden death. Thus, it is also important to assess directly the relation of diet to heart disease incidence because this will integrate all the adverse and beneficial effects of a dietary factor. Ideally, studies of diet and heart disease would be conducted as trials in which individuals are randomly assigned to one diet or another and followed for many years. Because of practical constraints and cost, few such studies have been conducted, and most of these have been in patients with existing heart disease. Although limited, these studies have supported benefits of replacing saturated fat with polyunsaturated fat, but not with carbohydrate. The best alternative is usually to conduct large prospective observational studies in which the

diets of many persons are assessed periodically over time and participants are monitored for the development of heart disease and other conditions. In these studies, smoking, physical activity, and other potential risk factors can be measured and accounted for in the analysis. Thus, we have followed nearly 90,000 women who first completed detailed questionnaires on diet in 1980 and over 50,000 men who were enrolled in 1989. After adjusting for smoking, physical activity, and other recognized risk factors, we found strong relationships between type of dietary fat and risk of heart disease in the direction predicted by the controlled feeding studies.<sup>5</sup> Because of the opposing relationships for specific types of fat, the percentage of calories from total fat was not associated with risk of heart disease. This adds further support to the conclusion of a report by the US National Academy of Sciences in 1989 that total fat intake per se is not a determinant of coronary heart disease.

As for coronary heart disease, belief that dietary fat is a major cause of cancer derived largely from correlations among countries between per capita intake of total and animal fat and rates of cancers common in affluent countries, including cancers of the breast, colon, and prostate. However, in large prospective studies in which confounding variables could be better controlled, there has consistently been little relation between intakes of total and specific types of fat during midlife and risks of cancers of the breast and colon. In the large randomized Women's Health Initiative, reduction in total fat intake had no significant effect on cancers of the breast, colon, cardiovascular disease, or a global score representing overall incidence of major diseases.<sup>6,7</sup> Data on diet and prostate cancer remain limited, but some studies have seen positive associations with animal fat.<sup>8</sup> Reassuringly, there is no suggestion that vegetable oils, which reduce risks of heart disease, are related to increased risks of these cancers and a suggestion of small reductions in risk have been seen in some studies. Thus, it is reasonable to make decisions about dietary fat on the basis of its effects on cardiovascular disease, not cancer.

Excess body fat, including both mild overweight and obesity, is the most important nutritional problem in many countries because this affects a high proportion of adults and many children, and also because it is a major risk factor for many diseases including type 2 diabetes; coronary heart disease; cancers of the breast, colon, kidney, esophagus, and endometrium; osteoarthritis; cataracts; and many other conditions. Dietary fat has been thought to be an important contributor to overweight because it contains more calories per gram, and because it may be more efficiently stored as fat than carbohydrate. However, it is now clear that any differences in metabolic efficiency are not practically important and that the balance of total calories rather than just fat calories is important in weight control. Thus, the critical issue is whether the fat composition of the diet influences our ability to control caloric intake, and theories abound why one diet should be better than another. Long-term empirical data are essential, but remarkably sparse. In randomized trials individuals assigned to low fat diets often tend to lose a few pounds during the first months, but then regain their weight. In randomized trials lasting a year or longer, there

has consistently been no greater weight loss with low fat diets.<sup>9</sup>

### **Carbohydrates**

Because adequate caloric intake is essential, a substantial reduction in dietary fat practically implies an increase in carbohydrate. Due to concerns about consumption of “empty calories” from sugar, high intake of “complex carbohydrates”, mainly starch in the form of bread, rice, pasta and crackers, has formed the basis of most dietary recommendations. However, refined carbohydrates, such as white bread and white rice, are very rapidly metabolized to simple sugars, and cause a greater rise in blood glucose and insulin levels than grains that have not been milled into fine flour. In addition to producing a rapidly absorbed form of starch, the refining process also removes many vitamins and minerals and fiber. Thus, the concept of “complex carbohydrates” is not based on sound physiological principles. A different way to classify carbohydrates is by their propensity to raise blood sugar levels, which is the glycemic index, and the glycemic load takes into account both the glycemic index of the food, and the amount of carbohydrate. In our large prospective studies, we have found that high intake of starches from refined grains and potatoes (i.e., a high glycemic load) is associated with higher risk of type 2 diabetes and coronary heart disease, and that greater intake of cereal fiber is related to lower risk of these conditions.<sup>10-12</sup>

As noted above, replacement of dietary fat with carbohydrate creates the adverse metabolic picture of low serum HDL and high triglycerides, and this picture is worse if the carbohydrate is highly refined starches low in fiber. Recent evidence also indicates that this adverse metabolic response to carbohydrate is substantially worse among persons who already possess a greater degree of insulin resistance, mainly the result of overweight, inactivity, and genetic predisposition.<sup>13</sup> This can account for the ability of peasant farmers in Asia and elsewhere, who are extremely lean and active, to consume large amounts of carbohydrate without experiencing diabetes or heart disease, whereas the same diet in a more sedentary population can have deleterious effects. The interaction between diet and underlying insulin resistance may be particularly important in Asia, and considerable evidence suggests that Asian populations tend to be more insulin resistant.<sup>14</sup> Thus, we have seen that for the same level of body mass index, diet, and physical activity, Asian women have nearly double the risk of diabetes compared to European women.<sup>15</sup>

### **Protein sources**

Although treated equally by US dietary guidelines, the health consequences of consuming red meat, poultry, fish, legumes, nuts, and eggs are quite different. High consumption of red meat has been associated with increased risk of coronary heart disease, probably due to its content of saturated fat and cholesterol, and higher risk of type 2 diabetes and cancers of the colon and possibly prostate. In contrast, the fat in poultry and fish is more unsaturated than that in red meat, and fish is an important source of the essential omega-3 fatty acids. Not surprisingly, we have seen that those who replace red meat with chicken

and fish have a lower risk of coronary heart disease and colon cancer. Eggs are high in cholesterol, but consumption of up to one per day does not appear to have adverse effects on heart disease risk (except among diabetics), probably because the effects of a slightly higher cholesterol level are counter-balanced by other nutritional benefits. Many people have avoided nuts because of their high fat content, but the fat in nuts, including peanuts, is mainly unsaturated, and walnuts in particular are a good source of omega-3 fatty acids. In controlled feeding studies nuts improve blood cholesterol fractions, and in multiple cohort studies those who consume more nuts have lower risks of heart disease. Thus, treating these various sources of proteins as equal fails to provide the public with information needed for healthy choices.

### **Fruits and vegetables**

High intake of fruits and vegetables is perhaps the least controversial aspect of dietary guidelines, and reduction in cancer risk has been a widely promoted benefit. However, most of the evidence for benefit has come from case-control studies, in which patients with cancer and selected control subjects are asked about their earlier diets. These retrospective studies are susceptible to numerous biases, and recent findings from large prospective studies have tended to show little relation between overall fruit and vegetable consumption and cancer incidence. Although some benefits probably exist for specific components of some fruits and vegetables and various risks, the benefit of a general increase in fruit and vegetable consumption has probably been overstated.

Although the benefits of fruits and vegetables for cancer prevention are probably small, substantial evidence from cohort studies indicates that higher intake will reduce risks of cardiovascular disease. This benefit is probably due to many constituents, but folic acid and potassium appear to be contributing factors. Inadequate folic acid is also responsible for higher risks of serious birth defects, and low intake of lutein, a pigment in green leafy vegetables has been associated with greater risks of cataracts and degeneration of the retina. Thus, there are many reasons, besides being a primary source of many vitamins needed for good health, to consume the recommended five servings per day of fruits and vegetables, even if this has little impact on cancer risk.

### **Dairy foods**

The dietary guidelines of many western countries promote high consumption of dairy products, which is usually justified by their high content of calcium and the prevention of osteoporosis and fractures. However, the highest rates of fractures are found in countries with high dairy food consumption, and large prospective studies have consistently not shown a lower risk of fractures among those with high intake of dairy products. Calcium is an essential nutrient, but the requirements for bone health have probably been overstated by reliance on short-term studies. Several lines of evidence now suggest that low calcium intake can modestly increase risk of colon cancer, but most of the benefit of higher intake appear to be achieved by a good overall diet plus the equivalent of about one 250 ml glass of milk per day.

High consumption of dairy products cannot be assumed to be safe because we are only now beginning to have the data to evaluate the consequences of high intake throughout life. In many studies, men who consume high amounts of dairy products have experienced increased risk of prostate cancer and in some cohort studies women with high intakes have had higher rates of ovarian cancer. Although fat was initially assumed to be the responsible factor, this has not been supported in more detailed analyses; high calcium intake itself seemed most clearly related to risk of prostate cancer. The role of dairy products in health and disease is an unsettled area in need of more research. At the moment, it seems imprudent to recommend high consumption, and intake of roughly 250 to 500 ml of milk per day may be a reasonable maximum.

#### *The overall impact of healthy diet and lifestyle*

To examine the potential for disease prevention by dietary factors and lifestyle within a US population, we calculated the population attributable risks using a dietary score based on lower intakes of trans fat and glycemic load, and higher polyunsaturated fat to saturated fat ratio, cereal fiber, folate, and fish, and also avoidance of smoking, normal body weight, moderate alcohol consumption, and higher level of physical activity. This analysis indicated that over 80% of coronary heart disease, 90% of type 2 diabetes, 70% of stroke, and 70% of colon cancer could be avoided by moderate lifestyle behaviors in a modern population. These high percentages should not be surprising because rates of these diseases have been low in many developing countries until recently, but we have now been able to identify specific aspects of diet and lifestyle that influence risk and document that a large increase in these diseases is not an inevitable consequence of economic progress.

#### **SUMMARY**

The emerging epidemic of chronic disease that is now affecting most parts of Asia could potentially become much worse than that experienced in Europe. However, we now know enough about the preventable causes to take actions that will promote healthy diets, encourage physical activity, and discourage smoking. At the same time, further nutritional research within Asia will enhance our understanding of diet and health and help focus preventive efforts.

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