

Chapter 2

Nutrition Policy for the Prevention of Disease: Issues of Cost-effectiveness

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Key Points

- Governments should implement nutrition policies that will improve population health.
- These policies include reducing the salt content of processed foods, use of dietary supplements of proven value, eliminating hydrogenated oils that contain *trans* fatty acids from food.
- Implementation of the proposed policies would cost relatively little and should achieve significant health benefits within a few years.
- These policies therefore have a very attractive cost-effectiveness (i.e., they generate quality-adjusted life years [QALYs] at a fraction of the cost of many types of conventional medical treatment).

Keywords Cardiovascular disease • Coronary heart disease • Cost-effectiveness • Dietary supplements • Food advertising • Food labels • Food prices • Government policy • Health care • Health promotion • Hydrogenated oils • Hypertension • Nutrition policy • Population health • Public health • Quality-adjusted life years • Salt • Statins • Subsidies on food • Taxes on food price • *trans* fatty acids • vitamin D

2.1 Introduction

It has been well established since the 1970s that dietary factors play a major role in the causation and prevention of a spectrum of diseases. These diseases have been referred to as Western diseases, non-communicable diseases, and chronic diseases of lifestyle (CDL). The major CDL include most forms of cardiovascular disease (CVD) (including coronary heart disease [CHD], stroke, and hypertension), obesity, type 2 diabetes, and several major types of cancer.

The high prevalence of these diseases across the Western world has created immense pressures on health-care systems. This crisis is most severe in the United States where the cost of health care now exceeds \$2 trillion and accounts for more than 16% of GDP. This level of spending has created great strain on both public and private finances. Unless drastic measures are taken this spending is set to increase sharply over the next two decades. One factor driving this is that millions of baby boomers are now moving into their sixties. Another major factor is that the epidemic of obesity that has swept

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the world since the 1980s is now precipitating other health conditions such as type 2 diabetes. Compounding these problems the relentless cost inflation of medical treatment has shown little sign of being brought under control.

The economic crisis that swept the world in late 2008, the worst since the 1930s, created enormous budget deficits for governments in many countries. Thus, while the cost of health care is on an ever-rising trajectory, governments have a reduced capacity to pay these costs. This crisis of overspending is equally severe where medical costs are paid by individuals or by insurance companies: The individuals and companies who must pay the bills, whether directly or via insurance premiums, are also under much financial pressure resulting from the economic crisis.

There was one positive outcome from the economic crisis: A large section of the population woke up to the realization that the capitalist system requires careful government oversight. For many years banks and investments companies operated with complete freedom to conduct business as they pleased with minimal government regulation or oversight.

But what has this to do with nutrition policy? Actually, there are strong parallels between the problems of the financial system and that of the national diet. The economic interests of the food industry have been the dominant driver of nutrition policy in most countries, including the United States. This has frequently occurred in disregard of the health impact of these policies [1]. This has directly led to many of the health problems that are so prevalent in today's society, and their huge economic consequences. In brief, a lack of government oversight of the banks and investments companies played a major role in the economic meltdown, while the willingness of governments to place the economic interests of the food industry above the health interests of the general population has caused a deterioration in public health and the consequent expanded cost of medical treatment.

This chapter argues the case for a strategic shift on nutrition policy in relation to population health. It is essential to see the consequences of nutrition policy, not merely in terms of the economic interests of the food industry, but also in terms of the huge cost of medical treatment resulting from diseases that can be prevented by a healthy diet. In many cases it is possible to make a direct comparison between the cost-effectiveness of these policies with those of conventional medical treatments that target the same conditions. As we shall see, a nutrition policy approach often achieves far more benefit per dollar of expenditure than does medical spending.

2.2 The Cost-effectiveness of Medicine

Many analyses have been made regarding the cost-effectiveness of medicine [2]. Benefits achieved as a result of medical interventions are often quantified based on how many quality-adjusted life years (QALY) are generated. The use of QALY allows all types of interventions to be directly compared, both those that prevent deaths and those that improve the quality of life. The cost-effectiveness of medical interventions can then be estimated based on cost per QALY. In the United States interventions that cost in the range of \$50,000–\$100,000 per QALY are often regarded as being acceptable, though there is a lack of consensus on this. Other countries, such as the UK, often use lower cost thresholds.

The cost-effectiveness of medical intervention covers an extremely wide range. Here, we shall briefly examine some clinical preventative services, using estimates based on costs in the United States. Some such interventions are cost saving. Examples are aspirin therapy for the prevention of cardiovascular disease (CVD) in persons at elevated risk, immunization of children, and screening for tobacco use followed by a brief intervention [3]. Nicotine replacement therapy costs less than \$5,000 per QALY [4], clearly making it highly cost effective. Drug treatment of hypertension for nondiabetics is estimated to cost approximately \$53,000 per QALY [5]. Statins are a family of drugs widely prescribed for

the prevention of coronary heart disease (CHD). Their cost-effectiveness depends greatly on the level of risk of the patients being treated: The higher the risk, the lower the cost per QALY. Thus, for patients at high risk of CHD their cost-effectiveness translates to a rather modest \$20,000, or so, per QALY [6]. But this figure becomes tenfold higher for patients at intermediate risk of CHD [6]. For that reason statins are justified only for people at high risk of CHD [7]. Nevertheless, these drugs are heavily marketed for patients at intermediate risk of CHD as this allows pharmaceutical sellers to hugely increase total sales. Statins are far from being alone as an example of extravagant medicine: Around 1 in 11 preventative interventions cost more than a quarter million dollars per QALY [8].

While the focus above is clinical preventative services, the same problem of widespread use of medical procedures that exceed reasonable cost limits is seen in many other areas of American medicine. While this issue is much discussed in academic journals, there is seldom any serious attempt to bring this discussion into the public arena. A major reason for this is widespread opposition by politicians and others in the United States to the use of cost as a criterion for decision making [9].

Other countries take a very different approach on this issue. In the UK a cost-effectiveness analysis (CEA) is routinely performed as part of the process of determining whether particular interventions can be employed by the National Health Service and therefore paid for using tax money. Such evaluations are done by the National Institute for Health and Clinical Excellence (NICE) [10].

2.3 Nutrition Policy and Public Health

The lesson from the previous discussion is that unless serious efforts are made to constrain costs, medical interventions can often be extremely expensive; most cost in the range \$20,000–\$200,000 per QALY. A very different picture emerges when we examine what happens when governments implement policies designed to improve public health. These can often achieve widespread benefit at remarkably low cost. For example, a CEA has estimated that the mandatory use of daytime running lights and of motorcycle helmets is cost-saving [11], while a smoke-free workplace can prevent disease and do so at an estimated cost of a mere \$500 per QALY [4]. Much the same is seen with regard to nutrition policies: A strong body of evidence reveals that they can also deliver major health benefits at relatively low cost. Unfortunately, few CEAs have been carried out in this area.

Here we consider the nutrition policies where the evidence is strongest. The proposed interventions have been arranged in approximate order of cost-effectiveness, starting with the lowest cost. The policies have been broken into two groups:

Group A. There is a high probability that implementation of these policies will achieve significant health benefits within a few years and are cost-effective.

Group B. Here the cost-effectiveness is much less clear and/or the health benefits may be delayed by many years.

2.4 Group A Nutrition Policies

2.4.1 *Cutting the Salt Content of Food*

A substantial body of evidence reveals that the great majority of people across the Western world consume a grossly excessive quantity of salt in their diets and that this plays a major role in the causation of hypertension [12, 13] and cardiovascular disease (CVD) [13, 14]. Salt is also believed to be an important causative factor in stomach cancer [15].

In order to substantially reduce the salt intake of the general population it is necessary to cut the salt content of processed foods by at least half as this is where 75–80% of the salt in the diet comes from. Feeding studies demonstrate that consumers have little problem accepting food with a much reduced salt content [16, 17]. As it would cost extremely little to implement this policy and the potential benefits are so large, it clearly follows that the cost-effectiveness would be highly favorable. Based on an Australian estimate this policy would cost approximately (US)\$1,180 per QALY [18]. According to an American estimate cutting the sodium content of the diet to 2,300 mg/day would save around \$18 billion/year in health-care costs [19]. Another study estimated that a population-wide reduction in dietary salt of 3 g/day (1,200 mg of sodium) would prevent between 44,000 and 92,000 deaths per year [20].

Despite the strong case for the immediate implementation of this policy no action has been taken in the United States: There was no change in the salt content of food between 2005 and 2008 [21]. This contrasts with the UK where policy implementation has led to real progress. In that country the Food Standards Agency (FSA) embarked on an ambitious campaign to lower salt intake from 9.5 g/day in 2000/2001 to <6 g (roughly 2,300 mg sodium) by 2010. Actual intake by adults had fallen to 8.6 g in 2008 [22].

2.4.2 Dietary Supplements

There are several dietary supplements that have proven to be a highly effective, safe, and low-cost means to prevent disease. Iodide and fluoride are well-known examples. The prevention of spina bifida by the fortification of grain products with folic acid, a policy introduced in 1996, provides another illustration of the potential value of this strategy.

A strong case can be made that vitamin D has the potential to repeat this success. There is convincing evidence that the vitamin is of significant value in the prevention of osteoporosis. Strong evidence has emerged in recent years that the risk of cancer is significantly reduced when vitamin D levels are optimal [23]. This benefit may also extend to CHD [24, 25]. Based on this evidence a large section of the population would likely benefit from supplemental intake. This applies especially to people at risk of poor vitamin D status, notably people with darker skin color and inhabitants of northern latitudes, such as the northern states of the United States, northern Europe, and the whole of Canada [26].

There is much controversy as to the optimal intake of vitamin D. The RDA is currently 5 µg (or 200 IU) per day at age 50 or younger, and double that at ages 51–70. While we still need to see the outcome of long-term clinical trials, our best evidence suggests that a higher intake is more effective for the prevention of the diseases discussed earlier. For that reason a supplemental dose of 25 µg (or 1,000 IU) per day is indicated for those whose vitamin D status is likely to be suboptimal.

This policy has already been partially implemented in Canada where all adults over age 50 are advised to take a vitamin D supplement, though at a lower dose than that suggested here. It is important to appreciate that the potent form of vitamin D is D₃. Many supplements have D₂ but that is only one quarter as potent.

According to a 2003 estimate, vitamin D supplements decrease fracture rates at a cost of \$800 or less per vertebral fracture avoided [27]. This indicates that vitamin D supplements are highly cost-effective, especially for people aged over 40 or 50 who may be vulnerable to poor vitamin D status.

2.4.3 Trans Fatty Acids

Partially hydrogenated oils contain *trans* fatty acids. Major food sources of these fats include hard margarine, cakes, donuts, cookies, pastry, and deep-fried foods. Lesser amounts of *trans* fatty acids

are present in ruminant animals. *Trans* fatty acids are now recognized as adversely affecting multiple cardiovascular risk factors and contribute significantly to increased risk of CHD [28]. By one estimate if these fats were removed from the American diet, CHD rates would be reduced by 3–6%, possibly by as much as 12–22% [29].

There is nothing to stop governments implementing a policy requiring that hydrogenated oils containing *trans* fatty acids be removed from food. But as is often the case with important issues of public health, governments in several countries have chosen the path of relying on voluntary efforts by industry to reduce population intake of these fats [30]. Serious attempts have, however, been made in several jurisdictions to reduce consumption. Denmark stands as a fine example. New York City and San Francisco have enacted regulations banning these fats from food sold in restaurants while British Columbia (Canada) has gone further and imposed a ban that affects not only restaurants but also bakeries and other food outlets.

Implementation of a policy that leads to the removal of *trans* fatty acids should prevent at least 13,000 CHD deaths per year in the United States. According to an estimate made in 2003 there would be a one-time industry cost of \$139–\$275 million for testing, relabeling, and reformulation [31]. The above information leaves little doubt that such a policy, calculated as dollars per QALY, would deliver improved health at bargain-basement prices.

2.4.4 Health Promotion

Since the 1970s many health promotion interventions have been carried out in the United States and around the world [32]. These have been done in varied settings, including schools, worksites, physician offices, and in the community. Some have focused on just one or two lifestyle changes while others have been more wide ranging. The most common goals have been to reduce excess weight, lower the blood cholesterol and blood pressure, and encourage people to quit smoking and exercise more. Overall, the results have been mixed; typically, progress has amounted to no more than a few percentage points. This might be expected to reduce the risk of CHD by about 5–15% [32]. Despite this limited impact well-designed health promotion campaigns can be a cost-effective way to improve lifestyles and thereby positively affect the health of large numbers of people [33–35].

Much health promotion is carried out independently of governments. However, governments have the resources and authority required to implement health promotion programs across diverse settings. For that reason the expansion of health promotion programs is best done as government policy.

2.4.5 Improved Food Labels

Food labels used in the United States and many other countries leave much to be desired; many consumers find them confusing. In the United States and Canada labels mix together food components where intake should be limited (sodium, sugar, and saturated fat) and food components that are often lacking in the diet (fiber and omega-3 fat). Labels give information as quantity per serving but similar products often use different serving sizes, thereby making it difficult for consumers to make accurate comparisons.

A system which I consider much superior is based on traffic lights. This has been developed in the UK by the FSA [36]. With this system colored circles are placed on the front of the pack and show

at a glance if the food has a high (red), medium (orange), or low (green) content of fat, saturated fat, sugars, and salt. The label also indicates the actual quantity of these substances per serving. This system is not as yet in widespread use but has been adopted by some supermarkets and food manufacturers. Research studies have reported that traffic lights labels increase the ability of people to assess the health value of a food [37, 38].

One possible improvement to this system is to add an extra traffic light to indicate the global health value of a food. Such a system requires a standardized methodology for nutrient profiling so as to compare foods. Several such systems have been proposed [39]. A British group has developed a system based on a limited number of food components [40]. The NuVal Nutritional Scoring System is an algorithm developed in the United States that generates a score based on more than 30 different nutrients and nutrition factors [41].

The long-term health benefits of improved food labels are difficult to predict. However, as the cost of implementation is modest and the expected benefits may be significant, it can be confidently predicted that their cost-effectiveness will be very favorable.

A special issue of food labels concerns restaurants. These are where a substantial part of the population consumes much of their diet. Dinners in restaurants often supply huge amounts of food energy, as much as 1,000–1,500 kcal, but most people have little realization of this. Menus in restaurants are therefore another area where nutrition information is needed, especially the energy content of meals [42, 43]. Proposals to implement such a policy are usually restricted to restaurant chains with at least ten restaurants. Legislation has been passed to implement this policy in several cities (including New York, San Francisco, and Philadelphia) and several states (including California, Oregon, and Massachusetts). The new health care bill passed in 2010 turned this policy into federal law for all restaurant chains with at least 20 outlets.

2.5 Group B Nutrition Policies

We now examine nutrition policies where the cost-effectiveness is much less clear. This is often because the health benefits may be delayed by many years.

2.5.1 Nutrition Policy, Children, and Adolescents

Several important nutritional policies concern children and adolescents.

Food advertising on TV that targets children is overwhelmingly (80–90%) for unhealthy food choices or for fast-food restaurants [44, 45]. Not surprisingly, such advertising is often successful in inducing children to consume the advertised foods [46, 47] and is strongly associated with the risk of obesity in children and adolescents [48]. As the advertising of unhealthy foods is clearly detrimental to health, the obvious remedy is an outright ban. This has been done in Quebec (Canada), Sweden, and Norway [49]. A much more common approach, despite its limited effectiveness, is based on voluntary agreements and self-regulation by the food industry [49].

A study was recently carried out on 395 American public schools [50]. Vending machines were present in 82% and 97% of middle and high schools, respectively. Among schools where food was sold, approximately five in six of them permitted the sale of foods or beverages that are nutrient poor but high in energy (i.e., “junk food”). When schools permit the sale of unhealthy food they are – implicitly – conveying an educational message that is the diametric opposite of the one stated in

food guidelines. Schools should therefore be compelled to restrict the sale of unhealthy food. Likewise, where meals are served in schools, these should be of high nutritional quality. This can be justified as a means to directly improve the nutrition of children.

The cost of these policies on food advertising, on food sold in schools, and on school meals is difficult to estimate. For example, many school authorities may oppose restrictions on the sale of unhealthy food as those sales can be a valuable source of extra income. However, from a societal perspective the true cost of the proposed policies is likely to be reasonably low as spending lost in one area will be directed to other areas. In particular, as the sale of less healthy foods declines, sales of healthier foods will rise, and so will advertising for it.

The proposed policies should bring about a reduced prevalence of obesity. Another important benefit is that improved dietary habits of children and adolescents will, at least to some extent, carry over to middle age. Clearly, most of the health benefits of the proposed policies will accrue many years (~50 years) after the initial expenditures. As much is unknown with regard to both the cost and health benefits of these policies, their cost-effectiveness cannot be estimated with any accuracy. Nevertheless, much like environmental protection, expenditures today are justified based on their long-term benefits.

2.5.2 Food Prices

Changing food prices by means of taxes and subsidies is an attractive means to encourage healthier eating patterns. The price structure of food in the United States and other Western countries means that less healthy foods with a high energy density (energy per gram) are generally cheaper than healthier food choices. Refined cereals and foods with added sugar and fat are among cheapest sources of energy, whereas the more nutrient-dense foods, such as fish, lean meat, vegetables, and fruit, are generally much more expensive when the price is expressed as the cost of food energy (dollars per 1,000 kcal) [51–53]. For that reason people with a low income are pressured to select a relatively less healthy diet with a low content of several micronutrients (such as vitamin C and beta-carotene) and a high energy density [54]. This is probably an important reason why the poorest people are often the least healthy.

An important factor responsible for the current price structure of food is that government subsidies are paid to agricultural enterprises with little regard for their nutritional consequences. For example, the subsidies paid to American corn producers have made high-fructose corn syrup a cheap energy source and this has helped bring about a huge increase in consumption of soft drinks. [55]. Likewise, the Common Agricultural Policy of the European Union gives much higher subsidies to farmers for production of full-fat milk than for skimmed milk, while large quantities of fruit and vegetables are withdrawn from the market and destroyed so as to maintain high prices [56].

Studies on both smoking and alcohol have revealed “price elasticity” (i.e., consumption falls in response to a rise in price) [57–69]. The effect is stronger among the lower socioeconomic groups. What applies to tobacco and alcohol also applies to food [61]. We can reasonably assume that the judicious use of taxes and subsidies can shift eating patterns in a healthier direction. This was explored by Jeffery, French, and colleagues in a series of studies conducted at worksites and in high schools in the United States [62–64]. They observed that halving the prices of healthier food choices (low-fat snacks sold in vending machines and of fruit and salad ingredients sold in cafeterias) lead to a doubling or trebling of sales.

The above evidence points to the potential of government policies concerning prices of food to be an effective means to bring about desirable changes in eating patterns: The healthier choice must also

be the affordable one. Taxes and subsidies could be used as tools to persuade people, for example, to consume whole grain bread rather than white, low-fat milk rather than full-fat milk, and chicken rather than beef. A tax on sugar-sweetened beverages has been proposed [65].

This strategy is potentially one the most powerful nutrition policy approaches but is also one the most challenging. There is likely to be much opposition from industrial lobbies. Another challenge with regard to the use of taxes and subsidies is that the “law of unintended consequences” can rear its ugly head. For example, a British study based on computer simulations concluded that a reduction in consumption of saturated fat was likely to increase salt consumption, while taxation on milk and cream tends to cause a decrease in fruit consumption [66]. Clearly, while attractive, the use of taxes and subsidies as part of a nutrition policy needs to be carefully researched before being implemented.

The cost of the proposed changes to food prices may be quite high in the short term due to disruptions in patterns of agriculture and food production. However, in the longer term the cost should be minimal; depending on how the program is planned, extra costs in one area are canceled out by savings in other areas. As is the case with several of the other policy proposals discussed here, the long-term health benefits are very difficult to estimate. For these reasons more research is required before a realistic CEA can be made.

A variation of a strategy based on direct changes to food prices is the provision of healthy foods to people by more direct means. The US government gives food assistance to the more needy members of its population by way of several different programs. The largest of these is the Supplemental Nutrition Assistance Program (SNAP; formerly the Food Stamp Program). These programs are a potential vehicle by which people could be encouraged to consume healthier foods [67]. As an example of this, studies in both the UK [68] and United States [69] reported an increased intake of fruit and vegetables when low-income women were given vouchers that could be exchanged for these foods.

2.6 Conclusion

The policy proposals discussed here fall into two distinct groups:

Group A. There is a high probability that implementation of these policies will achieve significant health benefits within a few years and are highly cost-effective. These policies include reducing the salt content of processed foods, use of dietary supplements of proven value (perhaps starting with vitamin D for selected population groups, such as middle-aged and elderly people who have a lack of sunshine exposure), eliminating *trans* fatty acids from food, carefully selected health promotion interventions, and improving food labels so that they present clear information on the health value of food (e.g., traffic-light labels and adding nutrition information to menus in restaurants, especially the energy content of meals). These policies are likely to cost well under \$1,000 per QALY.

Group B. Here the cost-effectiveness is much less clear and/or the health benefits may be delayed by many years. These policies include nutritional policies that target children and adolescents and changes to food prices by means of taxes and subsidies.

The proposals made here, especially those in Group A, should be seen as the basis of a new overall nutrition strategy. They should help counter the burden of chronic diseases of lifestyle. This proposed strategy is best seen in the wider context: The objective of all policies and actions that impact on human health, whether carried out by government or the health-care industry, can be viewed as simply a means to generate QALYs. This encompasses policies as varied as improved road safety, removing hazardous chemicals from the environment, protecting the population from epidemics of infectious disease, giving dietary advice to the general population, and treating people

with drugs to treat hypertension or cancer. Seen in this context the proposed nutrition policies are a logical development of the above policies and actions.

Measured as dollars per QALY – or bang for the buck – the proposed nutrition policies generate QALYs far more cheaply than is achieved by many types of conventional medical treatment. By making comparisons as dollars per QALY it becomes clear that conventional medical interventions, such as the use of drugs for lowering blood cholesterol and controlling hypertension, typically cost many times more than nutrition policies to achieve comparable benefit: whereas medical interventions mostly cost in the range \$20,000–\$200,000 per QALY, the proposed nutrition policies are likely to cost well under \$1,000 per QALY.

There is one important barrier that stands in the way of the implementation of the policies discussed here, namely that health care is typically viewed as an essential service whereas improved nutrition policies are seen as having a much lower priority. We see this in the high priority politicians give to maintaining first class health care, at least for the majority of the population. Costs are seen as something that should be reduced where possible. Nutrition policies, by contrast, are discussed narrowly in terms of improving population health and have a far lower priority for most governments. One important factor responsible for this is pressure on governments by commercial interests: On the one hand, the pharmaceutical industry reaps vast profits from treating disease while the food industry has a vested interest in ignoring the health impact of its products. I argue here that it makes far more sense to evaluate the costs and potential value of health care and nutrition policies with the goalposts in a fixed position. Clearly, we need a paradigm shift.

In coming years it is likely that the total cost of health care will steadily become higher and suck in an ever-greater proportion of the national economic pie. A logical response to this will be policy initiatives to reject the use of medical procedures that exceed preset limits, measured as dollars per QALY. As mentioned earlier, this policy has already been implemented in the UK. Proposals along these lines have been made for the United States [70]. The bottom line is that what makes obvious sense is to direct finite resources to where they can be most usefully deployed; to do otherwise should be seen as irrational. The proposed strategic shift on nutrition policy and health should be viewed from that perspective.

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