

Part One

Public Health Nutrition Tools

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Introduction to Public Health Nutrition

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Key messages

- Nutrition is fundamental for life and health. The term 'nutrition' encompasses both biological and sociological aspects of how cells, tissues and organisms access the substrates and cofactors that are necessary for normal conception, growth, development and ageing.
- Public health nutrition refers to nutritional aspects of public health, which is the science and art of promoting and protecting health and well-being, preventing ill health and prolonging life through the organised efforts of society.
- The historical focus of public health nutrition has been on under-nutrition, which is still a major problem across all levels of development. In less economically developed countries, it most commonly manifest as deficiencies of micronutrients as well as wasting and stunting (acute and chronic malnutrition) in childhood. In economically developed countries undernutrition is a common feature of ageing, though nutrition-related chronic non-communicable diseases such as obesity, type 2 diabetes, cardiovascular disease and several common cancers predominate. Increasingly, as less economically developed countries undergo nutritional transition, they are experiencing a rising burden of these diseases, so that these are now the major nutrition-related disease burden globally.
- The characterisation of human nutrient requirements is a fundamental activity for public health nutrition, and their application in clinical or public health settings requires training and experience that marks professional nutritional practice.
- Effective public health nutrition requires three discrete functions
 - the acquisition, synthesis and dissemination of knowledge relating nutrition to health and disease;
 - surveillance programmes to detect potential nutritional problems across the life course among the population, and to monitor change;
 - evidence-informed policy development, implementation and evaluation.
- Public health nutrition policy relies on ensuring that people have the necessary information to make healthy choices around food and physical activity, as well as on ensuring that the environment in which they live is conducive to making those healthy choices. Policy makers need to balance the evidence for health need against economic and other socio-political factors in determining what action to take.

1.1 Public health and nutrition

Nutrition lies at the heart of health. Human life – from conception or even before, through fetal and childhood growth, development and maturation, to adult life and old age – creates a demand for energy and nutrients, and relies on their adequate provision, and on the body's metabolic capability to transform these substrates and cofactors into the multitude of chemicals needed by cells for normal structure and function, driven by their genetic endowment. Nutrition is the process by which cells, tissues, organs, people and populations achieve this.

Poor nutrition leads to poor health; and poor health also often leads to poor nutrition.

Public health refers to those aspects of health that affect the population as a whole, their study and the services that aim to deliver it. Public health nutrition is where these two concerns – population health and nutrition – interact or overlap.

Public health is defined as 'The science and art of promoting and protecting health and well-being, preventing ill health and prolonging life through the organised efforts of society'.

It is worth elaborating on that concise definition, first to note the implicit recognition that the evidence (science) underpinning actions to promote or protect health may often be incomplete, and that professional judgement (art) is needed to interpret and apply it. This is no different in concept from the application of science in clinical care, where the demand for evidence-based practice exposes gaps in knowledge of how to manage the very variable presentations of individual patients, but does not paralyse clinical action. Second, it is important that prolongation of life is linked with the promotion of health and prevention of ill health, in order to avoid prolonged disability with ageing. The aim is to shorten the period of ill health (compression of morbidity) before death in old age. Third, public health needs to be organised. It is not a default, as can be seen in the many parts of the world where effective public health structures and systems do not exist, and where infant and maternal mortality are high, expectation of life is low, and infectious and increasingly non-communicable diseases are common, as was the case in now economically developed countries in the past. Finally, the responsibility to make efforts falls not only to the small group of people who are professionals in public health, but to society as a whole. This recognises that the determinants of health in populations have little to do with the health care system (which deals with the problems of failed health), and are mostly related to the wider environmental conditions in which people are conceived, born, grow, live, work and age. Public health is about creating environments that are conducive to health, and public health nutrition is about creating environments that are conducive to healthy nutrition.

1.2 History of nutrition in public health

The ancients regarded food and medicine as related aspects, and since the demonstration in the 18th century by James Lind that lime juice was effective in curing and preventing scurvy (even though the finding was initially ignored and later had to be rediscovered), it has been clear that the provision of appropriate quality and quantity of food is essential in securing people's health.

The importance of food for growth, development and health was apparent despite lack of knowledge of the biological processes involved. This ignorance of the detail of the body's nutritional demands and how different foods and diets can meet them meant that it was difficult to derive rational nutrition policies.

The UK offers a good illustration. In the UK during the First World War, disruption to food imports from abroad had a major impact on the food supply (see Table 1.1), but there was insufficient understanding of

Table 1.1 When food imports were seriously disrupted in the First World War (WW1), limited nutrition knowledge meant that a coherent food policy was not possible and the food supply was adversely affected. In contrast, despite similar disruption to food imports in the Second World War (WW2), the application of the new nutritional science into effective policy ensured that the food supply was maintained and equitably distributed to secure the health of the population.

	WW1	WW2
Milk	-26%	+28%
Eggs	-40%	-6%
Meat	-27%	-21%
Vegetables	-9%	+34%

Source: Magee (1946). Reproduced with permission of BMJ Publishing Ltd.

the nutritional consequences for a coherent political response to be mounted.

Subsequently, the British population experienced food shortages, and malnutrition was a major problem. After the establishment of the Ministry of Health in 1919, food and nutrition were early targets for a more systematic approach to policy. In 1921 the Ministry published a report on 'Diet in Relation to Normal Nutrition' that identified the importance of so-called 'protective foods' – green leafy vegetables, milk and eggs – for healthy growth in children. This period coincided with the explosion of nutrition research into the accessory food factors (vitamins, minerals and trace elements) and the biological mechanisms for their effects – a discipline which spawned the new word 'biochemistry'. By the time of the Second World War, when there was a similar disruption as in the first war to the food imports on which the British food supply depended, nutritional science had progressed sufficiently for the Government to base its food policy on sound science. This policy, which involved public education with enhanced local food production and controls on the equitable distribution of food, led to quite different effects on the food supply (see Table 1.1), and its success to the British Ministries of Food and Health later receiving the prestigious Lasker Award for public health.

This period set the foundations for the essential elements of food and nutrition policy into the future. The key aspects are

- a transparent mechanism for the provision of scientific nutrition advice to government;
- reliable means for monitoring diet and nutrition status among the population;
- effective means of developing and evaluating policies to assure the quality and quantity of the food supply, and the nutritional health of the population.

The most prominent aspect of nutritional advice was the establishment by groups of experts of so-called recommended daily (or dietary) allowances. These set the amounts of essential nutrients needed to be consumed by populations to minimise risk of deficiencies, based on the growing science. These reports, published in the UK in the same series as the 1921 report for the Ministry of Health, have now been supplanted in most countries, following the UK 1991 report on dietary reference values, by attempts to describe the estimated range of dietary requirements for different nutrients among populations, including the balance of macronutrients considered desirable to reduce risk of chronic disease.

The establishment in Britain in 1940 of the National Food Survey was the forerunner of a systematic programme of diet and nutrition surveys which characterise the food and drink consumption of the population from childhood to old age, as well as their nutrition status in terms of anthropometry and biochemical measurements of blood and urine, and relevant physiological measures such as blood pressure. Such food and health monitoring systems play an essential role in the detection of nutritional problems in the population, tracking their development, and evaluating the effectiveness of policies to address them.

The success of the wartime food policy in the UK may in part be ascribed to the possibility of applying stringent controls and restrictions on the national diet due to the national emergency, as well as the coincidentally high levels of physical activity that were prevalent at the time. However, such restrictive approaches, though effective, are unlikely to find favour beyond the stringent circumstances of such an emergency, and a critical issue for policy makers is to find effective means of promoting healthy nutrition without inappropriate interference with people's freedom to choose how they live. This dilemma has been addressed by various commentators, including the Nuffield Council on Bioethics.

1.3 Nutrition and public health in different parts of the world

For the majority of the 20th century, nutrition policy in industrialised countries was directed to the elimination of classic micronutrient deficiency diseases such as scurvy and rickets, which were major scourges in particular among the least affluent in society. In less economically developed countries, gross malnutrition with wasting and stunting of children, and high levels of maternal and child mortality, as well as specific nutrient deficiencies, remain common, mirroring the situation of the previous century in industrialised countries.

During the latter part of the 20th century and in the 21st century, the prominence in economically developed countries of deficiency diseases diminished with better access for all to a wide variety of foods, and effective food fortification policies. However, this was replaced by a growing burden of chronic non-communicable disease, at first cardiovascular disease, but increasingly cancers, obesity and diabetes. At the same time, some micronutrient deficiencies – in particular rickets – began to re-emerge, while undernutrition in the ageing population has become an important concern, sometimes simply due to poor dietary intake (with low lean mass and activity levels), and sometimes consequent to disease.

In less economically developed countries, the problems of malnutrition with stunting and wasting continue to dominate, but as the populations undergo an economic transition from rural to more urbanised ways of life, they also undergo a nutrition transition so that rates of obesity, and other chronic non-communicable diseases, are also rising, creating the so-called double burden (of over- and undernutrition). In places such as Thailand and Chile, which have had tangible success in reducing undernutrition, this has been at the cost of a rise in prevalence of overweight and obesity.

Clearly, malnutrition in all its forms affects all parts of the globe, though its segmentation within society varies.

1.4 Current role of nutrition in public health

Socio-demographic changes are affecting many parts of the globe. In most countries people are living longer, while economic development is also driving increased urbanisation, with rapid and profound changes in ways of life. In more affluent countries, average smoking rates are declining, while prevalence of overweight and obesity are increasing, and levels of physical activity have fallen. Traditional diets are being replaced by typical 'westernised' patterns, with more processed foods including fats, oils, refined starches and sugars, higher salt intake and a greater reliance on foods from animal as opposed to plant sources.

In less economically developed countries there is a rising burden of cardiovascular disease, and increasingly also the cancers more typical of affluent nations – breast, colorectal and prostate – related to nutritional factors, in place of the cancers caused by infections – liver, stomach and cervix. Lung cancer remains a scourge – though mostly of men – as smoking rates have not declined as in more affluent countries, and indeed are still rising in some.

In more affluent nations, rates of cardiovascular disease are declining, so that with increasing age the major non-communicable disease group is predicted to be

cancers, many of which are related to dietary patterns, body fatness and physical activity levels.

Meanwhile malnutrition – stunting and wasting in children, short stature in adulthood, as well as specific micronutrient deficiencies – remains prevalent, often within the same communities as increasing overweight and obesity. Even in richer countries, where food security is less of a problem, micronutrient deficiencies such as rickets remain persistent in vulnerable groups, and are possibly increasing.

1.5 Nutrition through the life course

Nutritional problems have always been recognised at all stages of the life course. Maternal overweight or obesity, or underweight, are known to influence the outcome of pregnancy both for the mother and the infant. Low birth weight remains a problem among low-income countries, and nutritional factors are key. Poor growth with wasting and stunting are classic nutritional problems of undernutrition, which remain prevalent in low income countries, while increasingly in high income countries obesity is becoming a serious problem in childhood. One consequence of the nutrition transition is the development of a cohort of people of short stature from undernutrition in childhood, but who then become overweight or obese; this combination carries enhanced risk for nutrition-related problems, in particular for maternal and fetal outcomes in pregnancy. Adolescence is a period of rapid growth and development, with increased demands for energy and nutrients, and so is a period of vulnerability to any constraint on supply, and this can be compounded by early pregnancy, which drives competing demands between mother and fetus. Micronutrient deficiencies remain prevalent where food supply is monotonous and insecure, emphasising the need for dietary diversity, while adult obesity with its attendant co-morbidities of diabetes, cardiovascular disease and some cancers is a major problem for high-income countries and increasingly so for middle- and even low-income countries. Undernutrition is also becoming an important cause of morbidity and mortality among older people.

There is growing recognition of the impact of nutrition not only in the immediate context, but as a determinant of future health. Non-communicable chronic diseases such as obesity, diabetes, cardiovascular disease and cancers result from the interaction of people's current exposures – their diet, activity levels and nutritional state – with their susceptibility. Susceptibility is partly determined by genetic endowment; however, it is now clear that early life events (in particular constraint of growth due to imbalance between the amount or quality of the demands for energy or nutrients, and their supply,

from conception to adulthood) can have a profound impact on later risk of these conditions.

1.6 Principles of public health nutrition

Effective public health nutrition requires three discrete functions

- the acquisition, synthesis and dissemination of knowledge relating nutrition to health and disease;
- surveillance programmes to detect potential nutritional problems across the life course among the population, and to monitor change;
- evidence-informed policy development and implementation.

The primary prevention of disease relies on the identification of the causes of disease, so that they may be addressed. The identification of infectious causes has led to the development of vaccination and antibiotics, and of means to control their vectors, such as the mosquito for malaria. The identification of a deficiency of the essential nutrients allowed for dietary approaches to their prevention, and policies such as food fortification. For nutrition-related chronic non-communicable diseases, with multiple causes and highly variable susceptibility in the population, not only is the identification and characterisation of the pathways of causation complex, but equally the appropriate medical, public health or political response is often difficult to agree. Nevertheless, an analogous approach to these problems allows an open dialogue on how to address them.

It is essential that any approach relies on the whole body of scientific evidence. As in all health practice, this may be epidemiological information, clinical trial data or laboratory evidence, or less reliable forms. In clinical medicine, randomised controlled trials (RCTs) are rightly regarded as superior to other forms of investigation because of their ability to test relevant hypotheses with a robust design and avoid the problems of confounding that arise in epidemiological studies. However, for primary prevention of chronic non-communicable disease that manifests in adulthood but has roots in early life, and where the impact of environmental exposures takes decades, it is less clear that RCTs have net overall advantage. While well-designed and –executed RCTs have strong internal validity (they give a correct answer to the hypothesis tested), they often lack external validity (that is, they cannot test the right hypothesis) perhaps because they are not conducted in an appropriate population or use atypical exposures. For primary prevention, intelligent interrogation of the whole body of evidence is required to infer causation from observed associations. This can be aided by using accepted frameworks such as

that derived by Bradford Hill. Such synthetic approaches to the evidence can identify preferred patterns of diet or lifestyle likely to reduce disease and promote health.

Once such patterns are identified, it is important to explore to what extent they are present in the population, and in potentially vulnerable subgroups. For this reason, proactive nutritional surveillance of the population is a necessary component of rational public health nutrition. Such monitoring surveys may identify the prevalence of disease risk factors in the population such as obesity or physical inactivity, or of biological factors such as high blood pressure or disordered blood lipids. They also allow the impact of policy to be evaluated.

Vulnerable subgroups may be defined in several ways. They are often defined in terms of age, sex, ethnicity or socio-economic state. However, it is equally possible to conceive vulnerability from a biological perspective. Diet and health surveys allow the distribution of relevant variables (such as risk factors or markers of nutritional status) within the population to be calculated. Though one aim of policy is to shift the whole distribution of risk in a population in a beneficial direction, interest – aided by newer technologies – is increasingly being paid to exploring the variability itself. Such variability reflects individual characteristics that determine susceptibility (e.g. to disease), and characterising the risks of individuals *within* the population and their determinants (as well as the determinants of differential risk *between* populations, which may be different) is an increasing focus of attention. For example, fortification of staple foods with folic acid has been proposed (and in some countries implemented) to ensure adequate intake in women who become pregnant to reduce the risk of neural tube defects in their offspring. However, there are concerns that such broad exposure to fortified foods might lead to excessive intakes among those who already have high intakes, emphasising the need to consider the shape of the distribution of intake, and not only the average.

Finally, effective public health action requires the development of policies based on the evidence. Though seemingly obvious, much nutrition policy may nevertheless be based on preconceptions or ideological preferences. Because the evidence for effectiveness of policy is difficult to obtain by conventional medical models of investigation, policy needs first to identify the nutritional problems that need addressing; to develop policies based on the best evidence available (even if incomplete) and implement them in a way that can be evaluated to allow the policy to be continuously improved (that is, to develop evidence from the evaluation of policies in action). Because policy often involves politics, and the

solution needs to embrace not only the health aspects but also socio-political considerations, tensions may arise in identifying the appropriate intervention or its degree. This aspect has been addressed by the Nuffield Council on Bioethics, which developed a ‘ladder’ of different degrees of intervention as a framework for consideration (Figure 1.1). While this ladder offers a valuable framework, it is predicated on relatively simple, single actions. This limits its practical use in public health, which has the characteristics of a complex system. Failure to recognise the inherent complexity in the determinants of people’s behaviour may in part be responsible for the relatively modest effects observed from many more linear interventions, as well as unwillingness to adopt policies that are more restrictive.

The question arises as to who should take action. The definition of public health draws attention to the need for organised efforts of society. While it falls clearly to the health professions and politicians to take the lead in the organisation of society’s efforts, it is clear that the roots of environmental exposures linked to health or disease fall far outside the ambit of health practice. The complex environmental determinants of people’s behaviour are formed by the cumulated actions of all sectors of society, many of whom have no sense of their role or responsibility in public health. Yet, it is only by engaging with all sectors, and creating a synergy of action, that the environment will become conducive to the promotion of healthy long life for all. Much public health policy is driven by professional and other sectors, attempting to impose top-down change on people, while examples of success are often characterised by a groundswell of demand from the grassroots (bottom-up). Finding ways to engage with people through their own communities, and manage the interface between them (us) and more powerful sectors, is critical for lasting and substantive success.

1.7 Conclusions

Public health nutrition, like other health professions, relies on the application of incomplete evidence in biological, psychological and sociological spheres. It requires the engagement of parts of society that are outside traditional health sectors, and the capacity to identify, collect, synthesise and disseminate relevant information, and to use it effectively to influence important players from the public to politicians. Public health nutritionists have a lead responsibility in organising the efforts of all parts of society to create an environment conducive to good nutrition and health.

The range of options available to government and policy makers can be thought of as a ladder of interventions with progressive steps from individual freedom and responsibility, towards state intervention as one moves up the ladder. In considering which 'rung' is appropriate for a particular public health goal, the benefits to individuals and society should be weighed against the erosion of individual freedom. Economic costs and benefits would need to be taken into account alongside health and societal benefits. The ladder of possible policy action is as follows:

Eliminate choice. Regulate in such a way as to entirely eliminate choice, for example through compulsory isolation of patients with infectious diseases.

Restrict choice. Regulate in such a way as to restrict the options available to people with the aim of protecting them, for example removing unhealthy ingredients from foods, or unhealthy foods from shops or restaurants.

Guide choice through disincentives. Fiscal and other disincentives can be put in place to influence people not to pursue certain activities, for example through taxes on cigarettes, or by discouraging the use of cars in inner cities through charging schemes or limitations of parking spaces.

Guide choices through incentives. Regulations can be offered that guide choices by fiscal and other incentives, for example offering tax-breaks for the purchase of bicycles that are used as a means of travelling to work.

Guide choices through changing the default policy. For example, in a restaurant, instead of providing chips as a standard side dish (with healthier options available), menus could be changed to provide a more healthy option as standard (with chips as an option available).

Enable choice. Enable individuals to change their behaviours, for example by offering participation in an NHS 'stop smoking' programme, building cycle lanes, or providing free fruit in schools.

Provide information. Inform and educate the public, for example as part of campaigns to encourage people to walk more or eat five portions of fruit and vegetables per day.

Do nothing or simply monitor the current situation.

Figure 1.1 The intervention ladder. Source: Nuffield Council on Bioethics (2007). Reproduced with permission of Nuffield Council on Bioethics.

References

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