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Nutrition policy: priorities for new research

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The objective of the present paper is to examine areas of nutrition policy where new research is needed to underpin good policy decisions. In that context, research is quite loosely defined to include not just the generation of new data but also the use of existing data in new ways and the derivation of new approaches to the analysis of problems and issues in nutrition policy.

NUTRITION POLICY AS A COMPONENT OF FOOD POLICY

Fig. 1. illustrates the main components of national food policies which embrace issues in agriculture, the environment, trade, national strategic interests and health. Within health, lie issues relating to toxicology, microbiology and nutrition. This matrix of food policy poses constraints on any one element of policy. For example, environmental policy might aspire to increase the level of organic farming but would be constrained in the extent to which this policy might be achieved by other issues in the food policy matrix, i.e. food prices and land use in respect to agricultural policy, and the capacity to meet nutritional needs in respect to nutrition policy. The greater the level of dialogue between the elements of food policy and the greater the understanding of how these elements interact, the greater will be our ability to identify those limits to change or areas where change must be put in place. In the US, there is a campaign in place to increase the consumption of fruit and vegetables to five servings per day. The data in Table 1 illustrate the scale of change that this would imply in US agriculture in that the supply of fruit and vegetables would need to be doubled (O'Brien, 1995). Against a background of a 10% rise in vegetable consumption over the period 1970–1990 and a rise of about 15% in fruit consumption in the same 20-year period, it is clear that the target of '5-a-day' is ambitious. From an environmental point of view, this has implications for land use, ground water supplies and agro-chemical use. Fruit and vegetables require twice as much fertilizer as seed crops and up to twenty times as much pesticides. To have identified the scale of increase in fruit and vegetable intake required by this '5-a-day' programme and to have considered its environmental impact is not to suggest that the programme is inappropriate. It merely helps policy makers see, in realistic terms, the possible challenges that their policy will create. Solutions, based on this real assessment can now be considered. Thus, one priority area for research is a high-level multidisciplinary analysis of the opportunities for and constraints on which the attainment of nutrition policy objectives exist in the food policy matrix.

OPTIONS FOR THE ATTAINMENT OF NUTRITION POLICY OBJECTIVES

Most nutritional advice, at both the level of individuals and of populations, centres on advice on how to change eating habits. Understandably, when nutrition policy is being formulated, its outcome is usually expressed as food-based dietary guidelines. That all the objectives of nutrition policy can be achieved by altering existing eating habits is

Table 1. *The implications of increasing fruit and vegetable consumption in the US on supply and on agro-chemical usage* (Adapted from O'Brien, 1995)

	Fruit	Vegetables
Food supply (kg/head per year)		
1990	118	113
1970–1990	+16	+17
To achieve five servings per d	+227	+518

	Fruit	Vegetables	Seed crops
Agro-chemical use (g/m^2)			
Fertilizer	9–51	42	2–26
Pesticides	5	6	0·3

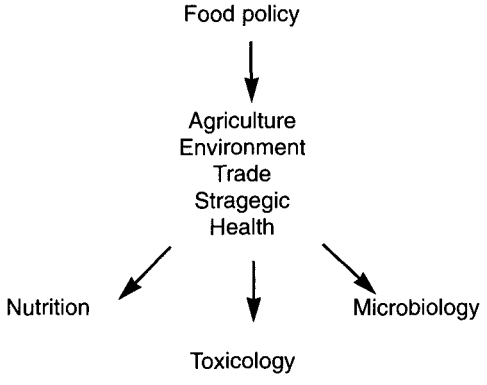

Fig. 1. The components of national food policies.

questionable. Some of these objectives will be attained by altering the nutritional properties of existing food. This can be achieved through biotechnology (Hayenga, 1993), through new food and ingredient processing technologies (Smith, 1993) and through simple enrichment of foods. An important strategic decision in nutrition policy is to identify which goals might be achieved through an altered food supply and which goals might be achieved through the technological modification of existing food supplies. For example, recent data show that increasing folic acid intake through increased intake of folate-rich food will not attain the level of erythrocyte folate required to significantly reduce the risk of a neural-tube-defect birth in women (Cuskelly *et al.* 1995). The same study clearly shows that increased intake of foods fortified in folic acid will attain this nutritional objective. New technologies which allow the incorporation of long-chain *n*-3 polyunsaturated fatty acids into spreadable fats may be more effective in attaining an increase in such fatty acids than advice on increasing intakes of oily fish (Roche & Gibney, 1994). Thus, a second priority area for research in nutrition policy would involve a multi-disciplinary analysis of the opportunities for, and limitations of, technological innovation to modify the nutritional properties of existing foods to attain specific nutrition policy objectives.

SUPPLY-DRIVEN NUTRITION POLICY: IMPLICATIONS FOR FOOD-FORTIFICATION POLICIES

Supply-driven food policies fully or partially deny any choice to consumers with respect to the intake of a particular nutrient. Policies which manipulate price or market availability of specific foods partially deny consumer choice, but such policies will become decreasingly significant with the growing liberalization of world trade and the agreed need to lower non-tariff trade barriers. Policies which oblige manufacturers or producers of specific foods to fortify their food with a given nutrient deny or greatly restrict any freedom of consumers to avoid increased intakes of that nutrient. Examples of such policies are the enrichment of salt with iodine to prevent goitre, the enrichment of flour with vitamin D to prevent rickets and the addition of fluoride to water to reduce the prevalence of dental caries. Such policies are highly successful in tackling nutritional issues provided certain conditions are met. First, the relationship between the target nutrient and the target nutritional disorder should be direct and not dependent on other conditions, e.g. family history, body weight, alcohol intake, etc. Second, the level of fortification and the vehicle food chosen should be such as to truly address the problem without creating any adverse effects. In the modern era of nutrition policy, the fortification of food with folic acid to reduce the incidence of neural-tube-defect births fulfils the first of these conditions. Whether it fulfils the second condition depends on whether it is acceptable that high intakes of folic acid may mask pernicious anaemia in older people. If the latter is not deemed to be a problem, then since no other possible adverse effects of high folate intakes are being presented as a potential barrier to fortification of foods with folic acid, the second condition is met. If, however, there is concern that life-time high intakes of folic acid may lead to a higher prevalence of pernicious anaemia in older people, then the second condition can only be met if the selected vehicle foods reach the target group (women aged 15–35 years) but do not reach older people (60 years old and older). Present US analysis of the issue does not appear to see any potential for adverse effects of high folic acid intake in older people given that their modelling calculations show that intakes of added folic acid in males aged 51 years and over would range from about 800 to 1000 μg/d (Crane *et al.* 1995). These estimates are based on the addition of folic acid to cereals, and cereals were considered in the modelling process because cereals are consumed by 90% of women of child-bearing age. These US calculations show that the addition of 1400 μg folic acid/kg cereal-grain products would increase folic acid intake to just over 50% of the target value (400 μg/d) in females aged 19–50 years at the lower end of cereal-grain-product intake (25th percentile). At a level of enrichment of 3500 μg/kg, these lower consumers of the vehicle foods would achieve just under 100% of the target value. Thus, where there is no concern about high intakes of folic acid, the selection of the target food and the determination of the level of fortification are both relatively straightforward. Where concern does exist about high intakes of folic acid in older people then some novel approaches to selecting appropriate foods and fortification levels, based on prevailing food intake patterns, are needed.

The following data are presented from the Irish National Nutrition Survey of the Irish Nutrition and Dietetic Institute (INNS-INDI) database of the Irish National Nutrition Survey to illustrate possible approaches to identifying foods which will provide folic acid to most of the target groups, while avoiding almost all the group needing protection against high intakes, i.e. older people. Therefore, the foods chosen and the resultant values presented are simply illustrative of a process and are not in themselves to be taken seriously.

Table 2. *Profiles of subjects with intakes of selected foods above the 90th percentile of intake among consumers only in the Irish National Nutrition Survey** (n *1214)*

	Mean age (years)	Age range (years)	No. of females (%)	No. of subjects over 65 years
Milk	22	9–80	24	4
Bread	42	10–92	27	34
Spreadable fats	36	9–80	15	12
Cornflakes	18	10–42	20	0
Yoghurt	27	9–88	62	9
Crisps	17	11–43	54	0
Soft drinks	20	13–33	38	0

* Irish National Nutrition Survey of the Irish Nutrition and Dietetic Institute database.

Table 3. *Evaluation of the use of four target foods to provide folic acid to females aged 15–35 years based on the Irish National Nutrition Survey of the Irish Nutrition and Dietetic Institute database*

	Corn-flakes	Yoghurt	Crisps	Soft drinks	Any two	Any three	All four
Servings per d among all consumers (*n* 1214) at or above the 90th percentile of intakes among consumers only	One large bowl	One carton	1·5 packets	One small can	–	–	–
No. of all subjects (*n* 1214) consuming one or more foods above the 90th percentile for consumers only	49	53	50	29	1–7	0	0
Percentage of females aged 15–35 years (*n* 275) who are non-consumers of the target foods	66	79	45	72	–	–	12

Table 2 shows the characteristics of high consumers (≥90th percentile of intakes among consumers only) of seven foods from the INNS-INDI database. Three of these foods, bread, spreads and milk would not be acceptable vehicles since the profile of high consumers shows a predominance of males and/or a reasonably large number of older subjects (≥60 years). Four others, yoghurt, cornflakes, soft drinks and savoury snacks are possible vehicles, since the profile of high consumers shows either a higher percentage of females or very low to zero number of older subjects. Since the search of the database was confined to these foods purely for illustrative purposes, other possible vehicles undoubtedly exist. In considering high consumers of foods, it is often wrongly believed that one is dealing with unusually high intakes. Table 3 clearly shows that intakes of these possible vehicle foods at or above the 90th percentile of intakes among consumers only, represents no more than habitual intake of one or two average servings. If, therefore, an average serving of these foods were to be fortified with 400 μg folic acid, two further questions would need to be

asked. The first is how many subjects would consume two or more of these foods at or above the 90th percentile of intake for consumers only? Table 3 shows that from a sample of 1214 subjects, at most seven would consume two of these target foods above the 90th percentile and none would do so for three or more foods. Thus, the risk of overexposure of subjects is minimal. The second question is what percentage of the female population aged 15–35 years would consume none of these foods? Table 3 shows that 12% of this group are non-consumers of any of these foods; therefore, were an average serving of each of these foods to contain 400 μg folic acid, 88% of the female target group would receive the desired intake and only 0·6% of the entire population would consume a double dose, of which almost none would be older people. This exercise, which is superficially illustrative, shows that such modelling is a vital part of nutrition policy planning, and increases our knowledge of food–food and food–nutrient interrelationships in population subgroups. With the possible rise in food fortification to meet nutritional policy objectives, such food consumption database analysis is a priority area for research, particularly in supply-driven nutrition policy.

DEMAND-DRIVEN NUTRITION POLICY

The bulk of effort by nutritionists to improve national diets involves demand-driven food policy whereby nutrition education policies stimulate consumer demand for healthier food choices. Implicit in this is an absolute need for detailed knowledge on patterns of food and nutrient intake in order to compare existing nutrient intakes with perceived population optimum intakes, and to prepare meaningful advice on food choices. Also implicit is an absolute need for knowledge on attitudes and beliefs of consumers with regard to health in general and, specifically, to their perception of the role of diet in health. Regrettably, much of our effort in nutrition policy does not take account of these factors in any scholarly way and, thus, within demand-driven nutrition policy three key areas for research are identifiable.

Defining meaningful dietary guidelines

Almost all dietary guidelines are developed from epidemiological principles. For example, variations in the incidence of colon cancer can be related to stool weight. A second set of data can relate fibre intake to stool weight. Putting the two data-sets together, an optimal fibre intake to reduce the incidence of colon cancer can be devised. The same is true for

Table 4. *The percentage of British adults (*n *2197) achieving one or more national dietary guidelines* (Ministry of Agriculture, Fisheries and Food, 1994)

	Men	Women
Fat	17·3	10·9
Saturated fatty acids	3·3	2·3
Sugars	15·0	10·3
Fibre	25·4	5·6
Fat and sugars	2·0	0·2
Fat, sugars and fibre	0·6	0·0
All guidelines	0·1	0·0

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Table 5. *Percentage energy from saturated fatty acids in Irish men and women at the mean of distribution and at points both one and two standard deviations below that mean*

	Percentage of population covered	Percentage energy from saturated fatty acids	
		Men	Women
Mean	50·0	15	18
Mean – (1 SD)	16·5	13	15
Mean – (2 SD)	2·5	11	12

serum cholesterol as a risk factor for CHD and dietary fatty acid patterns as determinants of serum cholesterol. When prevailing nutrient intakes are examined there is a considerable shortfall between actual intakes and dietary guidelines. Table 4 presents an analysis of the prevailing pattern in Britain (Ministry of Agriculture, Fisheries and Food, 1994); an exactly similar pattern is also seen for other north European countries such as The Netherlands (Hulshof *et al.* 1993). Clearly, these data indicate that there is considerable scope for the improvement of the diets of many developed countries. However, it is reasonable to ask whether nutrition policy should be driven by such apparently stringent guidelines. That is not to say that such guidelines are not representative of what is optimal for health. It is merely to ask whether immediate and short-term plans of action within a nutrition policy should take more account of prevailing practices rather than ideal practices. Consider, for example, the target of 10% energy from saturated fatty acids (SFA). Adjusted for within-person variation, the success rate in achieving this guideline is less that one per 1000 adults (Hulshof *et al.* 1993). If meaningful food-based dietary guidelines are to be established, which might be attained through short-term nutrition education programmes, an alternative guideline might be developed from prevailing dietary intake principles rather than epidemiological principles.

One possibility would be to embrace the principles traditionally used in developing recommended dietary allowances (RDA). An estimate of the mean and standard deviation for average requirement is first established. Then a value equal to the mean plus two standard deviations is obtained to give a value for the RDA. If one now looks at SFA intake with a view to identifying a meaningful lower value, it is feasible to take the mean intake and lower it by a value equivalent to one standard deviation. This value should be one attainable by 16·5% of the population given that the area of a normal distribution covered by the range of the mean minus one standard deviation to the mean plus one standard deviation is 67%. This value is attainable by one person in six. The attraction of this approach is that realistic targets for increased or decreased nutrient intakes can be achieved and, most importantly, that separate targets can be set for different subgroups with different distributions of the intakes of target nutrients. Table 5 illustrates the principle for SFA as a percentage of energy in 150 Irish men and women (A. Flynn, unpublished results). As would be predicted from the British and Dutch data, the lowest 2·5 percentile point on the distribution of SFA is above the standard target of 10% energy. Indeed, in this sample, no subject of either sex achieved this target. However, a target of 14% energy from SFA is attainable by about one in six of the population, and for short- and medium-term education strategies the dietary habits of individuals achieving this target may provide a realistic model upon which to develop food-based dietary guidelines.

Defining food-based dietary guidelines

An approach frequently adopted in devising food-based dietary guidelines is to search food composition databases for foods with high or low levels of the target nutrient. The problem with this approach is that the nutrient content of a food bears no relationship to its level of intake and, thus, its contribution to the diet. A second approach is to identify foods which contribute most to the population intake of the nutrient in question. A disadvantage of this approach is that, in fact, the main dietary sources of, for example, fat in the total population are also the main sources in those subgroups with low or high intakes of fat (Gibney, 1991). A second disadvantage is that where goals are expressed as a percentage of energy, the attainment of, for example, the goal for fat may largely be determined by carbohydrate intake not by fat intake. A reciprocal relationship between fat and sugar intake is consistently observed in analysis of food consumption databases (Gibney *et al.* 1995). Cluster and principal component analysis have been successfully used to identify eating habits indicative of particular patterns of nutrient intake (Gregory *et al.* 1990).

A very useful approach is to identify the social, economic and dietary characteristics of those who do attain, and those who fail to attain a given dietary target. Pryer *et al.* (1995) have recently done so for the UK, based on the database of the Dietary and Nutritional Survey of British Adults. Compared with 'non-compliers' (41% fat energy), 'compliers' (31% fat energy) had significantly higher intakes of wholemeal bread (men), high-fibre breakfast cereals, milk and sponge puddings (men), low-fat dairy products, polyunsaturated or low-fat spreads and poultry (men). In contrast, they had significantly lower intakes of full-fat milks, butter, bacon and ham (men), prepared meat products (women), fried potatoes (women) and savoury snacks (women). These findings seem to make common sense. However, it is notable that many of the examples of food-based dietary guidelines which might be issued for a reduction in risk factors for CHD, include foods which would not appear to determine attainment of the guidelines for total fat, and for SFA and *trans*-fatty acids, e.g. biscuits and pastries, puddings, red meat, vegetables, chips (men) and sugar confectionery. Research to improve our ability to identify key eating patterns which would predict achievement of particular guidelines are urgently needed. Within this research, more work needs to be focused on distinguishing between trends determined by variation among people consuming foods, and those determined by higher intakes among consumers of specific foods. Table 6 gives data on the consumption of butter and of high-fibre breakfast cereals across social classes in Britain (Ministry of Agriculture, Fisheries and Food, 1994). The average intake of butter does not vary across social class, but among butter consumers it does. Conversely, the average intake of high-fibre breakfast cereals falls with social class, but among consumers of these cereals it does not.

CONSUMER ATTITUDINAL RESEARCH

Demand-driven food policy requires knowledge of consumers' attitudes and beliefs regarding food, nutrition and health. Regrettably, this is an area which has been neglected. Qualitative attitudinal research using focus group methodology as outlined by Achterberg (1988) in Irish females has revealed a disparity between their concept of health, their concept of the health risk of excess weight and their concept of a balanced diet and these concepts as normally exposed in nutrition education programmes (Kearney & Gibney, 1994). A greater understanding of such attitudes and how they vary with different population

Table 6. *Intakes of foods which differ in intake across social class due to higher intakes among consumers (butter) or to higher numbers of consumers (high-fibre breakfast cereals)* (Ministry of Agriculture, Fisheries and Food, 1994)

Social class . . .	All men				Consumers only			
	I and II	IIIa	IIIb	IV and V	I and II	IIIa	IIIb	IV and V
Food (g/d)								
Butter	9·4	7·6	7·1	7·0	10·9	13·6	13·4	14·6
High fibre	23·8	19·4	11·6	9·7	45·3	47·7	37·7	42·4

subgroups is an essential requirement for the development of a successful nutrition education programme.

CONCLUSIONS

Priorities for research in the area of food and nutrition policy must include an evaluation of the non-health-related opportunities and limitations to altering the food supply. Existing databases on food and nutrient intake must be used to develop dietary models towards food fortification needs, to define quantitative dietary guidelines and to develop food-based dietary guidelines. Finally there is a compelling need to learn more of consumer attitudes to food, nutrition and health. Such research will facilitate the ultimate objective of nutrition policy, to modify nutrient intakes of populations to improve health.

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