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A FOOD AND NUTRITIONAL SURVEILLANCE SYSTEM FOR IRELAND

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1. INTRODUCTION

Background

The need for a national food and nutrition policy is increasingly recognised by governments of developed as well as developing societies. Such policies represent an agreed strategy for the most efficient use of national food resources to meet health, social and economic priorities. Given the inter-relationships between food production, food supply, consumption and health effects, any strategy of this kind must involve several sectors, both public and private. The outcome of such a strategy would be a series of recommendations to be applied through sectoral programmes in order to achieve a comprehensive and co-ordinated approach to a set of common goals. Tentative policies have been established by some European governments while discussion of scope and content of policy has been undertaken by others. In Ireland, various public services and institutions have considered the need for such a policy and the health sector has defined a set of recommendations for policy consideration. To date, no multisectoral policy body has been established. However, in the second quarter of 1981, a university-based seminar was conducted to examine the needs and mechanisms for policy making in this area (co-ordinated by Matthews, 1981).

It may be questioned whether there is a need for an explicit food and nutrition policy in Ireland, given that available food supply is in excess of population requirements (see Section 5 below). However, in common with most western societies, the existence of a surplus food supply in Ireland is of itself casually associated with the emergence of a series of health problems contributing to identified changes in mortality, morbidity and health care needs. In addition, various bio-social groups have been identified as suffering from specific deficiency states arising from changing requirements and patterns of food consumption (see McGann *et al.*, 1977, and Creedon *et al.*, 1975).

In attempting to resolve such nutrition-related health problems, governments and professional bodies, in this country and elsewhere, have made specific recommendations regarding changes in food consumption patterns that have been widely publicised (Turner, 1980, and report of the Health Advisory Committee – An Foras Taluntais, and references therein). These recommendations have already had direct effects on food consumption patterns in countries to which Ireland exports its products and more recently changes in consumption in the home market have commenced. These changes have been relatively rapid and are perceived to have potentially adverse effects on retailing, processing and production of specific food items. Clearly, consumer interests and health recommendations may be expected to have an increasing impact on all sectors of the food industry in the future. The need for a food and nutrition policy seems therefore to be evident, though government initiative in this area has not yet emerged on a multisectoral basis.

One of the basic prerequisites for the effective formulation of policy is a comprehensive data support system that will provide continuous information on a range of nutritional

and nutrition-related variables as a basis for scientific interpretation. Such a structure is commonly described as a nutritional surveillance system. During the last two years, a design for a surveillance system sponsored by the Agricultural Institute, was developed in the Departments of Statistics and Community Health in Trinity College, Dublin and tested with some success (Kelly, 1980). This paper will discuss the principal features of the system and illustrate its operation with some examples.

Definition and Objectives

Strategies to detect, control and prevent problems of human nutrition require accurate, reliable and up-to-date information on a wide range of causal and contributing factors. Hence, an operational definition of surveillance (proposed by Nichman and Lane, 1977) entails – ". . . the continuous collection, analysis, dissemination, and utilization of data relating to the nutrition and health status of population groups, the availability and consumption of food to these groups, and the status of variables which may have direct or indirect effects on both nutrition status and food consumption". Thus, the specific objectives of the surveillance system may be summarised in the following three points:–

(i) To identify and characterise those variables which provide information on past, contemporary and future nutrition conditions:

(ii) To assess the nutritional status of the population, in particular those sectors of it who are identified as being at risk:

(iii) To provide a basis from which decisions on policy, regarding preventive and promotive aspects of nutrition, can be made, and possibly to enable inferences about interrelationships between production, consumption and utilisation to be empirically tested.

Alternative Methods of Assessment

Prior to discussing the surveillance system in some detail, it must be said that ideally the nutritional status of the population should be assessed by a comprehensive survey conducted on a period basis. However, in practice the required resources, financial and human, are necessarily limited, and such a dedicated survey would be an expensive procedure and require a large number of trained personnel. Further, it is considered that a survey would be wasteful of those resources in that a large proportion of the surveyed population must be confirmed as being nutritionally "sound", thus dissipating resources which might otherwise be directed at selected target groups. Finally, an additional drawback with respect to a comprehensive survey relates to the inevitable delay between repeat surveys – the first, and last to date, such survey in Ireland was between the years 1946 to 1948 (Department of Health, 1949) during the interim no information is forthcoming concerning changing nutrition conditions. The alternative approach i.e., nutritional surveillance, is one which required considerably less investment of cash and personnel and is not subject to the above criticisms.

2. *THE SURVEILLANCE SYSTEM*

The surveillance system must be developed to fulfil (in so far as is feasible) the objectives put forward above. The design must therefore incorporate the following features:

(1) Provide a general specification for information requirements. This may be done in the form of a model which reflects the natural food-chain of production, consumption and utilisation. The model must take account of the individual elements com-

prising the food-chain, and indicate the association between these elements where this is previously understood. Where relationships are ill-defined, it must allow these to be elucidated, at least empirically.

(2) For such an organised set of elements the availability of data must be ascertained. Here, a distinction must be made between an ideal data base and a working data base. It should be appreciated that required data may be completely unavailable or available only in an unsuitable (for analysis) format.

(3) Analyses, appropriate both to the requirement of the system and the limitations imposed by data, must be proposed. Naturally, these may be subject to modification as experience is gained in the light of developing methodology.

(4) The selection of a number of indicators representative of the model, and sensitive to changes in the elements comprising it.

(5) Proposals for the interpretation of selected indicators to summarise the nutritional status of the population or sub-groups within it. This summary would constitute a report which would be submitted to a policy body for consideration.

These features are reproduced schematically in Figure 1. The natural environment is seen as providing relevant information for the model, through which the information is processed and from which the status of various indicators are obtained. Conditions are reported and the process is repeated. The possible consequences of the report may be a decision to intervene directly, through nutrition support programmes or indirectly, by information and education.

3. THE MODEL

A model of the factors affecting nutritional status may be constructed from the following series of hypotheses (modified version from World Health Organisation, Report 593, 1976):

> nutrient intake and health status determine the nutritional condition of an individual . . . health status is multicomponent, one aspect of which is diet related . . . diet, hence nutrient intake, depends in large part of food consumption patterns within the family . . . food consumption patterns reflect qualitatively: family size, composition and income, plus cultural and traditional influences . . . household availability of food may also be limited by market availability . . . market availability is determined by production, imports/exports, and agricultural and/or industrial utilization.

This model can be represented by a diagram like that of Figure 2. The model is strictly qualitative; links between components are only postulated, although intuitively reasonable, and its structure enables possible causal factors to be reduced to a logical sequence. The structure facilitates the selection of a number of indicators at various levels between food production and health status. The information provided by these indicators may then be integrated into a "picture" of current conditions. As stated above, interrelationships within this model are, as yet, unquantified, and must remain so in the absence of a fully comprehensive national data set. Therefore, any conclusions reached at present must remain fairly general and be considered as an initial assessment only.

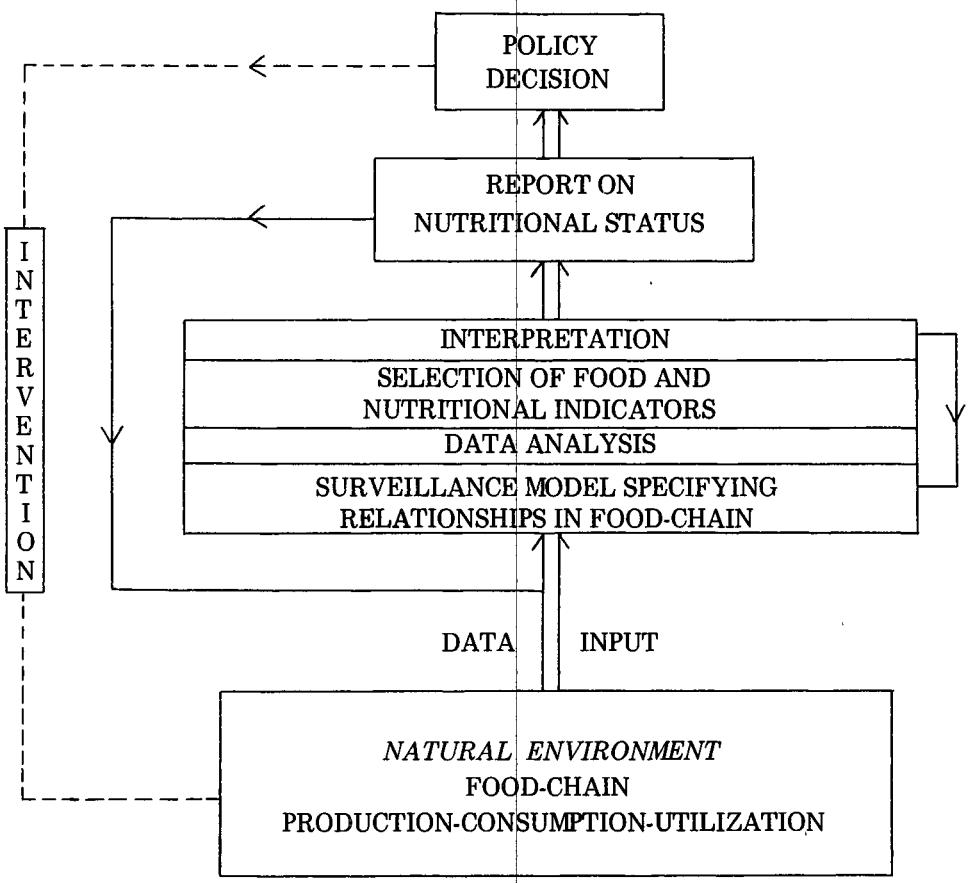

Figure 1. Schematic of Surveillance System.

econometric models for demand analysis, which would serve to indicate likely future trends in food consumption in response to changes in prices and income.

The HBS data may be further analysed at a number of levels – for instance, by dividing expenditure per item by the relevant cost per item, an estimate of the quantity of that item purchased may be derived, and if in turn quantity is multiplied by an appropriate factor representing nutrient composition, then an estimate of nutrient intake is obtained.[2] Thus, if expenditure is classified according to specified socio-economic groups, it is possible to examine and compare intake as between those groups. Obviously, with households described solely in terms of numbers of individuals, and with no information regarding the within-household distribution of food, it is difficult to assess adequacy of consumption against a set of standards which vary according to age and sex.

Biological Utilisation

Up to this point the assessment of nutritional status has been considered from the point of view of food and nutrient consumption, a complementary approach is to examine medical and health data which are affected by, and to some degree, reflect nutritional conditions. The range and type of data typically available is shown by the following selection:

> morbidity statistics for certain dietary related diseases such as: obesity, diabetes mellitus, coronary heart disease, etc., from the Hospital In-Patient Enquiry Scheme (from 1974, and compiled by the Medico-Social Research Board); mortality statistics for these same conditions from the Reports on Vital Statistics, CSO; birth weight data derived from Clinical Reports of the Maternity Hospitals; and anthropometric measurements for school children from the Eastern Health Board.

Trends in mortality statistics have been examined independently and in association with changing dietary habits for selected diseases. The availability of morbidity statistics on a sub-national basis is very recent; coverage is still incomplete at present but it has improved considerably in the past year or two. For the selected diseases, morbidity data are intended to complement mortality statistics and thus give a more complete indication of the prevalence of these diseases. The anthropometric data (age, sex, height and weight), for some 25 thousand Dublin school children, were analysed for each year 1973-1977, to provide an estimate of the proportion of malnourished children aged between four and fourteen. In a similar manner, the proportion of low-birth weight infants is indicative of, among other factors, the extent of malnutrition in mothers.

Data Flow

These various sources of data referred to in outline above constitute a working data base from which indicators of nutritional status can be extracted and integrated into a multisectoral nutritional surveillance system. Monitoring (i.e., on-going observation and analysis) is the central core of the system, and the essence of monitoring is the steady flow of data from collection point to processing centre. In the system discussion and co-operation have been on an *ad hoc* basis up to now, but steps are being taken to formalise arrangements between the agencies who routinely collect data and the surveillance centre.

[2]Nutrient composition for the 129 food commodities in the HBS was provided by Dr. P. Upton, Faculty of Veterinary Medicine, U.C.D.

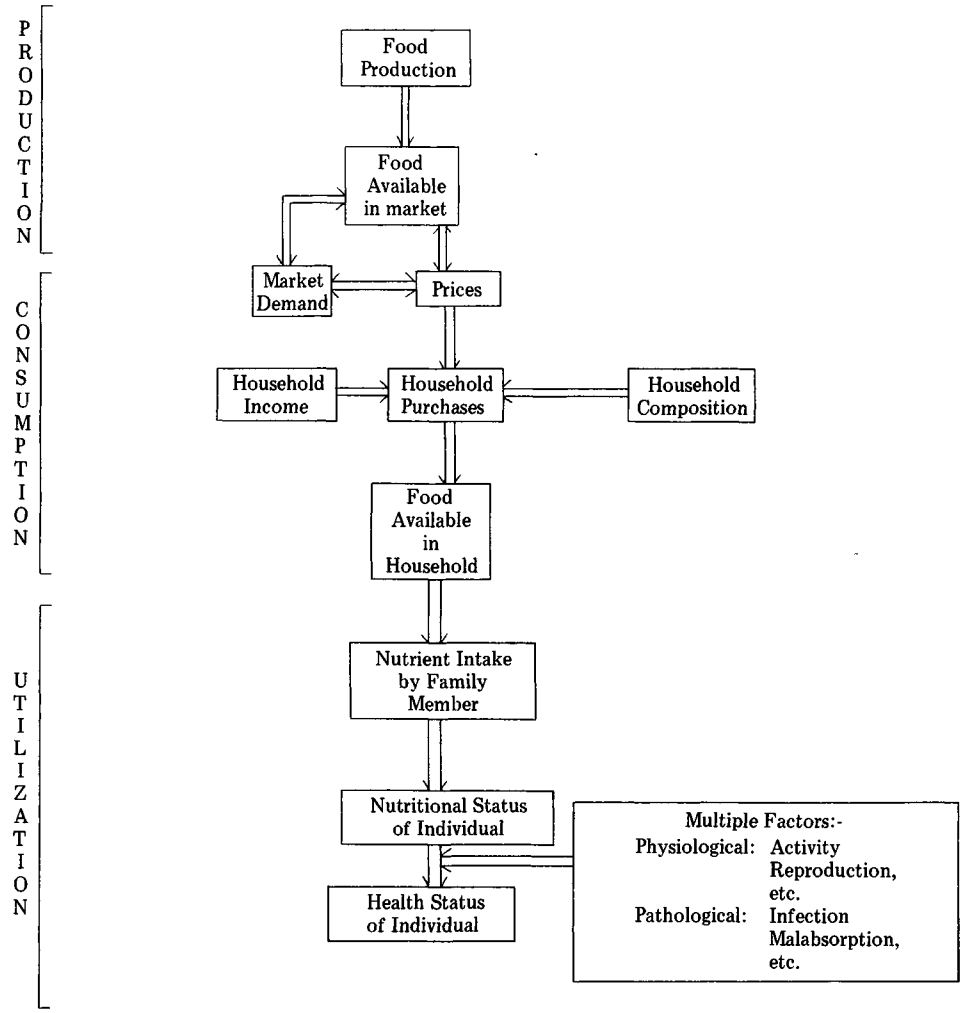

Figure 2. Flow-chart showing components of proposed system leading from food production to health and nutritional status of individual.

4. THE DATA BASE

The components of the model provide an implicit specification of data requirements. The distinction between an ideal and a working data base must be appreciated – it is the latter with which the model must contend. certain components are more completely represented, where data are more readily available, than others, where they are not. Nevertheless, although the system will be based on existing sources of data obtained regularly from government statistical services, through the Health Boards, and from agricultural agencies, the specification of an ideal data base is a useful exercise as circumstances change and new data may come on-line from time to time. So, flexibility is an important aspect of the design, additions to the data base involving new observations can then be considered in the light of available resources and priorities. In order to indicate the range and type of information encompassed by the model, there follows a brief description of the elements of the present data base.

Food Supply

Data on food production and market availability may be obtained from the Food Balance Sheet (FBS), which is compiled annually by the CSO since 1954 (and published by the OECD, 1975) and records the estimated annual production and supply figures for a broad range of foodstuffs. Data from 1954 to 1976, relating to twenty principal food commodities, have been examined to establish trends in supply and estimated per capita intake and thus determine the adequacy, or otherwise, of the national diet. The analysis of production and market availability is relevant in three ways to the surveillance system: (a) it allows any long-term change in food preferences to be seen, (b) it helps to explain any change in the quality or quantity of nutrient intake in terms of the major foodstuffs, and (c) possible relationships between trends in nutrient consumption and morbidity/mortality may be investigated. However, it must be borne in mind that national totals or per capita figures for food supply/consumption are not in themselves sufficient, for aggregate consumption levels may be sufficient to provide adequate nutrition for the whole nation, while at the same time segments of the population suffer from malnutrition because food is not equally available to all.

Food Consumption

In 1973 the CSO conducted a large-scale national (i.e., urban, rural farm and rural non-farm) Household Budget Survey (HBS), and in subsequent years an urban HBS.[1] The main purpose of the survey is to determine details of the current pattern of household expenditure. A special tabulation of the 1973 survey results (CSO, 1976) was obtained from the CSO with expenditure data on 129 foodstuffs cross-classified by the following socio-economic variables: income group, social group, location, and household composition. Data for the years 1974-1976 were obtained directly from the published reports (CSO, 1977 and 1977a). These data were analysed to provide a breakdown of expenditure under various cross-classifications for 1973 and also, by means of regression analysis, to investigate a functional relationship between expenditure and the classifying variables. Both analyses should lead to a better understanding of expenditure patterns and the influence of socio-economic factors in formulating those patterns.

Both the CSO and the National Prices Commission (NPC) publish price data on common food items, and from these the average retail price per annum of 129 foods, as required in the analysis of the HBS, may be derived. In addition, price data may be used in standard

[1] In 1980 the CSO repeated the large-scale national survey, while this year they re-introduced the small-scale survey, continuing, however, on a national rather than an urban basis.

5. SAMPLE ANALYSES

A review of the output from each stage of the model would be too extensive for this presentation, however the operation of the system may be illustrated by reference to a number of examples. The first relates to trends in food and nutrient supply at the national level during the last quarter century, the second examines the associated changing pattern of mortality, and a final example looks at the evidence of malnutrition in Dublin school children.

Example 1: The Food Balance Sheet

The measurement of food consumption is essential to any investigation of the relationship between diet and nutritional status. (Note: the terms "consumption" and "intake" are generally used herein to mean the uptake of food on an average per capita basis). Information about the dietary intake of populations can indicate ways in which a national food supply might be nutritionally inadequate or inappropriate. This intake can be measured by either direct or indirect assessment. Thus, statistics of production, imports and exports, may be used to give an indirect assessment of food consumption for the whole population. Data collected annually in this manner form the basis of the Food Balance Sheet (FBS), referred to previously.

The final column of the FBS proper gives the net amount of food available within the country for human consumption. By dividing this estimate of the national supply by the total population figure, an annual per capita consumption of each major foodstuff is obtained. Some points which must be borne in mind when interpreting these data will now be considered.

(1) At each state of the calculation leading to the estimated consumption, errors are introduced due to incomplete or inaccurate knowledge.

(2) The net food figure finally arrived at represents the "disappearance into consumption" rather than food actually consumed by an individual in the home or elsewhere.

(3) The consumption per capita is based on an estimate by the CSO of the population size; during inter-censal years this figure may be in error. Also, for the purpose of this calculation, all members of the population are weighted equally regardless of age and sex.

(4) Finally, and for the purpose of nutritional assessment, the most serious criticism of a dependence on FBS results for per capita intake must be, not possible inaccuracy, but rather the fact that the figures can clearly only indicate in a general way population nutrition conditions and cannot provide information on variation between groups or individuals. Caution is therefore necessary when commenting on the adequacy of dietary intake where no knowledge of the distribution (among age groups and between sexes) about the per capita mean exists.

Nevertheless, certain factors tend to minimise, or offset these limitations, namely: expertise in the CSO in the compilation of the FBS over many years, the fact that these data represent the only nationally available source providing information on the disposition of foodstuffs, at each stage, from production through consumption. On balance, the availability of the FBS covering the last quarter century is crucial in any attempt at understanding the contributory role which diet is believed to play in the changing pattern of disease evolving over this period.

Food consumption

With the advent of industrialisation, growth in modern agriculture and increased per capita national income, "rich" diets have become the norm. Calculations of the annual per capita intake of the principal foods between 1954 and 1976 indicate major changes in the consumption trends of these foodstuffs (see Table 1 below). Some 85 per cent of Total Food in 1954 was composed of cereals, potatoes, vegetables, meat and dairy products; in 1976 these foodstuffs accounted for almost the same percentage (c. 81 per cent), but the relative contribution of certain items had diminished considerably. Most notably, cereals and potatoes together dropped from 38.6 per cent to 26.9 per cent of Total Food, while the remaining items, excepting eggs and dairy products, increased in consumption. Total Food in 1976 had increased by some 18.6 kg. per capita over the 1954 figure. The increased contribution of meat, vegetables and fruit is pronounced, while the relative magnitude of sugar (refined sugar + glucose + honey) consumption is striking. Such trends are in line with expectation, and have been observed in other developed countries as the standard of living improved. Incidentally, although alcohol is not technically a food, its contribution to per capita calorie intake is not negligible and therefore it is worth noting that Total Alcohol (100 per cent) consumption has increased from 7.2 grams/capita/day in 1955 to 13.0 gms/c/d in 1976, that derived from Beer accounting for almost 70 per cent of the latter.

Nutrient availability

If the annual consumption estimates from the FBS are multiplied by appropriate conversion factors and expressed in terms of calories, protein and fat content, it is possible to investigate the pattern of macro-nutrient consumption during the last quarter century (graphed in Figure 3). In addition to the limitations already cited with respect to the FBS data, this last step introduces a further complication, i.e., as some of the foodstuffs represent whole classes of foods (e.g., meat), the value of the multiplication factor can only be approximated and may be subject to a significant systematic error. Nevertheless,

Table 1: *Consumption of Principal Foods 1954 and 1976*[1]

Food	*% Total Food By Weight*		*Annual % Rate of Increase*	*Mean Per Capita Consumption KG/YR*	
	1954	*1976*		*1954*	*1976*
Cereals	17.5	11.5	−1.8	128.7	86.9
Potatoes	21.1	15.4	−1.4	155.8	116.0
Sugars	5.4	7.3	+1.3	39.9	54.8
Vegetables	8.4	11.2	+1.3	59.7	80.5
Fruit	2.9	5.4	+2.7	21.2	41.0
Meat	7.3	12.3	+2.3	53.8	92.7
Eggs	2.3	1.6	−1.5	17.1	12.1
Fish	0.5	0.7	+1.5	3.8	5.3
Dairy Products (excl. Butter)	31.7	31.1	−0.1	233.7	235.3
Oils and Fats (incl. Butter)	2.9	3.5	+0.8	21.2	26.5
Total	100.0	100.0	+0.1	736.5	755.4

1. $X_{1976} = X_{1954}\,(1+R)^{23}$ where R is the rate and X is per cent Total Food.

Source: Derived from FBS

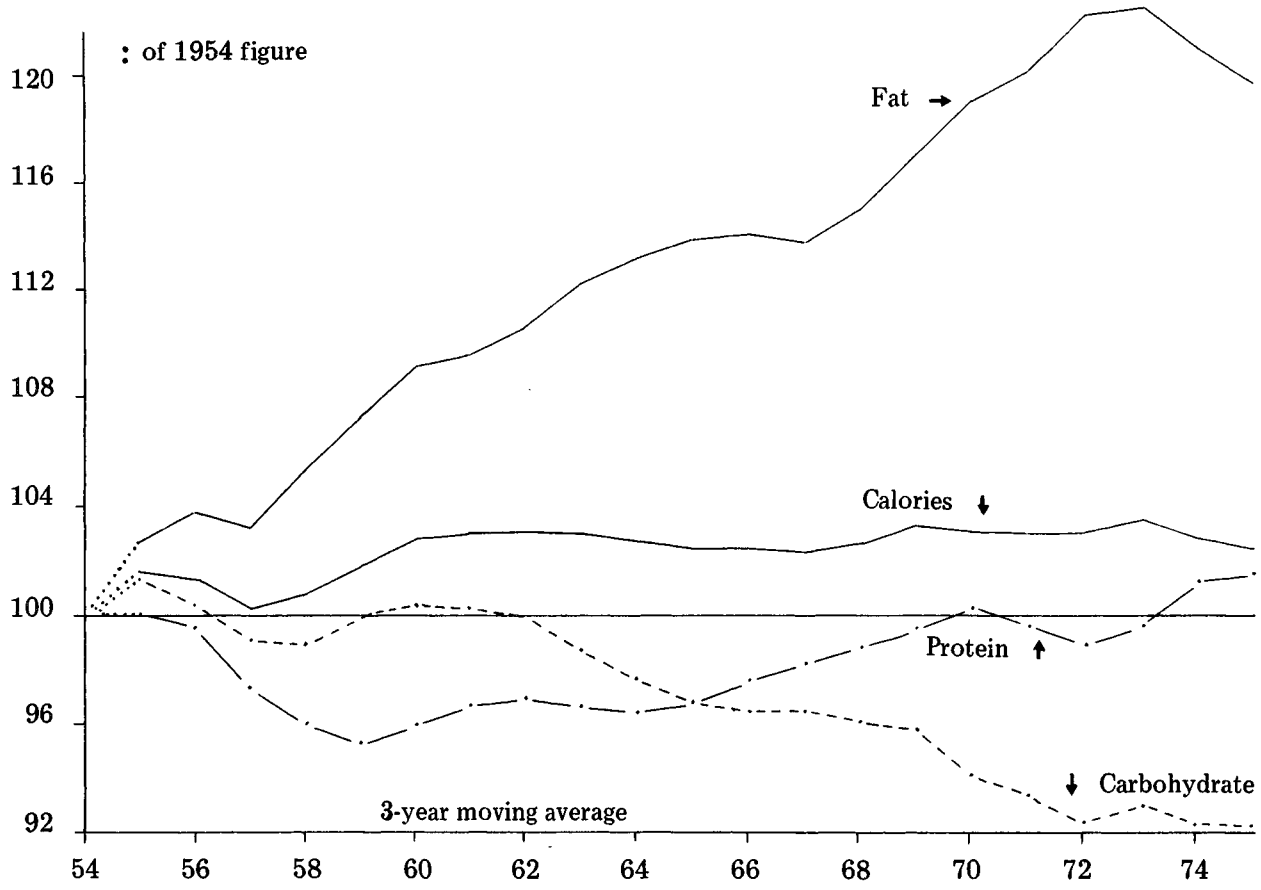

Figure 3. Trends in *per capita* consumption of the macro-nutrients

the series is at least comparable over time. Note that in the following presentation no allowance is made for domestic waste, which might be as high as 10 or 20 per cent depending on the foodstuff, household and season.

Protein

Intake of protein has remained fairly constant, with cereals, dairy products and meat as the major sources of dietary protein (see Table 2). As the consumption of cereals (as a group) has declined over the years, so its contribution to total protein has dropped from 36.6 per cent in 1954 to 21.9 per cent total protein in 1976. Very little change has occurred in the contribution of dairy products and "other" commodities (as a group), so leaving the 14 per cent reduction in protein derived from cereals to be offset by that derived from meat. The increasing importance of animal sources of protein is evident. Diets in which a high proportion of the protein is of animal origin have a well-balanced amino acid composition, this observed increase in consumption of animal protein tends to ensure an adequacy of supply of the essential amino acids.

Fat

Estimates of fat consumption for 1954 and 1976 are presented in Table 3. Total fat intake has risen by some 23 per cent over this period, with an absolute increase for each commodity excepting cereals, but with a relative increase (7.3 per cent) for meat alone. In 1954 butter contributed 38.2 grams to total fat intake, i.e., a substantial 30.3 per cent. However by 1976 its contribution had decreased to 26.4 grams, or 16.9 per cent of total fat. This dramatic drop is offset to some extent by an equally dramatic rise in the contribution of vegetable oils and fats (up from 6.6 per cent to 12.9 per cent total fat over the period).

The proportion of polyunsaturated to saturated fatty acids in the diet can be expressed as the P/S ratio, and from Table 3 this ratio is seen to be: 0.19/1.00. This is rather low when compared to the average EEC figure which is: 0.38/1.00 (Kock-Henriksen, 1977).

Table 2: *Protein Intake from Various Foodstuffs 1954 and 1976*

Commodity	*Year*	*Gms./C/D*	*% Total Protein*
Cereals	1954	34.6	36.6
	1976	20.7	21.9
Dairy Products	1954	24.0	25.3
	1976	24.1	25.6
Meat	1954	18.0	19.0
	1976	32.4	34.4
Other	1954	18.1	19.1
	1976	17.1	18.1
Total	1954	94.7	100.0
	1976	94.3	100.0

Type of Protein

Source	*Animal*		*Vegetable*	
Year	*Gms.*	*% Total*	*Gms.*	*% Total*
1954	49.6	52.4	45.1	47.6
1976	63.2	67.1	31.1	32.9

Source: Derived from FBS

Table 3: *Fat Intake from Various Foodstuffs 1954 and 1976*

Commodity	*Year*	*Gms./C/D*	*% Total Fat*[1]
Cereals	1954	5.5	4.3
	1976	3.2	2.1
Dairy Products	1954	20.5	16.2
	1976	24.3	15.6
Meat	1954	36.6	28.9
	1976	56.4	36.2
Oils and Fats	1954	57.0	45.1
	1976	64.2	41.3
Other	1954	6.9	5.5
	1976	7.5	4.8
Total	1954	126.5	100.0
	1976	155.6	100.0

Type of Fat: 1976

Source	*% Total Fat*
Animal	76.3
Vegetable	23.7
Saturated[2]	53.0
Monounsaturated	37.0
Polyunsaturated[3]	10.0
Total Fat (155.6 gms/c/d)	100.0

1. Approximate Percentages
2. Principally from Dairy Products and Meat
3. As c. 18:2 and 18:3; from Cereals, Pigmeat and Margarine

Source: Derived from FBS

This is a reflection of the high per capita consumption of meat and dairy products in Ireland relative to the other EEC countries. As animal derived fats have increased in consumption since 1954, so too has the per capita daily intake of dietary cholesterol, from 573 mg/c/d to 644 mg/c/d – some 16 per cent. (The US Senate Select Committee on Nutrition and Human Needs (1977) recommended a figure of 300 mg/c/d as an appropriate daily allowance).

Carbohydrate and fibre

Although the daily per capita consumption of carbohydrate fell by 42 gms. between 1954 and 1976 (Table 4), for the majority of the population carbohydrate still forms the main-stay of caloric intake. The contribution from sugar is approaching that of cereals and is clearly a cause for some concern, especially so having regard to the prevalence of dental caries. (While dental caries' rates have diminished substantially since the fluoridation of water on a national scale during the last 20 years, persisting levels of dental caries remain higher than predicted due in part to dietary factors.)

As dietary fibre (DF) is derived almost entirely from plant foods, the decrease in consumption of wheat and potatoes has resulted in a reduction of DF intake. The figures for DF are approximate and are of the same order of magnitude as those reported by Gormley (1979). In reality it is believed that actual intake of DF is lower than is suggested here, mainly due to loss during food preparation.

Table 4: *Source of Carbohydrate as per cent Total Intake 1954 and 1976*

Year	*1954*		*1976*	
Foodstuff	*Gms./C/D*	*%*	*Gms./C/D*	*%*
Dairy	32	6.2	34	7.2
Cereals	279	54.3	201	42.6
Vegetable/Nuts	9	1.9	14	2.9
Potatoes	71	13.8	53	11.3
Sugars	113	21.9	155	32.8
Fruit	10	1.9	15	3.2
Total	514	100.0	472	100.0

Estimated Dietary Fibre 1954 and 1976 (Gms./C/D)

Foodstuff	*1954*	*1976*
	DF	*DF*
Wheat[1]	9	6
Potatoes[2]	15	11
Fruit[3]	1	3
Vegetables[4]	3	4
Total	28	24

1. As White Bread: 2.7 per cent.
2. 3.5 per cent.
3. As Apples: 2.6 per cent.
4. As Cabbage: 1.9 per cent.

Source: Derived from FBS

Energy

Table 5 shows the distribution of the estimated energy supplied by selected food groups. These figures again reflect the shift in food preferences – a decline in the contribution from cereals, potatoes, eggs and butter – while the proportion of energy derived from sugar and meat has increased noticeably.

A comparison of the nutrient/energy balance for 1954 and 1976 (Table 6) indicates that an increasing percentage of calories in the Irish diet is derived from fat, while that derived from protein is virtually the same (with more emphasis on animal protein), and that from carbohydrate has fallen. Total calorie availability has increased by nearly 3 per cent; this fact being compounded by declining population activity levels producing a significant surplus of energy intake over energy expenditure.

Recommended dietary allowances – RDAs

These are dietary standards for given age/sex groups used to assess the adequacy of food intake in terms of energy and nutrients. The RDAs for a moderately active 70 kg. male aged between 23-50 years are:

	CALORIES	PROTEIN	FAT	CARBOHYDRATE
RDA	2,700	56gms.	105gms.	396gms.
Per capita intake (1976)	3,549	94gms.	156gms.	472gms.

Table 5: *Estimated Energy Supplied by Major Foods – Per Capita Per Day, 1954 and 1976*

Year	*1954*		*1976*		
Foodstuff	*Cals.*	*% Total*	*Cals.*	*% Total*	*% Change*
Cereals	1235	35.8	864	24.4	−30.0
Sugars	423	12.3	580	16.3	+37.1
Potatoes	299	8.8	223	6.3	−25.4
Vegetables	53	1.5	92	2.6	+73.5
Fruit	41	1.2	63	1.8	+56.3
Meat	407	11.8	649	18.3	+59.4
Eggs	68	2.0	48	1.3	−29.4
Fish	15	0.4	21	0.6	+40.0
Milk Products	401	11.6	442	12.4	+10.2
Oils and Fats	505	14.6	567	16.0	+12.3
(Butter)	(339)	(9.8)	(233)	(6.5)	(−31.2)
Total	3447	100.0	3549	100.0	2.9

Source: Derived from FBS

Table 6: *Sources of Energy: Per Capita Per Day, 1954 and 1976*

Year	*1954*		*1976*	
Source	*Gms.*	*% Energy*	*Gms.*	*% Energy*
Protein	94.7	10.9	94.3	10.6
Animal	49.6	5.7	63.2	7.1
Vegetable	45.1	5.2	31.1	3.5
Fat	126.5	33.0	155.6	39.4
Animal	106.7	28.9	118.7	30.1
Vegetable	19.8	5.1	36.9	9.3
Carbohydrate	515.1	56.0	472.4	49.9
Calories	3447		3549	
	Contribution of Alcohol (100%)			
	Gms.	*Cals.*	*Gms.*	*Cals.*
Alcohol	7.1	49.7	13.0	91.0
Total Calories		3496.7		3640.0

Source: Derived from FBS

– where the figures for fat and carbohydrate are derived from recommended intakes of 35 per cent and 55 per cent of dietary calories, respectively. These figures indicate that the daily per capita intake for calories, protein, fat and carbohydrate are thus 131 per cent, 168 per cent, 148 per cent and 119 per cent of RDA, respectively. This evidence of excess consumption is further aggravated when it is appreciated that the population is obviously not composed exclusively of adult 70 kg. males (in fact approximately one-third of the population is less than 15 years of age) – the group with the highest diet nutrient

requirements. The implications for community health of these figures are that diseases associated with gross undernourishment will be rare, but that diseases related to over-consumption, e.g., obesity, coronary heart disease, arteriosclerosis, etc., will be prevalent. The next section will examine the available evidence for this proposition.

With regard to the micro-nutrients – vitamins and minerals, the per capita availability of these appear to be adequate in most cases with the possible exception of vitamin D, and two of the B-complex vitamins: Thiamin and Riboflavin. However, synthesis of the first is promoted by exposure to sunshine and the remaining two are to be found in various artificially enriched foods. Nevertheless, one might expect that the elderly, perhaps house bound, and the poor would be particularly susceptible to these forms of nutrient deficiency.

Example 2: Observation on Health Variables

Malnutrition influences morbidity and mortality rates for various diseases, also rates of growth and development; conversely a variety of vital statistics may be considered as indicators of the extent of malnutrition in the community (see for example, Beaton and Bengoa, 1976). Aside, however, from such considerations as data availability and accuracy, there are various difficulties in using these data as indicators of public health. Malnutrition has important social as well as biological determinants, this is obviously true also of diseases, especially those with a large nutrition component, and consequently problems of "reverse" interpretation from health statistics to community nutritional status are considerable, and complicated by many concurrent factors. Nevertheless, these data are complementary (to food supply and consumption data) sources of information and as such, contribute to an overall appreciation of nutritional status. Subjects for monitoring and analysis include: morbidity and mortality data for specific nutrition-related diseases, anthropometric measurements of school children, and the distribution of birth weight.

Pattern of mortality in Ireland

Mortality data, due no doubt to its availability, completeness, and comparability over time, have been traditionally used to indicate the level of health and change in health status of a community. Note that such statistics provide no direct information regarding the health status of the survivors. (Hence, the system also recognises the need for reliable and detailed data on morbidity.)

The death rate per 100,000 population for all causes has fallen from 1206.2 in the mid-fifties to 1072.2 in 1976. However, if the mortality rate has declined, the major causes of death and the distribution of age at death have altered considerably. Cancer, diseases of the circulatory system, respiratory diseases (excluding influenza) and accidents, have all increased significantly; deaths from tuberculosis, infective and parasitic diseases and other conditions have declined. This latter may be attributed to the consequences of better nutrition, and better sanitation and health services arising from improved social and economic conditions; ironically, the attendant environmental and behavioural changes have undoubtedly contributed to the prevalence of the former.

An analysis of mortality by disease and age would enable an assessment of the relative importance of the major causes of death. A method which permits a simple ranking of causes of premature mortality while giving due regard to age, entitled "Potential Years of Life Lost Bestween Ages 1 and 70" (PYLL, due to Romeder and McWhinnie, 1977), was used for a range of disease categories specified by the International Classification of Diseases list (WHO, 1967) and based on Irish mortality data from the mid-seventies. The method of calculation is described in the appendix, and the results are diagrammed in Figure 4. It can be seen from this that the total number of years of life lost by males are more than one and a half times those lost by females within this age span. Death from

diseases of the circulatory system, accidents and cancer are the three leading categories in both male and female PYLL. In particular, this diagram indicates that diseases of the circulatory system and specific cancers have reached epidemic proportions in Ireland. The social and economic consequences of this situation are extremely serious and a cause of grave concern among health professionals.

Apart from personal and environmental factors, specific dietary components have been strongly implicated in the aetiology of a number of diseases. (Researching the former, Ward *et al.*, (1978) have shown location and marital status to be significant factors influencing mortality rates in Ireland.) The primary thesis underlying most discussions on diet and disease is the habitual overconsumption of food. The basis for this thesis has been the observation that as dietary patterns have changed during the post-war period in western societies, so also have the patterns of disease; additional support has been derived from intervention studies, animal experiments and comparative population studies. Coronary disease has been of primary concern due to its impact on mortality statistics, other diseases such as diabetes mellitus, cancer, arteriosclerosis, hypertensive disease and diverticular disease, have also been investigated in connection with the dietary hypothesis.

Internationally, a number of investigators have found significant correlations between dietary variables and mortality rates for coronary disease (Armstrong *et al.*, 1975, and Stamler, 1978). Dietary variables found to be significant in univariate analysis include: saturated fat, total fat, animal protein, total protein, total calories, meat, eggs, milk and sugar. Per capita cigarette consumption and the gross domestic product were also significantly correlated with CHD death rates. In the Irish context, attention has already been drawn to the fact that the average national consumption of macro-nutrients clearly exceeds the daily requirements, and that the trend is positive for calories and fat. Poor correlation was found to exist between mortality rates for certain diseases and various dietary components when no time lag was allowed for. However, with a lag of 10 years, i.e., nutrition variables 1954-1963 and health variables 1964-1973, then the findings may be said to be in line with medical opinion (see Table 7). Animal fat shows the highest correlation with the male death rate from ischaemic heart disease (IHD). The female death rate is not significantly correlated with any of the nutrition variables – this rate has been lower than the male rate and falling. Butter is negatively correlated with male IHD (which

Table 7: *Correlations*[1] *between Nutritional Variables 1954-1963 and Health Variables 1964-1973: (10 year lag)*

Source	*IHD (Male)*	*IHD (Female)*	*IHD (Total)*	*Diabetes*
Total Fat	0.71	0.20	0.41	0.82
Animal Fat	0.78	0.31	0.50	0.77
Animal Protein	0.66	0.22	0.35	0.88
Total Meat	0.69	0.27	0.38	0.91
Butter	–0.25	0.00	–0.01	–0.61
Dairy Products	0.62	0.15	0.32	0.84
Sugar (1954-1963)	0.57	0.22	0.30	0.73
Sugar (1947-1956)	0.69	0.41	0.52	0.84
Diabetes	0.83	0.52	0.65	1.00

1. Nominal Significance Levels: IRI 0.63, P 0.05; IRI 0.76, P 0.01
Source: Derived from FBS data and Reports on Vital Statistics.

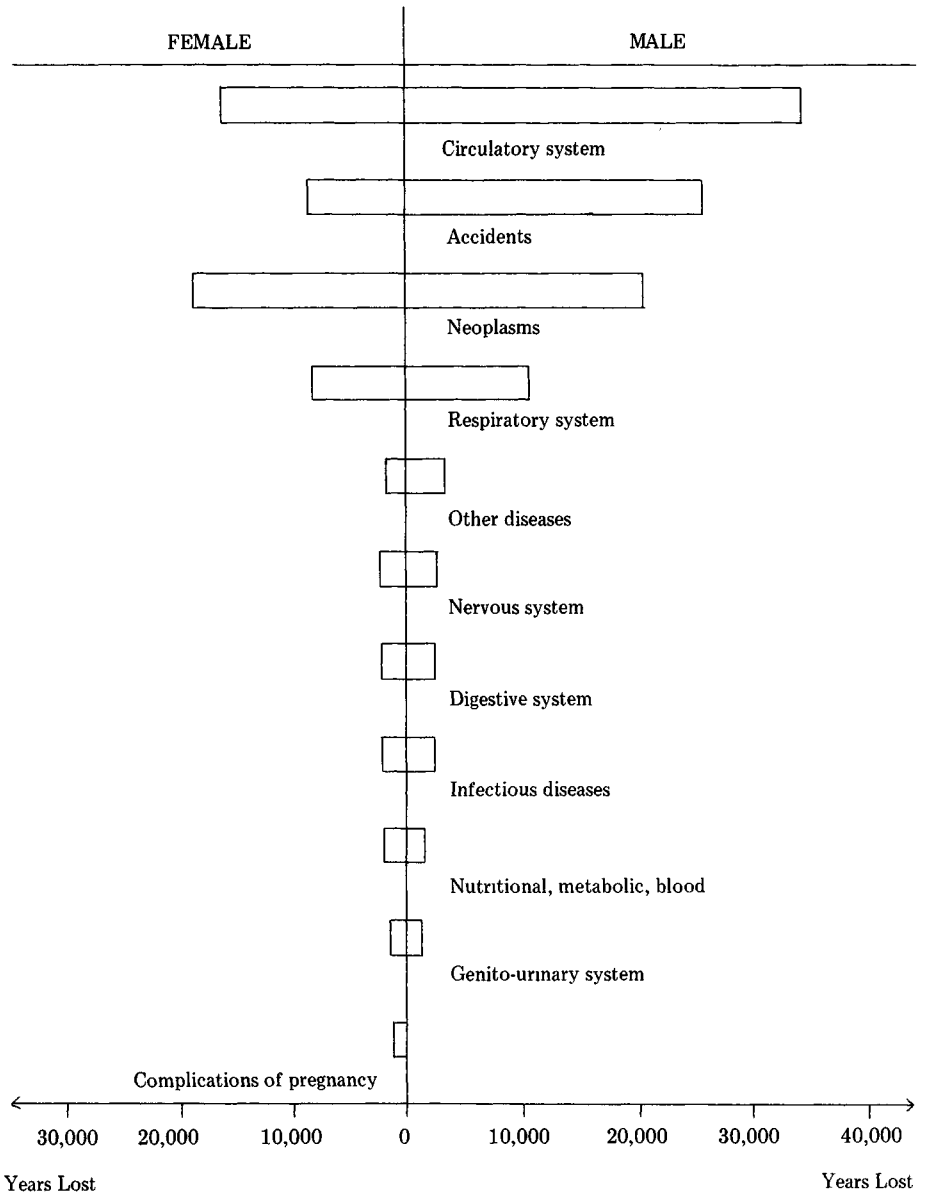

Figure 4. - PYLL (1-70 years) by major causes

has been increasing) as consumption has been decreasing gradually, although still high relative to other EEC countries. Both sugar (with a 20 year lag) and diabetes are significant with regard to the male IHD rate. Each of the nutrition variables is correlated with the mortality rate for diabetes, however as there is a strong inter-correlation between the nutrition variables, it would be difficult to decide on this evidence alone which, if any, are fundamentally related to this condition. Some additional relationships were investigated and selected results are set out in Table 8. Infant mortality is negatively associated with all nutrition variables (no time lag) except for butter – both have negative time trends. The Gross Domestic Product interestingly enough is highly correlated with these health variables. Meat and its components – fat and protein – are significantly correlated with arteriosclerosis, as is sugar. The death rate for anaemias is highly correlated with both maternal and infant mortality.

In presenting these statistics it is realised that interpretation is a matter of selection and convenience, and some of the correlations are certainly spurious. The standard caveat regarding correlation and causation needs no emphasis. Nevertheless, as Stamler (1979) points out in his detailed review of population studies during the past two decades – "... repeated studies of the foregoing type have yielded consistent findings concerning associations between nutrients, including saturated fat and cholesterol, and CHD mortality." And later – "... as the nutrients and food groups positively related to CHD in these univariate analyses are highly intercorrelated ... a basic problem presents itself, i.e., arriving at sound inferences as to which statistically significant correlations are aetiologically significant, and which are not." The usefullness of this approach must be viewed, not in isolation, but against the background of existing evidence provided by epidemiology, by animal experiments and by clinical studies, of the key role of diet in athero-scleroic (and other) diseases. Further analyses of data on nutrition and mortality/morbidity patterns, involving a multivariate modelling approach, is obviously the required next step and is being considered at present.

Example 3: Nutritional Anthropometry

The use of anthropometric data has become one of the most generally accepted

Table 8: *Correlations*[1] *between Nutrition and Health Variables 1954-1975 (22 years parallel)*

Source	*Diabetes*	*Infant Mortality 1 Year*	*Infant Mortality 4 Weeks*	*Arterio-Sclerosis*	*Hypertensive Disease*	
					Male	*Female*
Total Cals.	0.42	−0.39	−0.39	0.32	−0.29	−0.28
Total Fat	0.88	−0.88	−0.87	0.73	−0.84	−0.84
Animal Fat	0.83	−0.89	−0.89	0.74	−0.78	−0.79
Animal Protein	0.91	−0.98	−0.97	0.82	−0.93	−0.95
Butter	−0.57	0.71	0.69	−0.57	0.59	0.66
Meat	0.91	−0.96	−0.96	0.82	−0.93	−0.95
Sugar	0.67	−0.75	−0.71	0.67	−0.54	−0.58
Dairy Products	0.39	−0.52	−0.46	0.42	−0.26	−0.27
GDP[2]	0.94	−0.97	−0.98	0.86	−0.94	−0.95

1. Nominal Significance Levels: IRI 0.42, P 0.05; IRI 0.53, p 0.01
2. Gross Domestic Product per capita

Source: FBS data and Reports on Vital Statistics.

means of assessing individual or community nutritional status. Growth and development are normal biological phenomena that can be readily observed and easily measured. Both genetic characteristics and environmental factors influence the rate and degree of developments; full potential may not be achieved if limited by environment, as for example by restricted dietary intake and/or infectious disease. Abnormalities may arise from overnutrition as well as undernutrition; obesity is now regarded as a major public health hazard.

In 1971 the Eighth Joint FAO/WHO Expert Committee on Nutrition emphasised the importance of distinguishing between acute and chronic (or present and past) malnutrition. From this and subsequent meetings recommendations were made for the use of height for age and weight for height as primary indicators of nutritional status. A detailed analysis of data on some 25,000 Dublin school children (provided by the Computer Department of the Eastern Health Board – EHB) for each year, 1973 to 1977 inclusive, was completed with particular attention to the above indices. As anthropometric standards have never been developed for Irish children, reliance is normally placed on those published by Tanner *et al.*, (1966) for English children. The use of standards derived for other populations or ethnic groups has been criticised on the grounds that differences in growth and development patterns due to genetic divergence are effectively ignored (Goldstein and Tanner, 1980). In this study median values (as well as 3rd and 97th percentile values) were found to be below the standard equivalents for each selected index – suggesting that the Dublin sample is both shorter and lighter than the reference population. Clearly the use of such an external standard for individual or community assessment must, therefore, be questioned. So, for evidence of malnutrition internal relative differences were sought. In practice, values falling outside chosen limits (e.g., less than 80 per cent median weight for height and greater than 120 per cent weight for height) were deemed abnormal.

A cross-tabulation in which children are grouped horizontally by percentage weight-for-height (the nutritional present) and vertically by percentage height-for-age (the nutritional past), provides the maximum information regarding nutritional status obtainable from indices of weight, height and age. Table 9 shows the results of a two-by-three classification based on the 1976 EHB data for Dublin school children aged between 4 and 14. Individual components of the scheme have the following meaning:

< 90% Ht. for Age	– Stunted
> 90% Ht. for Age	– Not Stunted
< 80% Wt. for Height	– Wasted
80%-120% Wt. for Height	– Not Wasted
120% Wt. for Height	– Obese

Taken in combination the crucial categories are:

1. 90% Ht. for Age + 80% Wt. for Height – Stunted and Wasted
2. 90% Ht. for Age + 120% Wt. for Height – Stunted and Obese
3. 90% Ht. for Age + 80% Wt. for Height – Not Stunted but Wasted
4. 90% Ht. for Age + 120% Wt. for Height – Not Stunted but Obese

The percentage of the sample falling into the first category is very small in both sexes; this category represents children undernourished now and in the past. The second category consists of children showing a deficit in height with an excess in weight. This suggests undernourishment in the past accompanied by overnourishment in the present. Here again the percentages are small for both sexes. Category three, those of normal (or above) height, but wasted, relates to those who are presently malnourished. In the final category

Table 9· *Two-by-Three Classification of Height for Age by Weight for Height for Dublin School Children (1976)*

Sex	*% Height for Age*		*% Weight for Height* 80	80-120	120
Male	90	No.	39	522	225
		%	0.3	4.4	1.8
	90	No.	143	10827	421
		%	1.2	88.9	3.4
Female	90	No.	1	413	72
		%	0.0	3.3	0.6
	90	No.	194	10928	650
		%	1.6	89.1	5.4

Source: Derived from EHB (1976) data.

are those of normal height but overweight for that height and therefore possibly obese. This latter percentage is noticeably higher for both sexes than for any other abnormal category. Some evidence, therefore, of severe undernourishment in a small percentage (0.3%) of males, and the presence of obesity in both sexes – to a slightly larger extent in the females. It is interesting to note that for males and females, a significantly larger number show evidence of obesity than undernourishment.

6. PROVISIONAL ASSESSMENT

In order to reach a considered opinion concerning the nutritional status of the population, (1) a model was proposed which, it is believed, incorporates the salient factors pertaining to nutrition conditions; (2) the available data relating to the components of that model have been analysed; and (3) by means of a series of indicators suggested by, and representing, the diverse features of the model, the basic situation might be summarised. By virtue of present data limitations any conclusions arrived at must be necessarily tentative, and based simply on a concensus of the indicators. The use of an untried indicator to summarise results by expressing a wealth of data as a single figure entails a substantial loss of information. Any particular indicator then can at best only reflect the specific link in the surveillance system for which it was devised. However, the general table of indicators collectively provide the material upon which an assessment of nutritional status may be based. It should be mentioned at this stage that the following list is neither exhaustive nor unique, and elements should subsequently be evaluated under operational conditions and retained, modified, or discarded according to their observed effectiveness. Table 10 contains the proposed list of indicators and their values.

Table 10: *Indicators and their Values*

Parameter	*Indicator*	*Measurement*	
Food Supply			
1. Production of Staples (1976)	Per Capita Production (Gms/day)		FBS
Cereals	–		1194.8
Potatoes	–		882.0
Vegetables	–		247.8
Sugar	–		175.0
Meat	–		570.9
Dairy	–		6350.2
Fats	–		138.6
2. Market Availability (1976)	Per Capita Consumption (Gms/day)		FBS
Cereals	–		238.0
Potatoes	–		317.9
Vegetables	–		220.6
Sugar	–		130.9
Meat	–		254.1
Dairy	–		644.5
Fats	–		72.8
Alcohol	–		13.0
3. Nutrient/Energy Supply (1976)	Proportion of Calories from Nutrient		FBS
Prot/Cal Ratio (animal)	–		7.1
Prot/Cal Ratio (veg.)	–		3.5
Fat/Cal Ratio (animal)	–		30.1
Fat/Cal Ratio (veg.)	–		9.3
Carbohydrate/Cal Ratio	–		49.9
Alcohol/Cal Ratio	–		2.5
Sugar/Cal Ratio	–		16.3
Food Consumption			
4. Nutrient Intake (1976)	Per Capita Consumption	FBS	HBS[1]
Calories	(Kcal/Day)	3549	2799
Protein	(Gms./Day)	94	86
Fat	(Gms./Day)	155	126
Carbohydrate	(Gms./Day)	472	338
5. Distribution of Nutrient Intake (1973)	% Sample Deficient in Nutrients		HBS
Calories	% 2500 Kcal/Person		17.3
Protein	% 60 Gms./Person		1.6
6. Family Food Cost (1976)	% of Families with ratio of–		HBS[1]
(Expenditure on Food) (Disposable Income)	0.50 and over		14.2
	0.45 – 0.50		9.8

Parameter	*Indicator*	*Measurement*
Biological Utilisation		
7. Birth Weight (1978)	Mean Weight	NMH[4]
	% 2500 Gms.	4.8
	% 3000 Gms.	15.9
	% 4000 Gms.	16.9
8. Anthropometric Indices	Median Height–for Age	EHB
	% 90% Male	3.5
	Female	3.2
	Median Weight–for Height	
	% 80% Male	1.2
	Female	1.8
	% 120% Male	3.6
	Female	6.0
9. Mortality Rate (1975)	Rate	CSO
Infant Mortality,	4 weeks/1000 live births	12.0
	1 year/1000 live births	17.5
Diabetes Mellitus	/100,000 pop.	12.0
IHD (Male)[2]	" "	377.6
IHD (Female)[2]	" "	245.7
Specific Deficiency States	" "	0.6
Arteriosclerosis	" "	26.6
Hypertensive Disease	" "	15.9
Anaemias[4]	" "	3.4
10. Hospital Admissions (1974)	Rate[2,3]	HIPE
Diabetes Mellitus	/100,000 pop.	167.2
IHD (Male)[2]	" "	233.1
IHD (Female)[2]	" "	127.2
Specific Deficiency States	" "	64.9
Arteriosclerosis	" "	42.2
Hypertensive Disease	" "	198.8
Anaemias[4]	" "	73.0
Obesity	" "	26.3
Diverticular Disease	" "	51.3

1. Urban Households only.
2. Rate per 100,000 corresponding population.
3. Coverage by Hospital In-Patient Enquiry (HIPE) in 1974 was 52 per cent. Estimates are scaled up to 100 per cent coverage.
4. National Maternity Hospital.

Commentary

The following comments are numbered to correspond to the relevant indicator.

1. Production of Staples: Ireland is largely self-sufficient in food production. The gross output-volume for agricultural goods has increased by 15 per cent between 1970 and 1976 (26 per cent by 1977). According to FAO figures (quoted by Beaton and Bengoa, 1976a) the percentage rate of growth (1953-1972) of population, of food

production, and of domestic demand for food was:

Population	Production	Demand
0.1	1.7	0.3

Clearly, food production increases exceed demand by a considerable margin.

2. Market Availability: The figure for per capita consumption in toto is one of the highest in EEC countries. Indicators 1 and 2 confirm that there is no shortage of nationally available food, and also that a broad range of foods are available in sufficient quantities for a balanced diet.

3. Nutrient/Energy Supply: The relative proportion of protein, fat and carbohydrate as suppliers of energy is important in terms of dietary quality. Almost 40 per cent of our energy is derived from fat, at least 5 per cent more than is considered advisable. Alcohol and sugar are significant contributors of calories.

4. Nutrient Intake: Per capita calorie uptake is perhaps the highest in the world. The macro-nutrients are all consumed in excess of RDA, they are, as a percentage of estimated requirement (based on adult male):

	CALORIES	PROTEIN	FAT	CARBOHYDRATE
FBS	131%	169%	148%	119%
HBS	104%	154%	120%	85%

5. Distribution of Nutrient Intake: In addition to the apparent overconsumption as indicated in 4, there is also evidence of possible undernourishment in some sections of the population. The per capita percentage distribution of nutrients in the HBS (1973) sample was as follows:

Calories	*(KCal)*	*Protein*	*(Gms)*	*Fat*	*(Gms)*	*Carbohydrate*	*(Gms)*
	per cent		per cent		per cent		per cent
2000	0.6	50	0.3	80	0.9	300	9.5
2001-2500	16.7	51-60	1.3	81-100	11.9	301-350	18.3
2501-3000	20.1	61-70	12.9	101-120	12.5	351-400	12.5
3001-3500	12.4	71-80	8.8	121-140	20.8	401-450	16.1
3501-4000	28.7	81-90	17.0	141-160	20.3	451-500	15.6
4001	21.5	91	59.7	161	33.6	501	28.0

RDA: Calories–2700 KCal., Protein–56 gms., Fat–105 gms., Carbo–396 gms.

6. Family Food Costs: While income is not the main determinant as regards nutrient consumption (regression analysis showed family composition variables to be the most significant), it nevertheless is an important factor. Therefore, those families whose expenditure on food is a substantial fraction of their disposable income be considered at-risk. In 1976, 14.2 per cent of the sample households spent more than 50 per cent of household disposable income on food alone.

7. Birth weight: The percentage of low birth weights (2,500 gms.) has decreased from 6.4 per cent in 1971 to 4.8 per cent in 1978. (These figures are from records of the National Maternity Hospital.) For developed countries the norm lies between 2 and 10 per cent.

8. Anthropometric Indices: For the last year analysed – 1977, some 3-4 per cent of Dublin school children, aged 4-14 years, showed evidence of past malnourishment as indicated by stunted growth. Between 1 and 2 per cent are presently under-

nourished in terms of weight-for-height. However, some 3.6 per cent of males and 6 per cent of females are overnourished by the same index.

9. Mortality Rate: International comparisons confirm that mortality rates are similar to other western countries, Ireland having neither the highest nor the lowest rates for these diseases. Since the fifties, mortality rates for infant mortality hypertensive disease and anaemias have dropped considerably, while for diabetes mellitus, heart disease and arteriosclerosis, the trend is upwards.
10. Hospital Admissions: It can be seen that there is a shift in the relative "importance" of these diseases as between morbidity and mortality rates. IHD remains the leader, but thereafter the pattern diverges. In terms of total hospital admissions this selection of conditions accounts for approximately 10 per cent of cases; in terms of total deaths the selection accounts for closer to 40 per cent of cases.

From these indicators, the following inferences can be made:

A. Production and market availability of food is adequate to meet the population requirements.

B. Diet is unduly high in animal fats and refined carbohydrates.

C. Overconsumption of macro-nutrients is the norm, although a significant fraction of households (perhaps as many as one-sixth) may be borderline cases with individuals at risk through mild undernutrition.

D. The purchasing power of low income families may be insufficient to ensure adequate food supplies as disposable income is eroded by inflation. Advice on low-cost diets should be readily available to the public.

E. Both anthropometric and perinatal indicators attest to malnourishment (both under- and overnutrition) in a small percentage of the corresponding populations.

F. Disease patterns are consistent with, in the opinion of medical research, the risk factors associated with the life style and diet in western society.

7. FOOD AND NUTRITION ONLY

The usefulness of a fully operational surveillance system would be severely limited if, in the event that nutritional problems were identified, no mechanism existed whereby appropriate steps might be taken to redress the situation. An intervention programme might be designed and implemented on an *ad hoc* basis to meet a specific urgent problem in a localised context. However, it must be emphasised that approaches to intervention will be more effective and more permanent if they form part of a broad integrated approach to the control of malnutrition. Integration and co-ordination can only be feasible if part of an established food and nutrition policy. The objective of a national food and nutrition policy is to provide the population with the food and other social, cultural, and economic conditions essential to satisfactory nutrition and dietary well-being. This implies the formulation of provisional nutrition goals and the incorporation of these into various sectoral programmes. In effect, a primary function of such a policy is to ensure that the nutritional implications of policies developed by government departments are at least recognised and that these policies are modified if a conflict should arise. Such policies as those related to food supply – e.g., in agriculture, trade, industry, marketing, etc., to food demand – e.g., incomes, prices, education, supplementary feed-

ing, etc., and to health – e.g., school health programmes, pre-natal health care, etc., are often designed and implemented in isolation from each other, and each striving to achieve a particular objective. The success of these objectives in many instances would be more assured with the co-ordination of complementary programmes using as a guide a national food nutrition policy. The planning necessary to achieve satisfactory co-ordination of policies perceived to influence nutrition conditions is not a simple task, nor can it be considered as a "one-off" activity. As conditions and resources change, then planning must permit and encourage modification of programme approach either to take advantage of, or correct, new trends.

Dietary Goals

An intrinsic part of any policy which intends to curb the prevalence of community health problems is the promulgation of dietary advice or dietary goals. A digression to consider some of the issues raised by this topic is appropriate, in so far as a surveillance system must logically concern itself with the consequences of dietary recommendations, or failure to make them. Numerous official and unofficial reports have, in the past decade, recommended modifications to our diet; some proposing radical changes, others content with simple restrictions. Often, these reports are in conflict over which aspect of, and in what degree, our diet should be modified. Such disagreements as do exist between authorities are unduly emphasised in the press, resulting in confusion in consumers. In a Special Report to Nutrition Reviews McNutt (1980) reviews the areas of consensus which have evolved during recent years. The following is a synopsis of recommendations contained in various US reports: (1) more variety in the diet, (2) control of excess body weight by controlling intake of foods high in calories but low in essential nutrients, along with moderate physical activity, (3) the reduction of total fat as a percentage of calories for sedentary, middle-aged persons, (4) reduction in the consumption of simple sugars, (5) moderation in salt intake, (6) increased intake of fibre, (7) moderation in alcohol consumption, and (8) support for breast feeding.

McNutt also reports on the dietary recommendations of four national governments (Canada, Sweden, Norway, and Australia), which are summarised in Table 11 and include the following: a reduction in total fat and the proportion of saturated fat, an increase in polyunsaturated fat, a decrease in the consumption of simple sugars and an increase in complex carbohydrates, variety and moderation in the diet. In Ireland it is only a matter of time before the Department of Health publish dietary recommendations which are likely to parallel many of the above proposals.

The pros and cons of national dietary goals (whether quantified or not) have received a good deal of attention in the literature, particularly since the McGovern report in 1977. Clearly, if such goals were to serve as the basis for food supply policies in this country or in our export markets (UK for example), there would be far reaching consequences for the agricultural and food processing industries. Aside from economic considerations, are recommendations for dietary change justified in terms of potential health benefits? Unfortunately the answer to this question is anything but clear-cut. Reasoned arguments have been generated by both opponents and proponents of dietary goals. Hegsted (1978) in his defence of dietary goals states that the total evidence relating diet to IHD, strokes, diabetes, cancer, hypertension, obesity, etc., indicates that a more moderate diet will lessen the impact of these diseases without imposing nutritional risks. He also believes that it is the responsibility of nutrition scientists to attempt to answer such questions as – "How much sugar, how much salt, how much fat, and what kinds of fat, etc., are desirable" – and that a response of – "We are ignorant, that we have not learned anything useful, and that we have no advice to offer, . . ." is self-defeating and irresponsible.

In sharp contrast, Harper (1978) takes an extremely sceptical view of any benefits to

Table 11: *Comparison of Four National Nutrition Policies with that of the US*

Country	*Sweden 1971*	*Norway 1975*	*Canada 1977*	*Australia 1979*	*US 1980*
Maintain Ideal Body Weight	yes	ND	yes	yes	yes
Reduce Total Fat (% Calories)	yes	yes	yes	yes	yes
Reduce Saturated Fat	yes	yes	yes	ND	yes
Increase Poly-unsaturated Fat	yes	ND	yes	ND	no
Reduce Cholesterol	yes	ND	no	ND	yes
Reduce Simple Sugars	yes	yes	yes	yes	yes
Increase Complex Carbohydrates	no	yes	yes	yes	yes
Reduce Sodium	ND	ND	yes	yes	yes
Other Recommendations	2, 3, 5		3, 4	1, 3	1, 3, 5

ND – not discussed

Other Recommendations
1. Encourages breast feeding
2. Recommends iron supplementation
3. Decrease consumption of alcohol
4. Encourages variety of food choices
5. Increase physical activity

derive from an adherence to goals such as those contained in the McGovern report. He believes that they would "necessitate substantial changes in the food habits of consumers," and maintains that the assumption underlying proposed goals, i.e., that changes in our diet over the last quarter-to-half-century have contributed significantly to the incidence of "killer diseases", is unsubstantiated. He states that relationships between diet and disease are complex and poorly understood and resulting problems will not be solved by drawing unwarranted conclusions from insufficient and inappropriate research results, nor will they be solved by accepting simplistic proposals as if they were panaceas. In support of this stance, Harper examines the assumptions and evidence purporting to link diet with the aetiology of "killer diseases", citing contrary opinion or dismissing such claims as unproven.

Are recommendations for diet modification on a population basis premature? The statement endorsing the specific recommendations contained in the McGovern report proclaims – "We live in the present and cannot afford to await the ultimate proof before correcting trends we believe to be detrimental." On the surface, this would appear to be a reasonable attitude to take. However, the implication is that all must change their dietary habits for the purpose of reducing morbidity/mortality in those at-risk individuals. Perhaps the logical alternative, i.e., of addressing appropriate intensive measures to identify, inform and influence the at-risk groups, is surely to be preferred, under the present difficult circumstances.

Surveillance and Nutrition Policy

Multisectoral nutrition planning presents formidable bureaucratic, cultural, adminis-

trative and political problems. The fundamental objectives of a co-ordinated food and nutrition policy must be the promotion of good health and the control of nutritional disorders; the active and intelligent pursuit of these objectives must justify the necessary investment of time, energy and finance required to implement policy. A comprehensive food and nutritional surveillance system would act to provide the necessary information for problem definition, identify the conditioning factors against which intervention must be planned, evaluate the consequences of intervention, and continuously monitor all relevant data to maintain an awareness of the nutritional status of the population. At the Second AFT/MRC Workshop on Human Nutrition (An Foras Taluntais/Medical Research Council, 1981), the Steering Committee endorsed a proposal (among others) for the establishment of such a system. This proposal has been forwarded to the Minister for Health for consideration.

8. CONCLUSION

Nutritional surveillance as outlined in this paper can provide an invaluable tool for informed policy formulation and nutrition support planning by correcting deficiencies in information and presenting a coherent picture of nutrition conditions. The emergence in recent decades of a particular dietary pattern, when considered in conjunction with the significant increase in the incidence of certain diseases, has promoted much professional debate and a growing public awareness concerning the link between the two. Surveillance can help clarify the issues by monitoring trends in these and other socio-economically induced changes in life-style, and so can provide the necessary information over time on which epidemiological conclusions can be based.

The results mentioned here, and more fully documented in the report (Kelly, 1980) are preliminary and in some cases very tentative. This is a consequence of limited data and provisional analyses. Nevertheless, the exercise has been informative in three ways: (1) the extent and limits of present data availability (hence the effectiveness of the system) have been determined, (2) the feasibility of implementing a surveillance system for Ireland has been established, and (3) the analyses already performed have proved particularly interesting. This is the first occasion on which such diverse data sets have been approached in a unified manner in order to assess nutritional status in Ireland.

In conclusion, it is felt to be opportune from a social, economic and health standpoint that a national food and nutrition policy be established for Ireland in the immediate future. Arising from this need it is evident that a nutritional surveillance system should be formally implemented with the active participation of the appropriate national agencies.

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DISCUSSION

Geoffrey Dean: It is a fallacy to imagine that good health depends, except to a very limited extent, on medical care. The great improvement in health and life expectancy that has taken place since the middle of the last century has resulted, in the main, from the vast increase in food production, particularly in grain from the North American plains, and to improved sanitation. In the past, the high mortality, particularly the infantile mor-

tality as half of the children would die in the first year of life, was largely due to semi-starvation and the diseases that resulted from it. Malnutrition was one of the main reasons why tuberculosis was epidemic in Ireland and active tuberculosis was becoming much less common, because of improved nutrition in Ireland, before the introduction of anti-tuberculosis drugs.

The situation has now changed because we are now able to produce an abundance of food with the help of improved crops largely because of our ability to manufacture fertilisers, for instance nitrates from the atmosphere using fossil fuel, usually oil, as a source of energy. We are able to produce so much in grass crops that we no longer depend on a diet which is mainly grass seeds but process the cereals through animals and eat the products of the sun secondhand in the form of meat, poultry and dairy produce. Only 10 per cent of the available calories in grain or crops reaches us if it has to be first processed through animals. As Mr Kelly and Dr Kevany have pointed out, here in Ireland we have the highest consumption per head of calories and of meat and dairy produce of any country in Europe, perhaps of any country in the world.

Most of us in Ireland are overfed, particularly overfed with animal products, meat and animal fat, and with refined carbohydrates, for example white bread, sugar and alcohol. As a result, we are suffering from what are known as the "western diseases", diseases resulting to a large extent from our diet. We have departed from the vegetable diet which has been in the main the diet of most men for millions of years and which was high in fibre or roughage but relatively low in protein, animal fats and, of course, refined carbohydrates. Our diet today is largely responsible for heart attacks, high blood pressure, stroke, obesity, diabetes, certain cancers such as cancer of the breast and cancer of the colon, appendicitis, diverticulitis and a number of other common conditions.

Most of us consume too many calories for our usually very sendentary life. It is of interest that men living in the country in Ireland have lower heart attack rates and have a better expectation of life than men living in the city, for instance in Dublin, the reason being that while they eat as much as the city men they are exercising much more and smoke less. In the Irish/Boston study it was also found that while the men in Ireland ate more than their brothers in Boston the men in Boston were heavier and had higher heart attack rates, the reason was that the men in Ireland at that time tended to walk to the pub and elsewhere whereas the men in Boston took their cars.

It is hard in Ireland to tell our farming community that they must stop producing so many cattle and such large amounts of dairy produce, milk, butter, cheese and also pigs, poultry and eggs and sugar beet for sugar. However, let us face it, the writing is on the wall. In the United States, many people have changed their diet and are consuming much less in the way of animal fats and, incidentally, reducing their cigarette smoking and taking more exercise. Their heart attack rates are falling and their expectation of life is improving. This is not occurring in Ireland. Probably the most important change in lifestyle in the United States is the change in diet. For a combination of reasons, of which diet is certainly the most important, heart attack rates are also falling in some European countries such as Switzerland where men are taking similar measures to eat a "prudent diet".

What should we do, therefore, in Ireland? Any effort to develop a national nutrition policy which would spread the gospel that we must cut down on our consumption of milk products and meat and depend to a much greater extent on unrefined cereal foods such as brown bread and a diet high in vegetables, so that we have much more fibre in our diet, would meet with opposition from the very powerful farming and commercial interests in the country. Although such a change would be beneficial to our health the reasons for opposition are very understandable.

The decision is really a political one for the people to make. What do we consider an acceptable risk? Would we prefer to continue with our present overproduction and con-

sumption of meat and animal fat and pay the cost in a high death rate from heart attacks and strokes or are we prepared to accept a lower national income, reduce the general protein, animal fat, refined carbohydrates and excess salt in our diet and live longer and more healthy lives?

We certainly need a national nutritional policy but we will have to take great care whom we choose to be on the committee, which would direct such a policy. It is certain that in Ireland the change will only be gradual because of the powerful farming and commercial interests encouraging us to continue with our present eating habits. One thing a national committee could do would be to advise the poor, the underprivileged, how they could best optimise their diet with the money available to them, for example encouraging the use of wholewheat bread rather than white bread and making more use of the fish that abound around our shores. I think it will be easier to help the underprivileged to eat well than it will be to help the 95 per cent of the population who are already eating excessively well.

John Kevany and myself had the good fortune to go to the same school, Ampleforth College in Yorkshire, and during the war Ampleforth invited St. Paul's quaker school from York to occupy some of its building because of the danger that York would be bombed. The speech made by the headmaster of St. Paul's at the joint prize-giving of the two schools which I attended in 1941 was a fine example of how conflicting interests can, in fact, be reconciled. I remember he began his speech "Friends, Romans, countrymen". Perhaps in Ireland, too, we can reconcile the prosperity of our farmers with a prudent diet for our people. We are all countrymen.

I would like to express a vote of thanks to Mr A. Kelly and Dr J. Kevany for their outstanding paper "A Food and Nutritional Surveillance System for Ireland".

S. Trant: I am very pleased to have this opportunity of complimenting Mr Kelly and Dr Kevany on their paper, which has explored both the need for, and the practicalities of, a food and nutritional surveillance system for Ireland.

What has particularly impressed me about this paper is the extent to which it is based on actual fieldwork by the authors. It is one thing to have a good idea and to put it forward for discussion and criticism. It gives a totally new dimension to the concept when, as in this case, the originators have already laid the foundations, tested a number of hypotheses and put forward some provisional results relative to the nutrition status of the Irish population. They have also indicated some of the challenges and pit falls that lie in the way of establishing a nutritional surveillance system in this country. This paper, supported as it is by the pioneering work of the authors, has opened up for us the large and very complex question of nutrition surveillance and makes it possible for us to debate it in realistic and practical terms.

If I have one criticism to make of the paper, it is that it is so comprehensive, it contains so much material that it is difficult to absorb it all in one sitting.

I would like to take up one point from the paper which seems to me to be important to this debate. It is the question whether a surveillance system should be built on the umbrella approach, that is covering the nutrition needs and experience of the entire community, or whether it should concentrate on certain sections of the community which are known to be at risk.

I can see certain problems arising in starting with the umbrella approach. There is the danger of amassing a large volume of facts and figures, most of which may have little relevance to what we are trying to achieve and which will present problems of analysing the data and producing results.

There is also the possibility that the overall average values which will emerge from such a system may conceal serious instances of malnutrition for some relatively small sections of the community.

There may be some merit in concentrating, initially at any rate, on selected categories of persons, such categories being selected because they are known to be vulnerable to malnutrition or because correct nutrition is critically important to them.

One such group, for example, might be the elderly and especially elderly persons living alone. There are more than 360,000 persons in the over-65 age group and this number is increasing. There may be up to 50,000 of these living alone. The serious danger of under-nutrition among such persons is well established and a surveillance system which was aimed specifically at them might begin to show early results.

Another group which comes to mind is pregnant women and new-born infants. There is a considerable volume of evidence that low birthweight, perinatal mortality and some serious handicaps in new-born infants are associated with the mother's lifestyle, including nutrition, during pregnancy. In recent years there has been a very significant decline in infant mortality in Ireland. It fell, for example, from 18.0 deaths per 1,000 live births in 1971 to 12.4 in 1979 and the figures for the first quarter of 1980 show that the infant mortality rate for that quarter was 11.4. It is a reasonable assumption that the incidence of handicap has shown a similar decline. There are probably many factors associated with this trend and it is likely that the nutritional status of the mother is one such factor. It seems to me that this also is a section of the community which merits special attention in the study of nutrition status.

Of course, I realise that the two approaches, the umbrella approach and the at-risk group approach, are not mutually exclusive and, in fact, provision for both is made in the paper which we heard this evening. It is largely a question of emphasis and I feel that there is much to be said at this stage in favour of placing the main emphasis on selected at-risk categories.

It may be of interest to note here that the Department of Health is at present in the process of building up an information system which covers all live births and late foetal deaths. One of the objectives of this information system is to identify factors associated with the perinatal period which may have a bearing on mortality and morbidity. It is possible that the information which is emerging from this system can also be used to help study the nutrition needs and practices of this very important group of persons.

Dr Kevany has mentioned a possible alternative method of monitoring the nutrition status of the community, that is by way of a nutrition survey, but he has come down very firmly in favour of the surveillance method. I do not disagree with this conclusion but I would like to see the rationale for the survey method teased out more fully.

The value of any surveillance system will depend very largely on the quality of the information available to it. In the area of monitoring health problems the main sources of information visualised are death certificates and the Hospital In-Patient Enquiry. The former provides an excellent source of information on cause of death. It is reasonably comprehensive and quite accurate. The Hospital In-Patient Enquiry is also a good source of information of the numbers and causes of morbidity in so far as this relates to hospital admission. What these sources do not cover, however, is the incidence of sickness in the community which does not result in admission to hospital or in death. This information is not at present readily available. It may be a serious omission from a nutrition surveillance system and it is a matter to which some thought should be given. The whole question of nutrition surveillance has been opened up for us this evening and we have been encouraged to develop thoughts and ideas on this matter which might otherwise have lain dormant. We owe a great debt to Mr Kelly and Dr Kevany for stimulating us in this way.

It is my pleasure to second the vote of thanks to Mr Kelly and Dr Kevany for their excellent paper.

F. Embleton: I wish to be associated with the vote of thanks to the two authors for an

interesting and fascinating paper. On a personal note, I am particularly pleased that the usefulness of the Food Balance Sheets, as compiled by my Office, in a food surveillance system has been highlighted. I have long felt that the efforts devoted to compiling balances have gone unnoticed and largely unrewarded and it is therefore pleasing to note the good use made of the results in this paper.

Having said this, however, it is essential that users be fully aware of the limitations attaching to the balances and the authors quite rightly have enumerated most of these. I would add further qualifications. First, the data available on stocks are incomplete and relate solely to the manufacturing sector and thus exclude stocks held in the distribution network. Secondly, it will be readily appreciated that information on wastage is difficult to obtain and the wastage figures are therefore largely guesstimates and relate principally to the production phase. I need not indicate the effects of these two factors on the levels of consumption and in some instances on year-to-year comparisons.

With regard to per capita figures, the authors are correct in highlighting the equal weighting given to each member of the population. This is particularly to be noted where alcohol is concerned as no allowance is made for non-consumption by very young and general school-going population.

In general, therefore, users should recognise that, as the authors indicate, the Food Balance Sheets are best used to monitor changing levels and patterns of national food consumption over time. Likewise, international comparisons should be restricted to comparing changes in levels and patterns rather than to absolute levels of consumption. In this respect, due account should also be taken of the varying diets between nations (e.g., milk in Ireland, wine in France).

I have a query to put with regard to the comparisons of RDA with per capita intake, as derived from the Food Balance Sheets, and the later comparisons of the FBS and HBS data. There is a need to compare like with like and in particular I have in mind that in the case of the FBS figures, the basic commodity is not always expressed in product weight. Meat, for instance, in the balances is expressed in terms of dressed carcass weights compared with the more common product weight as obtained at retail outlets. Thus, in the case of the comparisons, if the factors used to derive calories, etc., used have not been related to a common weight measurement, an overstatement in the FBS will arise. This may go some way towards explaining the higher FBS figure – other factors, such as those mentioned earlier, in any one single year (e.g., 1976) may also affect the comparisons. The HBS figures, of course, also relate to urban households only and it is known from available statistics that rural, particularly on-farm, consumption of potatoes and milk exceed urban levels. Perhaps the authors might clarify this point for me.

Finally, I wish to thank again both authors for a very interesting and stimulating paper.

J. Durkan: I too would like to add my congratulations to those of other speakers. The authors have done a magnificent job with data from diverse sources and produced for essentially different purposes than the needs of the paper.

I have several queries and a comment.

First, with regard to the correlations in Table 7 it is not clear what is the basis of selection of a ten year lag. Was this empirically derived by considering different lag periods rather than on *a priori* grounds? What could these *a priori* grounds be?

Secondly, the correlations are between variables ten years apart. It is not immediately clear why animal fat consumption ten years ago would be highly correlated with male IHD now. The appropriate model might very well be the accumulated consumption of dietary components and mortality. In this case you require a regression model with some form of lag structure.

Thirdly, the correlations are calculated on the basis of ten observations, whereas the data clearly extend beyond this. Were later observations also used and what were the results of the correlations?

Fourthly, the lag for sugar at twenty years needs some justification – along the lines outlined in my first two queries.

Fifthly, the explanation of the negative correlation for butter – viz, that consumption has been decreasing gradually – misses the point. You need a full regression model to pull out the influence of butter *qua* butter and correlations will not do this.

Sixthly, the correlations in Table 8 suffer from similar problems with regard to lags – in this case no lags are used. While there are good *a priori* reasons for accepting this in the case of infant mortality, what is the basis for the other variables?

Seventh, with regard to item 6 in Table 10 the note on this item states "while income is not the main determinant as regards nutrient consumption (regression analysis showed family composition to be the most significant) it is nevertheless an important factor". Most analyses of Household Budget Surveys indicate that income, in fact, is responsible for explaining the greater part of the R^2 for food expenditure with household size, of course, also important. Household size is different to household composition and invariably adjustments to composition data must be made to take account of the age structure of the household. It would be interesting to have a fuller description of the statistical results referred to in the note. On this point in Table 10 it would be interesting to have the number of persons as well as the number of households in the different ranges for (Expenditure on Food)/(Disposable Income) – as there may be some concentration on the old or large families, etc.

Finally a comment. The proposed surveillance system might not be useful. By the time the results are in, the event may be over – people are already damaged through malnutrition or overeating. What this study does, and what a surveillance system can do, is to identify target groups, e.g., those likely to suffer from malnutrition for whatever reason. The expenditure pattern of target groups can be monitored by reference to price and income (including social welfare receipts). If, for instance, we know that food prices are rising or going to rise by 25 per cent then policies to alleviate the real income fall for some target groups can be introduced.

Reply by A. Kelly and J. Kevany: We wish to thank the Society for its invitation to present this paper and to express our appreciation to those who commented on it.

In particular, we are grateful for Mr Sean Trant's thoughtful and extensive comment which addresses the crucial question of allocation of limited resources to different information collection systems. There are arguably separate cases to be made for the "at risk" approach as opposed to the "umbrella" approach in nutrition and health surveillance.

The "at risk" approach is directed to secondary prevention activities, that is risk reduction in specified population sub-groups, while the "umbrella" approach deals with primary prevention in the sense of anticipating and preventing the emergence of risk status.

Thus, an "at risk" approach will require an information system which will primarily report sub-group characteristics associated with health status (physiology, morbidity, mortality) and risk behaviour (inadequate dietary intake). It will not address the broader environmental issues concerning the nature of the food supply itself and those factors that determine its use. For example, the progressive increase in the fat content and decrease in the fibre content of the nation's food supply over the past three decades represent environmental changes that permitted the development of one factor in coronary heart disease risk behaviour (excess dietary energy and fat) to emerge in a biologically vulnerable sub-group (sedantary middle-aged males).

In nutrition epidemiology terms, it is only by collecting a wide range of information

from several sub-systems that a complete picture can be obtained, including insight into causal and contributory factors. It can, of course, be argued that the complete picture is not necessary to meet the needs of a single sector (health) that has the primary responsibility for intervention in respect of health and disease problems; available resources should be invested in detailed surveys of biologically, and socially, vulnerable groups (mothers and infants, elderly). Unquestionably detailed surveys will always be required to elucidate the mechanisms of risk acquisition and disease process. If however large sums are to be invested in such surveys there is a strong case to be made for adequate and precise predefinition of the risk groups involved (which mothers and which elderly are most at risk?). Aspects of the surveillance system described, such as the Household Budget Survey, are available in such context for the preliminary identification of food consumption patterns associated with risk status.

The "at risk" approach does not permit wider conclusions to be drawn for policy making and programme planning, and is more suitable for defining specific sectional activities at the local level. The "umbrella" approach does not provide the level of detail required for determining exact causal mechanisms, however, it provides a more complete picture of past and current conditions, it will permit some prediction of the direction which a problem is taking and will permit some broad definition of "at risk" groups for the purpose of follow-up study.

In respect of Dr Dean's vote of thanks, we are grateful for his comments and insight into the topic of nutrition and public health. While we agree that there is a basic issue of selecting between health and risk behaviour options, and that this ia a political and social decision, we also feel that there are many other steps that could be taken to improve and predict public health without any major alteration of current consumption patterns. Considerable progress could be made in areas such as selective breeding of stock for low carcass fat, the development of low fat dairy products, the reduction of salt and sugar in processed foods. These would not require any major change in dietary patterns and would probably be well accepted by the public. A food and nutrition policy directed to such ends and supported by information from a surveillance system could notably improve several major chronic disease problems of our society today.

In regard to Mr Embleton's remarks concerning the interpretation and use of FBS data, we concur fully with these. A strict comparison between the FBS figures and either the Recommended Dietary Allowances or the results from the Household Budget Survey was never intended. In both instances our intention was simply to emphasise the evidence for overconsumption at the national level (on which, both sources agree) in view of the high prevalence of chronic degenerate disease in Ireland. Relating to the distinction between urban and rural consumption patterns which Mr Embleton draws attention to, the 1973 HBS results confirm this. The following figures which derive from the 1973 survey show that, for each nutrient, rural-farm consumption exceeds urban and rural non-farm consumption:

Mean daily per capita intake of nutrients by location: HBS (1973)

	Cals. (Kcal.)	*Protein (gm)*	*Carbo. (gm)*	*Fat (gm)*	*CA (mg)*	*FE (mg)*	*Vit A (mg)*	*Vit C (mg)*	*Vit D (mg)*
Urban	3057	91	383	133	1184	18	1496	103	2.9
Rural-Farm	4198	116	563	174	1580	23	1741	109	3.5
Rural Non-Farm	3454	96	483	136	1404	18	1315	107	2.5

Mr Durkan raised a number of points regarding the correlation analysis as reported in

Tables 7 and 8. The limitations of this approach are fully appreciated, and as we state in the text, the simple correlations serve only to suggest possible avenues of investigation along which a more detailed multivariate study might proceed. The choice of a lag period of 10 years was supported on two grounds: (1) epidemiological evidence suggests that for certain chronic diseases (IHD, for example) a latent period of development of from one to two decades exists, and (2) the work of Armstrong *et al.*, (1975, p. 455) in the United Kingdom, who found that in a similar analysis the correlation coefficients stabilised at around nine years. The inclusion of the 20 year lag for sugar was for comparison purposes only, the remaining commodity data were obtained from the OECD publications (references above) which were available in detail from 1954 onwards, thus permitting (an exploratory) 22 year parallel study.

Regarding the regression analysis of the HBS data, a rather brief description follows, a fuller account is contained in Kelly (1980) above. The dependent variable in each regression was the average household intake of a particular nutrient, e.g., protein. The independent variables were:

> Income (7 Levels), location (urban, rural-farm, rural non-farm), social group (1 to 4), and 3 quantitative variables relating to household composition – mean number of children, mean number of adults, and mean number of aged persons.

A range of models incorporating transformations of the independent and dependent variables were tested and the model used was selected as the overall "best" fit.