3 Indirect Nutritional Assessment of Human Groups

Vital Statistics

Malnutrition influences morbidity rates for various diseases (such as tuberculosis), maternal and perinatal mortality rates, life expectancy and other health statistics. A variety of vital statistics may therefore be considered as indirect indicators of the nutritional status of the community.

Difficulties in using data of this sort as indirect public health indicators of malnutrition are, first, the usual problems of collecting accurate information in the cross-cultural circumstances found in developing regions of the world. Before interpretation, it is necessary to ascertain not only the availability of local statistics, but their probable reliability, which will be related to the method of collection and its acceptability by the public, the percentage of deaths certified by doctors, occurring in hospital or autopsied, etc. The situation varies greatly from one country to another, and in some areas the numbers of deaths are recorded with comparative reliability, although the stated causes of death may be quite unreliable.

Secondly, problems of interpretation are considerable in relation to many other concurrent factors, such as a high incidence of infectious disease, overwork, poor housing and other socio-economic conditions.

This type of data, analysed where possible according to region, season, sex and age-group, should, then, be considered as important and suggestive, but not specifically indicative of the plane of nutrition of the community.

As far as morbidity and mortality are concerned, widespread malnutrition has its most marked general ill-effect among young children and pregnant women, and statistics relating to these groups are considered in detail both at this point and in subsequent sections.

Age-Specific Mortality Rates

Some types of malnutrition have a particularly high incidence at certain ages, so that the mortality rates at these specific age-periods have been suggested as indicators of the incidence of certain types of malnutrition.

2-5-month mortality rate

In areas where thiamine deficiency is a potential danger, it has been shown that there is a relatively high mortality rate due to infantile beriberi between 2 and 5 months of age, compared with similar areas where dietary lack of thiamine is uncommon (Aykroyd & Krishnan, 1941).

In view of the difficulty of assessing the incidence of infantile beriberi by other means, the 2-5-month mortality rate may be a valuable public health index. It will, of course, be imprecise, because other diseases, including pneumonia and diarrhoea, can be important causes of death in this age-range, although mortality is usually relatively low at this time in fully breast-fed babies in traditional tropical circumstances, except where the mothers are thiamine-deficient.

1-4-year mortality rate [1]

While the infant mortality rate has long been used as an indicator of the health of a community, it is now realized that, while the IMR in developing regions of the world may be 10 times as high as in industrialized countries in Europe and North America, the 1-4-year mortality rate may be 30 to 50 times as great (Table 13).

TABLE 13. MORTALITY RATES PER 1000 CHILDREN 1-4 YEARS OF AGE IN SELECTED COUNTRIES *

Country	Mortality rate in 1-4-year-olds per 1000
United States of America	1.1
Denmark	1.1
Colombia	18.6
Mexico	19.3
El Salvador	26.6
Ecuador	28.5
Federation of Malaya	45.1
Guatemala	46.6
Guinea	54.8

* Reproduced by permission from Scrimshaw (1964).

This is because the so-called pre-school-age period, especially its earlier part, is a time of combined nutritional, infective and psychological stress, and the high 1-4-year mortality rate is due to an accumulation of infections,

[1] The 1-4-year period includes children from 12 to 59 months (i.e., below their fifth birthday).

parasitism and malnutrition during this vulnerable period, which is normally characterized by rapid growth and high nutritional needs. The precise details of the responsible conditions will vary from one area of the world to another, but in most developing regions the principal factor is protein-calorie malnutrition of early childhood. The use of the 1-4-year mortality rate as a public health index of malnutrition has been particularly suggested in the West Indies (Wills & Waterlow, 1958; Harney, 1958; Uttley, 1963).

Estimation

In common with the collection of any statistics, there will be great difficulty in assessing the 1-4-year mortality rates in most developing countries. However, an estimate may be attempted in the following ways:

(*a*) *Analysis of birth and death records.* Records of births and deaths should be consulted, if available. These may be kept by a local authority, such as a chief or mayor, or by a religious leader, such as the priest or a missionary. If these are complete and accurately kept, which is unusual, it may be possible to calculate the infant mortality rate and the 1-4-year mortality rate, and to enumerate the commoner causes of death in various age-groups. However, with precise ages not known, with no cultural incentive to register births and deaths, and with little likelihood of medical certification of the cause of death, it is unusual to obtain much useful information. Nevertheless, it is worth while examining available records. Sometimes, at least, it may be possible to note which causes of death are notified, although these may be diagnosed only symptomatically or by means of the vernacular name.

(*b*) *Calculation from census figures.* This will be practicable only if a careful census has been repeated at intervals in the area (Rao et al., 1959).

(*c*) *Questionnaire at village level.* A sample of mothers may be questioned carefully, by someone speaking the vernacular and preferably from the local community, on the number of children they have had, the number that have died, and the approximate ages at death, which may have to be expressed in general terms in descriptive age-groups, such as " still on breast ", " able to walk ", " circumcised ", etc. The cause of death may also be sought and may be expressed symptomatically, e.g., " diarrhoea ", " convulsions ", " voiceless crying " (infantile beriberi), or as a syndrome recognized in the local culture, e.g., *obwosi*—one of the terms used for kwashiorkor by the Baganda people.

However, this type of inquiry is laborious and time-consuming, and may prove inaccurate. Where the birth-rates are high and many children die, mothers often do not remember details exactly. Also, there may be local concepts that confuse such data as are obtained. Thus, an abortion or the placenta may be classified by local custom as a separate " child ", or it may be considered inauspicious to enumerate children, whether alive or dead.

Further attempts to obtain figures concerning family structure and particularly child mortality may be carried out by questionnaire and by observation in the course of rapid ecological visits. The same difficulties arise as those connected with the questioning of mothers at the survey site. Moreover, in large extended polygamous families, or those with closely-knit clan ties, it may be extremely difficult to sort out the relationships of children and adults, especially if it is customary for children to stay for prolonged periods with relatives. Also, in some groups, it may be considered incorrect behaviour for a woman not to acknowledge all the young children in her house as her own. Nevertheless, useful information has been obtained through this type of approach, as in Kenya, where Grounds (1964) calculated the infant and total child wastage rates, expressed per 1000 live births for different regions of the country.

Expression of results

Mortality in early childhood can be expressed in various ways:

(*a*) *Percentage of deaths of children below 5 years in relation to total deaths at all ages.* This can be calculated either from birth and death records or from census data. Figures in Western Europe and North America are below 10%, while in some developing regions they may exceed 50% (Table 14). However, it is difficult to compare figures from developing and developed countries owing to the different population structures (Bengoa—personal communication, 1965).

(*b*) *Annual 1-4-year deaths per 1000 of the 1-4-year population.* This method has the disadvantage that it is necessary not only to have a good registration of deaths but to know the size of the 1-4-year population in the area, which is difficult to estimate. Rates of 10 : 1000 or over indicate a high mortality in this group, suggestive of widespread protein-calorie malnutrition (Bengoa, Jelliffe & Perez, 1959). In some developing regions, this figure may reach 20 to 200 : 1000, whereas in Europe and North America the corresponding figures are usually 1 to 2 : 1000.

(*c*) *Percentage of childhood deaths occurring in the 1-4-year period.* This information, with all the inaccuracies implicit in the method, can cometimes be sought by questioning the mothers.

(*d*) *Ratio of 1-4-year mortality rate to that of infants aged 1-12 months.*

This method of expressing the 1-4-year mortality rate was suggested by Wills & Waterlow (1958), based on experience in Jamaica, as an index of protein-calorie malnutrition of early childhood in the community. However, this depends on the assumption that complicating factors, such as infections and incomplete birth registration, are common to both age-groups, and that malnutrition affects mainly the 1-4-year-old children.

This is not always the case. In some areas, nutritional marasmus is the most common form of protein-calorie malnutrition of early childhood and

TABLE 14. INFANT AND CHILD MORTALITY IN COUNTRIES WHERE PROTEIN-CALORIE MALNUTRITION IS UNKNOWN OR EXTREMELY RARE, AND WHERE IT HAS BEEN FREQUENTLY ENCOUNTERED *

Country	Infant mortality per 1000 live births	Proportion of mortality, all ages (%)
Protein-calorie malnutrition unknown or rare		
Canada	28.4	10.8
Czechoslovakia	25.7	5.0
England and Wales	22.2	3.7
Japan	33.7	9.2
USA	26.4	7.8
Protein-calorie malnutrition frequent		
Chile (1958)	127.7	41.6
Mexico	74.4	46.3
Ceylon	57.5	39.1
India (1956)	101.8	33.4
Philippines (1958)	109.2	49.9

* The figures given in the table are for 1959 and 1960, unless otherwise stated, and are taken from *Annual Epidemiological and Vital Statistics* 1959 and 1960, published by the World Health Organization.

occurs mainly in the first year of life, as in Chile. In some more urbanized regions, the age-incidence of kwashiorkor itself has fallen with the decline in breast feeding, as, for example in Trinidad, where the peak incidence (86%) is in the first year of life (Jelliffe, Symonds & Jelliffe, 1960). In either of these circumstances, protein-calorie malnutrition will be related more to the infant mortality rate.

Furthermore the 1-4-year period often has a much higher incidence of certain parasitic infestations, such as malaria and hookworm, and of infectious diseases—e.g. tuberculosis and measles—than occurs in infancy, which is often relatively protected by close contact with the mother and by some persistence of transplacentally acquired antibodies.

A further problem is that children in the early pre-school-age group in some parts of the world—e.g., in Gambia (McGregor, Billewicz & Thomson, 1961)—can have a high mortality even where severe primary, dietary malnutrition appears to be uncommon, but where infections such as malaria are widespread.

It may be concluded that at the present time in many developing countries the 1-4-year mortality is much influenced by malnutrition—the influence

being greater than during infancy—and that this can be a useful index of malnutrition. However, in whatever way the mortality rate is expressed, to be of value it must be interpreted in the light of the knowledge of the local disease-pattern in early childhood, and particularly of the age distribution of the different forms of protein-calorie deficiency disease, and of bacterial and parasitic infections in infancy and the 1-4-year period, and of an analysis of the ecological factors responsible for malnutrition in the particular region.

As a refinement of this concept, mortality rates in early childhood need to be analysed by one-year age-groups, so covering periods more specific to the peak-age occurrence of malnutrition in the particular region (Aykroyd, 1965). These would vary in different parts of the world, depending upon such factors as the age of " weaning " and other infant-feeding practices. As a generalization, the 13-24-month (or " second year ") death rate would yield useful information in many countries, as this is the classical age-group principally affected by kwashiorkor, when the child is experiencing the " transitional " dietary period, when the main foods are likely to be largely carbohydrate pastes and gruels, and when the child is between the breast-fed sufficiency of early infancy and the omnivorousness of later childhood.

Morbidity and Cause-Specific Mortality

Information concerning the incidence and mortality of certain forms of malnutrition may be available, if looked for, while data concerning the commonness and mortality rates of certain " nutritionally relevant " diseases also require to be collected, if practicable.

Malnutrition

Once again, information specifically concerning protein-calorie malnutrition should be sought.

Surveys. The prevalence of the major, clinically identifiable syndromes, such as kwashiorkor, nutritional marasmus, pellagra, keratomalacia, etc., can be noted in the course of a community-wide nutritional survey, and will provide useful information on prevalence provided that note is also made at the same time of cases admitted from the same area to adjacent hospitals, and care is taken to ensure that affected persons are not being hidden.

Health centres. Useful, though biased, information concerning geographical distribution and seasonal incidence can be obtained by training staff, including paramedical personnel, to recognize kwashiorkor and nutritional marasmus at health centres and to record cases attending with these conditions (Gongora and McFie, 1961; Burgess and Dean, 1962). Diagnostic signs should be simple, clearly understood and taught to personnel by means of practical demonstrations and photographs. Kwashiorkor

should be recorded for every young child with oedema, poor growth (low weight) and wasted muscles, and nutritional marasmus diagnosed by very low weight with marked wasting of muscles and subcutaneous fat, with no oedema. Results can be expressed as percentages of children under 5 years of age attending the centre.

In well-organized young children's clinics, the percentage attending with " inadequate weight gains " (see Table 19) can be determined.

Hospitals. Lastly, hospital statistics can be of some value, although they do not reflect the actual community conditions. Difficulties of interpretation arise from the inadequacy of local transport and communications, the available bed-space, the admission policy and the attitudes of indigenous people to the hospital and to the causation of malnutrition and its therapy. At present, hospital data often fail to furnish as full information as they could do, because protein-calorie malnutrition of early childhood is not identifiable in the disease classification used. In addition, confusion may occur with regard to the diagnostic labelling of malnourished children who are also suffering from multiple infections.

It is suggested that *all* cases of kwashiorkor and marasmus, as defined later, should be recorded at hospitals, and that secondary conditioning factors should also be noted, especially associated infections. Annual figures can best be reported as percentages of the total number of patients under 5 years of age admitted to the wards. Similar records should be kept for out-patients. Care must be taken to avoid duplication of reporting if children with malnutrition are first seen in the out-patients' department and subsequently admitted. Figures should be broken down in relation to infants and 1-4-year-old children, and, if age assessment has been sufficiently accurate, figures for the latter should be analysed in yearly age-intervals.

Hospital admissions with kwashiorkor and nutritional marasmus can also be used to supply information on the seasonal incidence and the geographical distribution of these conditions in the surrounding area. The plotting of home sites of affected children on superimposed transparent nylon-acetate maps may permit correlation with local ecological factors, including population distribution, urbanization and staple food crop.

Children admitted to hospital with severe forms of protein-calorie malnutrition or keratomalacia can yield valuable information on important local conditioning factors in the etiology of these conditions (Oomen, McLaren & Escapini, 1964). For this, detailed clinical histories concerning feeding practices, method of " weaning " from the breast and antecedent infections, as well as laboratory and other investigations, including a tuberculin test, a stool examination for helminth ova, a thick blood film for malarial parasites, etc. will have to be carried out.

Lethality figures for various hospitalized forms of malnutrition, such as beriberi or kwashiorkor, should be available, but, of course, these give

no indication of mortality from these causes in the community. They are biased by the various factors common to all hospital data, and, in the case of kwashiorkor, by the associated conditioning infections common in the particular region and by the effectiveness of the treatment employed.

In relation to the assessment of the prevalence of avitaminosis A, Oomen, McLaren & Escapini (1964) have suggested that the age-specific blindness rate can be related to past keratomalacia, in that blindness occurs between 1 and 4 years of age, and is suggested by the presence of leucomata, staphylomata or phtisis bulbi in older children or adults, dating from the pre-school period.

Finally, where autopsies are obtainable, post-mortem evidence of protein-calorie malnutrition and causative conditioning diseases may be available.

Cause-of-death records. Where official records are reasonably accurate, the specific death rates due to malnutrition in 1-4 year old children can be very useful, as has been shown in Venezuela (Bengoa, 1940, and personal communication, 1965). Results are best expressed per 100 000 population in this age-group.

However, official notification of deaths in many countries gives very distorted figures of the real problem, as a great proportion of deaths in children below five years is attributed to either diarrhoeal diseases, parasitism, respiratory conditions or some infectious diseases, particularly measles and whooping cough.

All this information is of value but requires careful interpretation.

In the absence of death certification by medically trained personnel, the percentage of deaths due to malnutrition in different age-groups may be impossible to determine. Sometimes a simple " clinical feature description " may facilitate a workable cause-of-death classification and may give information of nutritional relevance—e.g., young children dying with swelling of the legs may in some circumstances in developing regions be equated with kwashiorkor. Alternatively, there may be vernacular names for syndromes or signs of malnutrition—e.g., *obwosi* and *omusana* for kwashiorkor among the Baganda, or *sisikan* (" fish's scales ") for Bitot's spots in Indonesia (Oomen, McLaren & Escapini, 1964), and, if these are recorded, analysis may yield useful information.

Where there is no adequate coverage by medical services and the population has no inducement to report births and deaths, incidence rates and mortality rates for malnutrition in a community can be discovered accurately only in special circumstances, i.e., when circumscribed areas are under continuous direct observation. This can take place in a special long-term study in a defined area adjacent to a model health centre from which home-visiting activities are carried out, or in a small community under close continuous observation by interested people, not necessarily with specific medical training, such as anthropologists or missionaries.

Nutritionally relevant diseases

Malnutrition is an important contributory cause of morbidity and mortality in such diseases as tropical ulcer, diarrhoeas of infectious origin, tuberculosis and measles, and death certificates should include mention of severe malnutrition whenever it occurs concurrently with the principal cause of death or primary disease.

Diarrhoea is one of the principal causes of death among young children in developing regions of the world. Its etiology is often complicated and varies from region to region, but alimentary bacterial infection and protein-calorie malnutrition are probably the two main causes. They often occur together and each can influence the other adversely (" weanling diarrhoea ") (Gordon, Chitkara & Wyon, 1963). It seems probable, however, that protein-calorie malnutrition of early childhood can, in isolation, result in loose stools.

Therefore, in view of the relation between diarrhoea and malnutrition, and between these and the methods of infant feeding employed, statistics concerning the morbidity and mortality attributable to diarrhoea of early childhood may be valuable indirect evidence of malnutrition.

Measles is a world-wide disease. The attack rate remains unchanged even in countries where mortality due to the condition is now very low. As there is apparently no evidence of variation in the virulence of the measles virus, the infection represents a uniform stress all over the world.

Under this uniform stress, mortality rates and the severity of the disease seem to be in considerable measure related to the nutritional state of the group involved, although late attendance for treatment, availability of health services and their quality, associated parasitic infestations, and a younger age incidence must also be taken into account. In a careful field study carried out over a four-year period in rural Guatemala, the mortality was found to be 11.5% and 8.5% in the first and second years of life respectively (Gordon, Jansen & Ascoli, 1964), while in El Salvador in 1959, the mortality rate was 105 times as high as in the USA (Scrimshaw, 1964).

In some regions, measles is well recognized as a common precipitating factor in the etiology of kwashiorkor. Thus, in Western Nigeria, the hospital lethality rate was 25%, and 13% developed kwashiorkor (Morley, 1962).

Measles is an easily recognizable condition, well known to lay people and often with a specific local name, so that information can often be obtained readily by field workers. Attempts can therefore be made to collect data concerning mortality from measles in the community as a whole and in children admitted to hospital, for such data will provide approximate indices of the nutritional status of the child population.

4 Assessment of Ecological Factors

Human malnutrition is always an ecological problem in that it is the end-result of multiple overlapping and interacting factors in the community's physical, biological and cultural environments (Bengoa, 1940).

Thus, the amount of various foods and nutrients available to persons of different age-groups will depend upon such environmental conditions as climate, soil, irrigation, storage, transport and economic level of the population, as well as on such cultural influences as local cooking practices and food classifications, especially in relation to the distribution or restriction of foods for vulnerable age-groups.

Similarly, the importance of non-nutritional conditioning diseases in the production of malnutrition has become increasingly realized in recent years; in particular, the synergistic influence of bacterial, viral and parasitic infections and psychological trauma is now recognized, especially in relation to protein-calorie malnutrition of early childhood.

It is therefore necessary to make an ecological diagnosis of the various causative or co-existing factors responsible for malnutrition in a community before it is possible to elaborate a locally appropriate preventive programme that can be " aimed at the vulnerable links in the chain of multiple causation " (Scrimshaw, 1964).

Preventive programmes aimed at eradicating kwashiorkor have to suit the particular area or community. Dietetically, the lack of protein in the children's diet may be due to parental poverty, to lack of availability, to inadequate knowledge of nutritional needs, to customs that prevent young children from receiving available protein foods, or to any combination of these factors. Furthermore, kwashiorkor is almost never exclusively of dietary etiology, but is precipitated by one or more infections, such as whooping cough, measles or diarrhoea, or parasitic infestations, such as hookworm disease or malaria, or the psychological trauma of abrupt weaning, or a combination of these.

A rational preventive programme should be directed at *all* the factors considered of public health significance in the particular area, so that, apart from other considerations, an immunization programme or malaria chemoprophylaxis for pre-school-age children may be planned, quite logically, for nutritional reasons.[1]

[1] This broad approach to the age-group is the basis of the "Pre-school Protection Programme (P.P.P.)" (*Journal of Tropical Pediatrics*, 1963).

Ecological factors related to the etiology and prevention of malnutrition are considered in this chapter under the following six artificially separated headings: (*a*) conditioning infections; (*b*) food consumption; (*c*) cultural influences; (*d*) socio-economic factors; (*e*) food production; (*f*) medical and educational services. In fact, all these aspects of the ecology are intimately related to one another, as stressed by Scrimshaw (1964).

Methods of Obtaining Information

Information of varying degrees of usefulness and accuracy concerning ecological factors can be obtained in various ways, some of which may be more or less feasible in different circumstances.

Background data

Background data should be sought early on, prior to the preliminary visit or field reconnaissance to the survey area. Library research, using books, journals and other publications in medical, nutritional, anthropological, agricultural and other relevant fields, will be required, if available.

Inquiries should be made from the various government departments whose officials and archives may be able to supply information—census figures, statistics, maps, national and regional food production, etc. The relevant departments will have various functions in the particular country, but the ministries concerned with health, agriculture, economic development, population studies, fisheries and community development should always be approached.

Discussion should be sought with those who have had general or professional experience in the area to be surveyed. This may include both foreigners—doctors, social anthropologists and missionaries—and educated indigenous people. In all cases, the possible bias of the informant must be considered.

Further information and clarification of background data will often result from the field reconnaissance.

General survey data

Limited, but valuable information on the ecological background can be gathered in the field during, and as a part of, the actual general nutrition survey.

(*a*) *Survey site.* Observations, based largely on impressions, can be made at the actual survey site when people have been assembled for examination. Staff should be encouraged to jot points down as noted, and notebooks should be available for this purpose. Co-ordination of these impressions can often best be carried out by a team discussion each

evening, and may suggest special features to be watched for in subsequent days.

Questionnaires concerning various types of information can be used on a subsample of those attending. However, other activities at the survey site may make this difficult, if not impossible. This method can, for example, be employed to obtain approximate qualitative information on the dietary pattern, especially of young children. If possible, advice on sampling should be obtained from a statistician beforehand.

(*b*) *Rapid ecological visits* (Fig. 45). As part of the survey, rapid ecological visits should be paid to a number of houses, cultivation sites, markets, local shops and other places associated with food production, e.g., fishing grounds, animal herds, etc. The type of information obtained, by means of observation, discussion and inquiry, is often mainly qualitative, but can be made more exact by the use of a suitable form or schedule, listing the facts to be noted on each visit. Again, a statistician should be consulted regarding the number of households, etc. to be visited.

Information obtained in the course of these rapid ecological visits is of great importance in throwing light on home life and its problems. It is so frequently neglected that, if staff resources permit, one small mobile team might with advantage be made responsible for these activities.

As a minimum, the team must include a senior person, usually either a doctor or a non-medical nutritionist, together with a respected member of the local community.

At the same time, it is desirable for *all* senior members of the survey team to take part in some visits, as personal observation of the ecological background is vital both to the subsequent interpretation of the survey findings and to the eventual planning of preventive measures.

Home visits should always be carried out in a friendly, diplomatic fashion, and with a minimum disruption of domestic privacy. The correct amount of time should be spent on greetings, which must be learnt, and local etiquette should be carefully followed. It is sound policy, as well as humane, to be willing, in the course of the visit, to treat or advise anyone who is really sick.

It is often unwise or impossible during these rapid visits to fill out a form within a household, since such action is often viewed suspiciously as being related to increased taxation. The practical extent of information to be gathered from such home visits depends on circumstances. Sometimes male visitors are debarred by custom, or the use of a questionnaire may be associated with potential witchcraft. Procedures must therefore be flexible to suit the actual on-the-spot reaction. Minimally, only observation may be possible. If completing questionnaires in households is not acceptable, a small pocket notebook may be carried, and facts obtained entered briefly between visits to houses. To facilitate this, the pages of the notebook can be prepared beforehand.

FIG. 45. ECOLOGICAL FACTORS

(a) Market sale of food, Indonesia

(*b*) Kitchen, showing food preparation, method of cooking and level of hygiene, Nile delta, rural Egypt

FIG. 45. ECOLOGICAL FACTORS (*continued*)

(*c*) Intra-familial food distribution at joint meal among Canadian Eskimos

The data so obtained should be transferred to the appropriate survey forms each evening, while the day's visits are still fresh in the observer's memory.

The ecological data to be collected at the survey sites and during rapid ecological visits are considered in the present section under six artificially separated headings. In practice, a composite form will be required and should, if possible, be planned with statistical guidance. Points to be noted are suggested later (see Table 16, page 131).

FIG. 45. ECOLOGICAL FACTORS (*continued*)

(*d*) Method of infant feeding, including newly introduced bottle feeding, Sarawak

Data from case analysis

As noted earlier, clues to possible ecological factors responsible for malnutrition in the community can sometimes be obtained by investigating the detailed etiological findings of malnourished persons admitted to adjacent hospitals, including the social, nutritional and clinical history, and laboratory investigations for conditioning infections. Often, however, this will not be possible because of shortage of staff, and because the notes on cases of malnutrition admitted to the wards contain inadequate information.

Special survey data

The gathering of accurate and detailed ecological information requires highly trained specialist personnel, such as social anthropologists, who may often employ special techniques and usually need to spend long periods in the field.

Conclusion

All these four methods of obtaining data may be practicable in some community assessments of nutritional status. If so, the most valuable

combinations will have to be decided upon in the light of the particular circumstances.

However, with the exception of food-consumption studies, which should, if possible, be carried out at least on a small sample, detailed special studies in depth will not usually be practicable in the course of prevalence surveys, so that approximate information on the local ecological scene will often have to be based on background data, and especially on the information obtained at the survey site and through rapid ecological visits.

In collecting data concerning ecological factors it is necessary to consider ways of recording information quantitatively and in a form capable of expressing degrees or types of information in a numerical code—e.g., type of housing, degree of literacy, etc.

Conditioning Infections

The association between bacterial, virus and parasitic infections, and malnutrition has been fully documented and critically reviewed recently by Scrimshaw, Taylor & Gordon (1959; in press). They stress that in human populations there is a synergistic interaction between nutrition and infection, and also that infections have an adverse influence on nutritional status, and may precipitate frank malnutrition.

Numerous pathological mechanisms may be responsible, either singly or together, including:

decreased intake, from poor appetite, diminished absorption or customs restricting food intake in illness;

increased loss from diarrhoea, vomiting or long-continued microhaemorrhage;

increased needs, both for the human host and for the responsible organisms or parasites.

Nutritionally relevant infections

Bacterial, viral and parasitic infections considered most likely to be nutritionally relevant in the survey area will have to be decided upon. The list will probably be based on those of world-wide significance in this regard and on probabilities suggested by such background data as may be available.

The list of infections may include the following: *bacterial*—tuberculosis, whooping cough (Morley, Woodland & Martin, 1966) diarrhoeal disease, including " weanling diarrhoea ", bacillary dysentery, amoebiasis; *viral*—measles; *parasitic*—malaria (Platt, Miller & Payne, 1961), intestinal helminths (ancylostomiasis, ascariasis).

Collection of information

Background data

Information may be available from the local health services, including hospitals and health centres, on the incidence (including epidemics) of some of these conditions. Although a biased sample, they should always be sought by means of visits to hospitals, etc., when attendances and admissions with malnutrition can also be noted. The age-incidence of the possible conditioning infections should be noted, particularly in relation to diarrhoea in young children in order to see if " weanling diarrhoea " [1] is an important local entity (Gordon, Chitkara & Wyon, 1963).

General survey data

At the actual survey site, two approaches are possible. First, a questionnaire can be used to try to determine the commonness of various infections in the community. This is rarely advantageous, as the collection of this type of retrospective medical information is both time-consuming and unreliable. Secondly, certain infections of a more chronic nature may be tested for, and may include:

(*a*) *Intestinal helminths*—by the testing of stool samples taken in the field (by the anal tube technique for young children) and kept in preservative (e.g., 10% formol saline, merthiolate-iodine-formaldehyde, etc.), which can be examined later, on return to base, or in camp with a standard microscope or a battery-operated portable model (McArthur, 1958);

(*b*) *Malaria*—by clinical examination for an enlarged spleen and by a thick blood film, stained with Giemsa or Field, etc., for malarial parasites;

(*c*) *Tuberculosis*—by carrying out a tuberculin test with a Heaf gun. The main difficulty here is the need to read the result of the test at a subsequent attendance 2-3 days later, which is always difficult, and may be impossible, to organize. Furthermore, tuberculin sensitivity may be influenced by protein-calorie malnutrition (Harland & Brown, in preparation).

An obvious drawback is that, unless an epidemic is occurring at the time of the survey, short-term, periodic or seasonal infections of nutritional consequence, such as measles, whooping cough and infective diarrhoea, cannot be assessed in prevalence studies, and it will be difficult to determine the importance of these illnesses as conditioning infections, except by investigating the etiology of malnutrition in adjacent hospitals. The ability to document the occurrence of such illnesses is among the advantages of longitudinal studies.

[1] " Weanling diarrhoea " is not a specific clinical or etiological entity, but a variable syndrome, usually due to combined intestinal infection and malnutrition at the time when other foods, likely to be both low in protein, bacteriologically contaminated and indigestible, are given to the child in addition to breast milk. Its age-incidence varies with local infant feeding practices but is often between 6 and 18 months (Gordon, Chitkara & Wyon, 1963).

Food Consumption

It is obviously important to have as much detailed knowledge as possible of the foods actually eaten in the community, both for assessing nutritional status and for discovering the dietary etiological factors that may be amenable to correction.

Collection of information

Background data

Gross food-consumption figures and food balance sheets may be available at the national or regional levels, and should be studied. Their value in the assessment of the nutritional status of a community is limited by the fact that they supply approximate information on deficiencies or otherwise for the country or region as a whole, and not for different communities, socio-economic levels, occupations or physiological groups at special risk, particularly young children and pregnant women.

Even qualitative data are, however, useful. Thus, the widespread use of low-protein high-starch staple means that protein-calorie malnutrition of early childhood is likely to occur, while data on crops, seasonal availability and methods of food storage may indicate the likelihood of a hungry season.

Unless previous dietary studies have been carried out in the region, the relevant literature is likely to give no more than outline information, mainly useful as a guide for subsequent inquiries during the survey.

General survey data

As noted earlier, it is sometimes practicable to arrange for a subsample of the persons examined to be questioned about their current diet. This should be carried out by someone speaking the local language, preferably belonging to the same community. The interview should, if possible, be held in private. The questionnaire should be simple and easy to fill up by marking written alternatives (e.g., cow's milk: yes/no—daily: $^1/_4$; $^1/_2$; $^3/_4$; 1 litre, etc.) and be based on indigenous foods and dishes given in their vernacular names, and on local domestic measures of weight and volume—all of which will be known from the background data, and as a result of the preliminary visit or field reconnaissance. Quantities can be described more accurately if the interviewer has with him the various locally used measures—e.g., bottles, gourds, spoons, etc.

The information thus gathered will be approximate, extremely crude and unproven. Much will depend upon the skill of the interviewer and the accuracy of the person questioned, which may be affected by exaggeration, understatement or poor memory, and upon the difficulty of assessing the foods taken outside the house, e.g., wild fruits, insects, etc. This technique

is probably of more use for young children with their individualized food intakes within the family group.

Rapid ecological visits are especially important in connexion with dietary inquiries, because although quantitative data are not obtainable, an outline of the general feeding pattern will emerge, and some idea can be formed on the probable degree of reliability of the information supplied in a simple questionnaire.

The kitchen is of particular importance during home visiting. The stove or other cooking device (e.g., fire, oven, pit), the type of fuel and its apparent availability; the number, size and types of pots; the methods of cooking (e.g., boiling, steaming in leaf packets, barbecuing, roasting), the sources of water; the storage and preservation of uncooked foods and prepared dishes; and the local weights and measures, which are usually related to domestic items—spoons, bottles, gourds, coconut shells, etc.—should be noted. The preparation and cooking of food are the subject of a valuable observation, together with the inspecting and tasting of the meal when completed.

Inquiry should also be made concerning the local meal pattern, including the number of meals daily, their composition and the intrafamilial order of feeding. Special attention should be paid to the foods given to young children, e.g., how the adult dietary is fed to them, whether specially prepared dishes are made for them or not.

Special survey data[1]

For accurate dietary data most helpful in the nutritional assessment of the community, some type of family food-consumption study is indicated. Among urbanized, literate peoples, who purchase most of their food, this study can sometimes be based on results of food accounts filled in by housewives, concerning foods bought, eaten and left over at the end of the investigation period. For various reasons, including illiteracy and the common use of home-grown foods, this technique is not usually practicable in developing regions.

Household food-consumption surveys

The principles and practice of household food-consumption surveys have been very fully covered by Hollingsworth (1961), Flores (1962) and various publications of the Food and Agriculture Organization (Norris, 1949; Reh, 1962; Food and Agriculture Organization, 1964a, 1964b).

The present account is confined to a brief consideration of certain important aspects and is based largely on the above-mentioned FAO

[1] The dietary intake of special groups living in institutions, such as boarding schools or military forces, may be required and can be obtained fairly easily. Techniques for food-consumption studies of troops are given in ICNND (1963) and Wilson et al. (1964).

Techniques of collecting information on family food consumption include (*a*) interviewing with recall list; (*b*) food accounts, and (*c*) actual measurement of food (Food and Agriculture Organization, 1964a). Sometimes a combination may be the most suitable.

publications, which should be consulted in the planning of a family food-consumption study. Family food-consumption studies are conducted in the following successive stages (Reh, 1962):

(*a*) *Assessment of food consumption.* This is carried out by dietary survey teams that visit households and record the quantities of all foods eaten during a set period, often of seven days' duration, by weighing and measuring them in the raw state, and also, if methods of cooking are fairly standard, by weighing cooked food portions. At the same time, details of the family composition are collected.

Certain difficulties, inherent in this type of survey, comprise human problems, including establishing friendly rapport, and ensuring that the diet is typical and unmodified during the survey period, practical problems, such as the estimation of wastage and refuse, alteration of foods produced by cooking, use of local domestic units of weight and volume, the need to record some foods descriptively rather than by weight, assessment of food eaten away from home, and statistical problems, especially in relation to combining scientific sampling with practical realities, such as the lack of a local census, or the inaccessibility or hostility of certain households.

However, these intensive periods of home-visiting also permit much other valuable information to be gathered, partly by questioning and partly by observation. Food preparation (including methods of cooking, storage, the number of meals daily and the common dishes that are taken), food purchasing, local household economics, agricultural practices and social patterns can be observed and discussed.

Information can be collected by the home-visiting team on specially prepared forms (Reh, 1962). In most agricultural communities, consumption studies may require repetition to cover seasonal variations in availability of food. The home-visiting should cover a period of not less than three, and preferably of seven, days. Where relevant, a complete " eating cycle " should be covered—in many cases, of one week. Often, however, a shorter period of observation may be sufficient in developing regions where the diet tends to be limited in range and monotonous.

(*b*) *Calculation of nutritive value of food.* Initially the data collected on food consumption have to be converted into uniform terms of weight and cost, and then their nutritive values calculated, by means of appropriate food-composition tables containing references to local foods (Chatfield, 1954; Platt, 1962).

Difficulties in the use of food-composition tables arise from variations in techniques of food analysis, regional differences in composition of foods (including moisture content and methods of preparation) (Asenjo, 1962), and the fact that foods of local importance may not be included. Ultimately, tables will have to be prepared for individual regions. Some are already available and a list of these has been compiled recently. These should show

values for foods AP (" as purchased ") or EP (" edible portion ") (Food and Agriculture Organization, 1964a).

Exceptionally, analysis of foods may be practicable on samples chemically preserved and brought back to the base laboratory (Wilson et al., 1964).

Food consumption should then be calculated *per capita* per day. This requires the collection of social details of the families, e.g., number of members, relationships, sex, ages, physical conditioning factors, such as pregnancy or illness, etc. Unless cooked servings are weighed, it is impossible to gauge the distribution within the family, including the amounts reaching young children.

(*c*) *Comparison with nutritional requirements.* The last stage of the analysis of food-consumption data is a comparison of the nutritive values of the diets with standard nutritional allowances, corrected, where necessary, for sex, age, body weight, environmental temperature and physiological state, especially pregnancy and lactation. Allowances suggested for calorie requirements are those laid down by the FAO Committee on Calorie Requirements (1957), and for other nutrients by the United States National Research Council (1964), although it must be realized that these are probably too generous, and that no allowance is made for possible special regional needs and adaptations. Requirements of thiamine and niacin are calculated in relation to the calorie intake.

Consumption can then be expressed as a percentage of the requirements with respect to calories, protein (total proteins and the proportions from animal and vegetable sources) and other nutrients. If practicable, an analysis of the amino acid patterns should be made, expressed as a percentage of the recommended pattern (FAO Committee on Protein Requirements, 1957). Results can also be further analysed to show the proportion of families in the survey sample whose diets reach stated levels of adequacy, or to show differences between given economic, social and cultural groups. The effect of certain non-dietary influences on intake may require consideration, e.g., iron from cooking pots and calcium from the water supply.

In presenting survey data concerning food consumption, the nutritional allowances used as standards of comparison must be clearly defined. If the food consumption of the group falls below the estimated requirements or recommended allowances for one or more nutrients, this finding should not be expressed in terms of degrees of " undernutrition " or " malnutrition ". The report should simply state the difference between the observed consumption and the allowances as a percentage of the latter (Reh, 1962).

Conclusion. Household food-consumption surveys are difficult to carry out and time-consuming; they call for carefully trained personnel capable of undertaking the meticulous work required, often under arduous field conditions. Apart from the problem of obtaining accurate data, analysis and interpretation are not easy, owing to the possible incompleteness and

inconsistencies of food-composition tables (Harris, 1960) and the scientific uncertainty regarding optimum nutrient needs.

Nevertheless, the results of household food-consumption surveys greatly assist the over-all assessment of the nutritional status of the community, if read in conjunction with complementary information obtainable by clinical, anthropometric, biochemical and other methods. They serve as a basis for nutrition education, which must be based on existing practices. Every effort should be made to include at least a small subsample of household food-consumption studies in the survey.

Special problems of early childhood

Despite the frequent occurrence of malnutrition in the vulnerable period of early childhood, knowledge of food intakes in this age-group is especially scanty. Reasonably precise data are difficult to collect—more so even than with dietary studies in adults. In particular, it is difficult to assess the exact situation with regard to breast feeding, especially in late lactation. The quantity of breast-milk taken by the child varies with the output of the particular mother at that time, the daily number of feeds, the activity of the " let-down " reflex, and the time spent actively suckling the breast. Similarly, quantitative information with regard to the small, though increasing, amounts of food given to young children is not easy to obtain, especially in poorer homes in developing countries.

Basically, most accounts are qualitative, consisting of a combination of careful questioning of mothers, field observation of feeding practices (often including a note on whether the mother breast-feeds the child at the investigator's suggestion), and inspection of the local scene in the course of rapid ecological visits to homes, kitchens, gardens, markets, etc. Outline information of this type has been collected in South India (Rao et al., 1959) and in the course of East African community child health surveys—for example, among the Lugbara people of Uganda (Jelliffe et al., 1962a). It is useful to obtain an approximate outline of practices in the early years, including the number of daily meals and the preparation, or lack of preparation, of special protein-rich dishes for young children, especially for use during the dangerous, protein-deficient transitional period.

Local household utensils of known size should be used as adjuncts to the questionnaire when mothers are interviewed, in order to assess approximate quantities.

The questionnaire can be used on a sample of mothers attending, and it should aim at ascertaining only the foods taken *currently* (that is—yesterday and today), with no attempt at retrospective assessment. Its construction will be guided by background data and by information gained during field reconnaissance. Neutral, non-leading questions are preferable.

A simplified, rapid technique for use in a dietary inquiry has been suggested by Blankhart (1965) for most field work, both at the survey site and in home visits. In this, the mother is first asked to say spontaneously what the child was eating at the time. Following this, she is questioned as to how many times a day each item is being eaten. The information obtained is recorded as given by the mother, e.g., rice, twice a day, etc.

When the mother has given her spontaneous answers, questions are put systematically on the use of other foods, and, in the event of an affirmative answer, on the number of times daily.

This questioning is done quickly, as, according to Blankhart (1965), too much interrogation and cross-checking defeat their purpose and leave both the mother and the interviewer confused.

The information may be entered on double foolscap lined sheets, on which columns are ruled for each of the local foods likely to be used for young children. The frequency of use of different foods can be calculated and expressed as the number of times they have been eaten per week per child (Table 15).

TABLE 15. FEEDING OF YOUNG CHILDREN IN A SIERRA LEONE VILLAGE*

Type of meal	Average number of times different foods taken per week at following ages (and number of children studied):		
	7-12 months (12 children)	13-18 months (15 children)	19-24 months (11 children)
Breast-milk	21	10	2
Rice	6	13	14
Cassava and *foo-foo* pap	6	3	1
Sweet potato		⅓	½
Custard or cornflour	4	2	
Leafy vegetables	1[a]	12	10
Bananas		2	1 ½
Oranges		1	1 ½
Tomatoes			
Milk	13	1 ½	½
Egg	½[a]		
Fresh fish			
Dried fish		5	5
Oil			

* The information for this table was obtained by the rapid technique of Blankhart (personal communication, 1965).

[a] One child only.

The questionnaire should cover the number and timing of meals and the following aspects related to the usual limiting factor, protein intake, both from breast-milk and from other foods:

Breast-feeding: still carried on or not; complete or partial, i.e., night only.

Largely carbohydrate foods : types (e.g., part of adult foods, or specially prepared gruels or pastes); quantities; times.

Protein foods—animal milk : type (e.g., fresh or boiled liquid from cow, goat, etc., sour-milk products; tinned—powdered, condensed or evaporated); quantities (daily and monthly); cost; number, approximate timing and volume, dilution and other ingredients (e.g., sugar) in feeds; method of feeding (e.g., bottle, cup and spoon, indigenous feeding vessel, etc.).

Other animal proteins: types (e.g., eggs, fish, meat, etc.); quantity; frequency.

Vegetable protein foods : types (e.g., legumes,[1] green leafy vegetables); quantity; frequency; method of cooking.

Household studies of food consumption in early childhood have been performed only rarely; they are extremely difficult to carry out. Investigations by household visiting and direct observation of foods eaten by young children have been undertaken by Oomen & Malcolm (1958) in Papua, by Flores & Garcia (1960) in Central America, and by Blankhart (1965) in Indonesia.

More recently, Flores et al. (1964) carried out three-day family food-consumption studies in three Indian towns in Guatemala, at yearly intervals for four years. The pattern of food consumption was constant. Pre-school children received the general family diet, though with smaller amounts of protein.

Assessment of the quantity of breast-milk produced can be attempted in either of two ways, both of which require observation for several days.

First, test-feeding may be carried out, in which the child is weighed before and after a feed, although this shows only the amount of milk taken rather than the amount secreted. If the child is at home and if (as is usually the case) permissive breast-feeding is being practised, this presupposes a continuous surveillance in the house and, because of the often small quantities taken at irregular intervals, an extremely accurate weighing machine. If carried out with a set feeding schedule in hospital, there may be an inhibition of the let-down reflex.

Secondly, following the period of observation of food intake by the young child, a period can be allocated when the breast-milk can be expressed manually or mechanically by the investigator at 3-4 hour intervals,

[1] An assessment of the value of various legumes for infant feeding has to be based on a knowledge of protein content, cooking properties, digestibility and other factors (Aykroyd & Doughty, 1964).

measured and then fed to the child with a cup and spoon. It may be more convenient to do this is at a nearby health centre or hospital, in which case the mother may require compensating for her trouble. Again, a disturbance of the let-down reflex is likely.

A further problem with regard to the measurement of dietary intake in this age-group is that infant feeding is, or should be, a progressive, dynamic process, quite different from the relatively static and monotonous (though seasonally variable) diet of the average adult in the tropics. To achieve accurate results, longitudinal studies by direct observation would be required on a number of children.

Cultural Influences [1]

Knowledge of the local culture pattern is essential for the successful conduct of the field investigation, for an understanding of the local etiology of malnutrition, and for the ultimate implementation of any programme aimed at improving the situation. Ideally, such knowledge should include an understanding of the leadership structure, kinship systems, religion (including attitudes towards life, death and disease), and the cultural philosophy concerning life-goals and values. However, certain aspects of the culture pattern have a more direct bearing on the problem, and only these will be touched upon.

Cultural patterns

Food attitudes

Very seldom does man eat all the potentially edible materials available to him. More often his culture pattern, learned from his parents and associates by subconscious observation and by explicit instruction, classifies for him items as appropriate or inappropriate as food.

The food classifications employed, which usually have no relation to scientific divisions (e.g., protein, vitamins, etc.), are often extremely complex, but appear natural, normal and correct for the particular community. The more important and commonly found classifications of nutritional importance include the following:

(*a*) *Food and non-food*—those of the potentially edible local items that are viewed as food and those which are not eaten.

(*b*) *Age-group, or sex-linked, foods*—items regarded as suitable, or forbidden, for various age-groups or sexes, in particular for young children or women, and during pregnancy, the puerperium or lactation.

[1] Detailed consideration of cultural factors and nutrition has been given by Mead (1953), Burgess & Dean (1962), Jelliffe (1955b, 1957, 1962, 1964) and by Jelliffe & Bennett (1961, 1962a, 1962b).

(*c*) *Celebration foods*—items especially associated with culturally defined holidays or periods of rejoicing.

(*d*) *Disease-linked foods*—items deemed to produce illness in some circumstances (e.g., eggs and fish are believed to cause intestinal worms if given to young children in Malaya), or items to be avoided in certain diseases (e.g., the restriction on " hot " *(garam)* foods in illnesses of the same classification in India).[1]

(*e*) *Cultural " super-foods "*—often the main staple (e.g., rice in much of South-East Asia, and plantains for the Baganda of East Africa), having great historical, psychological and emotional significance to the particular community and tending to dominate the local dietary.

(*f*) *Modern prestige foods*—relatively newly introduced foods, most often in towns, which may have become symbols of prestige and modern living (imitation of socio-economic " superiors "; influence of advertising). The may include various forms of tinned milk, milk-carbohydrate powders, aerated bottled drinks, etc.

A consideration of food attitudes must also include methods of food preparation (e.g., cooking practices, types of pots, stove and fuel, domestic measures) and meal patterns, including times, usual dishes, family order of eating, special dishes for children, way of taking food, use of cutlery, chopsticks, fingers, etc.

Disease causation

Local concepts of the causation, cure and prevention of disease are extremely important. Illnesses, especially diarrhoea, are often treated by dietary changes, mainly of a restrictive nature, as well as with herbals and appropriate magical ritual.

The advanced, and therefore more obvious, syndromes of malnutrition are often recognized and classified by uneducated indigenous peoples. The terms used usually refer descriptively to some striking feature, or to the presumed causation—for example, the Luganda word *obwosi* (synonymous with kwashiorkor), which means " disease of the displaced child "—but show no connexion with the actual dietary etiology.

Child rearing

The general pattern followed in rearing young children must be known, especially with regard to the following:

(*a*) *Obstetrical*—prenatal maternal diet, immediate procedure with placenta (e.g., draining of blood).

(*b*) *Neonatal*—" pre-lacteal " feeds, laxatives, discarding of colostrum.

[1] Disease-linked food classifications are often related to local concepts of body physiology (Foster, 1952, 1966), as, for example, the ancient Indian view that health or ill-health are related to the balance in the body of three *dosha* (humours) (Jelliffe, 1957).

(*c*) *Breast-feeding*—when started, techniques of nipple preparation, indigenous tests of breast-milk, duration of complete and partial breast-feeding, local galactogogues, diet of the mother (normal, restricted, increased).

(*d*) *Animal milk*—type, quantity, dilution, additions, feeding method (e.g., cup and spoon, bottle, local feeding-vessel, etc.), milk preparations (e.g. yoghourt, cheese).

(*e*) *Feeding orphans and twins*—wet nurse, induced lactation, artificial feeding and method.

(*f*) *Supplementary foods*—age introduced, type, quantity, method of feeding (e.g., spoon, finger, tongue).

(*g*) *Other protein foods* (animal and vegetable)—age introduced, type, quantity, method of feeding.

(*h*) *Method of stopping breast-feeding* (weaning)—age, abrupt or gradual, sent away or not, child prepared or not, the use of deterrent substances on breast, " compensation " or not, apparent reasons for weaning.

(*i*) *Food preparations for children*—special foods and their preparation; if none, which part of adult dietary used, recipes, number of meals daily, methods of child feeding.

(*j*) *Person responsible for feeding*—mother, grandmother, older sibling, etc.

(*k*) *Attention to sex of child*—preferential treatment of male or female child.[1]

Food production

Important aspects of the local culture pattern will be concerned with food production and will include customs relating to methods of cultivation, animal husbandry and food storage.

Cross-cultural survey problems

While many problems may arise in both prevalence and long-term survey work as a result of cross-cultural misunderstandings, the following difficulties have been observed commonly in various parts of the world:

(*a*) *Local concept of modesty*, which often limits the extent of the clinical assessment by restricting the examination of women to female team members.

(*b*) *Specimen collection*, which may be misunderstood and resisted through fear that the blood or urine may be used for occult purposes, or that its loss may weaken the donors.

[1] In a Beirut hospital, McLaren, Ammoun & Houri (1964) reported twice as many female admissions with marasmus, although the general paediatric admission ratio was 1 girl : 2 boys.

(*c*) *Difficulties with names and numbers*, which arise when the culture forbids that one's own name or that of one's husband or child, or the number of children in the family, should be mentioned before strangers.

Collection of information

Background data. Library research into cultural factors is difficult because in most countries anthropological publications are not generally available to nutritionists, and are seldom directly concerned with aspects of the culture immediately relevant to nutrition.

Special survey data. Detailed information can be obtained only through prolonged and intensive investigations on the part of a trained cultural anthropologist. Such studies do not fall within the scope of a cross-sectional nutritional prevalence survey. Yet the results of intensive investigations " in depth " are of great value in the selection of the areas or population groups for a nutrition survey, and in the planning of programmes for the solution of the nutrition problems revealed.

Exceptionally, an anthropologist may already be working in the survey area, in which case collaboration is obviously indicated. Alternatively, if there are several culturally and ecologically similar groups in an area, it may be possible to select one in which an anthropologist is already at work. If so, the ideal time for collaboration between nutritionist and anthropologist is late in the second year or early in the third year of the latter's field study, by which time he will speak the vernacular fluently, be accepted by the community and be deeply versed in at least some aspects of its culture.

Furthermore, by that time, the social anthropologist may be expected to welcome the further insight into the community that can result from study by a group with different technical knowledge and skill.

It may often be found that while the anthropologist has been concentrating principally on a particular aspect of the local culture pattern, —for example, the clan system or kinship relations—he has also acquired a great deal of information useful to the nutrition worker, although he may not appreciate its public health significance. Conversely, the deeper subtleties of the causation of behaviour that so greatly influence nutrition may be obscure to the non-anthropologist until the fundamental concepts of a group's attitudes to all aspects of life have been explained and discussed.

General survey data. Generally, however, this type of collaboration with a trained anthropologist is not possible, and the nutrition team must be prepared to collect as much information as possible concerning the culture pattern in the course of the prevalence survey. This is obviously difficult to do in the short time usually available, and care should therefore be taken to avoid drawing anything but the most broad and tentative conclusions.

Nevertheless, guided by such background information as is available, and by knowledge of the ways of " parallel groups " with similar modes of

life, the nutrition team can obtain some information on the local culture pattern at the survey site and in the course of rapid ecological visits.

It is particularly valuable to have a daily meeting of all staff after the survey has been completed for the day, when impressions of the local way of life can be pooled and possible clues to relevant features of the culture pattern discussed. For example, it may be noticed that certain types of charms or amulets are commonly worn, or that certain medicinal scar patterns are frequent in some age-groups, or that differences of costume or physical adornment exist in different age-groups. Such clues are always to be found and can be followed up subsequently by further directed observation, and by discreet and friendly indirect questioning at the survey site or in the homes.

Socio-Economic Factors

The socio-economic circumstances of a community are particularly difficult to assess quantitatively, because people are understandably reluctant to reveal their income and other wealth to strangers—often, indeed, fearing that these inquiries may lead to increased taxation. Also, the relevance of earning capacity to human nutrition is usually less obvious when the particular community's food supply is principally home-grown.

Socio-economic data of nutritional relevance

It is convenient to consider socio-economic data relating to nutrition in their separate aspects rather than in combination. The following is a list of items in each group:

Social data

(*a*) Population of community—number, age and sex distribution, geographical distribution.

(*b*) Family details—size, relationships, stability, intervals between children.

(*c*) Education—literacy of men and women of parent and grandparent age-groups, presence of books and newspapers, children attending school (type of school, classes, examinations passed).

(*d*) Housing—type, floor, roof, walls, lighting, ventilation, furniture, provision for sleeping, number of rooms, population per house, owned or rented.

(*e*) Kitchen—building, location, stove, fuel, type and condition of cooking utensils, rubbish disposal.

(*f*) Food storage—size, contents, pest-proofing.

(*g*) Water supply—source, distance from house, purity, approximate amount of water available per person.

(*h*) Latrine—type (if any) and condition (cleanliness, fly-proofing).

Economic data

(*a*) Occupation—primary (e.g., farmer), secondary (e.g., home industry, seasonal unemployment).

(*b*) Family income—wages, home industries, cash crops, non-cash income (e.g., foods grown), debts, intrafamilial distribution of goods or cash.

(*c*) Tangible wealth—land, number of livestock, boats, modern status symbols (e.g., sewing machine, bicycle, motor-scooter, radio).

(*d*) Budgeting—expenditure on food, clothes, rent, fuel, light, education, transport, domestic services, charitable contributions, recreation (including tobacco and alcohol).

(*e*) Prices of foods—shops and markets, seasonal variation (with special reference to protein foods suitable for young children).

Collection of Information

Background data. Figures for national *per capita* income, sometimes broken down on a regional basis, and legal minimum wages may be available in the appropriate government departments and should be ascertained.

Special survey data. For detailed information, careful, tactfully conducted surveys will have to be carried out by appropriate experts.

General survey data. Most often, approximate data have to be collected by observation at the survey site and in the course of the rapid ecological visits.

However, any attempt to assess socio-economic circumstances by tangible western yardsticks, such as clothes or type of house, may be difficult because in some cultures these are of less importance. Wealth and status may be measured by the number of cattle (whether healthy and productive or not), or by gold ornaments owned by women, which will certainly not be displayed for the investigator. The local " indicators " of wealth must be discovered, and—if easily identifiable by observation—carefully noted.

It is useful, while the survey is proceeding, to make notes on the clothes and ornaments worn, provided that it is also known whether, in the particular culture, the population would or would not tend to wear their best clothes for the occasion.

Items selected from the foregoing points can be looked for during the rapid ecological visits. In particular, the houses can be noted (e.g., bamboo or mudbrick construction, thatched or metal roof) as well as their furnishings and the type of household water supply, e.g., natural (pond or stream) or man-made (roof-drainage to barrel or tank, or bore-hole and pump). The type of transport available is also easily observed (buffalo cart, canoes or

boats, bicycle, motor scooter, etc.), as well as other relatively expensive items, such as radios.

In the cultivation area, the amount of land available should, if possible, be observed. This may be complicated where a family has multiple small cultivated areas in various places, and where the land may or may not be suitable for the growing of particular crops. Approximate areas devoted to high-protein vegetable foods, particularly legumes and ground-nuts, can be noted, and also the extent and type of cash crops grown (the area under cultivation with cotton, coffee, tea or cocoa) or the number of coconut palms.

The number of stock and poultry also should be estimated, if possible, due account being taken of the local cultural significance of various animals that may be kept as symbols of wealth—for example, cattle for some African pastoralists—or as sources of food for the household (e.g., the buffalo for its milk in India), or as celebration food (e.g., pigs in the New Guinea Highlands), or as beasts of burden (e.g., the buffalo in Thailand), or as producers of saleable products (e.g., chickens and their eggs), or for a combination of these reasons.

Visits to markets and nearby shops may disclose another important socio-economic factor, namely, the cost of the major, nutritionally significant foods, particularly the animal and vegetable protein foods suitable for young children. These are best made unobtrusively by a junior team member, preferably one belonging to the local community, otherwise the prices quoted are likely to be higher than usual.

Family size and structure must also be ascertained: they constitute a basic factor in the interpretation of the socio-economic data referred to above. This may be very difficult to undertake in the course of a field survey. Many peoples are suspicious of family enumeration or regard it as inauspicious. Also, with large families, relationships may be complex and confusing to the foreigner because of a completely different system of nomenclature and classification of kinship relations. A further complicating factor may be the practice of " borrowing " children or sending them to stay with relatives.

Food Production

The assessment of food production in a country or region has ultimately to be considered in terms of the availability of the production to families. It is therefore dependent upon such factors as preservation, distribution, marketing and economics.

Data of nutritional relevance

All aspects of food production and supply are relevant to the assessment of the nutritional status of the community. Among the important aspects are the following:

(*a*) Family food supply: home produced, purchased, wild (collected, hunted, fished), obtained by barter; seasonal variation.

(*b*) Farming methods: hoe, plough, mechanized; bush clearing, rotation, double-cropping; irrigation; drainage; fertilization; insect and pest control; availability of modern extension services.

(*c*) Land: tenure, area per family, suitability (for different crops, pasture, infertile, etc.), actual utilization (especially staples, vegetable protein foods, cash crops); number of agricultural workers (family, labourers).

(*d*) Livestock and fishing: number of livestock (cattle, sheep, etc.), milk production (yield, milk not used), fishing facilities (freshwater, ponds, sea, methods, yields).

(*e*) Finance: capital available, facilities for credit, purchasing power, stabilization of prices, co-operatives, indebtedness.

(*f*) Distribution: communications (roads, transport); storage, preservation and processing (home, industrial); marketing (local, regional and world trade, prices and availability of foods).

Collection of information

Background data. In some countries, national food-production figures are available, usually from the Ministry of Agriculture. These data include information on imports and exports, and may need to be corrected for potential human food produced but not intended for human consumption (e.g., soya press cake used for cattle feed).

FAO has recommended techniques for the presentation of production figures in a standardized form. Though of value in indicating national production figures for certain types of food (especially animal and vegetable protein foods) and—if revised at intervals—in demonstrating production trends, these data have the disadvantage of being approximate: they usually make no distinction between the diverse geographical, ethnic, socio-economic and agricultural regions within a country, and give no indication of the distribution of food to vulnerable groups.

Specific survey data. As in the case of surveys, detailed information concerning the production of food and its availability to families calls for a lengthy and specialized investigation by agricultural nutritionists. Such an investigation is not normally possible in the course of most surveys. FAO has, however, been encouraging governments to participate in a world-wide agricultural census scheme, and more figures may become available for certain regions in the future.

A small-scale study of food production and other ecological factors may be practicable for a limited sample of homesteads, as shown by the surveys carried out by Collis, Dema & Omolulu (1962a, b) in Nigeria.

In this type of study, at least one investigator will have to spend several weeks in making a detailed investigation on a statistically selected sample of households. Where there is a considerable seasonal variation, as is usually the case, it will be necessary to repeat the investigation at appropriate times within the year.

General survey data. In the course of rapid ecological visits to cultivation sites and markets, some outline information can be obtained concerning food production and availability. The approximate areas under cultivation with different types of crop (especially vegetable protein-foods and cash crops), the number of livestock and methods of agriculture can be noted.

In the event that an agricultural nutritionist cannot be attached to the team, any details of local methods of food production, preservation and storage that cannot be understood should be noted, for discussion with experts after the team's return to base. Similarly, if any food plants, cultivated or wild, cannot be recognized by the team, the complete plant, i.e., leaves, fruit etc., should be brought back, together with a record of the indigenous name, for exact identification.

Health and Educational Services

Although not " ecological factors " related to the development of malnutrition, information can sometimes be usefully collected at the same time concerning existing health and educational services in the area, since programmes concerned with bettering the nutritional status of the community will often be in part related to the improvement of these services and in part channelled through them.

Hospitals and health centres

Full information should, if possible, be gathered on the following points:

General : number of hospitals and centres, distribution, number of beds (total, paediatric, maternity), record keeping

Admissions : number, age-groups, diagnoses, results of treatment (cured, improved, not improved, died, proportion of autopsies to deaths), mothers admitted with children, maternity admissions (rooming in), percentages of births to prenatal attendances

Out-patients : number, age-groups (including prenatal attendances and " young child clinics "), diagnoses

Follow-up system : home visiting

Staff : doctors, medical assistants, nurses, and assistant nurses, midwives, and assistant midwives, laboratory technicians, domestic staff

Buildings : wards, outpatients, laboratory, offices, kitchens, accommodation for relatives

Equipment: transport, drugs, food supplements (especially dried skimmed milk)

Training programmes: medical and paramedical personnel

Miscellaneous: methods of prevention and treatment of malnutrition (especially use of dried skimmed milk), use of nutrition rehabilitation units, immunization.

Educational facilities

The following data are useful:

Schoolchildren: number, type, distribution, percentage in school, nutrition education (formal curriculum, school meals, school gardens)

Young people: clubs (Young Farmers, Scouts, etc.)

Adults: literacy (percentage, sex distribution), parent-teacher associations, clubs, etc. (community development, voluntary organizations)

Mass media: radio, press, television.

Collection of information

Background data. These will be available, in varying degree of completeness, at the Ministries of Health and of Education and at the headquarters of other relevant agencies—for example, Community Development, Ministry of Information, and voluntary organizations.

General survey data. Concurrently with the gathering of information on conditioning infections from hospitals and health centres in the area, data concerning the medical and educational services should be assembled. This will be a full-time job occupying a senior team member for some days, either before or after the survey is carried out.

Conclusion

It is evident that any assessment of ecological factors in the course of a nutritional prevalence survey must vary greatly in complexity, depending upon the type and number of staff, the time available, and the purpose of the investigation. Obviously, as much information as possible is desirable to give a complete picture of the existing situation and of the scope for improvement. Nevertheless, rapid screening surveys using a limited number of clinical signs and, possibly, basic anthropometry can give useful preliminary information as to prevalence of malnutrition. The economical use of limited staff and opportunities enables data on causative ecological factors to be assembled, which will indicate any more-detailed studies, including special investigation of selected aspects of the ecological background, that may be necessary.

TABLE 16. GUIDE LIST OF FEATURES OFTEN IDENTIFIABLE DURING RAPID ECOLOGICAL VISITS

	Home
Family size :	number, relationships, ages, sex, interval between children
Occupations :	primary, secondary
Education :	adult literacy, presence of books and newspapers, children at school
House :	type and construction (roof, walls, floor), number of rooms
Economic :	furniture, clothes, radio, transport (bicycle, wagon, motor scooter, car)
Kitchen :	stove, fuel, cooking utensils, dishes in preparation
Feeding pattern :	meals seen, foods not used, breast-feeding, modern " prestige " foods
Food storage :	size, contents, pest-proofing
Water supply :	type, distance, purity
Latrine :	type, state
	Cultivation site
Land :	area, utilization with different crops (including cash crops)
Farming methods :	tilling procedure, irrigation
Livestock and fishing :	number of beasts and poultry, fish pond
	Markets and shops
Food and weaning equipment :	availability and prices of foods (especially protein foods for children), advertising, availability of bottles and nipples

In many surveys conducted in developing countries, the size and training of the team and the time available will both be limited. In such circumstances it may sometimes be possible for a sample of homesteads to be investigated in some detail (Collis, Dema & Omolulu, 1962a, b). If, as is often the case, even this is not feasible, information on major ecological factors can be gauged only roughly during the actual survey. Factors that can be noted in practice will obviously include only some of those in the lists given earlier in each section. Those chosen for observation on the particular prevalence survey will depend on various local circumstances and especially on their probable relevance to nutrition and their ease of identification in the course of rapid ecological visits (Table 16).

5 Nutrition Surveys

TYPES OF SURVEY

The nutritional status of a community can be assessed directly by two types of field investigation: longitudinal incidence studies, and cross-sectional prevalence studies (Gordon, 1963).

Longitudinal Incidence Studies

In the longitudinal incidence study, selected members or families in a community are kept under continuing systematic surveillance for a prolonged period " in the setting of prevalent social customs, economic vitality, nutrition and pathology " (McGregor, 1964).

Frequently these studies are undertaken on children, when environmental variables can be assessed, particularly the diet, infections, socio-economic circumstances and cultural practices, and their effect evaluated longitudinally in so far as growth, development and physical and mental health are concerned (Stewart & Acheson, 1964). They are, in fact, general health surveys, with particular emphasis on nutrition (Phadke & Panda, 1965).

This type of approach owes much to the initial work of Spence and his colleagues in Newcastle upon Tyne (Spence et al., 1954; Miller et al., 1960), and recently longitudinal studies have begun to be undertaken more frequently in developing tropical regions.[1]

The advantages of longitudinal incidence studies

Longitudinal investigations are usually carried on for at least one year and thus not only permit the true annual incidence of malnutrition and

[1] Longitudinal studies of child health have been carried out, or are under way, in many parts of the world, including the following places: *Eastern Mediterranean*—Beirut, Lebanon (J. Harfouche—personal communication, 1965); Jordan (Pharaon et al., 1965); *Asia*—rural Hyderabad, India (Jyothi et al., 1963; Swaminathan et al., 1964); *Africa*—Keneba village, Gambia (McGregor,Billewicz & Thomson, 1961); Sukuta village, Gambia (Marsden, 1964); Durban, South Africa (Kark & Steuart, 1962); Imesi village, Nigeria (Morley, 1963); Aku'o village, Nigeria (Gilles, 1964); Lagos, Nigeria (N. Rea—personal communication, 1965); Ibadan, Nigeria (M. Janes—personal communication, 1965); *the Americas*—joint INCAP-ICNND Guatemala study (W. Unglaub—personal communication, 1965); Guatemala (W. Ascoli & N. S. Scrimshaw—personal communication, 1965); Mexico City (Ramos-Galvan, 1966); Cali, Colombia (C. Canosa—personal communication, 1965); Bogota, Colombia (R. Rueda-Williamson—personal communication, 1965); *West Indies*—rural Jamaica (Standard & Miall, 1965).

disease to be determined, but show the seasonal variations caused by the climate, the availability of food, community activities and other factors.

Most illnesses in early childhood are short-term episodes, and in longitudinal studies the incidence of such severe diseases as infantile beriberi and measles, or such minor conditions as impetigo, can be discovered and correlated both with one another and with other environmental circumstances. This contrasts with the short-term cross-sectional prevalence surveys, which miss most of the acute conditions and tend to overemphasize chronic diseases (Williams, 1964).

Another advantage is that the ages of children born during the study will be known with accuracy, together with the dates and causes of death. Growth can be compared with standards for age, and such vital statistics as the mortality rates and causes of death in infants, in the 1-4-year age-group, and in the perinatal period, can be assessed.

Above all, longitudinal studies permit of an understanding of the dynamic interplay of factors at work, and in particular enable an identification of locally important causes of malnutrition to be made (Williams, 1964).

Finally, the prestige attaching to the research aspect of this type of work may help to attract young doctors to work in rural districts, while the detailed knowledge gained of the particular area may ultimately lead to its use for the field training of medical and paramedical personnel, and, above all, help to plan long-term medical services adapted to local problems.

The disadvantages of longitudinal incidence studies

Long-term incidence studies are not easy to organize. They can be expensive, and are by their nature time-consuming. Also, by the time the results of a longitudinal study are completed and analysed, they may be out-of-date because the community itself may have changed.

Constant standards and methods of examination and interview have to be maintained over the whole period and not be altered with experience.

The ethical question of the degree of clinical responsibility to be assumed will have to be decided in advance, clearly defined and adhered to throughout. This will have to be judged according to the circumstances of the particular study. In some surveys, it may be justifiable to limit the therapy and advice given to the use of placebos and emergency medical care; in many others more than this will be necessary. Moreover, " any survey inevitably alters both the observer and the observed " (Williams, 1964).

Preparation of the population to be surveyed calls for careful thought and explanation, obviously much influenced by the type of clinical care to be offered to parents.

Many practical difficulties may arise—for example, the seasonal or other movement of people between the town and rural villages, or a high incidence of defaulters due to indifference or suspicion.

Lastly, suitably trained staff may be difficult to recruit, and still more to retain. A large measure of patience, dedication and team-spirit is needed on the part of the survey group—well exemplified in the Newcastle upon Tyne study (Spence et al., 1954).

Techniques

In the longitudinal surveys being undertaken in different parts of the world (p. 132), numerous variations in technique and procedure are applied; these are often dictated by local circumstances and the special aims of the particular study, which must be clearly defined at the outset. Nevertheless, certain general principles seem to be common to many such investigations.

Sampling. Statistical guidance will be required with sampling regarding the number to be covered, the frequency of examinations, the length of study and the selection of families. Allowance must be made for a probable decrease in the total during the observation period due to defaulting and to deaths.

In view of the present-day interest in the nutritional problems of early childhood, many longitudinal surveys aim at observing a selected group of full-term babies, born by normal delivery, through the first 2-5 years of life. If—as is rarely the case—the ages of children are known with precision, an alternative may be the surveillance of a group of infants and pre-school children (N. Rea—personal communication, 1965).

Selection of area. The area selected should be as typical of the particular ecological situation as can be judged on the available evidence. Frequently, a simultaneous survey may be made of contrasting socio-economic groups [1] (R. Rueda-Williamson—personal communication, 1965; N. Rea—personal communication, 1965) or ethnic communities (J. Harfouche—personal communication, 1965). In the INCAP-ICNND Guatemala long-term study, another major factor in area selection has been the varying levels of infant mortality rates (W. Unglaub—personal communication, 1965). In such cases also the advice of a statistician and an anthropologist should be sought.

Selection of places of examination. Usually three examination sites have to be planned: a regular clinic for the survey children, systematic home-visiting, and some form of emergency morbidity clinic service for the acutely ill.

Home visits are essential for the assessment of environmental and socio-economic circumstances, for the coaxing of defaulters and for the investigation of any deaths that may have occurred.

It is also important to arrange for transport, for those attending the regular clinic, for home-visiting staff and for emergency cases.

[1] If one of the contrasting groups consists of children of the local élite, it may be possible to use the results obtained as a basis for local standards for growth and development.

As pointed out by Kark & Steuart (1962), useful, though incomplete and biased, longitudinal information exists already in many parts of the world in the records of such health centres as have an adjacent defined area and sufficient staff to permit home-visiting. The disadvantage of this information is that it is necessarily influenced by the health centre's activities, and hence not typical of areas lacking similar facilities.

Selection and training of staff. A full-time staff is needed for continuous employment throughout the whole survey period, preferably headed by a doctor with paediatric and public-health experience.

An adequate preliminary period must be devoted to the selection and training of auxiliary staff and to pre-testing methods, in particular the techniques of interviewing and home-visiting, often culminating in a pilot study.

Type and frequency of investigations. Although the detailed arrangements vary, a longitudinal survey commencing at birth may often start with regular examinations held monthly for three months, and thereafter at three-monthly intervals. Care should be taken to ensure that children are seen within a defined number of days of their scheduled appointment —for example, three monthly-intervals: $\pm$ 7 days (C. Canosa—personal communication, 1965).

Data collected during longitudinal surveys

Longitudinal surveys of children often include the serial collection of some of the following data:

(*a*) *Anthropometric measurements*—weight, height (length), circumference of the head, chest and arms, skin-fold thickness

(*b*) *Clinical characteristics*—general, nutritional stigmata, physical development (milestones, sometimes radiological bone-age), psychological development

(*c*) *Biochemical data* [1]—haemoglobin, haematocrit, plasma proteins

(*d*) *Parasitological data*—results of examining stools for ova, etc., thick film for malaria

(*e*) *Tuberculin test results*

(*f*) *Health history*—type and duration of illnesses since last visit (e.g., diarrhoea, respiratory-tract infection), immunization

(*g*) *Dietary history*—types and approximate quantities of food given in previous period (often 24 hours).

Data on socio-economic circumstances of the family and cultural attitudes also have to be collected. Some may be obtained by questionnaire

[1] Biochemical tests are usually carried out at less frequent intervals than the clinical examination and anthropometry. Special local problems may suggest other biochemical tests as a matter of routine—the serum alkaline phosphatase if rickets is prevalent, or urinary thiamine if beriberi is common.

initially, but usually more-personal details will only be learnt later either by questioning when rapport has been established or by observation during home-visiting.

If practicable, a brief study of other family members should be undertaken, including the obstetrical history of the mother and a clinical and anthropometric examination of the parents and siblings.

Items of information collected in this type of survey require to be carefully pre-defined and graded numerically, so that they may lend themselves to analysis on punch cards. Precise criteria for the retrospective diagnosis of illness must be laid down—for example, diarrhoea may be defined as six or more loose watery stools in 24 hours. Likewise, the grading of socio-economic data must be defined—for example, various degrees of overcrowding, types of water supply, or social groups.

Subsampling techniques may be employed to obtain more-detailed information on a percentage of those being studied. It is particularly valuable if family food-consumption studies, made by actual measurement of foods cooked and eaten, can be carried out on a statistically selected subsample. Similarly, more-detailed biochemical tests, such as serum levels of vitamin A or the amino-acid imbalance test may be carried out on a subgroup.

Conclusion

More longitudinal health surveys are needed in representative rural and urban areas of the world, and the nutrition of the community must form a major aspect of all such studies.

Unfortunately, in many places such long-term incidence studies will not be feasible, principally because of cost and shortage of staff. In addition therefore to longitudinal studies in selected areas, the assessment of the nutritional status of the community will often have to be evaluated by short-term cross-sectional prevalence studies.

Cross-Sectional Prevalence Studies

These studies can be single examinations of populations undertaken in a specified short interval, usually of a few days or weeks, when they are known as point prevalence surveys, or they can be repeated on the same groups at prescribed intervals, when they are termed periodic prevalence surveys.

The advantages and disadvantages of cross-sectional prevalence studies

Short-term prevalence surveys offer the obvious advantages of being relatively inexpensive, requiring few staff and taking little time to carry out.

The limitations and disadvantages of these surveys are again clear. They are brief in duration, and, unless supplemented by information from health services, reflect conditions during only one season of one year.

They are short episodes and thus afford extremely limited opportunities for gaining a real insight into the way people live and the causes of their nutritional problems.

They provide accurate figures only for relatively chronic conditions, such as fluorosis or protein-calorie malnutrition; they are misleading with regard to important acute conditions of short duration, such as infantile beriberi.

Lastly, it is a frequent and at times valid complaint that surveys can easily become sterile academic exercises that fail to better the conditions in the community. Plainly, surveys are not carried out solely to satisfy scientific curiosity, but to define problems and suggest logical means of improving the situation.

Accordingly, point prevalence surveys are not the complete answer for the nutritional assessment of the community. Their results must be carefully weighed against the evidence from other sources, particularly local health statistics and against information derived from long-term incidence studies, if these become available.

Alternatively, an attempt may be made to cover possible seasonal differences in nutrition and to obtain a rough estimate of probable disease incidence by carrying out periodic cross-sectional prevalence surveys at selected periods of the year representative of the annual climatic and agricultural cycle (Collis, Dema & Lesi, 1962; Collis, Dema & Omolulu, 1962a, b; Pharaon et al., 1965).

Types of prevalence survey

Nutrition prevalence surveys can vary greatly in complexity, scope and purpose. The term may cover a wide range of activities, from small, unelaborate teams with limited objectives, relying mainly on rapid screening by clinical assessment, to large multi-disciplinary groups, including doctors, non-medical nutritionists, biochemists and dietitians, disposing of ample funds and extensive laboratory facilities and working in an area for longer periods.

Surveys of all the different types can yield valuable information. The most appropriate type for a given situation depends on the aim of the survey and the local resources in skilled staff, money and time.

In addition to obtaining information on the nutritional condition of the community, surveys can have other useful by-products. They provide valuable opportunities for the testing of new or modified methods suitable for field conditions. They can be most helpful in the teaching of professional and non-professional personnel, concerning survey techniques, and in fostering an appreciation of the ecology of malnutrition in rural areas. Moreover, they may involve the people of the community themselves, especially those assisting in the planning and carrying out of the survey, and prompt them to study practical ways of improving their own nutrition.

Special groups

Prevalence surveys can be carried out on certain special groups within a community, including schoolchildren, personnel in the armed forces, prisoners, and other groups subject to some form of discipline and, by that token, more easily accessible and organized for nutritional survey work. These are, however, selected samples with particular problems and with nutritional advantages and disadvantages. The results obtained refer solely to the group examined and are not necessarily typical of the community at large.

Organization of prevalence surveys

Careful, detailed consideration must always be given to the planning of the particular survey in question, and, while each will be unique in purpose and scope, the principles involved can often be usefully considered in the following stages: planning (preliminary planning, field reconnaissance, technical planning, team training), field work, analysis, interpretation, and action.

PLANNING

Preliminary Planning

Purpose of the survey

Basic to the planning of a survey is a clear definition of its purpose. The decision will be influenced by various factors, including available background data, and the potential scope of the survey team. This, in turn, will determine whether the survey should be general or specific, whether it should consist mainly of simple clinical signs, used as a preliminary screening, or should include more elaborate biochemical investigations on a research basis.

Consideration of the purpose of the study may also suggest the geographical area and population groups to be included, and possibly the desirability of restricting the investigation to a particular age-group or sex.

It is often not sufficiently appreciated that time devoted to careful planning represents a saving of time and the avoidance of confusion and failure in the field.

Preliminary plan of action

At an early stage, a written preliminary plan of action must be drawn up. Of necessity this will be a tentative outline based on available information and background data.

Field Reconnaissance

Approach to local people

The success of a community survey depends largely on the thoroughness of the planning, which will be guided by available information concerning the local environment and culture patterns and by statistical considerations.

Usually, several months have to be given over to communication with various categories of officials and people in the area. These will normally include government departments and officials and local community leaders who may be traditional, political or religious, or all of these.

At an opportune moment, a senior member of the survey team must make a preliminary visit or field reconnaissance to the area in order to meet the local public health workers, community leaders and administrators, to assess the situation with regard to accommodation and transport, and to make a preliminary inquiry into the pattern of malnutrition, food habits and general mode of life.

Careful prolonged explanations in simple, non-technical language, and a full discussion concerning the purpose of the survey and the methods envisaged are essential. It cannot be stressed too much that these are the people who must be convinced, since they will, in most cases, be primarily involved in telling the community of the team's visit and intentions, and in attempting to ensure co-operation and attendance. Without local understanding, success in a community nutrition survey is unlikely.

It is vitally necessary to provide a stimulus whereby to ensure the attendance of the population. To this end, an undertaking to treat any sickness found is helpful. A knowledge of possible local reactions to the techniques and methods to be employed is important—for example, the willingness of women to undergo clinical examination, or anxiety that samples of blood, faeces or urine may be misused for occult purposes. Frank discussions with local leaders may help to clarify ideas and suggest ways of obviating cross-cultural misunderstandings.

Apart from explaining the purpose of the survey, and so allaying fears and misconceptions, preliminary discussions and correspondence will lead to the arrangement of a survey time-table. At this point practical problems, such as the selection of the most useful collecting points, seasonal travel difficulties and social problems resulting from periods of widespread community activity (related to agriculture, religion or ritual) should be borne in mind.

Involvement of local health workers

It is particularly important that local health workers should be associated as team members in every activity, from the planning stage to the actual field work. Clearly, they cannot remain mere bewildered spectators, since it will probably fall to them to try to implement any action suggested.

Practicability of preliminary plan

Information and advice obtained during field reconnaissance also permit of an assessment of the extent to which the theoretical preliminary plan of action is suited to the conditions in the area.

Technical Planning

Once the purpose of the survey and its extent and depth have been decided, technical planning can be undertaken. This will probably be based on the preliminary plan of action, influenced by observation during the field reconnaissance and by the advice given by local leaders.

Technical planning may be considered under four headings: selection of methods, statistical guidance, selection of equipment, and training of personnel.

Selection of methods

As noted earlier, three main categories of methods of assessment are available for use in a community nutrition survey: direct assessment of human groups; indirect assessment of human groups; and assessment of ecological factors.

Direct assessment of human groups

Reference has already been made to the four methods of assessing the nutritional status of groups of individual human beings in a community directly: clinical signs; anthropometric measurements; biochemical tests; and biophysical methods. Usually, a combination of these methods will be favoured.

The range of practicable clinical signs, anthropometric measurements and biochemical tests is listed elsewhere. In all surveys, the selection of tests and methods to be used depends upon various factors, in particular the age-groups to be covered and the nutritional public health problems likely to be encountered. For example, tests for serum-alkaline-phosphatase levels would not normally be included in a nutritional survey of young children in a tropical community, in a sunny rural area, where rickets was known to be a rare clinical problem.

Surveys almost always include examination for clinical signs. In general surveys, the signs to be looked for should include a selection of the stigmata listed earlier. For research purposes, less certain or newly recognized signs may also have a place, in an attempt to assess their significance. In rapid screening surveys, covering large numbers and often employing junior staff, only certain selected signs are noted, on the assumption that, if necessary, suggestive findings may be followed up with more-detailed investigations in affected areas.

The clinical signs looked for will also have to be adjusted to suit a particular age-group. Thus, a survey of young children, among whom protein-calorie malnutrition is the main problem, would not be concerned with testing the ankle jerks.

Finally a rapid survey may, though rarely, be undertaken without clinical signs being included. For example, haemoglobin estimations may

be carried out to screen for iron deficiency, or the urinary thiamine for deficiency of this nutrient.

Basic anthropometric measurements will usually be carried out and may consist, for all age-groups, of weight, height (or length), triceps skin-fold and arm circumference. When young children are being studied, the circumference of the head and chest should also be measured.

It is difficult to generalize concerning the range of biochemical tests to be applied, as these will depend on the purpose of the survey, the age and sex of the group under investigation, and, above, all, the available laboratory facilities. In most surveys, where tests are employed, they are normally limited to a sample of those attending, as they are often expensive, time-consuming and difficult to perform, collect and interpret. Often the selected tests are related to possible deficiencies suggested by a general knowledge of the local diet and disease pattern, or, by analogy, to findings from some other ecologically similar area. A haemoglobin estimation should always be included, both as a screening test for iron deficiency and other types of nutritional anaemia and because of its relationship to malaria and hookworm infection—both important conditioning diseases.

As described elsewhere, biophysical tests usually play little part in nutrition surveys but may be required for certain specific investigations, such as the dark-adaptation test for avitaminosis A, or radiological examination of the wrists for rickets.

In practice the individual assessment of groups in most nutrition prevalence surveys is based on the use of clinical signs, associated with basic (or more extensive) anthropometric measurements and selected, locally appropriate and practicable biochemical tests (always including a haemoglobin estimation) usually carried out on a sample of the population that has been examined clinically.

Indirect assessment of human groups

In addition to the health statistics obtained from background data, it should be possible to collect further information during the survey period from local medical service records, from data on birth and death registration, and by means of a questionnaire concerning the mortality and morbidity rates of different age-groups relating to malnutrition and nutritionally relevant infections.

Assessment of ecological factors

Apart from evaluating the nutritional status of the community by clinical, anthropometric, biochemical and other means, nutrition surveys must also attempt to collect as many data as possible concerning the epidemiology of the malnutrition found. Information concerning ecological factors—conditioning infections, food consumption, cultural influences, socio-economic factors and food production—may be drawn from back-

ground data and special surveys (e.g., family food-consumption studies), or by means of observation and questionnaire at the survey site, together with rapid ecological visits to homes, cultivation sites, etc.

Statistical guidance [1]

Statistical guidance is of importance at every phase of survey work, but especially at the planning stage and in relation to sampling, design of survey forms, and evaluation of results.

Sampling

If statistically sound sampling procedures based on probability are not followed, the significance of survey results will at best be uncertain, and possibly biased and incorrect. By contrast, with correct sampling, investigations can provide accurate information on an examination of only a portion of the population, with a consequent saving of time, money and staff and with less disruption of the local community (Woolsey et al., 1954).

However, sampling problems are far from simple and usually require the specialized skill of the statistician. Some understanding by the nutritionist of statistical principles is valuable on order to bridge the gap between the two technical fields of knowledge.

It is neither possible nor necessary to examine all members of the population; the basis of sampling is to select a random sample of sufficient size to give accurate, unbiased and representative results for the community as a whole (Witts, 1964).

Sampling will be based on checked local census figures (if available), or other community lists, preferably those including population numbers, age-groups and household distribution, and on a knowledge of variable factors, such as those related to the yearly meteorological and agricultural cycle, to migrations of population, etc.

Random sampling may be achieved by two main selection methods (Reh, 1962)—systematic procedures, which are based on the selection of house numbers from the census at specified numerical intervals, and unrestricted procedures, in which the sample in chosen by lottery or from standard printed tables of random numbers.

The size of the sample for each individual survey is determined by the size of the population-group, the probable prevalence of the characteristic sign or syndrome to be measured, and the degree of precision required in the results. Attention must also be given to the practical, non-statistical errors (e.g., inter-observer, experimental, etc.) inherent in the measurement.

In practice, in the selection of the sample size, a balance will have to be struck between statistical requirements and local field realities, such as difficulties of travel in certain terrain or the absence of a local census. Also,

[1] Further detailed consideration is given by Reh (1962), Swaroop (1966) and Schaefer (1961).

provision should, if possible, be planned for any adjustments necessitated by unforeseen changes in the field.

The combination of methods and approaches usually adopted in nutrition surveys will call for different sample sizes and, possibly, different sampling techniques, using the multiphase method. For the more general measurements, such as clinical assessment, weight and height, a large sample may be manageable, while for the more complicated biochemical determinations and time-consuming food-consumption studies, a smaller sample will have to suffice. Statistical advice will also be required concerning the number of rapid ecological visits to be made in the course of the survey.

The ICNND survey procedure is based on the practical application of subsampling. All persons attending are given an " abbreviated clinical examination ". A sample of them are given a " detailed clinical examination " and selected biochemical tests. Finally, a smaller proportion undergo special biochemical investigations (Wilson et al., 1964).

If biochemical tests are carried out on a random subsample and on subjects selected because they show marked clinical signs, the two groups must be clearly differentiated (Sinclair, 1964).

Unfortunately, in some circumstances, expert guidance from a statistician may not be available on the spot. At times advice may be sought by correspondence; otherwise, every effort should be made to ensure that representative areas are included, if the region under study is not homogeneous. Variations in age structure, ethnic groups, geography, agriculture, food patterns, economic level, religion, occupations, levels of modern education, health facilities and known disease patterns must be taken into consideration.

Survey forms

Forms employed must be easily identifiable—for example, through the use of coloured paper or card. They must show the items to be filled in clearly and unambiguously.

Two main types of composite survey form are in widespread use in varying sizes and degrees of complexity: the single sheet and the punch-edge card.

All newly designed forms need an accompanying guide sheet listing exactly what is wanted under each heading, with definitions. They should be tried out on a small scale before use in an actual survey.

(*a*) *Single sheet.* This can be of paper or cardboard, and examples are shown in Figs. 46 and 47. They are not presented as ideal patterns, nor do the signs and other data listed necessarily coincide with suggestions made in the present monograph. They are, however, forms that have been found useful in practice.

(*b*) *Punch-edge cards.* These are cardboard rectangles of various sizes, with space in the centre for recording data in the field, and with holes punched round the edge (Fig. 48). Two widely used brands are the McBee

FIG. 46. ABBREVIATED SURVEY SHEET USED AT NSAMBYA, KAMPALA (ALSO LISTING OTHER NON-NUTRITIONAL DISABILITIES)

NSAMBYA URBAN CHILD HEALTH SURVEY

NO: 52 NAME: HERINA ADHIAMBO SEX: F

ADDRESS: Plot 72 BIRTHDAY: 18/7/63 AGE: 16 mo.

CLINICAL

Nutrition + dyschromotrichia / + sparse hair / — oedema / — moon face / — other (state)

Remediable complaints — chronic otitis media / — conjunctivitis / — spleen / — other (state)

Congenital or other abnormalities — club foot / — harelip / — polio / — other (state)

Skin disease — sepsis / + scabies / — tinea / — burn scars / — molluscum

Medicinal + vaccination scar / — charms / — incisions / — other (state)

ANTHROPOMETRY

Wt.	9·37 kg.	Wt/age	+80% level
Length	74·1 cm.	Wt/ht	+90 % level
Head Circ.	46·0 cm.	Wt/hd	+90 % level
Chest Circ.	48·0 cm.	Chest/head ratio:	(over one)/under one
Arm Circ.	14·0 cm.	Arm circ.	+80 % level
Skin fold	9·1 mm.	Skin fold	+90 % level

LABORATORY

Hb. 9·5 gm %

Stool negative / + Ascaris / — Hookworm / — Giardia / — E.histolytica / — Strongyloides / — other (state)

Thick B.F. negative / + MT / — QT

FIG. 47. DETAILED CHILD HEALTH AND NUTRITION SURVEY FORM USED BY ICNND

(a) Front of card

Pediatric Card for Children Ages 0–4 years. READ INSTRUCTIONS BEFORE USING.

DATE	NAME	☐ Boy ☐ Girl	AGE ___yrs___mo	CARD NO.
LOCATION	AREA OF ORIGIN	☐ Rural ☐ Urban	☐ Other siblings examined	☐ Informant not mother

LENGTH in / cm	STD	%	WEIGHT lb / kg	STD	%	1	2	3	4	5	6

MOTHER AGE yrs (U M R)	If now pregnant mos	Number of PAST PREGNANCIES ___	MULTIPLE BIRTHS	Of the liveborn:	Of those dying:	Mother's age at:
		___liveborn ___stillborn ___abortions		___now living ___now dead	___died at < 1 yr ___died at 1–4 yr ___died at 5+ yrs	term. 1st preg. ___ yrs term. last preg. ___ yrs

THIS CHILD:	Age (U R M)	Birth order	Premature? YES NO	Walked mos	DIARRHEA	RESPIRATORY	
					☐ Current ☐ Recent ☐ Recurrent	☐ Current ☐ Recent ☐ Recurrent	☐ Pica ___ ☐ Parasites ___ ☐ Malaria ___ ☐ Other ___

GENERAL IMPRESSIONS
- ☐ Apathy
- ☐ Pallor
- ☐ Irritability

HAIR
- ☐ Dry staring
- ☐ Dyspigmentation
- ☐ Thin
- ☐ Easily pluckable

EYES
- ☐ Conjunctival dryness
- ☐ Conjunctivitis
- ☐ Bitot's spots
- ☐ Xerophthalmia
- ___

LIPS
- ☐ Angular lesions
- ☐ Cheilosis

GUMS
- ☐ Swollen red papillae (diffuse)
- ☐ Bleeding

TONGUE
- ☐ Filiform papillary atrophy ☐ Mild ☐ Mod. ☐ Severe
- ☐ Glossitis

GLANDS
- ☐ Thyroid enlarged (visible)

SKIN, GENERALLY
- ☐ Inelastic
- ☐ Petechiae
- ☐ Dermatitis, with desquamation or crazy pavement type
- ☐ ___

ABDOMEN
- ☐ Hepatomegaly
- ☐ Splenomegaly
- ☐ Pot-belly

LOWER EXTREMITIES
- ☐ Bilateral edema
- ☐ Calf tenderness

SKELETAL
- ☐ Cranial bossing ☐ Frontal ☐ Parietal
- ☐ Craniotabes
- ☐ Costochrondrial beading
- ☐ Enlarged joints
- ☐ Bone tenderness
- ☐ Muscle wasting
- ☐ ___
- ☐ ___

OTHER
- ☐ 1. ___
- ☐ 2. ___

CLINICAL IMPRESSION
- ☐ Marasmus
- ☐ Pre-kwashiorkor
- ☐ Kwashiorkor

REMARKS:

PHOTOGRAPH #___ of ___

G F P

EXAMINER'S INITIALS ___

☐ URINE sample #___ ☐ BLOOD sample #___ ☐ FECES sample #___

URINE DATA
- Urine volume ___ ml, during ___ hours
- Creatinine ___ mg/ml or ___ mg/ hrs
- Thiamine - - - - - - - - ___ ___
- Riboflavin - - - - - - - ___ ___
- N'methylnicotinamide - - ___ ___
- Other, #1 ___ - - ___ ___
- Other, #2 ___ - - ___ ___
- Other, #3 ___ - - ___ ___

PARASITOLOGIC FINDINGS

1___, 2___, 3___, 4___, 5___, 6___, 7___

BLOOD DATA
- Total plasma protein - - - - - ___ ___
- Albumin - - - - - - - - - - - - ___ ___
- Hemoglobin - - - - - - - - - - ___ ___
- Hematocrit (PCV) - - - - - - - ___ ___
- M.C.H.C. = 100 Hgb/PCV - - - - ___ ___
- Serum Vitamin C (mg/100 ml) - - ___ ___
- Serum Vitamin A (mcg/100 ml) - ___ ___
- Serum Carotene (mcg/100 ml) - ___ ___
- Alkaline phosphatase - - - - - ___ ___
- Other, #1 ___ - - ___ ___
- Other, #2 ___ - - ___ ___

FIG. 47. DETAILED CHILD HEALTH AND NUTRITION SURVEY FORM USED BY ICNND (*continued*)

(*b*) Reverse of card

DIETARY Information obtained by:

CHILD — BREAST FEEDING	CHILD NOW FED: (one or more) ☐ Breast milk ☐ Other milk ☐ Other foods	IF CHILD NOW NURSES: ____feedings/day ☐ Self-demand OR ☐ Schedule ____hrs	IF NURSING TERMINATED: ☐ Abruptly at____months ☐ Gradually____to____mos ☐ NEVER breast fed	FACTORS IN TIME OF WEANING: Maternal ☐ Illness ☐ Work ☐ Pregnancy ☐ _____ Infant ☐ Illness ☐ _____
CHILD — INITIAL NON-MILK FOODS	1	2	3	
	4	5	6	

CHILD — PHARMACEUTICAL SUPPLEMENTS	☐ Iron	from ____months	to ____months or ☐ PRESENT	☐ Regularly ☐ Occasionally
	☐ Vit A & D	from ____months	to ____months or ☐ PRESENT	☐ Regularly ☐ Occasionally
	☐ Vitamin C	from ____months	to ____months or ☐ PRESENT	☐ Regularly ☐ Occasionally
	☐ _____	from ____months	to ____months or ☐ PRESENT	☐ Regularly ☐ Occasionally

CHILD — MILK FEEDING (not breast)	Fresh milk: ☐ Cow ☐ Water buffalo ☐ Goat ☐ _____ ☐ Sheep ☐ Camel	Processed milk: ☐ Dry skim ☐ Dry whole ☐ Evaporated ☐ _____	PRESENT intake: _____(vol)/day _____(wt.)/day _____(times)/day	Is formula water boiled? YES NO Is drinking water boiled? YES NO

CHILD'S PRESENT DIET

Do you give this child any special foods or juices other than the family diet? YES NO

If YES, what kinds? _____

Usual present diet:

Food type	Food	Quantity/Day	Times/day	OR times/wk	Age this food first started
MILK					
GRUELS, CEREALS					
VEGETABLES					
FRUITS					
MEAT, FISH, FOWL					
EGGS					
OTHER					

MOTHER'S DIET during LATEST PREGNANCY

	Foods avoided	Why?	Special foods	Why?	Supplements	Why?
1	Salt	____	Milk	____	Iron	____
2		____		____	Calcium	____
3		____		____	Vitamins	____
4		____		____		____
5		____		____		____
6		____		____		____

MOTHER'S DIET during LATEST LACTATION

	Foods avoided	Why?	Special foods	Why?	Supplements	Why?
1	Salt	____	Milk	____	Iron	____
2		____		____	Calcium	____
3		____		____	Vitamins	____
4		____		____		____
5		____		____		____
6		____		____		____

At what age do your children begin to drink... Coffee?_____yrs Wine?_____yrs Soft drinks?_____yrs (kind_____)

Tea?_____yrs Beer?_____yrs Other?_____yrs (kind_____)

Cards, employed by ICNND, and the Cope-Chat Cards. They offer the advantage that positive findings can subsequently be marked by slotting the appropriately numbered edge-holes, and the cards may then be needle-sorted by hand.

In both types of form, if it is proposed to transfer the information to punch cards, such as those of IBM or ICT, for mechanical sorting and analysis, it is necessary for each item to have a code-number. This can be done with a list of items and their corresponding punch-card code numbers, or, alternatively, by means of an entry against the appropriate item on the sheet or card (Fig. 48); the transfer of information is thereby facilitated.

Design of survey forms

The designing of the most useful forms for a particular survey (including the size and material) is a complicated task and will be influenced by personal preference and by the purpose of the investigation. The guidance of a statistician is helpful in order to ensure that the relevant data are recorded in a form that can be easily analysed, preferably by transfer to punch cards.

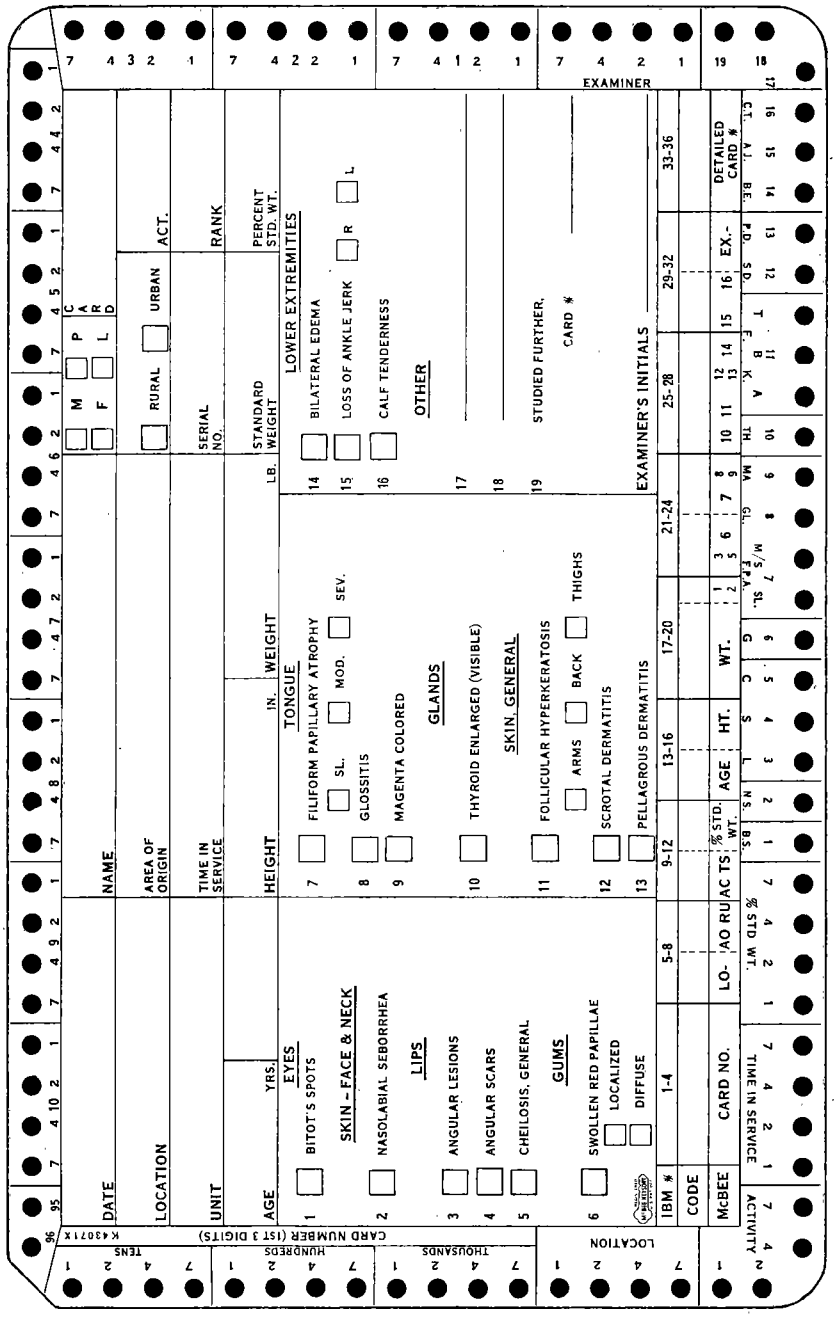
Common types of form. Large numbers of different types of form have been employed in nutrition surveys all over the world, and the locally most suitable system will have to be developed for each survey. Basically the following types of information have to be recorded: data on individuals (identification, clinical assessment, anthropometry, laboratory tests); dietary information; findings of rapid ecological visits; and, if possible, food-consumption data.

Composite survey forms. These are commonly used, and each lists some or all of the data for the survey, and sometimes dietary information as well. A form is issued to each individual being examined, to be kept by him until the field assessment is completed, when it is collected. Personal data concerning identification, clinical assessment, anthropometry and recent diet are filled in as the person moves from " station " to " station ", while laboratory results are added later. Forms for children must show the state of dental eruption, recorded by the standard visual coding (see Fig. 32).

Identification data will consist of at least the date, location, survey day, number, name, age, and sex, and also such other details as may be necessary in the particular community (e.g., " son of ", or home village). It may be useful to have spaces for both stated and verified ages (or birth-dates).

Whatever the form used, it is important that *both* positives *and* negatives should be marked appropriately (+ or −); otherwise, uncertainty will exist later as to whether a clinical sign has been looked for or not. As noted earlier, the classification of physical signs into degrees of positivity (i.e., +, ++, +++) is not usually recommended (except for the degree of thyroid enlargement), because grading of this kind is difficult to define objectively.

FIG. 48. ABBREVIATED PUNCH-EDGED SURVEY CARD USED BY ICNND (McBEE CARD)



The recording of past histories is not usually advisable in prevalence surveys in developing countries (e.g., " recent attacks of diarrhoea ") as the resulting information is not sufficiently reliable to justify the time and effort involved.

Forms for rapid screening surveys. In addition to detailed clinical assessment schedules, abbreviated simplified forms will be required for rapid screening surveys.

Dietary questionnaire forms. These may be used at the survey site or in the home. The inquiries should be condensed, precise, in logical order and should try to avoid leading questions. They should be concerned with only a short preceding period—often of no more than 24 hours. A system of ticks or check marks should be used for the answers, and space should be allowed for comments. The detailed construction of the questionnaire will obviously depend on local dietary habits and food resources and will be based on background data and information obtained during field reconnaissance. Approximate quantitative information may be obtained if local measures of content and utensils, such as bottles and spoons, and even cooked servings, of dishes are available to the questioner.

The dietary questionnaire may be a separate form or may be included as part of the composite form.

Rapid ecological visit forms. These will be used by the small mobile group visiting homes, cultivation sites and markets. Suggested data that may be included are given in Table 16.

Food-consumption forms. These have been fully discussed by Reh (1962) and will not be considered here.

Expression and evaluation of results

Statistical assistance is needed for the evaluation of results, and in particular for testing the significance of various findings.

Selection of equipment

The type of equipment will vary widely, depending not only on the scope and purpose of the survey, but on the terrain in which it is being carried out. Maintenance in the field must not be overlooked.

Transport and accommodation

The more remote the community the more comprehensive and carefully planned the details of transport and accommodation will have to be. Road conditions as well as financial considerations will determine whether standard cars, or four-wheel-drive utility vehicles (e.g., Land-Rover, Jeep), or even a mobile field laboratory, housed in a lorry with an electrical generator for refrigeration, etc., and with a gas supply for Bunsen burners, should be used.

In less developed parts of the world, questions of fuel and water for vehicles, which may have to be carried by the team itself, call for special attention. A strong trailer, sufficiently sturdy to be towed by a utility vehicle over rough roads, may prove a very useful and economical way of transporting water and heavy equipment.

In some areas, part of the journey may have to be made on foot, or by bicycle, dog sled, boat, or canoe, in which case some form of water-proofing of equipment must be provided. Also, in remote roadless areas, porterage of equipment may be necessary. Advance arrangements may have to be made for porters, money in a convenient form and the packaging of equipment in bundles suited to the local method of carrying.

Accommodation and food for the team have to be planned. During the field reconnaissance, a senior team member will have gauged the situation. The type of accommodation, and hence the degree of organization and planning, necessary in connexion with sleeping, washing, toilet and cooking arrangements will vary according to whether a hotel, a rest-house or tents are to be used. The amount and type of food, drink and cooking utensils to be taken or bought locally must also be planned ahead. Easily carried packaged meals and bottled soft aerated drinks are often the most convenient for lunch, which will usually be eaten in the field. Some extra food should always be carried, because local volunteer assistants and helpers may have to be included.

Team members will be wise to adopt a perhaps unduly cautious attitude to food and drink while carrying out the field part of a survey. Apart from serious illness, bouts of " traveller's diarrhoea " may disrupt the team's efforts, and are in any event difficult to deal with in the often closely scrutinized circumstances in some rural village areas. All food should be freshly cooked, if possible, and always thoroughly cooked. Drinking-water should be boiled, while milkless tea or coffee, or bottled carbonated so drinks may be used instead of dubious " boiled " water.

Anthropometric equipment

The types of scales and equipment for measuring weight and height or length will have to be decided. If both young children and adults are to be included, two types of each apparatus will probably be needed. Other items, such as tape measures and skin-fold calipers will also be required.

All this equipment must be carefully packed to minimize damage incurred on a jolting journey over bad roads. Items may also be needed for the setting up of the equipment (e.g., a table as a level surface for a length-board), together with weights for testing the scales through the full weight-range envisaged.

Laboratory equipment

This will depend on the range and number of biochemical and other tests envisaged. The amount carried should exceed the estimated need by 20%.

The collecting apparatus for blood samples will consist of cutting needles or commercially pre-sterilized paper-wrapped lancets for capillary blood, as well as sterile syringes or vacuum tubes for venous samples. The more expensive disposable blood lancets and dry disposable syringes are most useful, and should be chosen if funds permit.

The quantities of other items needed for taking blood samples must be calculated, including material for cleaning the skin (e.g., gauze swabs, spirit or merthiolate), tourniquets, etc.

For the collection of urine, routine screw-capped glass, or preferably plastic, bottles can be used.

Containers for blood samples may be capillary tubes; if so, material for sealing the ends must be available, either a flame (from a Bunsen burner with gas from a portable cylinder), or clay or plasticine brought for the purpose. For larger samples, screw-capped flat-bottomed bottles—if necessary containing an appropriate preservative—will be required. If various samples are taken for different purposes, the requisite number of each type of container must be estimated.

Haematology. For haematological purposes, blood may be taken directly with a pipette into Drabkin's solution in flat-bottomed, screw-capped bottles, a haemoglobin examination being carried out with an electric photometer at the end of the survey.

Thick blood films for malaria are made on a glass slide; with care and practice, up to five films can be made on each slide, which is pre-labelled and divided into sections by transverse lines drawn with a grease pencil. These will require to be stained in the field with Giemsa (or other) stain. Thin blood films, for subsequent examination for red-cell morphology, can be made one per glass slide, fixed by immersing in methyl alcohol, and stained on return to base.

For these haematological tests, sufficient lancets, bottles with Drabkin's solution, labelled glass slides and staining equipment (including Giemsa or other stain, staining racks for the thick films, and wide-mouthed vessels for spirit for fixing thin films) are required.

Stools. For stool samples from adults and older children, screw-cap glass containers can be used with a small quantity of stool preservative. For young children, the small stool sample can best be obtained through the use of an anal tube. Equipment needed will consist of sufficient small 2-ml screw-capped containers containing 1 ml of 10% formol-saline, open-ended glass anal tubes (0.5 cm × 7.5 cm) and wooden applicators, for poking out the core of the stool obtained by inserting the tube into the rectum.

Packing. Containers must be as unbreakable as possible and flat-bottomed, so that they can be packed upright into boxes ensuring the minimum of rattling. If possible, specially designed boxes, trays or shelves of the correct size should be constructed from the cheapest local materials.

Glass slides are dried after fixing or staining in the field and made into convenient-sized packets of about 50, wrapped in labelled white paper.

Refrigeration. Biochemical specimens requiring refrigeration pose special problems depending upon the degree of cooling required and the local facilities. Large, ice-containing thermos flasks may be adequate, with ice brought each day from a near-by hotel, rest-house or local hospital, and the specimens may be kept thereafter in these flasks. More rarely, dry ice may be available and necessary. An electric refrigerator can be fitted into a four-wheel-drive utility vehicle or mobile laboratory.

Special care may have to be taken with particular specimens in order to avoid exposure to sunlight or excessive shaking.

Apparatus may be required for centrifugation. This may be carried out using a low-r.p.m. hand machine or a fast electric centrifuge, which can be operated off a car battery, depending on the particular specimens.

Labelling. This is of paramount importance, and much confusion and waste of effort will be avoided if strict attention is paid to this aspect of the survey. The numbering system must be clear and understood by every member of the team. A simple alphabetical list of days (A, B, etc.) and the consecutive numbering of those attending are often advisable. Specimen containers can then be pre-labelled with the appropriate letter and number (e.g., C1, C2, etc.) if specimens are being taken from all those attending, or with blank labels if random sampling is to be used. The labels used should be waterproof and should not smudge or smear.

Whenever possible, specimens should be taken that can be preserved or refrigerated in the field, and brought back to base at the end of the survey. In some circumstances, however, a field laboratory may be set up at the survey site or in a near-by building or town. Problems of transport between the survey site and the laboratory will, in that case, have to be worked out in regard to vehicles, drivers, time, fuel, etc., if the specimens taken have to be examined before the survey team returns to headquarters.

Drugs and inducements

The treatment of illness found in the course of a survey, or its appropriate referral, is often a major incentive to attend, and especially for mothers to bring children. Sometimes it may be felt necessary to issue a minor " medicine ", such as a few tablets of inexpensive ferrous sulphate, to the mothers of all the children. In addition, cheap, effective, easily administered drugs must be carried in quantities roughly estimated beforehand for the treatment of those actually found to be sick.

Drug lists will vary from region to region. The following is a simple and economical basic list of drugs routinely used in community child-health surveys in East Africa (Jelliffe & Jelliffe, 1963):

Eye infections :	small tubes of sulphacetamide (10%) and tetracycline (1%) eye ointments.
Skin disease :	gentian violet (1%) aqueous solution, sulphur ointment, benzoic acid ointment.
Ear infections :	boric and spirit ear drops.
Sepsis and miscellaneous infections :	disposable syringes of benethamine (long-acting) penicillin (1.2 mega units) for intramuscular injection, sulphathiazole tablets, small quantity of chloramphenicol capsules.
Malaria :	chloroquine tablets.
Intestinal helminths :	piperazine tablets, bephenium packets.
Miscellaneous :	iron tablets, dried skim milk, dressings, bandages, etc.

In addition, paper is needed to wrap up the tablets, and squares of newspaper can be prepared beforehand, or small, inexpensive envelopes purchased. A packet of wooden tongue depressors should be available for dispensing ointment, together with a limited supply of small bottles and boxes.

Other inducements may be advisable, especially for children. Thus, the issue of a cheap sweet or lump of sugar to children after the laboratory specimens have been taken is well worth while. In less sophisticated communities, e.g., the Karamojong pastoralists of Uganda, more " classical " gifts of tobacco, matches and ornaments for parents and elders were found to be helpful (Jelliffe et al., 1964).

General equipment

In a mobile survey, it may be necessary to take chairs and tables: lightweight, folding aluminium chairs and collapsible wooden tables of various sizes are preferable.

Shelter from the rain and sun may be required. Sometimes sticks and string are useful as a fence around each " station " to create an orderly line of flow.

Clothes should be practical, cool, easily washable and culturally acceptable to the local community and, where necessary, should include raincoats and umbrellas.

Training of personnel

Some weeks before the survey begins, the complete team must meet on several occasions. The purpose of the survey should be outlined and available background data discussed, preferably with a senior team member who has already made a field reconnaissance and can report on accommodation, transport problems and recent news from persons on the spot with whom the team will be co-operating.

The planned " lines of flow " to be followed on the survey should be discussed in detail—move by move—with the person responsible for each particular aspect. A complete set of equipment should be available, including anthropometric apparatus and all types of record forms, which can be displayed in appropriate numbered " stations " as they will be used on the survey. As procedures are described, the actual materials should be employed for purposes of demonstration. The techniques and forms to be employed by the group engaged in rapid ecological visits to homes, cultivation sites and markets should also be demonstrated and discussed.

A lengthy discussion is desirable, and an adaptation of forms, equipment or procedure to the circumstances of the particular survey may result.

To ensure a standardization of techniques of measurement and clinical signs, the team should study descriptions and illustrations, such as those given in the present volume. At a subsequent meeting, the clinical signs should be presented one by one, if possible with accompanying colour slides, followed by a full exchange of views and a practical demonstration of the anthropometric measurements to be employed. It is also necessary to demonstrate the correct method of recording results on appropriate forms, and to afford an opportunity for practice.

At a further meeting, a " mock survey " may be organized, with children attending and with the " stations " set up as they will be in the field. It is important that the entire team, including senior members, should understand the complete operation and be capable of carrying out all the component tests and examinations. At this stage the composition of the groups to work at each station can be decided upon and their duties clearly defined.

The importance of ensuring an orderly flow of subjects and of labelling needs to be stressed, for an apparently minor error in the course of a survey day may upset the clinical and laboratory results and nullify the day's work.

In a new area or with newly recruited staff, it may be necessary to carry out a preliminary pilot project.

Types of staff. The types of staff required will vary with the survey methods to be employed. In the field, specially trained staff will be needed to cover the following activities: assessment of clinical signs, anthropometry, taking samples for laboratory tests, completing questionnaires on diet and during rapid ecological visits, as well as for the various techniques required for household food-consumption studies.

A variety of persons, including doctors, non-medical nutritionists, public health nurses and medical students, can be trained to do any of these tasks. The active participation of members of the local public health services in the survey teams is strongly recommended.

In all cases, there must be a clear definition of the duties and functions of the team members. It is useful if the members are trained to be inter-

changeable, to allow for absence due to illness or accident, and because a variation of duties prevents staleness.

Laboratory technicians, supervised by a biochemist, will be needed at local or base laboratories, if biochemical tests are taken.

While carrying out the actual field work, local untrained volunteers will be required. In most cases they can be engaged for a small remuneration, and are invaluable for interpreting, directing and keeping the line of flow intact and moving steadily.

FIELD WORK

Household surveys

Ideally, prevalence surveys should be carried out by means of house visiting, which offers the advantage of seeing the family together in their domestic setting, of not missing sick individuals, such as children with kwashiorkor, who may be kept at home, and of causing the least disruption of normal life and behaviour.

In general, surveys by systematic home visiting are usually not practicable owing to the difficulty of transporting equipment and the time taken to see a limited number of persons. However, if time permits and few laboratory specimens are to be taken, and also, if the people live in villages or in large family units, household nutrition surveys can contribute greatly to an understanding of the domestic background of malnutrition, as shown by the studies of Oomen & Malcolm (1958) in New Guinea. Moreover, a survey by house visiting may be necessary where it is not culturally permissible for the population, particularly for women, to attend a public meeting-place.

In some parts of the world, no villages exist, and people live instead in scattered homesteads with adjacent cultivation areas. In such circumstances, the population to be surveyed has to be assembled on a selected day at a suitable point, which should be so situated as to enable everyone, including mothers with children in their arms, to attend with a minimum of inconvenience. Clearly, this cannot be arranged without the full co-operation of the local authorities.

Great difficulty in this respect arises with nomadic or pastoralist peoples, and still more with hunter-food gatherer groups, such as the Hadza of northern Tanzania (Jelliffe et al., 1962b).

Surveys at collecting points

In a community nutrition prevalence survey, as distinct from a study of " ready-made " groups such as schoolchildren and armed forces, the major problem often is how to collect the entire population of the particular age-range under investigation from the circumscribed geographical or administrative unit that has been selected statistically.

If villages or similar population groups exist—as on small islands—there may be little difficulty, provided that the community leaders understand and support the project. Suitable assembly points may be arranged at the health centre, the chief's compound, the community hall or other socially familiar focal point, such as the village square.

However, in countries where there is a shortage of doctors, the prior announcement of the survey team's arrival may mean that sick persons, including those suffering from malnutrition, will be brought into the villages from the surrounding countryside, thus giving a false impression of the health situation. In such a circumstance, the village mayor, headman or other official who can recognize, and exclude from the main survey, persons from outside the area can help greatly. He may have a census list of the population or, at least, know whether all of his people have attended or not.

Frequent movements of village populations, such as those occurring during market days in Haiti (Jelliffe & Jelliffe, 1960), also create problems. In every case all persons who may be absent, whether visiting relations or working in industry or agriculture at distant points, must be taken into consideration. It should also be borne in mind, in the assessment of malnutrition and disease prevalence, that sick persons may have been admitted to local hospitals or hidden at home; they must be sought for and included in order that the findings in the community may be complete.

Poorer areas in cities are often difficult to survey, unless low-cost housing estates exist and are treated as population units.

Slum areas are of increasing relevance in the urbanizing tropics, but present peculiar difficulties. Understandably, the inhabitants are often uncooperative or, at best, indifferent. Furthermore, because of the sprawling, overcrowded nature of slum districts it is not easy to concentrate on a limited, circumscribed area, and it may therefore be necessary to carry out the survey, at least in part, by means of home visiting—an unduly lengthy method yielding a slender return for the time spent. The collection of laboratory specimens is particularly difficult.

Essentially, the problem is to collect the entire population of the selected age-groups in the given area, to exclude persons from other areas, and to ensure that the examination is not limited either to the relatively healthy or to the very sick.

In every case, surveys carried out at collecting points must be complemented by visits to homes, kitchens, cultivation sites, shops, etc.—i.e., rapid ecological visits.

Stations and line of flow

It is indispensable, though difficult when dealing with rural people, to organize a smooth, continuous line of flow. Without this, the team's field

work will become progressively more confused as the day advances—to the point where the results may have to be abandoned.

To help in the preliminary organization and to supervise its continuation throughout the day, the co-operation of a schoolteacher, the chief, the village mayor or analogous official, accompanied by his assistants, is essential.

Before the day of the survey, the local authorities must know how many stations will be required, where they should be situated, and what each should comprise.

The stations may be set up in rooms in a single building or adjacent buildings, or in the open, in the shade of a tree. The site chosen will depend on local circumstances, including the probable degree of wind, rain or sunshine. If shade is available, some stations, including those for the clinical examination and anthropometric measurements of children, may best be located out of doors. They will be cooler and have better light than a dark crowded room. If necessary, the open-air stations can be surrounded by a rough " fence " of string and sticks brought by the team for the purpose. It is usually better to set up the laboratory station, where blood samples are taken, in an enclosed room so as not to frighten children waiting their turn.

Problems of modesty arise in connexion with the clinical examination and anthropometric measurement of adults or older children. As already noted, weighing is best carried out with subjects lightly clothed or nude, but since this is not usually possible, adults may have to be weighed in their clothes, subject to an appropriate adjustment.

Clinical examinations of entire populations can be carried out either by setting up one station for men and older boys and another separate one for girls, women and their young children, or by making a combined visit to a family group. In either case, examinations will have to be carried out in rooms or, in some parts of the world, in *ad hoc* screened-off areas of thatch or palm-leaf. Of these two methods, the visit to the family group is often preferable, as the family composition can be observed and only one station is required, making for greater simplicity in the line of flow. Whichever is chosen, undressing rooms or screened-off areas are required. In the family-group examination, two to three rooms are needed in order to ensure a continuous flow.

Even where privacy has been arranged, the examination of the genitals for scrotal or vulval dermatosis may be resisted. A further problem will arise if urine samples are collected. Either separate urine-passing rooms or screened-off areas will be needed for each sex; collection may be attempted at the time the clinical examination is made.

The requisite number of stations and the line of flow will have been determined in the planning phase. The degree of simplicity of each station will depend upon its function and on the facilities available, and improvisation will clearly be called for. A certain amount of basic furniture will be necessary, such as four chairs (two for the team, one for the person to be

examined, and one for the local assistant/interpreter) and one or more tables (e.g., a small table for the clinical examination and one or two large tables for laboratory specimens).

Stations should be so placed that they are in the actual line of flow. They should not be near enough to one another to cause possible confusion and noise, or too far apart to give rise to difficulties in directing people. Thirty metres normally represents a reasonable distance. It will probably be found advantageous to place the station at which most time has to be spent close to the start of the line of flow.

Example of lines of flow: community child health surveys in East Africa

As an example, the line of flow normally applied in the community child health surveys in East Africa will be described. These surveys are carried out on young children, so that questions of modesty do not enter into the clinical examinations, which can, if necessary, be undertaken in the open air.

Five stations are ordinarily employed, in the following sequence: (i) identification; (ii) anthropometry; (iii) clinical assessment; (iv) laboratory specimens; (v) dietary inquiry.

(i) *Identification station*

At the first station, a survey form is issued to each person on which is listed the survey date and number, the person's name (and, if this is not culturally specific, other data, such as " child of "), sex, age, group or tribe, religion, if relevant, and village, town or area.

This form has to be kept by the individual, or the child's mother, until the last station has been reached; it is then collected. It is most important to ensure that the data obtained at each station are consistent—i.e., that they refer to the same subjects. At each station the form must be checked before examination, in order to obviate any confusion with the numbering, which can occur very easily and, once it has developed, prove difficult or even impossible to sort out in a crowded rural survey.

The station can be manned by one team member, assisted by one or two clerks who have been shown the routine but who will need to be supervised closely if errors in numbering are to be prevented. A local policeman or other responsible person can sometimes be persuaded to control the flow of persons so that they present themselves one at a time. A local schoolboy or other volunteer can carefully direct the person to the next station after the form has been completed.

If it has proved difficult to make an accurate age-assessment, this may be attempted by means of an " events calendar " (Table 3, p. 60) at the first station, in which case an additional team member familiar with the local language will be required. Alternatively, the assessment may be made later

—on a sample of the persons seen—either at a separate station, or in conjunction with the dietary inquiry station.

If some of the team members do not speak the local language, those who do should be deployed where they will be most needed (e.g., age-assessment and dietary inquiry). In addition, where language problems exist, as many as possible of the local volunteer assistants should be bilingual.

(ii) *Anthropometry station*

At the second station, anthropometric measurements are carried out. Again, two local volunteers will be required, the one to direct the line of persons waiting, and the other to guide people to the next station.

Weighing machines and length-measuring apparatus should be set up on flat surfaces. A length-board for young children may be placed on a large table.

For the measurement of adults, two persons are needed: a team member to do the measuring and a trained clerk or assistant to record it. For young children, two more volunteer assistants are needed, to hold the child while the measurements, etc. are being taken. The results should be announced clearly, occasional checks being made to ensure that they have been correctly recorded. They are recorded in the appropriate spaces on the survey form.

In addition to anthropometric instruments, two tables (one small for the recorder, one large for the length-board) will be required, with 3 or 4 chairs.

(iii) *Clinical assessment station*

Again, two local volunteers are used, for controlling the queue and directing people to the next station.

Clinical assessment is carried out by one of the team physicians, who has at hand a list of the signs to be looked for. These will have been typed, in the order in which they are to be sought, on a piece of paper affixed to a sheet of cardboard and covered with cellophane. The examiner can then check through the list (e.g., oedema—negative; Bitot's spots—positive, etc.). Each sign and its result are read aloud by the physician and marked appropriately as positive or negative on the clinical assessment sheet (see Fig. 46) by a trained clerk or assistant, whose work must be continuously scrutinized.

The person being examined should be in a good light and wearing as few clothes as possible. In the case of adults and school-age children, this will usually consist of shorts or drawers; young children should be examined naked. An approximately head-to-toe sequence of inspection is best followed, with palpation (e.g., liver, spleen, muscle wasting, pre-tibial oedema, etc.) done after this. Auscultation is not usually needed, and, in any case, it is difficult to hear sounds such as cardiac murmurs in the noise attending most surveys. However, the physician should wear a stethoscope

in case it is needed for a particular sick person who may be discovered—for example, a child with respiratory tract infection, and also as a token that the team is a genuine medical one, with a doctor present to examine and treat the sick.

Whilst most signs should be reported as " positive " or " negative ", and the recording of grades of positivity is not recommended, certain signs may sometimes be given some qualitative definition. For example, in the East African child health surveys the shade of dyspigmentation of the hair is stated, e.g., RB = red brown.

In addition, unexpected findings may be briefly noted in the space reserved for this purpose. The clinical assessor should also carry a small notebook for the recording of his observations.

In the case of young children, the state of eruption of the teeth should be recorded according to correct dental convention (Fig. 32), as this may help in confirming the estimated age.

A minimum of equipment is needed. Apart from a stethoscope, only the check list of signs, pencils, one small table and three or four chairs are usually required. A pocket torch and a box of wooden tongue depressors should be at hand for the examination of the mouths of recalcitrant young children. It is useful to have a reference book, such as the present volume, available at the station, with descriptions and illustrations of clinical signs. It may also be helpful to have a chart of local hair colours at hand.

(iv) *Laboratory station*

At the fourth station, samples are taken for subsequent biochemical or other tests. It is at this station that cross-cultural clashes are most likely, as the taking of a " piece " of the body, especially blood, may be considered, in some rural groups, to be intended for an occult purpose, particularly if blood is taken by a woman wearing lipstick. However, misunderstanding may sometimes help, as in Haiti, where finger-prick blood collection for thick-film examination for malarial parasites was equated with a popular and highly successful penicillin anti-yaws campaign that had been carried out in preceding years (Jelliffe & Jelliffe, 1961).

It will be found expedient in the first place to examine, and take samples from, the local dignitaries—in Africa, the chief's family—and educated people, such as the schoolteacher, both as a matter of courtesy (especially as they will usually be helping the survey team) and as an example. Should any of the procedures prove unacceptable, especially the collection of blood samples, they may have to be deleted and the programme modified. The taking of venous samples from young children cannot be recommended, for the insertion of a needle into the jugular vein in the neck or the femoral vein in the groin, though safe, routine procedure in hospital practice, is understandably alarming to rural mothers.

The taking of samples for laboratory tests should, wherever possible, be carried out in the privacy of a room, partly to allay the fear of waiting children and parents. A sweet or a lump of sugar should be given to each child at the end; otherwise the fear experienced is likely to be communicated to other children waiting in line and to intensify their anxiety and resistance.

Flies, which can rapidly ingest a blood sample from a slide may complicate the taking of specimens, as can wind-blown dust. Appropriate measures must be taken.

Whatever the number and type of samples taken, the collecting apparatus —needle or syringe and correct containers—must be at hand in the proper place on the table used in the field as a laboratory bench. Similarly, equipment for sealing or closing tubes or containers, items for labelling (e.g., grease-proof pencil, ball-point pen), and boxes or thermos flasks for specimens must be available in selected places.

The detailed routine for taking specimens cannot be discussed here. In fact, it is necessary for those carrying out the sampling to devise a routine based on time-and-motion studies carried out before leaving for the field. Minor differences in practical technique can mean an increase in efficiency, as judged by the fatigue of those engaged in collecting the samples and by the numbers that can be dealt with in a given period.

Each member of the laboratory group must know his detailed function and how to carry it out speedily, with economy of movements and a minimum of interference with his co-workers.

Ideally, two laboratory workers are needed, one to take the sample and the other to have the container ready and seal it, to label it and place it in the appropriate box or thermos flask, and to record the tests taken from the person, both on the survey sheet and in a record-book.

As noted earlier, blood samples from adults and older children are collected from venous blood with a Vacutainer (vacuum tube) with a disposable needle attached to a plastic tube or with a syringe, or from capillary blood by finger-prick. The latter technique is the only one for young children in field circumstances. A heel-prick is found to be more suitable by some workers.

Stool samples may be brought in by families in containers that have been distributed at least the day before. With illiterate groups there is the difficulty that the containers cannot be labelled in advance by the survey team or by educated local volunteer assistants, nor can they be labelled by the subjects themselves. There may thus be confusion in identifying the samples.

There may also be a lack of co-operation, so that few stool samples are brought in. This may be due to misapprehension, suspicion of witchcraft, distaste for the task, or a cultural prohibition on contact with excreta. On receipt, the stool samples must be correctly labelled, and without delay—in any event on the same day—stool preservative (10% formol

saline, MIF, etc.) can be added, if only a small specimen has been brought. If too large a sample has been submitted, a small portion will have to be transferred to another container and preservative added. Plainly, it is better merely to add preservative to the initial sample. For this, a small specimen of stool the size of a pea or other locally known object of similar size should be requested in clear terms.

For young children, a stool sample is best obtained by means of the anal-tube technique. This is not advisable in the case of infants, especially in the first six months of life, as the stool is too liquid or semi-solid. In pre-school-age children, a practised operator can obtain samples from about 75% of the children. The disadvantage of the method is that the sample is very small. After removal of the tube from the anus, the core of stool is poked out of the tube with a wooden applicator into a small flat-bottomed screw-capped vial, containing 1 ml of 10% formol saline.

Urine sampling is always difficult. As noted earlier, random samples may be collected from adults in the privacy of the clinical assessment, special rooms may be set aside, or an available latrine used for the purpose. For young children, special collection techniques may be employed, particularly for males, but they are very difficult to apply at a crowded survey site; alternatively, mothers may be asked to " catch " a specimen in a plastic jar supplied to them at the survey site. Fasting samples of urine are usually impossible to guarantee with any certainty.

The laboratory samples taken from each subject can be checked on the survey form by means of ticks at the side of the appropriate space. The laboratory results can be filled in later when they are available.

Apart from the two laboratory workers and the two local volunteers for directing and controlling the flow, a further local assistant, preferably bilingual, will often be required for explaining, reassuring and, in the case of frightened young children, assisting the mother to restrain the struggles of her child.

One or two large tables will be required, together with a minimum of four chairs. A plastic basin, soap, towels and, if necessary, a light plastic jerry-can of water should be brought by the team to the station.

(v) *Dietary inquiry station*

In the East African child health surveys, the last station deals with the questioning of mothers about the diets of their young children. This has to be done by a relatively senior team member, fluent in the local language and preferably belonging to the same community.

As the task calls for unhurried care, not all the mothers can be questioned, and some system of statistical sampling has to be adopted. A suitable form for this rapid dietary inquiry will be required, and will have to be based on some background knowledge of local foods and cooking practices. It is

useful to have a range of local measures and utensils at hand—spoons, cups, bottles and gourds—to help the mothers to reply accurately.

Mothers should be asked solely about their children's present diet, without reference to the dietary progress in the past. Direct questions should be avoided. Replies are likely to be approximate and inaccurate, and the item that can be verified by observation at the survey site, at least in some traditional societies, is whether the child is still breast-fed or not.

In addition, at this station drugs are issued according to the written instructions of the physician at the clinical assessment station. The survey form is collected from each person and placed in a large envelope.

The staff for this station will consist of one team member and a junior medically-trained assistant to dispense drugs and give other treatment. Both will have to speak the local language. One local volunteer assistant will be required to direct the flow. Apart from dietary inquiry forms and medicines, one or two small tables will be required and three chairs.

Rapid ecological visits

Concurrently with the prevalence survey, rapid ecological visits will be carried out, and information obtained from local hospitals and health centres, and from collection points for vital statistics.

General remarks

It is evident that the stations and line of flow will vary in detail from one survey to another. In planning the line of flow, it should be borne in mind that the activities at certain stations (e.g., collection of laboratory samples; dietary inquiry) take much longer than at others (e.g., clinical assessment). The time required at each station should be tested in advance of the survey. A selective system may have to be introduced, whereby only a proportion (e.g., 20%) of those attending go to the stations at which the examinations, etc. are protracted.

The question of operator fatigue is of importance. Where practicable, team members should have rest periods or, if qualified to do so, move from one station to another.

Public relations

Adequate preliminary explanations to the local authorities and leaders, the provision of medicine for the sick, a sympathetic and friendly approach, and—not least—the unusual " circus " appeal of the team's visit to rural areas are normally sufficient to ensure attendance.

Nevertheless, cross-cultural problems may arise, as, for example, among the San Blas Indians of Panama who consider disease to be due to " soul abduction ", with the result that a survey based on modern concepts was neither easily acceptable nor relevant (Jelliffe et al., 1961b).

Regard must, of course, be had to local conventions and customs in the matter of social salutations and greetings, behaviour during home visits, and the choice of clothing. The families of local leaders and dignitaries should be the first to be examined, both as a matter of courtesy and as a means of inducing wavering members of the community to follow their example. Luncheon should be arranged for some of the local volunteer assistants, and possibly for the local leader also, at which the organization of the survey could be discussed, and queries about local customs raised in a discreet and friendly manner.

Finally, on completion of a survey, an abridged report drafted in general terms should be sent to the local authorities (subject to the concurrence of the central authority concerned). The customary letters of thanks will, of course, go to all who have assisted.

Daily programme

The day's programme obviously should start as early as possible. The hour chosen will depend upon the distance of the collecting point from the team's quarters and the time needed for the population to travel, often on foot, to the survey site. The local leaders should be consulted.

In the evening, the laboratory workers must ensure that samples are packed or, if necessary, stored in a refrigerator, as well as attend to other work that has to be done in the field, such as staining thick blood films with Giemsa and checking the next day's supplies.

Finally, the whole team should meet to exchange impressions, discuss problems and decide upon any necessary changes in procedure. A member of the team should be detailed to make the day's entry in a survey log book or field diary: this should list the place visited, the number seen by age-group and by examination (e.g., clinical, laboratory tests), the names of the principal persons met, the number of houses visited by the rapid ecological visit group, general impressions and organizational problems. Cultural practices observed may also be discussed and a précis included in the field diary.

ANALYSIS, INTERPRETATION AND ACTION

The purpose of this phase of survey work is to determine, through analysis of the data obtained, whether or not the nutritional status of the community is satisfactory. The analysis of the facts gathered is followed by their collective interpretation in relation to the local ecology.

Forms of malnutrition of local importance as public health problems can then be defined, together with the probable causative factors. Finally, plans for remedial action must be suggested. The data and the conclusions drawn therefrom must be presented logically and clearly to ensure the understanding, co-operation and support of the administration.

The present section deals with broad principles. The problem of expressing results for certain special groups (e.g., young children) will be considered.

Analysis

Analysis of the data will be easier if the forms have been prepared with the assistance of a statistician.

Some results can be worked out by hand, in particular the simpler data such as the percentage of a population with a given physical sign. This is, however, time-consuming, even with the aid of logarithm tables, slide-rule or calculating machine. There is also the risk of mathematical error.

If punch-edge cards of the Cope-Chat or McBee type are used, findings will be recorded in the field in the centre of the card. Later, positive findings can be marked on the same card by slotting the suitably numbered edge-holes, and then sorted by hand with a special knitting-needle.

Where practicable, data may be transferred from the survey forms to punch-cards of the IBM, ICT or similar type. The task is greatly facilitated if the survey forms bear the punch-card code numbers, against each item recorded, when the punching operation can be carried out with no intermediate step. Sorting and analysis can then be done by an electrical counter-sorter.

If a very detailed analysis is required, including, for example, multiple correlations, data on IBM or ICT cards can be used for analysis by a digital computer. While the actual analysis of data is extremely fast, highly specialized programming is required before it can be carried out. This is likely to be time-consuming, especially as many computers have only one programmer dealing with a flow of projects of many types.

If mechanical sorting, with either an electric counter-sorter or an electronic computer, is the process chosen, the programme must be planned in advance with the machine operators.

Grouping of results. The data may be analysed for the whole population, if desired; they should, however, be grouped in various ways according to the local circumstances. Results may be analysed by age-group, sex, socio-economic standing, ethnic group, religion or other classification.

Age considerations

There are four principal problems with regard to age in the analysis of survey data:

(*a*) *Age estimation.* The difficulties with regard to estimating age, especially of children in developing countries, have been discussed on page 58.

(*b*) *Age standards.* The need for anthropometric standards appropriate to the stage of life is self-evident. What is less appreciated is that different

biochemical and haematological standards are also needed. In some cases, these are not available: adult standards may have to be used tentatively. As some of the standards given cover age intervals that are longer than those required in practice, interpolation will be necessary for the intermediate age-levels—for example, an assessment of the significance of the triceps skinfold of a 5-month infant will be based on interpolation between the standards for a 3-month infant and those for a 6-month infant (Annex 1, Table (5)).

(*c*) *Age abbreviation.* If ages are grouped broadly, the question of method of " age abbreviation " has to be considered. It is suggested that this should be to the nearest unit, e.g., 12 years and 5 months should be recorded as 12 years, and 4 years and 9 months as 5 years. Ages at the halfway point should be recorded to the next higher unit (e.g., 7 years and 6 months should be recorded as 8 years).

(*d*) *Age-groups.* Certain well-recognized, broad age-groups can be used: infants (birth to 11 months); pre-school-age children (1-4 years; 12-59 months); school-age children (5-15 years); young adults, 16-35 years; adults, 36-55 years, old adults over 55 years. The term " young children " is used in the present work as a convenient, if approximate, term to include both infants and pre-school-age children.

Results in children are often given—depending upon the investigation—in 3-month age-groups for the first year of life, in six-month or yearly groups for children of 1-5 years, and in yearly groups for school-children.

Within these groups, the degree of differentiation by smaller age intervals depends on the type of examination, the standards available for comparison and the need to pin-point the age-incidence of a given type of malnutrition. For example, for the identification of infantile beriberi as a public health problem, mortality in the first year of life, if recorded with sufficient accuracy, may be broken down into monthly intervals in order to assess the number of deaths occurring in the characteristic 2-5 month period. Similarly, it is most valuable to consider the first years of life year by year, and to view the second year of life (12-23 months) in isolation with regard to clinical signs and anthropometric measurements in protein-calorie malnutrition, as this is usually the main danger period for this condition.

Expression of results

Data from nutritional surveys are largely concerned with the prevalence of certain clinical signs, or with the results of biochemical tests or anthropometric measurements, both of which are expressed as figures. Special attention is given later to the problem of the presentation of data for protein-calorie malnutrition (page 198).

Clinical signs

The positive clinical signs found should be reported initially as " percentage of positives " for each sign in the total population examined, and in each broad age-group, e.g., infants, pre-school-age children, school-age children and adults. A further break-down of results into smaller age-groups and by sex will often be required, especially for adults, because the cumulative strain of continuous reproduction often results in severe malnutrition in women.

As noted earlier, no diagnostic conclusion can usually be drawn from the high prevalence of a single sign. However, in order to assist interpretation, positive signs may be considered together in two ways. First, the positive signs present should be listed together in accordance with the grouping of signs suggestive of various deficiencies (see page 43). Secondly, the percentages of the total population, or of specific age-groups, which show combinations of three or more suggestive signs listed in the different groups should be calculated. Thus, the pre-school-age segment of a population surveyed might be found to have 23% positive with a combination of three or more signs regarded as suggestive of protein-calorie malnutrition of early childhood (see page 43).

Nutritional anthropometry

Results from nutritional anthropometrical measurements should be reported in two ways: (*a*) mathematically; and (*b*) in relation to standards of reference.

(*a*) *Mathematical reporting.* Measurements in figures should always be given for each relevant age-group and sex as the mean plus or minus twice the standard deviation ($\pm$ 2 S.D.).[1] These mathematical figures are required in order to ensure an understanding of the results by other workers, and, if need be, to permit further interpretation (including construction of percentile levels), and analysis or comparison of the findings to be made in the future.

The reporting of results in relation to percentiles of the standards is not recommended because this mathematically correct procedure is not easily understood by junior health personnel or administrators, while in less-well-fed communities a high proportion will fall without differentiation into the " below 3rd percentile " level.

(*b*) *Reporting in relation to standards of reference.* Anthropometric measurements must also be expressed in terms of standards of reference. As noted earlier, it is recommended that each measurement be compared with two standards—a general standard of reference and a local standard of reference.

If no local standards are available, comparison can be made only with the general standard. The advantages and problems of using this somewhat

[1] Falkner (1962a) gives an excellent simplified account of mathematical considerations of anthropometry.

arbitrary yardstick are discussed on page 56. Sometimes a regional standard—from a near-by country with a population of similar genetic composition—may be available in place of a strictly local standard.

With the exception of the problem of obesity in more privileged parts of the world, the anthropometric assessment of malnutrition in the community is concerned exclusively with enumerating those who fall in varying degrees below the standard measurements.

The method of expressing the degree of inadequacy has to be easily understandable to junior staff and simple to calculate. It must also permit of easy comparability between one group and another, while, at the same time, precluding the drawing of unduly broad conclusions.

For these reasons, it is suggested that anthropometric measurements in community prevalence surveys should be reported in relation to 10% categories below the standard. Suggested general standards of reference [1] in metric measurements are set out in the 19 tables in Annex 1.

By the use of the appropriate table, the percentage below standard can be read off, and results for a community expressed as percentages in the suggested 10% categories.

For example, in a community survey the weight for age of pre-school-age children might be found to be distributed as follows:

over 90% standard	30%
90-81% standard	35%
80-71% standard	20%
70-61% standard	10%
60% standard and below	5%

This type of classification has one obvious disadvantage. It does not record the normal range of distribution of anthropometric measurements, and will therefore include some non-malnourished but genetically small persons in the lesser degrees below the standard. Nevertheless, it is simple, practical and easily understood, and it is recommended that the anthropometric results of field surveys of communities should be expressed both mathematically and in this manner, in relation to the general standards of reference given and to the local standards of references, where such exist.

Biochemical tests

The results of biochemical tests should be presented for the total population investigated, if appropriate, and also broken down into the main age-groups and for both sexes, especially for adults.

[1] The general standards of reference have been derived from the following sources:
Young children: Harvard Standards (Stuart & Stevenson, 1959), except for triceps skin-fold (Hammond, 1955a), arm circumference (N. Wolanski—personal communication, 1964), and weight-for-height figures (Stuart & Stevenson, 1959);
School-age children: Baldwin-Wood Standards (Baldwin & Wood, 1923), except for triceps fat (Hammond, 1955b) and arm circumference (O'Brien, Girshik & Hunt, 1941);
Adults: Actuaries Standards (Society of Actuaries, 1959), except for triceps fat (Brozek, 1956) and arm circumference (Hertzberg et al., 1963; O'Brien & Shelton, 1941).

The results should be expressed mathematically as the mean plus or minus twice the standard deviation. In addition, they should be presented as percentages falling into different ranges of values. These may be given tentative labels (e.g., " low ", " deficient "). However, with the exception of a low haemoglobin, the labels given must be interpreted with extreme care in view of the inadequate state of knowledge concerning possible variability in different ecological circumstances, especially in relation to prolonged adaptation to dietary patterns. Suggested guides to the interpretation of biochemical and haematological findings are given elsewhere.

Dietary assessment

Where detailed food-consumption studies have been carried out, Reh (1962) recommends that the results should be given as the difference for the group between observed consumption and the suggested allowances for all nutrients, expressed as percentages. She advises against the labelling of groups as " undernourished " or " malnourished " in respect of one or more nutrients on the basis of food-consumption studies alone.

If outline information has been obtained by means of a questionnaire and observation during rapid ecological visits, the results can be expressed as percentages of persons or families stating that they eat certain foods. In young children, analysis can often be made in three-month groups for the first year (e.g., birth to 3 months; 4 to 6 months, etc.), and in six-monthly periods thereafter. In all cases, it must be stressed that this information is at best only qualitative, giving an extremely approximate outline of the general dietary pattern.

Other ecological data

Similarly, other information concerning the ecological background, including conditioning infections, cultural influences, socio-economic factors and food production, gathered by means of observation and questionnaire, can be expressed as percentages of families or people in different age-groups having certain characteristics. Again, the superficial and approximate nature of findings obtained in this way must be stressed.

Results with regard to malaria (e.g., parasite and spleen indices) permit the degree of endemicity to be expressed.

Interpretation

Nutritional surveys—both prevalence and incidence studies—are epidemiological investigations into the nutritional status of a population by various direct and indirect methods, together with an evaluation of the determinant ecological factors in the environment.

They are attempts to make a community diagnosis, and, as with the diagnosis of illness in an individual, information obtained by several

methods is usually required. Thus, while in clinical medicine a diagnosis may very occasionally be made on the basis of one pathognomonic sign, such as the rash in herpes zoster, more usually information obtained by several means is required, including the history, clinical examination, radiology, biochemical and haematological tests.

Similarly, the diagnosis of certain limited types of malnutrition in the community can occasionally be strongly suggested on the basis of one clinical sign only, as with iodine deficiency and goitre, or of one test as with a low haemoglobin and iron deficiency. Yet, even with these examples the possibility of factors other than nutritional deficiency, including goitrogenic substances in the diet and malaria (respectively), has to be considered. Moreover, at times, advanced syndromes of a particular deficiency may be readily identifiable, such as kwashiorkor and nutritional parasmus, but give no idea of the prevalence of more common, less advanced forms of protein-calorie malnutrition of early childhood.

All the methods that can be used for the assessment of the nutritional status of a community are individually imperfect, inaccurate and subject to their own technical errors. It is therefore particularly important to avoid drawing sweeping conclusions based on limited evidence. The literature is full of examples of the unwarranted use of survey results.

The assessment of the nutritional status of a community must, then, be based on a thoughtful consideration of all available findings and information (Table 17).

Although valuable information can certainly be obtained with less than the complete range of methods, which usually cannot be applied on many small-scale prevalence surveys, the probability of obtaining a valid picture of the nutritional condition of the community in its widest sense increases if various approaches can be employed in conjunction. The different methods are aimed at assessing quite diverse aspects of human nutrition, ranging from food production to cellular metabolism. Not only do they permit of a wider understanding of the causes and effects of malnutrition in the area, but the results obtained by the different methods can be used collectively to confirm or diminish the probability of a particular deficiency's being present in the community (Krehl & Hodges, 1965).

The evaluation of the combined information gathered from the various methods of assessment should be aimed at delineating, as thoroughly as the complexity of the survey warrants, the following:

(*a*) the principal deficiency diseases in the community in different age-groups, and their priority;

(*b*) the probable causative factors.

In the more usual short-term cross-sectional surveys with which this monograph is principally concerned, prevalence figures will be obtained, together with approximate incidence data at hospitals and health centres,

TABLE 17. INFORMATION USEFUL FOR ASSESSMENT OF NUTRITIONAL STATUS *

Sources of Information	Nature of information obtained	Nutritional Implications
(1) Agricultural data Food balance sheets	Gross estimates of agricultural production Agricultural methods Soil fertility Predominance of cash crops Overproduction of staples Food imports and exports	Approximate availability of food supplies to a population
(2) Socio-economic data Information on marketing, distribution and storage	Purchasing power Distribution and storage of foodstuffs	Unequal distribution of available foods between the socio-economic groups in the community and within the family
(3) Food consumption patterns Cultural-anthropological data	Lack of knowledge, erroneous beliefs and prejudices, indifference	
(4) Dietary surveys	Food consumption Distribution within the family	Low, excessive or unbalanced nutrient intake
(5) Special studies on foods	Biological value of diets Presence of interfering factors (e.g., goitrogens) Effects of food processing	Special problems related to nutrient utilization
(6) Vital and health statistics	Morbidity and mortality data	Extent of risk to community Identification of high-risk groups
(7) Anthropometric studies	Physical development	Effect of nutrition on physical development
(8) Clinical nutritional surveys	Physical signs	Deviation from health due to malnutrition
(9) Biochemical studies	Levels of nutrients, metabolites and other components of body tissues and fluids	Nutrient supplies in the body Impairment of biochemical function
(10) Additional medical information	Prevalent disease patterns, including infections and infestations	Interrelationships of state of nutrition and disease

* Adapted from WHO Expert Committee on Medical Assessment of Nutritional Status (1963).

while long-term studies will reveal the incidence in the community itself.

Statistical guidance will be needed for the assessment of the findings. At the same time, it is salutary to note the comment of Gordon (1963): " Modern methods of machine tabulation, computer analysis and statistical manipulation have obvious value in dealing with long-term projects with many data, but the interpretation of results remains rooted in the value judgements of workers in the field."

Presentation

The presentation of data may often be organized at two levels. First, in order to speed up any action that may be considered necessary, a short, lucid typewritten synopsis of the main findings should be sent as soon as possible to the appropriate authorities in the country. The analysis of data always takes time, and, if a preliminary report is not presented, further extensive delays will occur before the final draft, with tables, graphs, etc., is ready, and one or two years may pass before the report is finally published and reprints made available.

Secondly, a fuller and more detailed report of the survey is needed, whether published or not. This main report should be clear and logically developed, with figures for the most part kept out of the text and incorporated in tables, graphs or histograms. It should be as detailed as possible, although editorial policy usually insists on limiting the text to the essentials.

Obviously, the method of presentation will vary with the purpose and scope of the survey, with the object and range of the report, and with individual preference regarding style and emphasis.

In general, however, the report should contain the sections described in the following paragraphs.

Background data

These will comprise a brief account of the area, often illustrated with a map, containing information about the particular community, including its culture pattern and ethnic groups, the geography and climate, including communications, the social development, including level of education, schools, information on economic status, food production, including processing and storage, health facilities and demographic data, including the population and its age and geographical distribution, and morbidity and mortality statistics.

Purpose of survey

A general definition of the purpose of the survey is required, perhaps with an explanation of the reasons for carrying out the particular study in the area.

Methods employed

This section will contain a description of sampling procedures, practical methods used in field work, including pilot projects, and the details of the techniques employed in the clinical assessment, including definitions of signs looked for and control of observer error, in the biochemical estimations (with references to the published accounts of the techniques), in the anthropometric measurements, including the instruments used, in the dietary investigations, including food-composition tables used, in the assessment

of ecological factors, and in the gathering of information concerning local health statistics. Copies of questionnaires used should be attached.

Results

These are usually best presented in tabular form under the heading of the particular method of assessment (clinical, biochemical, etc.) broken down by broad age-groups and by sex, where necessary.

The tables showing the results of the clinical examination should show the numbers examined and the percentages positive with different signs. These can be more meaningfully presented in the "groupings of signs" suggestive of various deficiencies given earlier. If necessary, a separate table may be required for a presentation of three or more suggestive signs in combination.

Both biochemical and anthropometric results are shown in figures (e.g., units, grams, centimetres). These can be presented in a table giving the numbers examined and the mean (average) result plus or minus twice the standard deviation ($\pm$ 2 S.D.) for each group.

The biochemical findings should also be given as percentages falling within certain specified levels. Thus, with haemoglobin findings in pregnant women, where the standard is 10 g/100 ml, levels should be given as: 10 g to 8 g, 17%; 8 g to 6 g, 21%; etc., or if space permits, presented as a histogram. Sometimes it may be feasible to show biochemical findings that fall below the standard of reference in tentatively labelled groups, e.g., " low ", " deficient ". The uncertainty regarding the universal correctness of these labels is emphasized by the inverted commas.

Anthropometric measurements should also be expressed in a simple, understandable way by means of percentages of the population examined that fall in various 10% levels below the standard of reference, e.g., 90%–81%; 80%–71%; 70%–61%; 60% and below. As suggested earlier, presentation should, if possible, be given in relation to two yardsticks—the general standards of reference and the local standards of reference. To emphasize the differences between the results obtained and the standards, graphic presentation, though not essential, may be helpful.

Data on ecological factors may be presented in tables. Much of the information is, however, semi-qualitative and can be given descriptively.

Photographic illustrations in the report may be of value in describing various ecological circumstances, showing examples of the types of malnutrition, and illustrating techniques and methods. Their reproduction is, however, costly, and they take up considerable space. Perhaps the main value of a limited number of photographs is in supplementing the descriptive account of the local people and their way of life, and ensuring that the reader receives a clear impression of the subjects and the site of the survey.

Discussion

(*a*) *Correlation of evidence.* Essentially, this will be concerned with a consideration of the positive findings and the collective evidence they provide of the presence of different types of malnutrition in the several age-groups in the community. At times it may prove impossible to attempt anything beyond a forecast requiring fuller investigation—for example, therapeutic trials or additional biochemical tests.

(*b*) *Ecological diagnosis.* The deductions must be correlated with the ecological factors that appear to be etiologically relevant in the particular region. From the analysis of all the data available, suggestions can be made for future action.

(*c*) *Recommendations for future action.* The aim of public-health investigations is to improve the health of the public. They should not become mere academic exercises undertaken in a spirit of scientific curiosity. Responsible officials and administrators should therefore be associated with the investigations at an early stage, and a summary of findings, interpretations and suggestions should be sent to them without delay.

Action

Follow-up surveys may be necessary to note the development of certain nutritional trends (e.g., in infant feeding or in an apparent increasing incidence of some form of malnutrition) or to assess the effects of recommended preventive measures.

Apart from follow-up surveys, further investigation may occasionally be desirable in order to clarify some of the results obtained. Therapeutic trials or more detailed and specific biochemical tests on selected groups may be indicated. The etiological factors may have to be identified with greater precision, or the value of the preventive measures investigated scientifically.

Specific recommendations for action must be realistic in terms of needs, cultural, social and economic considerations, existing and potential resources and health and educational services. They should be clearly set forth in strict order of priority. Thus, the prevention of doubtful subclinical deficiencies should not receive undue emphasis if severe forms of malnutrition with a high incidence and mortality are common in some age-groups; it is obviously incorrect to give prominence to a recommendation for an expensive and difficult campaign to iodize salt in a rural tropical community where goitre is moderately prevalent as a largely cosmetic clinical entity, when a high percentage of pre-school-age children in the same region are dying of kwashiorkor.

Obviously, the range of recommendations may vary widely. They should be aimed at the most important potentially preventable etiological factors

responsible for the particular forms of malnutrition. Detailed study of possible recommendations is beyond the scope of the present monograph, but the following are likely to merit consideration: improvement of health services, especially for mothers and children; agricultural improvements, including increased production of protein foods, storage, processing, distribution and marketing; health education (MCH services, schools, etc.); legislation, including fortification of foods, rationing and minimum wage-levels; supplementary food programmes for young children, pregnant and lactating mothers, and schoolchildren; and the prevention of infective diseases, through immunization, improved water-supply, anti-malaria measures, etc.