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GUIDELINES FOR THE DEVELOPMENT OF A FOOD AND NUTRITION SURVEILLANCE SYSTEM FOR COUNTRIES IN THE EASTERN MEDITERRANEAN REGION

Based on the Deliberations
of a
WHO/FAO Intercountry Meeting on
Nutrition Surveillance
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In the Name of God, the Compassionate, the Merciful

FOREWORD

by

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Nutrition surveillance is increasingly being recognized as a necessary tool for monitoring the food and nutrition situation in a country, especially among the disadvantaged population groups and in nutritionally backward areas, so that early action may be taken if the situation deteriorates. Through such a system, food and health planners are able to gain insight into nutritional trends over a period of time, information that is vital to forward planning and policy formulation. Similarly a tool such as this is invaluable to health administrators in the planning, management and evaluation of health and nutrition activities.

There is a great deal of evidence to indicate that, in times of disaster, emergency relief operations and supplies, however abundant, generally do not serve the purpose for which they are intended and usually fail to prevent large-scale death and destruction. This is largely because of a lack emergency preparedness. From the standpoint of nutrition, the use of food and nutrition surveillance methodologies as the basis of an early warning system for predicting emergency situations, such as drought and famine, is an area of considerable importance to several disaster-prone countries of this Region. Moreover, it is vital for those countries where chronic malnutrition already prevails and is periodically exacerbated to an acute degree by such emergencies.

I would like to emphasize the importance of actually using the output of a nutrition surveillance system. Without a clear indication of the uses of such a system and a commitment to take action on a regular basis, its development is a waste of time and resources, similar to conducting time-consuming expensive nutrition surveys with no attempt at utilizing the results. However, if properly planned and executed, a nutrition surveillance system is an essential tool for the effective functioning of a national food and nutrition policy. As I have mentioned, it is of invaluable assistance to health and nutrition planners; it can also be of great use to

the managers of any development programme with health and nutritional objectives, to policy and decision-makers in both the food and agriculture sectors and to national development planners. Obviously, the precise nature of a surveillance system will depend upon the needs of the target population.

An intercountry meeting on nutrition surveillance jointly held by WHO and FAO in Islamabad, Pakistan, in October 1988, was attended by experts from fourteen countries of the Region. They exchanged views and experiences and developed guidelines for formulating a national nutrition surveillance system. This booklet is the outcome of that meeting, and I do hope that it will be of considerable help to the Member States of our Region in developing their own national nutrition surveillance systems.

PREFACE

Food and nutrition surveillance is a mechanism by means of which information relating to the food and nutrition situation in a country is obtained on a continuing basis to enable close monitoring of the nutritional status of the population in different regions of the country so that appropriate measures may be taken, if and when it becomes necessary. As such, a nutrition surveillance system is a basic requirement of a national nutrition policy or strategy, without which such a policy or strategy cannot be institutionalized. It uses certain preselected indicators and processes this information according to a predetermined pattern.

While the use of health indicators such as mortality and morbidity data to monitor the health situation of a country is now common practice, food and nutrition surveillance is not yet established practice in most developing countries. However, a number of countries in the Eastern Mediterranean Region are seriously considering the need for such a system as a prerequisite for a national food and nutrition policy.

In October 1988, the Regional Office for the Eastern Mediterranean Region of the World Health Organization, in collaboration with the Food and Agricultural Organization of the United Nations, convened an intercountry meeting in Islamabad, Pakistan, which was attended by experts from several government sectors of fourteen countries of the Region. The aim of the meeting was to exchange experiences and to make recommendations which would assist countries interested in developing a food and nutrition surveillance system. Based on the deliberations of the meeting, simple guidelines were developed for this purpose and are now presented in this publication. The names and designation of the participants are presented in Annex 11 and their contributions in this respect are gratefully acknowledged.

The aim of presenting the guidelines in this booklet form is two-fold: to acquaint senior administrators and decision-makers with the facts of nutrition surveillance; and to provide technical personnel with information on indicators. To this end the booklet is in two sections. The first section presents the basic facts regarding nutrition surveillance for senior administrators and decision-makers, and advocates for its use. The second section comprises, for the most part, a number of information annexes useful to technical persons responsible for developing and

implementing such a surveillance system. It is hoped that the booklet will serve the purpose for which it was prepared and that governments will soon be able to take the positive action required to make malnutrition and food and nutrition emergencies aspects of the past. The booklet was compiled by Dr K. Bagchi, WHO Consultant in Nutrition and in charge of the Nutrition Unit in EMRO, and Dr W. Keller, Short-term Consultant in Nutrition, EMRO. The compilers would like to acknowledge the secretarial support given by Miss Baheya El Sherif, EMRO.

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SECTION I

DEVELOPING A NUTRITION SURVEILLANCE SYSTEM

THE FACTS

DEVELOPING A NUTRITION SURVEILLANCE SYSTEM
THE FACTS

1. WHAT IS NUTRITIONAL SURVEILLANCE?

The countries of the Eastern Mediterranean Region of WHO cover a wide area which extends to Morocco in the west and to Pakistan in the east and, thus, present a spectrum of different social, economic, ecological, health and nutritional conditions. The Region includes countries with a per capita gross national product amongst the highest in the world, and countries which come into the United Nations' category of Least Developed Countries (LDC). Some countries are highly urbanized while others are predominantly rural; life styles vary similarly, from the modern to the traditional, often within the same country. Nutritional problems vary accordingly, ranging from those arising out of deprivation to those arising out of affluence. Moreover, the situation is not stable but is changing rapidly.

The nutrition and health problems of today are often quite different from those of twenty or thirty years ago. In some countries, sudden climatic changes have occurred at irregular intervals leading to drought, flooding and famine, while others have suffered as a result of war or sudden changes in the world economy on which they depend. Obviously, such factors cannot be eliminated but they can be allowed for in advance. However, in order for governments to cure, alleviate, or prevent the various forms of malnutrition, whether caused by want or excess, and to provide for nutritional emergencies by timely action, the first and foremost need is for an adequate system of information. Food and nutritional surveillance is intended to provide such information routinely, continuously or periodically at varying intervals in time, according to the needs in each particular case. The establishment of a food and nutrition surveillance system will enhance the monitoring of both population-specific and region-specific trends in the occurrence of nutrition-related risk factors and conditions.

Information systems for food and nutrition are not a recent invention. In Pharaonic Egypt, there was a food safety mechanism whereby government grain stocks were used as a vehicle to manipulate the markets, based presumably on information on prices and demand. In 19th century Europe, some countries monitored growth in school children or the heights of army recruits and how these

fluctuated in relation to the prices of major food items. In the 1930s, in the wake of world economic depression, the League of Nations recommended its member countries, most of whom were developed countries, to collect data on the heights and weights of children in order to monitor undernutrition.

The present use of the term nutritional surveillance started with the recommendation by the World Food Conference, convened by the United Nations in 1974, to initiate surveillance activities of nutritional status and of "all factors which influence food consumption patterns and nutritional status"[1] This was followed in 1975 by a joint FAO/UNICEF/WHO Expert Committee Meeting on the Methodology of Nutritional Surveillance which defined most of the various terms and definitions as they are used today.

Nutritional surveillance is an instrument for the formulation, modification and application of the food and nutrition policy of a country. Such surveillance is intended to supply information on the basis of which decisions are to be made. The principles of a food and nutrition policy exist in every country, whether or not these are formulated as an official policy. Since such a policy affects several different sectors, nutritional surveillance has to collate the information from these various sectors and analyse and interpret it as a whole. A system of food and nutrition surveillance has meaning and purpose only in so far as it supplies information upon which decisions concerning nutrition can be based. It is essentially a practical part of the machinery by which a government may safeguard the nutritional status of its population and is not intended for purely research or academic exercises.

2. PLANNING FOR NUTRITIONAL SURVEILLANCE

2.1. Major determinants of nutritional status

The nutritional status of a population is affected by a number of variables, such as: food production and availability; purchasing power; dietary practices; disease patterns; other related factors. These factors can be arranged in a causal sequence or model as follows.

(i) Nutritional status depends on, apart from disease, dietary intake of food.
(ii) The dietary intake or food consumption of a family or a person depends on the food available to the family and on nutrition awareness in the family.
(iii) Food availability depends: (a) in a market economy, on the relation between food prices and earnings; (b) in subsistence households, on the food

[1] Report of World Food Conference, Rome, Italy, 5-16 November 1974 (E/CONF. 65/20).

harvests; and (c) in mixed market and subsistence households, on both the price-wage relation and on production (the exact relationships between these and food availability in a mixed household economy are not usually known and are difficult to determine).

(iv) The relation between food prices and earnings is largely influenced by, among other factors, the balance between food production, food stocks, food imports, and in some cases food aid.

(v) Local food production is influenced by the weather as well as a host of other interrelated factors, both inside and outside the country.

(vi) Food utilization depends on the physiological status of the human body which, in turn, is influenced by the environmental situation, accessibility to safe water, and the morbidity status which itself results from inadequacies in the environmental and water and sanitation situations.

Figure 1, taken from the report of the FAO/UNICEF/WHO Expert Committee Meeting in 1975, describes these same relationships in graphic form and goes into

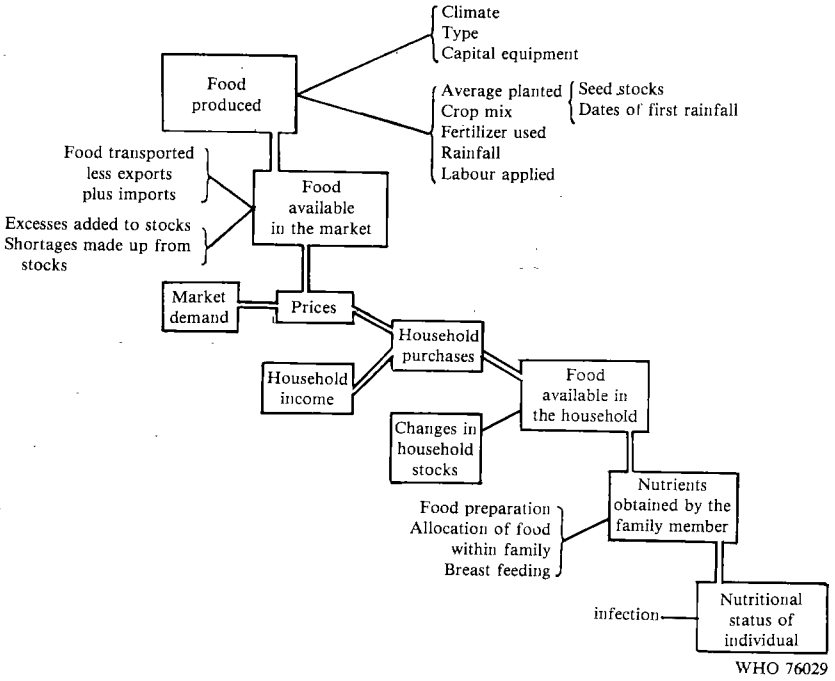

FIGURE 1. Model of causal factors for nutritional status[1]

[1] Source: WHO Techn. Rep. Ser. No.593 (1976).

further detail, especially in the area of commercial food production and food markets. Models could similarly be developed which concentrate on other aspects of the complex network of relations affecting nutritional status; for instance, the interactions between malnutrition and infections, sanitation or water supply. For the purpose of planning a nutritional surveillance system, the simplified list given above should be sufficient. Annex 4 in Section II itemizes the components of food and nutrition surveillance as determined by the 1988 WHO/FAO Intercountry Meeting on Nutrition Surveillance.

2.2. Why is a surveillance system needed?

The first question the planner has to ask is: Why is a food and nutrition surveillance system needed? Is it needed (a) to prevent a shortage in food supply and a deteriorating nutritional status arising in the short term, as in countries that are prone to drought or other natural disasters? (b) to ensure adequate food supply to regions in the country with chronic food shortage? or (c) as a long-term measure to monitor the nutritional situation in a country suffering from food deprivation due to poverty or from excessive consumption due to affluence? The answer to this question will determine to a large extent the design of the system, the type of information collected and the sector that will take the main responsibility for operating surveillance. Table 1 indicates the three major purposes of a surveillance system.

TABLE 1. AIMS OF NUTRITION SURVEILLANCE

Purpose	Time-frame	Type of information required	Leading sectors
A. Warning of nutritional emergency	Short-term	1. Food availability 2. Early effects on nutritional status	1. Agriculture 2. Meteorology 3. Livestock 4. Food 5. Health
B. Trends of malnutrition over a number of years	Medium to long-term	1. Change in nutritional status 2. Trends in economy and agriculture	1. Health 2. Economic 3. Agriculture
C. Trends in nutritional effects of affluence	Medium to long-term	1. Change in nutritional status 2. Morbidity and mortality from specific diet-related diseases	1. Health 2. Food

3. PREPARATORY ASSESSMENT

3.1. Identification of available information

Before proceeding any further in planning a nutrition surveillance system it is usually advantageous, even necessary, to take stock of what is already known. National food balance sheets, estimating the average amounts of different food commodities available, though not necessarily eaten, per person are drawn up regularly by nearly all countries of the world. In many countries household expenditure surveys are regularly conducted, and, if combined with local market prices for food, these can give useful information on the variability of consumption. Similarly, ministries of agriculture are usually well informed about food production patterns in their countries and often have estimates about the production and presumable consumption of the subsistence sector in different regions.

The information available on nutritional status is usually less clear-cut. Many countries have at some time carried out national nutrition surveys and thus have some idea concerning the nature and extent of their major nutritional problems; very often, however, these surveys have only been carried out among children and, in some cases, women during pregnancy and lactation. Results of surveys conducted more than ten years previously may sometimes give a distorted and/or exaggerated picture of malnutrition among children because of the use of indicators that are now obsolete. Therefore, in order to complete the picture of the distribution of malnutrition it may be necessary to set up quick sample surveys of nutritional status in different representative regions of the country. Limited surveys of nutritional status are not particularly expensive. If well planned, they can be carried out by one or several small teams, and, with modern computer facilities and specialized software, the data analysis is cheap and fast.

It is more difficult to obtain epidemiological data on the nutritional consequences of affluence. Obesity, non-insulin-dependent diabetes, hypertension and cardiovascular diseases are chronic conditions which, with the exception of obesity, usually manifest themselves relatively late in life. Beyond hospital statistics and mortality data, some effort may be required to obtain the data necessary for a complete picture of the prevalence of these chronic conditions. Community surveys are essential in this regard. A monitoring system based on the prevalence of obesity, hypertension and diabetes in the various communities might serve as a simple base for surveillance.

With regard to the diseases which accompany or follow on from obesity, the quality of the diet attains perhaps greater importance than it does in undernutrition. Aside from overeating, it is the high intake of animal foods, of fats and, especially,

of saturated fats, that appears to play the most sinister role. It is therefore important to obtain information on the dietary intake of the groups at risk, and this is usually obtained by means of consumption surveys or, more indirectly, household expenditure surveys; indeed the latter already exist in many countries, at least for the urban and wage-earning population groups.

3.2. Use of available information

The initial assessment should, in the first instance, make use of the information that already exists. Experience shows that, in most countries, much more information is collected by government and other agencies than is actually used. Even ministries of planning and other coordinating government bodies may not be aware of all existing information systems and the outputs from these. An important part of the initial assessment should therefore be to find, list, and make use of such hidden information.

After all the available information has been considered the decision has then to be made as to whether additional information is needed, keeping in mind that the assessment is intended: (a) to give an overview of the nature and extent of nutritional problems in the country; and (b) to decide on what should be monitored for surveillance purposes and how it should be done. Since the collection of additional information may be expensive and time consuming, only what is essential to the purpose of the surveillance should be included.

In certain situations the collection of additional information is an unavoidable requirement if a meaningful assessment is to be made. In an agricultural population, where rainfall is crucial for successful crops, meteorological information must be available for monitoring the status of agricultural production. In order to monitor the nutritional status of that section of the population at the lower economic level, data on the nutritional status of the infants and young children are essential. In rural areas, where incomes are known to be low, and where health services cover only a fraction of the population, a survey of nutritional status is the only means of providing the information necessary to determine whether or not the population is suffering from malnutrition. In an affluent society where hospital reports indicate a high rate of death from cardiovascular diseases, data on the degree of obesity and/or hypertension in certain age groups and on the consumption of certain foods would be essential for a first assessment of the situation.

In fact, the search for information for an initial assessment usually brings with it, as a side-effect, the identification of information systems which already exist within the various sectors and which regularly supply information for other, non-

nutritional purposes. The economic and agricultural sectors, being more important to the well-being of the nation than health and nutrition, usually have well established and developed systems that supply, on a continual basis, the information necessary to decision-making in sectoral and development planning. Such systems may provide a basic format upon which a more comprehensive nutritional surveillance system might be built. Indeed early warning systems currently being attempted for drought, crop failure and food shortage are mostly set up within the food or agricultural sectors, with contributions from the meteorological services and market information. Although these systems may be less concerned with the nutritional status of the affected population than with the effects on the agricultural sector and on the national economy, in many situations they could be enlarged to include nutrition-related indicators to provide information on nutritional status as well.

4. INDICATORS FOR NUTRITIONAL SURVEILLANCE

The information collected in the field and transmitted through a reporting system has to be transformed into indicators that are suitable to nutritional surveillance. Data on incomes, for example, has little meaning nutritionally unless combined with data on food prices and minimum food requirements, while the heights of children at a given age only become an indicator of growth if expressed in relation to the proportion of children below a certain height.

Certain characteristics should be carefully considered before selecting indicators for nutritional surveillance. Thus, whatever an indicator indicates should be relevant to the purpose of surveillance; as far as possible an indicator should be specific to what it is intended to measure; and it should be sufficiently sensitive to change, though not to the extent that it reflects minor oscillations with no significance for the purpose at hand.

Indicators should have the capacity to be disaggregated below the national level according to geographical, social or economic criteria. Only when the various indicators can be disaggregated and re-aggregated can they be brought into relation with each other and combined into a multisectoral surveillance system. A national income figure (GNP) or food balance sheet cannot be used to monitor food availability and nutrition of a marginal subgroup that may be at particular risk. Finally, indicators should be suitably simple, the information should be easy to collect and the meaning comprehensible to the non-specialist.

There is a large number of possible indicators, and extensive lists of them have been compiled in WHO publications on nutritional surveillance; Annexes 1, 2 and 3

in Section II give some samples. When a surveillance system is being planned in a particular country, those indicators should be selected that fit the specific purpose of the surveillance and that, at the same time, are obtainable. Different types of indicators can be distinguished according to their function in the surveillance system. For example, one group of indicators (sometimes called output indicators) describes the outcome of a food and nutrition situation; these are the indicators of nutritional status and of disease conditions and mortality due to a specific nutritional status. Another group (sometimes called flow indicators) describes the situations and conditions leading to the first group; these relate to diet, food consumption, availability of food and factors affecting them. A third group describes or indicates factors or conditions that contribute to the nutritional pathology with which the surveillance is concerned, such as diarrhoeal diseases which contribute to malnutrition in children, or cigarette smoking which relates to cardiovascular diseases in adults. It is obvious that a surveillance system intended to monitor trends in nutritional status should make use of indicators from all three groups.

In considering indicators in more detail it is of advantage to look separately at the indicators for a malnourished population and the indicators for nutritional problems arising from affluence.

4.1. Indicators for a malnourished population

4.1.1. Anthropometric indicators of nutritional status

The key indicators estimate the degree of child malnutrition in the population, in particular the percentage of wasted children (low weight-for-height) in a given age group, usually between 0 and 5 years. The data needed for each child are weight, height or length, age and sex, from which the percentages of wasted (thin) and stunted (short) children can be calculated as well as the percentage of children with low weight for their age. These are the most commonly used anthropometric indicators and analytic procedures and interpretations are well developed; calculations can be carried out by computer with the help of available software. Weight-for-height is the only indicator that gives an unequivocal measure of undernutrition among children (see Annex 3). Another, less frequently used, indicator is the circumference of the mid-upper arm and the percentage of children with low circumference values. Experience with arm circumference is still limited and there are problems in interpreting values that are not extreme i.e. degrees of malnutrition.

A complete guide to the use and interpretation of anthropometric indicators is reproduced in Section II Annex 5 and Tables of Reference Values in Annexes 6-9.

4.1.2. Indicators of dietary intake

Direct measures of the dietary intake of families or individuals are used in the various forms of dietary surveys. They are generally not well suited for nutritional surveillance since the data collection is lengthy and expensive, the analysis is time consuming and the results generally provide statements about **average** dietary intake of a group and do not permit firm conclusions regarding the distribution of intake (i.e. whether intake is very high or very low).

A more indirect estimate of dietary intake can be obtained from household expenditure surveys if details about food commodities and local market prices are included. Such surveys are already carried out periodically in many countries by the central statistical offices, or the ministry of planning, often on a fixed sample of households; these may be utilized to provide reasonably reliable information on food consumption and nutrient intake at little extra cost. The results are biased in so far as account is not usually taken of kitchen waste and of meals eaten outside the household. However one advantage of using such household surveys lies in the fact that they are often already stratified by geographical or socioeconomic group and are therefore relevant in the context of nutritional surveillance. Household expenditure surveys are thus a valuable tool in monitoring the food consumption of that section of the population that receives an income and is not dependant on subsistence agriculture.

For those groups depending for their food supply on subsistence agriculture, no direct method of assessing dietary intake or food consumption appears feasible at present. Some indication can be obtained from yield estimates of agricultural services in combination with other information, for instance the extent of local bartering, which may seriously influence results.

4.1.3. The food basket

An indicator which is currently in use for nutritional surveillance in some countries is the proportion of families that is able to purchase a "minimum food basket". The food basket contains the components of what is considered the cheapest acceptable adequate diet in a given cultural setting. The diet has to be adequate nutritionally, acceptable from a culinary point of view, and conform to local eating habits. In deciding whether a family is able to purchase the food basket allowance has to be made for non-food expenses. However, the minimum food basket is not really an indicator of food consumption but of purchasing power related to food.

4.1.4. National food balance sheets

National food balance sheets give an estimate of the average national food consumption. They are produced annually in almost all countries of the world and record annual production, importation and export of food, movement of food stocks around the country, and foods used industrially or for non-human consumption, the balance being the amount consumed in households. With allowances made for loss and wastage, foods and major nutrients are given in annual or daily amounts per caput of the population. Food balance sheet values tend to be higher than values obtained from household surveys, although not always so, so that generally the information is only useful for estimating trends in consumption. Also, because of the high level of aggregation involved, the values are not sensitive to change, except of an extreme nature as in national emergencies.

4.1.5. Meteorological data

Meteorological data, production forecasts and data indicating trends in the general economy of a country are of importance in nutritional surveillance as complementary information. Their analysis and interpretation are complex and usually carried out by specialized institutions.

4.1.6. Biological utilization of food

Acute disease is often a major contributing factor in malnutrition, especially among small children. Its action is direct, at the level of the metabolism and of appetite, and not related to food supply. Age specific morbidity and mortality statistics, with seasonal variation and including causes of death, are therefore important for interpreting variations in nutritional status. The health information system can be utilized for the reporting of data on nutritional status, i.e. heights and weights of pre-school children. This usage will enhance the nutritional surveillance system, because it will provide additional information on nutrition status which, when considered with other health-related data, such as information on provision of safe drinking water and data on environmental sanitation, may be important in a changing health situation.

4.2. Indicators for monitoring diet-related clinical disorders due to excessive and imbalanced food intake

4.2.1. Morbidity and mortality statistics

Morbidity and mortality data from cardiovascular diseases, cerebrovascular accidents, diabetes and hypertension are the indicators of nutritional ill-effects from

affluence. The role of diet in these disease groups is today generally accepted and well-documented, although there remain many unanswered questions with regard to their epidemiology. Mortality data can serve as excellent indicators in monitoring the prevalence of such diet-related disorders.

TABLE 2. NATIONAL CHOLESTEROL EDUCATION PROGRAMME – ADULT TREATMENT PANEL CLASSIFICATION[1]

	Total Cholesterol	LDL Cholesterol
	mg/dl	mg/dl
Desirable	<200	<130
Borderline high	200 – 239	130 – 159
High	>240	>160

LDL: low density lipoprotein

TABLE 3. CLASSIFICATION OF BLOOD PRESSURE IN ADULTS 18 YEARS OR OLDER[1]

Range in mm Hg	Category
Diastolic	
<85	Normal blood pressure
85 – 89	High normal blood pressure
90 – 104	Mild hypertension
105 – 114	Moderate hypertension
>115	Severe hypertension
Systolic, when diastolic blood pressure is < 90	
<140	Normal blood pressure
140 – 159	Borderline isolated systolic hypertension
>160	Isolated systolic hypertension

[1] Source: Surgeon-General's Report on Nutrition and Health (1988).

4.2.2. Clinical indicators

Clinical indicators are more feasibly obtained in affluent populations than in poor ones. Even in their simplest form and obtained from non-random samples they offer the best insight into the progress of these diseases or, if countermeasures are effective, their regress. Tables 2 and 3, taken from a recent report of the Surgeon-General of the United States of America (1988), give examples of simple clinical indicators for cardiovascular disease and hypertension. The scaling into normal, moderate and severe is designed for conditions and prevalence in the U.S.A. and may need to be adjusted according to the local situation in other countries.

4.2.3. Anthropometric indicators

Obesity, which is often a precursor to cardiovascular disease and diabetes, is measured by means of anthropometric indicators. Since obesity is a condition that usually develops in adult life, it has to be measured in adults. Obesity increases with age until about the sixth decade, which makes it necessary to monitor age groups separately. Among the many measurements and indices that have been used to assess obesity, the commonest and best documented one today is the body mass index (BMI) calculated by dividing the body weight in kilograms by the square of the height in metres. Table 4 gives the BMI for men and women as determined by surveys in the U.S.A.

TABLE 4. BODY MASS INDEX (kg/m^2) USED TO DEFINE DESIRABLE WEIGHT AND OVERWEIGHT ACCORDING TO THREE DIFFERENT "IDEAL" REFERENCE POPULATIONS[1]

		BMI for "Ideal" Reference Population					
Study	"Ideal" Reference Population	Mean		Overweight		Severe Overweight	
		Men	Women	Men	Women	Men	Women
NHANES II	20 to 29 year-olds	24.3	23.1	27.8	27.3	31.1	32.3
Metropolitan 1959	Desirable weight insured	22.0	21.5	26.4	25.8	30.8	30.1
Metropolitan 1983	Desirable weight insured	22.7	22.4	27.2	26.9	31.8	31.4

[1] Source: Surgeon-General's Report on Nutrition and Health (1988).

Since obesity develops as a gradually increasing deposition of fat in the body, the point from which a condition is called obesity has an element of arbitrariness which does not correspond to any sudden increase in risk of disease. However, the risk of cardiovascular disease and diabetes increases gradually with a rising body mass index. The same is apparently true, according to some studies, for cholelithiasis and, perhaps, some forms of cancer. In recent years obesity has become increasingly prevalent among children in developed countries and there are obvious reasons to expect the same to happen in certain countries of the Eastern Mediterranean Region. Since obese children tend to grow into obese adults, an increase in child obesity would have to be seen as a forewarning of a future rise in obesity-related diseases. It seems important, therefore, to watch the development of obesity in children as well as in adults.

The appropriate indicator of obesity in children up to ten years of age would be the proportion of children with a high weight-for-height; the age group that is easiest to monitor in populations with a high level of primary school attendance would be school children. In the age period from 10 to 20 years the weight-height relation is compounded by the course of puberty, precluding the comparative use of weight-for-height and body mass index. Annex 10 gives the classification of obesity in adults according to weight and height.

4.2.4. Indicators of dietary intake

Indicators of dietary intake are needed to estimate trends in overconsumption of animal products, fats and sugar whose role in the aetiology of the nutrition-related diseases of affluence is known. Direct monitoring of intake is rarely necessary, since indirect indicators derived from periodic household expenditure surveys and figures from trade and commerce are usually relatively easily obtainable and can give sufficient information on consumption trends to assess the situation and to observe the effects of preventive measures which are mainly concerned with dietary change.

4.2.5. Incomes and income distribution

Estimates of incomes and income distribution will contribute to an understanding of the epidemiology but will probably rarely be available at sufficiently frequent intervals to form part of a nutritional surveillance.

4.2.6. Health-related behaviour indicators

The most important health-related behaviour indicators are, without doubt, cigarette smoking and alcohol consumption, both of which are strong non-dietary

factors in the causation of cardiovascular diseases, in particular coronary heart disease and hypertension. Data on sales of cigarettes and alcoholic beverages may give an overall orientation. Since tobacco smoking and alcohol consumption are habit-forming more detailed information is needed about consumer groups that are at a special risk.

Since the situation may change relatively quickly within a few years alcohol and tobacco consumption must be monitored closely and in some detail. The information will be essential also for evaluating eventual prevention campaigns. Health-related behaviour indicators are not part of nutritional surveillance in a strict sense; but when nutrition-related diseases of affluence are considered a public health problem such information is essential for public health action and will have to be collected, analysed, interpreted and presented in the context of nutritional surveillance.

5. DATA COLLECTION AND REPORTING

All efforts should be made to ensure that data for nutritional surveillance come from existing data collecting and reporting systems. Even when new data are needed that are not already being collected, this should be done, if at all possible, by existing information systems. It may be justified, at the stage of the initial assessment, to bring together a wide variety of information, even from specially conducted surveys, in order to obtain as complete a picture as possible of the situation. However, during monitoring, when data types are collected and reported routinely, the number of data types to be used should be as few as possible. In most cases the most critical part of a surveillance system, and the one where the biggest delays might occur, is the analysis and interpretation of the incoming data in a central unit. It seems important, therefore, not to overload the central analysing facility with too many different types of data. The present guideline is aimed at limiting the data to a minimum. Once the system is established and functioning it will, in any case, be necessary to revise the pattern, omitting certain types of information and adding new ones for which a need has been recognized.

There are, in every country, a number of functioning data collection systems which may already report information to their respective sector or institution. These could be utilized for nutritional surveillance once agreements have been reached with the sector in question. Table 5 shows which types of data might be supplied by which sector although, for most indicators, or groups of indicators, there are several possible sources which may be alternative or complementary. For instance, for morbidity in adults from diseases of affluence, data might be sought from health services to cover the most affected socioeconomic groups, from hospital records and

even records of medical practitioners, and from special surveys which, in some situations, may be the only reliable data source for this kind of information and may or may not confirm available hospital data. Table 5 is intended to provide examples only. It is unlikely that all the listed types of information will be needed in one surveillance system or that the listed data sources will correspond to a list made for a particular country.

TABLE 5. DATA SOURCES FOR KEY INDICATORS

	Health services	Medical practitioners	Hospital statistics	School health services	Local administration	Statistical office and household surveys	Census Bureau	Special surveys
Anthropometry in pre-school -age children	+					+		+
Health data in school-age children				+				
Health data in adults		+	+			+		+
Morbidity data in children	+							
Disease specific morbidities	+	+	+					+
Disease specific mortality	+				+		+	
Dietary information					+	+		
Socioeconomic conditions						+	+	

Before the information, whether already available or obtained by newly initiated collection of data, can be used for nutritional surveillance, certain enquiries, decisions and preparation are needed. These concern the quality of the data, coverage of the population in question, the degree of disaggregation, frequencies of reporting, sample sizes and sample strata, equipment, forms, and availability of computer hardware and software. These details have to be related to the requirements of nutritional surveillance and adapted accordingly.

6. THE CENTRAL NUTRITIONAL SURVEILLANCE UNIT AND ITS ROLE

Once the decision has been made to start nutritional surveillance, the necessary preparatory work will have to be carried out by a group of technical personnel. It is generally advantageous to establish a nutritional surveillance unit at central level as early as possible. The administrative location of the unit in any government sector will depend on its role in implementing the system. Ideally the national planning body should have responsibility for such a unit. In some countries the health sector takes the leading role in nutrition surveillance and has a surveillance set-up. If a surveillance system is designed for early warning of a potential food situation, the unit would logically be located in the food or agriculture sectors; where a food and nutrition institute exists, this would be an ideal place for its location. Experience has shown, however, that a nutritional surveillance unit placed in one particular sector may later experience difficulties in carrying out its multisectoral functions unless it is given an independent administrative location in the governmental structure which allows it access to all sectors.

In addition to preparatory work, the tasks of the central unit will be the analysis of incoming data, the interpretation of changes in individual sectoral indicators as well as of relationships between indicators, and the periodic presentation of the results in a form that is suitable for policy and programme decision-making. In order to carry out these multiple functions the central unit will need a wide range of expertise including nutritionists, epidemiologists, statisticians, and economists and the staffing of such a unit may initially create problems which may be more than financial only. It may therefore be advisable to build up the staff gradually, increasing the workload of the unit slowly while utilizing the expertise available among the various sectors.

It is important that the initiative to start nutritional surveillance comes from the future user. In the past, limited nutritional surveillance activities have sometimes been undertaken elsewhere, for example by a university department, and have faltered because they did not respond to a felt need at the level of the potential user and did not receive the sustained support necessary.

It is suggested that a start be made in one sector (most often the health sector which has a direct responsibility for the health and well-being of the population) or in a central statistical bureau or a planning body, by estimating food and nutrient consumption from household survey data. Quite often, the health sector, due to its inherent interest in collecting all health-related data from the vulnerable segments of the population, initiates a nutrition surveillance system through a recently introduced health information system (HIS). Incorporation of a few relevant

nutrition-related data e.g. anthropometric data, in the HIS, can be a good start to nutrition surveillance through primary health care. As interest in the potential of the system grows, other data sets may be gradually developed and linked to it. The most important step is to start the process, establish a flow of information and present it in a usable form to the level of planning and decision-making at which the need for monitoring food and nutrition has been felt in the first place.

Apart from some expenditure for data collection, the central unit constitutes the major item of expenditure in nutritional surveillance. Within the central unit, costs will break down into, in order of magnitude, staff, computer time, travel and transport, printing of periodic reports, forms and stationery, anthropometric equipment etc. If laboratory determinations are part of the surveillance, for example blood cholesterol levels, this may add substantially to the total. It is obvious that a central analytical unit needs a budget in order to function but as mentioned earlier, data collection costs will not be a significant item of expenditure if all existing data collection systems are utilized.

The frequency with which the central unit will issue reports will depend on the degree of urgency felt regarding nutritional problems, the speed with which the situation is expected to change, and the characteristics of the selected indicators. In an emergency situation reports on nutritional status may be needed monthly or even fortnightly, while in more normal times quarterly, semestrial or annual reporting may be sufficient. For frequent reporting the time required for collection, transmission and analysis of data and preparation of the report has to be correspondingly short if the reports are to be useful. Anthropometric data on nutritional status may be processed quickly with the appropriate facilities, but food consumption derived from household expenditure survey rounds will take several months to be made available. Decisions on the frequency of reports need to be made carefully, taking into account the need for information and the cost of obtaining it.

Closely related to the practical aspects of reporting are questions of sample size. The minimum sample size is determined by the statistical properties of the indicator in question, the quantum of changes one intends to measure, and the degree of disaggregation needed. If, in order to cut costs, the sample is reduced too greatly in size, it may not be possible to recognize any but the most drastic changes or to distinguish between different parts of the country, or different socioeconomic or age groups. On the other hand, too large a sample will flood the system with data that is not necessary for the purpose of surveillance and will delay the issuing of reports. This may happen for example in the case where the heights and weights of pre-school children are continuously reported by the peripheral health services from all health centres or health posts. In this case it may be better to take samples of the

reported data or to request reports only from a sample of health posts. The latter has the advantage of enabling attention to focus on known problem areas, but care has to be taken to remain within the pattern of disaggregation of other key indicators with which one wants to link the information. Careful and competent selection of the sample is thus essential for future success.

There is no established pattern of nutritional surveillance that can be applied universally. Instead, each country has to develop its own design to fit its priorities and living conditions. Much still depends on experience and to a certain extent on trial and error. It is therefore essential that countries with similar nutritional problems and similar determination for prevention work pool their experiences in developing a surveillance system.

It should be remembered that nutritional surveillance, if carried out seriously for a definite purpose, is neither very cheap nor very simple. It requires considerable effort, sustained over time to establish and develop it until it is fully operational. From the moment the first set of data arrives, it may take several years until the system functions fully as an intersectoral information system for food and nutrition. The effort needed to establish nutritional information systems seems justified as the first major step towards creating a firm epidemiological basis for prevention. A national nutrition policy cannot be institutionalized without a nutrition surveillance system.

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SECTION II

INFORMATION ANNEXES

Annex 1

COMMONLY USED INDICATORS FOR NUTRITION SURVEILLANCE

CATEGORY	FACTOR	DATA TO BE COLLECTED	INDICATOR AND SUGGESTED CUT-OFF POINTS[1]
Nutritional status	Growth retardation	Birth weight	Percentage of infants born alive with a birth weight $\leq$ 2.5 kg
		Weight-for-age	Percentage of children with a weight $<$ 75% of standard weight-for-age (or more than 2 S.D. below standard or $<$ 3rd percentile)
		Height-for-age	Percentage of children with height-(length) for-age below 90% of the reference median
			Percentage of seven-year-old schoolchildren with height $<$ 90% of standard height-for-age
		Weight-for-height	Percentage of children with weight below 80% of expected weight for actual height
		Arm circum-fererence	Percentage of children with less than 75% of expected arm circumference for age or for height; percentage of children in red and yellow zones, if tape being used
	Clinical malnutrition	Presence of clinical signs of malnutri-tion	Prevalence (percentage of people examined with clinical signs present): goitre, xerophthalmia, bilateral oedema of lower limbs, night blindness, etc.
			Percentage of recognized cases of malnutrition diagnosed as marasmus, kwashiorkor, or marasmic kwashiorkor
		Observed morbidity	Percentage of children under 5 years of age with diagnosis of malnutrition at first visit, or on admission to hospital, regardless of the reason for consultation or hospitalization
	Biochemical alterations	Blood haemoglobin	Percentage of individuals with haemoglobin below standard level for age, sex and physiological status
		Plasma retinol	Percentage of individuals with retinol below 200 ug per litre
	Morbidity	Pre-school mortality rate	Deaths of children aged 1 – 4 years per 1000 children in the same age group

[1] Cut-off points are suggested for a number of indicators. They correspond to values generally accepted in the literature. For the other indicators cut-off points should be established according to local situations.

Source: A guide to nutritional assessment: Ivan Beghin, Miriam Cap and Bruno Dujardin, WHO, Geneva, (1988).

COMMONLY USED INDICATORS (Cont.)

CATEGORY	FACTOR	DATA TO BE COLLECTED	INDICATOR AND SUGGESTED CUT-OFF POINTS
		Case-fatality rate	Percentage of children who die in hospital, malnutrition being mentioned as the basic or associated cause of death, out of total number admitted for or with malnutrition
		Proportional mortality	Percentage of deaths of children aged 1 – 4 years (or under 5 years of age) over total number of deaths
		Infant mortality rate	Deaths of children aged 0 – 11 months per 1000 live births
Food intake	Breast-feeding	Weaning age	Average age at weaning (age at which 50% of the infants no longer received breastmilk)
			Percentage of children still breast-fed at 3, 6, 9, or 12 months
	Food intake of young child	Daily calorie and protein intake	Percentage of children with calorie intake below recommended daily allowance
			Percentage of children with protein intake below recommended daily allowance
	Food intake of household	Daily calorie and protein intake	Percentage of families eating on the average less than the minimum food basket
	Biological value of food	Protein quality	Average net protein utilization (NPU) rate of average diet
			Percentage of calories of protein origin (group average)
Health factors	Health status	Morbidity	Percentage of children with at least one attack of diarrhoea during the preceding month
			Percentage of consultations (admissions) for diarrhoea over total number of consultations (admissions) in age group
		Mortality	Infant mortality and mortality rates for children aged 1 – 4 years (see above)
	Health services		Hospital beds per 1000 inhabitants
			Doctors per 1000 inhabitants
			Health personnel (total) per 1000 inhabitants
			Percentage of villages (municipalities, communes, etc) with a health facility
			Average number of contacts (preventive and curative) per person per year
			Percentage of immunizations completed among target group (per vaccine)
			Pregnant women attending ante-natal clinic per 1000 births
			Admissions to maternity wards per 1000 births

COMMONLY USED INDICATORS (Cont.)

CATEGORY	FACTOR	DATA TO BE COLLECTED	INDICATOR AND SUGGESTED CUT-OFE POINTS
			Admissions to hospitals per 1000 inhabitants per year
	Sanitation	Water	Percentage of households with tap water laid on
			Percentage of households less than 200 m from a clean water source
		Latrines	Percentage of families with latrines (per category of latrine)
Education and culture	Formal education	Literacy rate	Percentage of population ≥15 years with elementary school completed (total of women only).
			Percentage of population ≥15 years, who know how to read and write (total or women only)
		School attendance	Percentage of children of school age who are registered at (or who actually attend) a school
	Food habits	Frequency of meals	Percentage of families in which children receive 2 meals or fewer per day
Demography	Family size		Average family size
	Mortality		See data on pre-school and infant mortality
Economic	Food prices		Average price of basic cereal (or legume) over period of observation (in US$)
			Average price of minimum food basket in US$ or as percentage of minimum legal wage
	Food expenditure		Average family expenditure for food in US$ or as percentage of total expenditure
	Income		Average family income per capita (all sources) in US$ or as percentage of minimum legal wage
			Percentage of families below the minimum legal wage or below "poverty" level
	General prices		Increase in index of prices as percentage of increase in minimum legal wage or "real" wages
	Employment		Percentage of active population gainfully employed
			Percentage of mothers working outside the home
			Distribution of population by occupational category
			Average time available to mothers for child care
Food production	Production	Home production	Kg of basic food (cereals, legumes, etc.), produced by the household per year, value in money of total home food production per year

COMMONLY USED INDICATORS (Cont.)

CATEGORY	FACTOR	DATA TO BE COLLECTED	INDICATOR AND SUGGESTED CUT-OFF POINTS
		Productivity	Kg of basic food (cereals, legumes, etc.) produced by the family per hectare per year
	Factors affecting production	Arable land	Hectares of arable land per person
			Percentage of households with less than a given area of arable land per person in the family
		Rainfall	Average annual rainfall in mm

Annex 2

NUTRITION INDICATORS

Proposed by the WHO/FAO Intercountry Meeting on Nutrition Surveillance
Islamabad, 23 – 27 October 1988

	DATA TYPES	GROUP	FREQUENCY OF COLLECTION
A.	**Anthropometric**		
	1. Birth weight	Newborns	
	2. Weight and height	0 – 1 year 1 – 3 years 3 – 5 years	Once/month Once/3 months Once/6 months
	3. Weight	Pregnant mothers	Once/month
	4. Weight and height	Schoolchildren	Once/year
B.	**Clinical**		
	General health and nutrient deficiency signs	0 – 5 years Pregnant mothers Schoolchildren	Once/year Once/month Once/year
C.	**Laboratory data**		
	Hb, etc.	0 – 5 years Pregnant mothers Schoolchildren	Once/year Once/trimester Once/year
D.	Breast-feeding and weaning practices	Lactating mothers and 0 – 2 years old	

Annex 3

SHORT LIST OF INDICATORS OF NUTRITIONAL STATUS[1]

PHENOMENON	INDICATOR
Maternal nutrition	Birth weight
Infant and pre-school child nutrition	Proportion being breast fed and proportion on weaning foods, by age in months
	Mortality rates in children aged 1,2,3 and 4 years, with emphasis on 2 year-olds.
	If age known:
	height-for-age
	weight-for-age
	If age unknown:
	weight-for-height
	arm circumference
	clinical signs and syndromes
Schoolchild nutrition	Height-for-age, and weight-for-height at 7 years or school admission
	Clinical signs

[1] Source: WHO Techn. Rep. Ser. No.593 (1976).

Annex 4

FOOD/AGRICULTURE/SOCIOECONOMIC COMPONENTS OF FOOD AND NUTRITION SURVEILLANCE

Proposed by the WHO/FAO Intercountry Meeting on Nutrition Surveillance
Islamabad, 23 – 27 October 1988

AREAS OF INFORMATION AND FACTORS	TYPES/SOURCES OF DATA	INDICATORS FOR FNS SYSTEM
FOOD AVAILABILITY (National level)		1. Per caput energy supply
– Rainfall, yields etc.	Early warning system	2. Per caput nutrient supply
– Food production	Agricultural statistics	
– Production cost (price of inputs including fertilizers, pesticides etc.		3. Per caput availability of major staple foods
– Price policy		4. Percentage coverage of requirements
– Agricultural production for non-food use, animal feed		
– Seeds		
– Industrial use		
– Food losses		
– National disasters, drought, food lost through locusts		
– Food reserves		
– Food imports including food aid	Food trade statistics/ donor agencies and/or ministry of foreign affairs, food trade	
– Food exports		
FOOD AVAILABILITY (Regional/District/ Local level)		Same as above according to level if available
– Same factors as above if available		
– Distribution:	Data on food movement, traffic, etc.	
– Food transportation		
– Marketing		
– Storage facilities		
FOOD CONSUMPTION		1. Access to food indicators
– Food prices (staple foods)		– Percent of minimum wage to cover national food basket (NFB), No. of hours of labour
– Household income, if not, any proxy indicator, occupational activities of	Consumer price index Budgetary surveys Economic statistics	

FOOD/AGRICULTURE/SOCIOECONOMIC COMPONENTS (Cont.)

AREAS OF INFORMATION AND FACTORS	TYPES/SOURCES OF DATA	INDICATORS FOR FNS SYSTEM
the household head, educational level, ownership of land/house/radio/TV, etc. – Age group	Census Education statistics Employment statistics Demographic data	(at minimum wage) to cover NFB – Percent of people that purchase NFB 2. Index of access/prediction of access to food can be constructed

Annex 5

USE AND INTERPRETATION OF ANTHROPOMETRIC INDICATORS OF NUTRITIONAL STATUS[1]

Based on the report of a WHO working group on the purpose, use and interpretation of anthropometric indicators of nutritional status in 1983

INTRODUCTION

It is widely accepted that for practical purposes anthropometry is the most useful tool for assessing the nutritional status of children. Admittedly almost any illness will impair a child's growth, but in practice in developing countries growth deficits are caused by two preventable factors, inadequate food and infections. In general, infections influence body size and growth through their effects on metabolism and nutrition. The classical use of anthropometry as the most readily available method of assessing nutritional status is therefore logical although other methods, such as biochemical and immunological tests, are being increasingly used in clinical practice. However, a deficit in growth is not necessarily the most sensitive indicator of inadequate nutrition; for example, a marginally inadequate energy intake may cause a reduction in physical activity before there is any impairment of growth. It is also recognized that the extent to which genetic factors, both within and between populations, may affect growth cannot be ignored. With these caveats, we may continue to accept the central role of anthropometry in nutritional assessment, particularly of children in groups or communities.

At first sight the assessment of nutritional status by anthropometry may seem to be a simple matter, in which the main constraints are practical, such as the availability of equipment and personnel and, in many cases, the difficulty of reaching the sample to be covered. However, anthropometric data are collected in order to be used, and experience shows that, in addition to the problems of data collection, there are important considerations in the presentation, analysis and interpretation of the data.

In a 1977 report on this subject, the following proposals were made:

(1) Anthropometric measurements should be reported in relation to international reference values. For this purpose it was recommended that the reference

[1] Bulletin of the World Health Organization, 64 (6): 929-941 (1986).

population defined by the US National Center for Health Statistics (NCHS) should be used, a recommendation subsequently endorsed by WHO.

(2) The basic data are age, sex, weight and height. In most circumstances separate indices should be constructed of weight-for-height and height-for-age, in addition to or in place of the classical index, weight-for-age.

(3) For statistical reasons, measurements of a study population should be related to the reference population by standard deviation scores (Z-scores) rather than as a percentage of the median of the reference, which had been the general practice up to that time.

(4) All anthropometric data on children should be presented for separate age groups; recommendations were made about appropriate age ranges.

Most workers seem to have accepted these proposals in principle, if not always in practice, and there does not seem to be any need to modify them. However, experience since 1977 in making use of the results of anthropometric surveys has revealed a number of problems which were not considered in the earlier report. Anthropometric assessment is useful in many different contexts, ranging from national planning to the identification of individuals at risk. Depending on the purpose there will be differences in the measurements that are most useful, in the indices and indicators that are most appropriate, and in the method for presenting the findings. There will also be differences in the practical constraints on data collection and analysis. As before, we have considered only the three basic measurements – age, weight and height – in assessing the nutritional status of children. No attempt is made here to discuss the usefulness of other measurements, such as skinfold thickness, mid-arm circumference (AC) or head circumference (HC).

TERMINOLOGY

Frequent utilization of the terms *measurements, indices and indicators* in this text makes it useful to be able to distinguish between them:

- The basic *measurements* to be considered are age, weight and height.
- *Indices* are combinations of measurements. Thus, it is evident that a value for weight alone has no meaning unless it is related to age or height. Indices have two functions: they are necessary for the interpretation of measurements and for grouping them. They may take different forms; for example, the relationship of weight to height may be expressed arithmetically, e.g., by the Body Mass Index (BMI) of Quetelet (Wt/Ht^2), or by relating the weight to that of a reference subject of the same height.

- The term *indicator* relates to the use or application of indices and the indicator is often constructed from them. Thus the proportion of children below a certain level of weight-for-age is widely used as an indicator of community status. Sometimes an index and an indicator may be the same. For example, the infant mortality rate is an index (ratio of deaths to births), but it is also used as an indicator of the state of public health.

An index may be thought of as a biological concept; one can usefully discuss the different biological meanings of indices such as weight-for-height and height-for-age. An indicator would represent a social concept; one can discuss its value, e.g., its sensitivity and specificity, for a particular application. These distinctions, although apparently academic, may sometimes avoid confusion. Other terms will be defined, as needed, throughout the text.

BIOLOGICAL SIGNIFICANCE OF INDICES OF WEIGHT AND HEIGHT

When it began to be recognized that it may be important to distinguish between deficits in weight-for-height and in height-for-age, it was necessary to find names to describe these two deficits and the processes which cause them. The words "wasting" and "stunting" were proposed, as they are purely descriptive of what is observed.

Other words which could fulfil the same function and which are more readily translated are thinness (for wasting) and shortness (for stunting). Terms such as "acute" malnutrition (for wasting), "chronic" malnutrition (for stunting) and "acute-on-chronic" for the combination of wasting plus stunting, are not direct observations but deductions which may not always be correct. In particular, the word "chronic" is unsatisfactory, because it is sometimes used to mean "long continuing", at other times to mean "a residue of the past". (It may be noted that strictly speaking in the English language, "wasting" and "stunting" represent processes, while "wasted" and "stunted" represent end-results, determined according to the criteria defined below).

Wasting indicates a deficit in tissue and fat mass compared with the amount expected in a child of the same height or length, and may result either from failure to gain weight or from actual weight loss. It may be precipitated by infection or some other household crisis and usually occurs in situations where the family food supply is limited and the food intake of children is low. The determinants will differ in different environments. Very often there are seasonal episodes of wasting, related to variations either in food supply or in disease prevalence. One of the main

characteristics of wasting is that it can develop very rapidly, and under favourable conditions can be restored rapidly.

Stunting signifies slowing in skeletal growth. The growth rate may be reduced from birth, but a significant degree of stunting, representing the accumulated consequences of retarded growth, may not be evident for some years. Stunting is frequently found to be associated with poor overall economic conditions, especially mild to moderate, chronic or repeated infections, as well as inadequate nutrient intake.

There are several obvious biological differences between wasting and stunting. In the first place, one can fail to gain height but one cannot lose it. Secondly, linear growth is a slower process than growth in body mass. A child should treble its weight in the first year, but only double its height; in consequence, a significant degree of stunting takes longer to be established. Thirdly, although catch-up in height undoubtedly can occur, as shown by the effects of treatment in severely stunted children with coeliac disease, it takes a relatively long time even with a favourable environment.

Wasting and stunting are frequently combined; nevertheless, analysis of a number of representative population groups shows no statistically significant association. The two deficits show different patterns at different ages and in different populations. The prevalence of wasting is greatest between 12 and 24 months of age, when dietary deficiencies are common and diarrhoeal diseases more frequent, and tends to decrease later on. By contrast, the prevalence of stunting increases over time up to the age of 24 or 36 months and then shows a tendency to level off.

It follows from these age-related differences in prevalence that, as pointed out earlier, for the proper interpretation of surveys on children, the results should be analysed separately according to age. Useful age ranges were provided in the 1977 report. Since, as pointed out above, wasting may be established and restored quite rapidly, the prevalence of wasting at one point of time may be a reasonable indicator of the incidence of the process that is causing weight deficit. However, this is certainly not the case for stunting. Thus, it is totally incorrect to suppose that because the prevalence of stunting in a population of children is greater at 4 years than at 2 years, more 4-year-old children are "malnourished". The prevalence is greater simply because the process of retardation has been going on for a longer time.

There are not only age-related differences in the prevalence of wasting and stunting, but also differences in geographical distribution. In some groups there is a relatively high prevalence of wasting with a relatively low prevalence of stunting,

whereas in other areas the opposite is found. For these comparisons prevalences were derived from the proportion of children below the conventional cut-off points of −2SD, or 80% of the reference median weight-for-height and 90% of the reference median height-for-age. Studies of this kind show, for example, marked differences between Asia and Latin America, wasting being much commoner in Asian populations.

It seems clear, therefore, on biological, epidemiological and statistical grounds, that wasting and stunting represent different processes of malnutrition. More information is needed on the determinants of the two processes and the relative effectiveness of given interventions for their prevention and treatment. Particularly important questions deal with the functional implications of stunting and its eventual reversibility. A detailed examination of stunted growth by velocity data may provide a better understanding of the process.

Experience will show how far the distinction between wasting and stunting is of practical importance. For the evaluation of nutritional and health interventions it is clearly essential, because of differences in the responsiveness of the two indicators. For long-range planning, the distinction may not be so important.

It has been shown that weight-for-height and height-for-age together account for more than 95% of the variance in weight-for-age. This means that weight-for-age represents the sum of the information given by the other two indices. For this very reason it may remain an appropriate index only for certain applications.

USE OF THE NCHS POPULATION AS A STANDARD

Discussion has continued in recent years on whether or not it is necessary and appropriate to utilize an international reference. In analysing this question, it is important to distinguish between a reference and a standard.

A reference is a device for grouping and analysing data. Thus the average weight of a group of children has no meaning unless they happen to be exactly the same age, whereas the average value of the index "weight-for-age" does have meaning. For the construction of such an index a reference population is necessary. In principle, it does not matter what set of reference data is used, provided that it is large enough to contain adequate statistical information and the population is reasonably healthy and well-nourished to avoid major distortions. It is also clearly desirable, for comparative purposes, that there should be a common reference. These principles underlay the recommendation, which was made in 1977 and subsequently endorsed by WHO, to adopt the NCHS population as a reference for international use.

A standard embodies the concept of a norm or target – that is, a value judgement. It is this concept that has led to difficulty, since the international reference is widely used also as a standard. The justification for this usage is the evidence collected by Habicht and others that in populations the effect of ethnic differences on the growth of young children is small compared with the effects of the environment. It is accepted that there may be some ethnic differences between groups, just as there are genetic differences between individuals, but for practical purposes they are not considered large enough to invalidate the general use of the NCHS population both as reference and as a standard. This judgement has been endorsed in the report of a recent FAO/WHO/UNU Expert Consultation.

There are, however, circumstances in which this usage is felt to be inappropriate and in which local standards are preferred. As a matter of principle, those who are concerned with planning in a particular country may find it unacceptable to base their targets on the characteristics of an alien population. In countries where growth failure in children is widespread and severe, such targets would be unrealistic and unattainable and therefore serve as a hindrance to practical planning.

A realistic target or local "norm" could be set by shifting the international reference downwards. This approach is acceptable if it means simply altering the target, so that, for example, the stated aim would be for the mean height of children to be within 95% rather than 100% of the international reference. It is not acceptable if it means that in the calculation of height-for-age the expected height is taken as 95% of the reference median rather than 100%. When that is done, it is not possible to use the centiles and standard deviations of the reference population, so that the statistical value of the reference is lost.

It is neccessary to distinguish between two types of local standards: that derived from an elite, presumably well-nourished group and that which represents the average of the population. A disadvantage of the former is that often an elite group may not be ethnically representative of the population as a whole. Where elite standards have been established in some cases (e.g., Colombia, Mexico, Brazil), they differ little from the NCHS reference. Local standards which represent an average of the population rather than an elite are only useful for identifying groups or individuals who differ from the rest of the population and who may therefore constitute priority targets for intervention. However, many developing countries are experiencing secular trends of increasing weight and height, making it necessary to update local population-average references after several years. The development of statistically valid national reference values is costly and often beset with logistic problems, particularly in a very large country such as India. There appear to be no

major advantages to offset these drawbacks, and therefore the establishment of local or national reference values is not an urgent priority.

PURPOSES OF ANTHROPOMETRIC ASSESSMENT

In this paper we are mainly concerned with the use of anthropometric indices and indicators for the assessment of populations or groups. Their application for the diagnosis and follow-up of individuals, e.g., in health centres or obesity clinics, is also important but will only be briefly considered.

The basic objective of anthropometric assessment at the community level is to provide an estimate of the prevalence and severity of malnutrition. This information is of obvious importance for the formulation of health and development policies. Within this general objective there are a number of specific purposes which will determine the type of population to be studied, the type of information to be collected, the indices to be used, and the most useful method of presentation.

CHOICE OF APPROPRIATE INDICES AND INDICATORS

The choice of indices and indicators is subject to constraints. There are practical limits to the feasibility, accuracy, and precision of all measurements, including that of age. The size of the sample and the number of measurements that can be made are constrained by the resources available.

For children, the use of two indices, weight-for-height and height-for-age, is to be recommended for most purposes but not necessarily for all. In certain instances the combined index, weight-for-age, may be practical for giving an overview of the distribution of nutritional problems in a country, or the direction of change.

Weight-for-height is an index that is particularly important for the description of current health status. This index alone, or its equivalent – arm-circumference-for-height – may be a sufficient tool for screening in emergencies, that is, for counting the undernourished.

Deficits in height-for-age seem to reflect overall social conditions. Therefore an indicator based on height-for-age, such as the proportion of stunted children, has been suggested as a measure of overall social deprivation.

It will generally be desirable to use more than one method for presenting and analysing the data: both to describe the distribution as a whole by one of the techniques discussed above, and to give information about the extremes of the distribution by the use of cut-off points. For some purposes, it may be enough to

present the proportion below a particular cut-off, e.g. for screening or for overall international comparisons.

Some examples of different situations in which anthropometric assessment may be used are given below.

(1) *Overall assessment of a population* requires a widely representative sample. It is generally accepted that such a study shold concentrate on children up to 5 years of age, because their condition constitutes a sensitive indicator of that of the population as a whole. When comparisons are being made, an appropriate method of presentation is the population below −2SD as a cut-off point.

(2) For *identification of target groups or areas for priority action* a combination of indices of weight-for-height and height-for-age is needed in order to assess the nature of the problem as well as its magnitude.

(3) *Nutritional surveillance* is a tool for planning and involves the continuous or periodic collection of agricultural and economic information as well as of anthropometric data. The basic problems here relate to the choice of the sampling frame and the coordination, analysis and interpretation of the information.

(4) As a specialized aspect of surveillance, the *monitoring of nutritional status* to determine trends is of particular importance to national health authorities. Here it is desirable to use, wherever possible, a combination of health indices including weight-for-health and height-for-age. The most useful method of analysis will be by examining the total distribution, rather than only the extremes.

(5) In *evaluating the impact of programmes,* anthropometric assessment has a dual function: it provides information about the nutritional status of children, which is important in its own right, but it also constitutes a sensitive indicator of impact on the population as a whole. In the special case of evaluating supplementary feeding programmes, it is important to take account of the period of time over which the evaluation is made, as different indices may be more appropriate for shorter or longer times. For example, even with a successful programme it will be some time before significant changes in height can be observed.

(6) In *emergency situations,* where the needs are urgent but resources limited, anthropometric indicators, based on a cut-off point of a particular index such as weight-for-height, are used for screening, to select those who need priority attention. For this use the cut-off point has to be chosen to provide optimum sensitivity and specificity, according to the particular circumstances. This question has been discussed in detail by Habicht and will not be further considered here.

(7) *Sequential measurements* are particularly valuable for studying the effects of seasonal changes in food supply or disease prevalence, and for identifying alterations in growth at an early stage. Large samples are not required. On the other hand, the information obtained should be as detailed as possible.

(8) *Anthropometric assessment of individuals* is regularly carried out in clinics with the help of growth charts. This method of assessment depends on consecutive measurements, which make it possible to determine whether growth is proceeding satisfactorily. Assessment of an individual from a single measurement is inevitably insensitive because of the wide range of intra-individual variation. The records from such clinics are of potential value for assessing the status of the population, but they have seldom been used for this purpose, partly because of the difficulty of analysing sequential data.

CONCLUSIONS

An attempt has been made to clarify various questions which have appeared during the last few years on the use of anthropometric indicators. Several terms causing confusion have also been identified and defined. The main conclusions are:

- The terms "wasted" and "stunted" or "thin" and "short" are preferable to "acute" and "chronic" malnutrition, which can sometimes be misleading.
- Since wasting and stunting refer to different biological processes of malnutrition, their indicators, weight-for-height (wasting) and height-for-age (stunting), should be used whenever possible in anthropometric surveys.
- Because of logistical problems in creating local reference values, creation of such values is not considered a high priority. The continued use of the NCHS population as a reference is supported; if necessary, realistic goals can be set by lowering the cut-off points.
- It is generally desirable to use more than one method of presenting and analysing anthropometric data: both to describe the distribution as a whole and to utilize cut-off points to give information about the extremes of distribution.
- For most group or population comparisons, where uniformity is important, the standard statistical cut-off points of mean ± 2SD and presentation of the whole distribution utilizing Z-scores should be maintained.
- A reduction in growth velocity, as determined by sequential measurements, can be used as an earlier, more sensitive index of growth failure than can a deficit in attained weight or height. This is especially relevant to growth monitoring in primary health care.
- Anthropometric nutritional assessment has several public health and development uses, such as overall population assessment, identification of

target groups or areas for intervention, continuous nutritional surveillance as a tool for development planning, monitoring nutritional status to determine trends of particular health importance, evaluating the impact of programmes, selecting persons in need of immediate attention in emergency situations, studying the effects of seasonal changes in food supply or disease prevalence, and individual nutritional assessment, including use of sequential measurements to determine if growth is proceeding properly.

Many areas requiring further research have been pinpointed, three of which have been discussed in some detail:

(1) *Wasting and stunting.* More information is necessary on the natural history of the processes which lead to wasting and stunting. There is also a gap in information on the effectiveness of interventions for prevention and treatment of these two conditions. Very little is known on the functional implications of stunting and its reversibility.

(2) *Sequential measurements.* There is an urgent need for an international reference for growth velocity which will give an idea of the expected coefficient of variation on which to base criteria to assess longitudinal growth. There is at present limited knowledge on the differences between countries in seasonal changes in growth velocity. The most appropriate analysis and presentation of velocity and sequential data have yet to be determined.

(3) *Anthropometry of non-child populations.* Since the majority of anthropometric research has been done on children, knowledge about other age groups presents many more gaps; only a few of these gaps have been touched upon in this paper. More information is necessary on the distribution of body mass index by age and sex in different populations, and whether or not this is the best indicator for adult anthropometry needs to be determined. It is unclear how well pregnancy weight gain can be used for nutritional assessment and prediction of pregnancy outcome or whether another indicator could be developed. The interpretation of weight-for-height in adolescents is still unclear.

Although there are many other questions regarding the use and interpretation of anthropometric indicators of nutritional status, the importance of anthropometry as a public health indicator has been firmly established.

Annex 6

WEIGHT-FOR-HEIGHT: REFERENCE VALUES[1]

A. Supine Length

Supine length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
49.0	2.5	3.2	2.6	3.3
49.5	2.5	3.2	2.6	3.3
50.0	2.5	3.3	2.6	3.4
50.5	2.6	3.4	2.7	3.5
51.0	2.6	3.5	2.7	3.5
51.5	2.7	3.6	2.8	3.6
52.0	2.8	3.7	2.8	3.7
52.5	2.8	3.8	2.9	3.8
53.0	2.9	3.9	3.0	3.9
53.5	3.0	4.0	3.1	4.0
54.0	3.1	4.1	3.1	4.1
54.5	3.2	4.2	3.2	4.2
55.0	3.3	4.3	3.3	4.3
55.5	3.3	4.5	3.4	4.4
56.0	3.4	4.6	3.5	4.5
56.5	3.6	4.7	3.6	4.6
57.0	3.7	4.8	3.7	4.8
57.5	3.8	5.0	3.8	4.9
58.0	3.9	5.1	3.9	5.0
58.5	4.0	5.2	4.0	5.1
59.0	4.1	5.4	4.1	5.3
59.5	4.2	5.5	4.2	5.4
60.0	4.4	5.7	4.3	5.5
60.5	4.5	5.8	4.4	5.7
61.0	4.6	5.9	4.6	5.8
61.5	4.8	6.1	4.7	6.0
62.0	4.9	6.2	4.8	6.1
62.5	5.0	6.4	4.9	6.2
63.0	5.2	6.5	5.0	6.4
63.5	5.3	6.7	5.2	6.5
64.0	5.4	6.8	5.3	6.7
64.5	5.6	7.0	5.4	6.8
65.0	5.7	7.1	5.5	7.0
65.5	5.8	7.3	5.7	7.1
66.0	6.0	7.4	5.8	7.3
66.5	6.1	7.6	5.9	7.4
67.0	6.2	7.7	6.0	7.5
67.5	6.4	7.8	6.2	7.7
68.0	6.5	8.0	6.3	7.8
68.5	6.6	8.1	6.4	8.0
69.0	6.8	8.3	6.5	8.1
69.5	6.9	8.4	6.7	8.2
70.0	7.0	8.5	6.8	8.4
70.5	7.2	8.7	6.9	8.5
71.0	7.3	8.8	7.0	8.6
71.5	7.4	8.9	7.1	8.8
72.0	7.5	9.1	7.2	8.9
72.5	7.7	9.2	7.4	9.0
73.0	7.8	9.3	7.5	9.1
73.5	7.9	9.5	7.6	9.3
74.0	8.0	9.6	7.7	9.4
74.5	8.1	9.7	7.8	9.5
75.0	8.2	9.8	7.9	9.6
75.5	8.3	9.9	8.0	9.7
76.0	8.4	10.0	8.1	9.8
76.5	8.5	10.2	8.2	9.9

[1]Data Source: National Center for Health Statistics, USA.

WEIGHT-FOR-HEIGHT: REFERENCE VALUES (Cont.)

A. Supine Length (Cont.)

Supine length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
77.0	8.6	10.3	8.3	10.0
77.5	8.7	10.4	8.4	10.1
78.0	8.8	10.5	8.5	10.2
78.5	8.9	10.6	8.6	10.3
79.0	9.0	10.7	8.7	10.4
79.5	9.1	10.8	8.7	10.5
80.0	9.2	10.9	8.8	10.6
80.5	9.3	11.0	8.9	10.7
81.0	9.4	11.1	9.0	10.8
81.5	9.5	11.2	9.1	10.9
82.0	9.6	11.3	9.2	11.0
82.5	9.6	11.4	9.3	11.1
83.0	9.7	11.5	9.4	11.2
83.5	9.8	11.6	9.5	11.3
84.0	9.9	11.7	9.6	11.4
84.5	10.0	11.8	9.6	11.5
85.0	10.1	11.9	9.7	11.6
85.5	10.2	12.0	9.8	11.7
86.0	10.3	12.1	9.9	11.8
86.5	10.4	12.2	10.0	11.8
87.0	10.5	12.3	10.1	11.9
87.5	10.5	12.4	10.2	12.0
88.0	10.6	12.5	10.3	12.2
88.5	10.7	12.7	10.4	12.3
89.0	10.8	12.8	10.5	12.4
89.5	10.9	12.9	10.6	12.5
90.0	11.0	13.0	10.7	12.6
90.5	11.1	13.1	10.8	12.7
91.0	11.2	13.2	10.9	12.8
91.5	11.3	13.3	11.0	12.9
92.0	11.4	13.4	11.1	13.0
92.5	11.5	13.5	11.2	13.1
93.0	11.6	13.7	11.3	13.3
93.5	11.7	13.8	11.4	13.4
94.0	11.9	13.9	11.5	13.5
94.5	12.0	14.0	11.6	13.6
95.0	12.1	14.1	11.8	13.8
95.5	12.2	14.3	11.9	13.9
96.0	12.3	14.4	12.0	14.0
96.5	12.4	14.5	12.1	14.2
97.0	12.5	14.7	12.2	14.3
97.5	12.7	14.8	12.4	14.4
98.0	12.8	14.9	12.5	14.6
98.5	12.9	15.1	12.6	14.7
99.0	13.0	15.2	12.8	14.9
99.5	13.1	15.4	12.9	15.0
100.0	13.3	15.5	13.1	15.2
100.5	13.4	15.7	13.2	15.3
101.0	13.5	15.8	13.3	15.5
101.5	13.6	16.0		
102.0	13.8	16.1		
102.5	13.9	16.3		
103.0	14.0	16.5		

WEIGHT-FOR-HEIGHT: REFERENCE VALUES (Cont.)

B. Stature

Stature length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
55.0	3.1	4.6	3.2	4.6
55.5	3.2	4.7	3.3	4.7
56.0	3.3	4.8	3.4	4.8
56.5	3.4	5.0	3.4	4.9
57.0	3.5	5.1	3.5	5.1
57.5	3.6	5.2	3.6	5.2
58.0	3.7	5.4	3.7	5.3
58.5	3.8	5.5	3.8	5.5
59.0	3.9	5.6	4.0	5.6
59.5	4.0	5.8	4.1	5.7
60.0	4.2	5.9	4.2	5.9
60.5	4.3	6.1	4.3	6.0
61.0	4.4	6.2	4.4	6.2
61.5	4.5	6.4	4.5	6.3
62.0	4.7	6.5	4.7	6.4
62.5	4.8	6.6	4.8	6.6
63.0	4.9	6.8	4.9	6.7
63.5	5.1	6.9	5.0	6.9
64.0	5.2	7.1	5.1	7.0
64.5	5.3	7.2	5.3	7.2
65.0	5.5	7.4	5.4	7.3
65.5	5.6	7.5	5.5	7.5
66.0	5.7	7.7	5.7	7.6
66.5	5.9	7.8	5.8	7.7
67.0	6.0	8.0	5.9	7.9
67.5	6.2	8.1	6.0	8.0
68.0	6.3	8.2	6.2	8.2
68.5	6.4	8.4	6.3	8.3
69.0	6.6	8.5	6.4	8.4
69.5	6.7	8.7	6.5	8.6
70.0	6.8	8.8	6.7	8.7
70.5	7.0	8.9	6.8	8.8

Stature length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
71.0	7.1	9.1	6.9	8.9
71.5	7.2	9.2	7.0	9.1
72.0	7.3	9.3	7.1	9.2
72.5	7.5	9.4	7.3	9.3
73.0	7.6	9.6	7.4	9.4
73.5	7.7	9.7	7.5	9.5
74.0	7.8	9.8	7.6	9.6
74.5	7.9	9.9	7.7	9.7
75.0	8.0	10.0	7.8	9.8
75.5	8.1	10.1	7.9	10.0
76.0	8.2	10.3	8.0	10.1
76.5	8.4	10.4	8.1	10.2
77.0	8.5	10.5	8.2	10.3
77.5	8.6	10.6	8.3	10.4
78.0	8.7	10.7	8.4	10.5
78.5	8.7	10.8	8.5	10.5
79.0	8.8	10.9	8.6	10.6
79.5	8.9	11.0	8.7	10.7
80.0	9.0	11.1	8.8	10.8
80.5	9.1	11.2	8.8	10.9
81.0	9.2	11.3	8.9	11.0
81.5	9.3	11.4	9.0	11.1
82.0	9.4	11.5	9.1	11.2
82.5	9.5	11.6	9.2	11.3
83.0	9.6	11.7	9.3	11.4
83.5	9.7	11.8	9.4	11.5
84.0	9.8	11.9	9.5	11.6
84.5	9.8	12.0	9.6	11.7
85.0	9.9	12.1	9.6	11.8
85.5	10.0	12.2	9.7	11.9
86.0	10.1	12.3	9.8	12.0
86.5	10.2	12.4	9.9	12.1

WEIGHT-FOR-HEIGHT: REFERENCE VALUES (Cont.)

B. Stature (Cont.)

Supine length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
87.0	10.3	12.5	10.0	12.2
87.5	10.4	12.6	10.1	12.3
88.0	10.5	12.7	10.2	12.4
88.5	10.6	12.9	10.3	12.5
89.0	10.7	13.0	10.4	12.6
89.5	10.8	13.1	10.5	12.7
90.0	10.9	13.2	10.6	12.8
90.5	10.9	13.3	10.7	13.0
91.0	11.0	13.4	10.8	13.1
91.5	11.1	13.5	10.9	13.2
92.0	11.2	13.6	11.0	13.3
92.5	11.3	13.8	11.1	13.4
93.0	11.5	13.9	11.2	13.6
93.5	11.6	14.0	11.3	13.7
94.0	11.7	14.1	11.4	13.8
94.5	11.8	14.2	11.5	14.0
95.0	11.9	14.4	11.6	14.1
95.5	12.0	14.5	11.7	14.2
96.0	12.1	14.6	11.8	14.4
96.5	12.2	14.8	12.0	14.5
97.0	12.3	14.9	12.1	14.6
97.5	12.4	15.0	12.2	14.7
98.0	12.5	15.2	12.3	14.9
98.5	12.6	15.3	12.4	15.0
99.0	12.7	15.4	12.5	15.1
99.5	12.8	15.6	12.6	15.3
100.0	12.9	15.7	12.7	15.4
100.5	13.1	15.8	12.8	15.5
101.0	13.2	16.0	12.9	15.7
101.5	13.3	16.1	13.0	15.8
102.0	13.4	16.3	13.1	15.9
102.5	13.5	16.4	13.2	16.1
103.0	13.6	16.5	13.3	16.2
103.5	13.8	16.7	13.5	16.3
104.0	13.9	16.8	13.6	16.5
104.5	14.0	17.0	13.7	16.6
105.0	14.1	17.1	13.8	16.8
105.5	14.3	17.3	13.9	16.9
106.0	14.4	17.4	14.0	17.0
106.5	14.5	17.6	14.2	17.2
107.0	14.7	17.7	14.3	17.3
107.5	14.8	17.9	14.4	17.5
108.0	14.9	18.1	14.5	17.6
108.5	15.1	18.2	14.7	17.8
109.0	15.2	18.4	14.8	17.9
109.5	15.3	18.5	14.9	18.1
110.0	15.5	18.7	15.0	18.2
110.5	15.6	18.9	15.2	18.4
111.0	15.8	19.0	15.3	18.6
111.5	15.9	19.2	15.4	18.7
112.0	16.1	19.4	15.6	18.9
112.5	16.2	19.5	15.7	19.1
113.0	16.4	19.7	15.9	19.2
113.5	16.5	19.9	16.0	19.4
114.0	16.7	20.0	16.2	19.6
114.5	16.8	20.2	16.3	19.7
115.0	17.0	20.4	16.5	19.9
115.5	17.1	20.6	16.6	20.1
116.0	17.3	20.7	16.8	20.3
116.5	17.4	20.9	16.9	20.5
117.0	17.6	21.1	17.1	20.6
117.5	17.8	21.3	17.2	20.8
118.0	17.9	21.5	17.4	21.0
118.5	18.1	21.7	17.6	21.2

WEIGHT-FOR-HEIGHT: REFERENCE VALUES (Cont.)

B. Stature (Cont.)

Supine length (cm)	Boys		Girls	
	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
119.0	18.3	21.9	17.7	21.4
119.5	18.4	22.0	17.9	21.6
120.0	18.6	22.2	18.1	21.8
120.5	18.8	22.4	18.2	22.0
121.0	18.9	22.6	18.4	22.2
121.5	19.1	22.8	18.6	22.5
122.0	19.3	23.0	18.8	22.7
122.5	19.5	23.2	18.9	22.9
123.0	19.6	23.5	19.1	23.1
123.5	19.8	23.7	19.3	23.4
124.0	20.0	23.9	19.5	23.6
124.5	20.2	24.1	19.7	23.8
125.0	20.4	24.3	19.9	24.1
125.5	20.6	24.5	20.1	24.3
126.0	20.7	24.8	20.3	24.6
126.5	20.9	25.0	20.4	24.8
127.0	21.1	25.2	20.6	25.1
127.5	21.3	25.5	20.8	25.4
128.0	21.5	25.7	21.0	25.7
128.5	21.7	26.0	21.2	25.9
129.0	21.9	26.2	21.4	26.2
129.5	22.1	26.5	21.6	26.5
130.0	22.3	26.7	21.9	26.8
130.5	22.5	27.0	22.1	27.1
131.0	22.7	27.3	22.3	27.4
131.5	22.9	27.5	22.5	27.7
132.0	23.1	27.8	22.7	28.0
132.5	23.3	28.1	22.9	28.4
133.0	23.5	28.4	23.1	28.7
133.5	23.7	28.7	23.4	29.0
134.0	23.9	29.0	23.6	29.4
134.5	24.1	29.3	23.8	29.7
135.0	24.4	29.6	24.0	30.1
135.5	24.6	29.9	24.3	30.4
136.0	24.8	30.2	24.5	30.8
136.5	25.0	30.5	24.7	31.2
137.0	25.2	30.9	24.9	31.5
137.5	25.4	31.2		
138.0	25.7	31.5		
138.5	25.9	31.9		

Annex 7

WEIGHT-FOR-AGE: REFERENCE VALUES[1]

A. Ages 0 – 24 Months

	Boys		Girls	
Age (months)	Median −2SD (kg)	Median (kg)	Median −2SD (kg)	Median (kg)
0	2.5	3.3	2.2	3.2
1	2.9	4.3	2.8	4.0
2	3.5	5.2	3.3	4.7
3	4.1	6.0	3.9	5.4
4	4.7	6.7	4.5	6.0
5	5.3	7.3	5.0	6.7
6	5.9	7.8	5.5	7.2
7	6.4	8.3	5.9	7.7
8	6.9	8.8	6.3	8.2
9	7.2	9.2	6.6	8.6
10	7.6	9.5	6.9	8.9
11	7.9	9.9	7.2	9.2
12	8.1	10.2	7.4	9.5
13	8.3	10.4	7.6	9.8
14	8.5	10.7	7.8	10.0
15	8.7	10.9	8.0	10.2
16	8.8	11.1	8.2	10.4
17	9.0	11.3	8.3	10.6
18	9.1	11.5	8.5	10.8
19	9.2	11.7	8.6	11.0
20	9.4	11.8	8.8	11.2
21	9.5	12.0	9.0	11.4
22	9.7	12.2	9.1	11.5
23	9.8	12.4	9.3	11.7
24	9.9	12.6	9.4	11.9

[1]Data Source: National Center for Health Statistics, USA.

WEIGHT-FOR-AGE: REFERENCE VALUES (Cont.)

B. Ages 2 – 5 Years (Cont.)

Age (years)	Age (months)	Boys Median – 2SD (kg)	Boys Median (kg)	Girls Median – 2SD (kg)	Girls Median (kg)
2	1	10.2	12.5	9.6	12.0
2	2	10.3	12.7	9.8	12.2
2	3	10.4	12.9	9.9	12.4
2	4	10.5	13.1	10.1	12.6
2	5	10.6	13.3	10.2	12.8
2	6	10.7	13.5	10.3	13.0
2	7	10.9	13.7	10.5	13.2
2	8	11.0	13.9	10.6	13.4
2	9	11.1	14.1	10.8	13.6
2	10	11.2	14.3	10.9	13.8
2	11	11.3	14.4	11.0	13.9
3	0	11.4	14.6	11.2	14.1
3	1	11.5	14.8	11.3	14.3
3	2	11.7	15.0	11.4	14.4
3	3	11.8	15.2	11.5	14.6
3	4	11.9	15.3	11.6	14.8
3	5	12.0	15.5	11.8	14.9
3	6	12.1	15.7	11.9	15.1
3	7	12.3	15.8	12.0	15.2
3	8	12.4	16.0	12.1	15.4
3	9	12.5	16.2	12.2	15.5
3	10	12.6	16.4	12.3	15.7
3	11	12.8	16.5	12.4	15.8
4	0	12.9	16.7	12.6	16.0
4	1	13.0	16.9	12.7	16.1
4	2	13.1	17.0	12.8	16.2
4	3	13.3	17.2	12.9	16.4
4	4	13.4	17.4	13.0	16.5
4	5	13.5	17.5	13.1	16.7
4	6	13.7	17.7	13.2	16.8
4	7	13.8	17.9	13.3	17.0

WEIGHT-FOR-AGE: REFERENCE VALUES (Cont.)

B. Ages 2 – 5 Years (Cont.)

Age (years)	Age (months)	Boys Median – 2SD (kg)	Boys Median (kg)	Girls Median – 2SD (kg)	Girls Median (kg)
4	8	13.9	18.0	13.4	17.1
4	9	14.0	18.2	13.5	17.2
4	10	14.2	18.3	13.6	17.4
4	11	14.3	18.5	13.7	17.5
5	0	14.4	18.7	13.8	17.7

Annex 8

HEIGHT-FOR-AGE: REFERENCE VALUES[1]

A. Ages 0 – 24 Months – Supine Length

Supine length				
	Boys		Girls	
Age (months)	Median −2SD (cm)	Median (cm)	Median −2SD (cm)	Median (cm)
0	45.9	50.5	45.5	49.9
1	49.7	54.6	49.0	53.5
2	52.9	58.1	52.0	56.8
3	55.8	61.1	54.6	59.5
4	58.3	63.7	56.9	62.0
5	60.5	65.9	58.9	64.1
6	62.4	67.8	60.6	65.9
7	64.1	69.5	62.2	67.6
8	65.7	71.0	63.7	69.1
9	67.0	72.3	65.0	70.4
10	68.3	73.6	66.2	71.8
11	69.6	74.9	67.5	73.1
12	70.7	76.1	68.6	74.3
13	71.8	77.2	69.8	75.5
14	72.8	78.3	70.8	76.7
15	73.7	79.4	71.9	77.8
16	74.6	80.4	72.9	78.9
17	75.5	81.4	73.8	79.9
18	76.3	82.4	74.8	80.9
19	77.1	83.3	75.7	81.9
20	77.9	84.2	76.6	82.9
21	78.7	85.1	77.4	83.8
22	79.4	86.0	78.3	84.7
23	80.2	86.8	79.1	85.6
24	80.9	87.6	79.9	86.5

[1] Data Source: National Center for Health Statistics, USA.

HEIGHT-FOR-AGE: REFERENCE VALUES (Cont.)

B. Ages 2 – 5 Years – Stature

Stature					
Age		Boys		Girls	
(years)	(months)	Median – 2SD (cm)	Median (cm)	Median – 2SD (cm)	Median (cm)
2	1	79.9	86.4	78.8	85.3
2	2	80.6	87.2	79.6	86.2
2	3	81.3	88.1	80.3	87.0
2	4	82.0	88.9	81.0	87.9
2	5	82.7	89.6	81.8	88.7
2	6	83.4	90.4	82.5	89.5
2	7	84.1	91.2	83.1	90.3
2	8	84.7	92.0	83.8	91.0
2	9	85.4	92.7	84.5	91.8
2	10	86.0	93.5	85.2	92.5
2	11	86.7	94.2	85.8	93.2
3	0	87.3	94.9	86.5	94.0
3	1	87.9	95.6	87.1	94.6
3	2	88.6	96.3	87.7	95.3
3	3	89.2	97.0	88.4	96.0
3	4	89.8	97.7	89.0	96.6
3	5	90.4	98.4	89.6	97.3
3	6	91.0	99.1	90.2	97.9
3	7	91.6	99.7	90.7	98.6
3	8	92.1	100.4	91.3	99.2
3	9	92.7	101.0	91.9	99.8
3	10	93.3	101.7	92.4	100.4
3	11	93.9	102.3	93.0	101.0
4	0	94.4	102.9	93.5	101.6
4	1	95.0	103.6	94.1	102.2
4	2	95.5	104.2	94.6	102.7
4	3	96.1	104.8	95.1	103.3
4	4	96.6	105.4	95.6	103.9
4	5	97.1	106.0	96.1	104.5

HEIGHT-FOR-AGE: REFERENCE VALUES (Cont.)

B. Ages 2 – 5 Years – Stature (Cont.)

Stature					
Age		Boys		Girls	
(years)	(months)	Median – 2SD (cm)	Median (cm)	Median – 2SD (cm)	Median (cm)
4	6	97.7	106.6	96.7	105.0
4	7	98.2	107.1	97.1	105.6
4	8	98.7	107.7	97.6	106.2
4	9	99.2	108.3	98.1	106.7
4	10	99.7	108.8	98.6	107.3
4	11	100.2	109.4	99.1	107.8
5	0	100.7	109.9	99.5	108.4

Annex 9

SMOOTHED 5TH PERCENTILE AND MEDIAN OF ARM CIRCUMFERENCE[1]

Exact age in years	Boys		Girls	
	5th percentile (cm)	median (cm)	5th percentile (cm)	median (cm)
2.0	14.3	16.0	13.8	15.9
2.5	14.5	16.3	14.0	16.1
3.0	14.7	16.5	14.3	16.2
3.5	14.9	16.7	14.5	16.4
4.0	15.0	16.9	14.7	16.6
4.5	15.1	17.1	14.8	16.8
5.0	15.1	17.2	15.0	17.0
5.5	15.2	17.3	15.1	17.3
6.0	15.3	17.5	15.2	17.5
6.5	15.4	17.7	15.4	17.8
7.0	15.5	17.9	15.5	18.0
7.5	15.7	18.1	15.7	18.4
8.0	15.9	18.4	15.9	18.7
8.5	16.2	18.8	16.1	19.1
9.0	16.5	19.1	16.3	19.4
9.5	16.8	19.6	16.6	19.9
10.0	17.2	20.0	17.0	20.3

[1] Data Source: National Center for Health Statistics, USA.

Annex 10

BODY MASS INDEX

Weight/ Height^2 [kg/m^2]

CLASSIFICATION OF OBESITY IN ADULTS

Grade	BMI
0	20 to 24.9
1	25 to 29.9
2	30 to 39.9
3	40 and over

CRITICAL WEIGHT AT DIFFERENT HEIGHTS IN THE CLASSIFICATION OF OBESITY BY BODY MASS INDEX

BMI	20	25	30	40
Height (m)	Weight	(kg)		
1.50	45.0	56.2	67.5	90.0
1.55	48.4	60.0	72.1	96.1
1.60	51.2	64.0	76.8	102.4
1.65	54.4	68.1	81.7	108.9
1.70	57.8	72.2	86.7	115.6
1.75	61.2	76.6	91.9	122.5
1.80	64.8	81.0	97.2	129.6
1.85	68.4	85.6	102.7	136.9
1.90	72.2	90.2	108.3	144.4

Remark: the weights resulting in a BMI of 20, 30 and 40 correspond to 80, 120 and 140% of the weight at BMI = 25.

Annex 11

WHO/FAO INTERCOUNTRY MEETING ON NUTRITION SURVEILLANCE

Islamabad, 23 – 27 October 1988

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