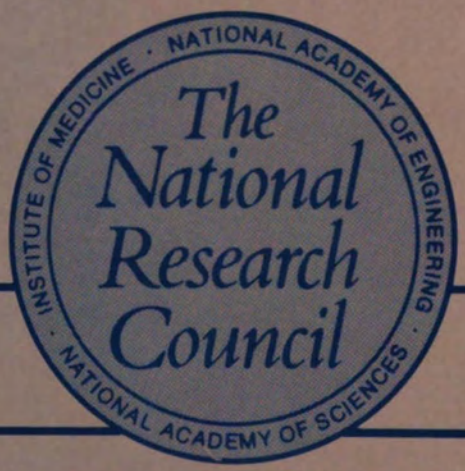
Assessment of Basic Field Surveys of Nutritional Status in Young Children (Monograph No. 1)

As It Relates to National Nutrition Surveillance



Committee on International Nutrition Programs

Food and Nutrition Board

Assembly of Life Sciences

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ASSESSMENT OF "BASIC FIELD SURVEYS OF NUTRITIONAL STATUS IN YOUNG CHILDREN (MONOGRAPH NO. 1)"

AS IT RELATES TO NATIONAL NUTRITION SURVEILLANCE

Committee on International Nutrition Programs
Food and Nutrition Board
National Research Council

National Academy of Sciences

Washington, D.C.

1979

NOTICE

The project that is the subject of this report was approved by the Governing Board of the National Research Council, whose members are drawn from the Councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. The members of the Committee responsible for the report were chosen for their special competences and with regard for appropriate balance.

This report has been reviewed by a group other than the authors according to procedures approved by a Report Review Committee consisting of members of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine.

ACKNOWLEDGMENT

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Attachment: "Basic Field Surveys of Nutritional Status in Young Children (Monograph No. 1)"

INTRODUCTION

The Committee on International Nutrition Programs (CINP) of the Food and Nutrition Board, National Academy of Sciences, was asked by the U.S. Agency for International Development (USAID) to assess the Basic Field Survey (BFS) of Nutritional Status in Young Children (see attachment to this report). The BFS was revised in October 1978 by an ad-hoc panel of the CINP; Drs. Joe D. Wray, J. Michael Lane, Ruth L. Huenemann, and Jean-Pierre Habicht (Chairman), in consultation with Drs. Milton Z. Nichaman (Center for Disease Control), who had been using this basic survey protocol, and Dr. John I. McKigney and Mr. Alan Randlov of USAID. The ad hoc panel's report was then reviewed and modified by the CINP.

The CINP evaluated the applicability of the BFS to a National Nutrition Surveillance System according to the criteria contained in the FAO/UNICEF/WHO guidelines, "Methodology of Nutritional Surveillance" (WHO, 1976). The FAO/UNICEF/WHO guidelines state;

> Surveillance is not an isolated activity, but goes hand in hand with the formulation and execution of policy. p.7
>
> Surveillance should provide ongoing information about the nutrition conditions of the population and the factors which influence them. This information will provide a basis for decisions to be made by those responsible for policy, planning, and the management of programmes relating to improvement of food consumption patterns and nutritional status. p.8

The document defines the objectives of nutritional surveillance as follows:

1.2 Specific objectives

Nutritional surveillance is a continuous process, that should have the following specific objectives:

(1) To describe the nutritional status of the population, with particular reference to defined subgroups who are identified as being at risk. This will permit description of the character and magnitude of the nutrition problem and changes in these features.

(2) To provide information that will contribute to the analysis of causes and associated factors and so permit a selection of preventive measures, which may or may not be nutritional.

(3) To promote decisions by governments concerning priorities and the disposal of resources to meet the needs of both normal development and emergencies.

(4) To enable predictions to be made on the basis of current trends in order to indicate the probable evolution of nutritional problems. Considered in conjunction with existing and potential measures and resources, these will assist in the formulation of policy.

(5) To monitor nutritional programmes and to evaluate their effectiveness. p. 9

The thrust of all these statements is that the information from surveillance activity should provide information for rational decisions about food and nutrition programs and that this information will in fact be used in nutrition planning and in the implementation of national nutrition programs. In theory, the only information that should be gathered should be relevant to proposed decisions pertaining to active governmental policy in food and nutrition. In practice, nutrition surveillance activity may motivate and therefore it may precede major government commitments to active food and nutrition programs. Nevertheless, the data should be relevant to policy decisions. Thus, collection should never proceed before the probable options for intervention have been specified.

The FAO/UNICEF/WHO guidelines define, among other things, various phases of nutritional surveillance, including "initial assessment." The CINP reviewed the BFS protocol in this context (WHO, 1976):

> 2. Initial assessment
>
> Before a system of nutritional surveillance can be designed for any country there must be an initial assessment of the situation in that country. This assessment should include as far as possible information of four types:
>
> --type, extent, and timing of the nutritional problems,
> --identification and description of the groups particularly at risk,
> --reasons for the existence of malnutrition,
> --existing sources of data on which a surveillance system could draw.
>
> Where no information is available, the first steps in setting up surveillance will have to be based on analogy with countries in which there are similar socioeconomic and ecological conditions. At the next stage qualitative information may be obtained from reports of cases of malnutrition in hospitals and spot surveys. This qualitative information may indicate what the nutritional problems are. At a more advanced stage data may be available from representative surveys that will give a quantitative answer to the questions "Who is malnourished?" "Where?" "How many?" and will provide some information on "Why?". This progression knowledge is illustrated by the history of the protein-energy malnutrition problem: in which the problem was not even recognized to a situation in which there are reports from hospitals, and sometimes community studies of prevalence, severity, and causal factors. p. 11

Initial assessment data may be obtained from many sources including national or regional surveys such as BFS. Additional documents relating to specific portions of the BFS (e.g., survey organization and administration, sample selection, analysis and interpretation of data, training of survey personnel) and other surveys are being prepared by USAID. The BFS is specifically designed to describe the extent and distribution of the types of malnutrition that result in anemia, stunted growth, or wasting and to provide reliable estimates of the prevalence

of those conditions in children through precise sampling and measurement procedures.

EXPERIENCES WITH THE BFS

The BFS protocol has been used for assessment in nine countries. Reports have been issued for five of these countries, Vietnam, Nepal, SRI Lanka, Liberia, and Lesotho (see Attachment). The prevalence of malnutrition other than that resulting in stunting, wasting, and anemia was apparently also measured with the BFS sampling procedures by including other measurements than those described in the BFS protocol.

Experience with the nine surveys indicates that a survey can be planned, completed, analyzed, and transmitted in 1 year. Preplanning requires at least 3 months. Field work can be completed in 2 to 5 months, depending upon logistical constraints and the number of geographic areas for which valid estimates must be derived. Data analysis and preparation of a report take from 3 to 6 months. The basic core module, specifically the anthropometry and hemoglobin results, can be analyzed and presented within 4 weeks.

Certain constraints upon timing, such as availability of personnel and interruptions caused by climate, can modify this timetable. The planning stage may be extended by administrative, logistical, and other complexities encountered when implementing a survey and by the profitable, but time-consuming involvement of local nutrition policymakers. However, once field activities have begun, data collection, analyses, preparation, and dissemination of the report must be accomplished quickly if the results are to have maximum impact.

Ultimately, BFS activity should contribute to the establishment of a full-scale nutrition planning program, through the provision of data. It may also stimulate concerns about nutrition through the planning process, the implementation of the survey itself, and the training of personnel.

Sensitization of those responsible for food, nutrition, and health policy depends on how planning is done, with whom the survey team collaborated during the survey, and the analysis and interpretation of the data. While none of these steps were presented in this protocol and, therefore, cannot be judged, the CINP observed that a number of contractual matters had to be resolved before the nine surveys were undertaken. Basically, these related to requests for assistance with the survey and follow-up activities from the host governments, donors of multi-and bilateral aid, and other agencies. This included initiation of a formal request for the survey from the host government, assurance that the government could provide personnel and financial assistance with local costs of the survey, and determination that the government had the capability and intent of following-up on survey results. These criteria, requests, and certifications increased the probability that the survey results would be utilized.

In spite of this attempt to assure local involvement in the surveys, experience with the BFS has indicated that the desired degree of involvement of responsible local officials has been difficult to achieve in some cases because of their other duties. Thus, experience with this protocol has revealed the importance of both extending the preplanning phase long enough to involve nutrition policymakers and involving indigenous and nonindigenous nutrition planners in the presentation of the results to the government.

The data from this BFS activity have apparently been used more quickly and more extensively in the planning and implementation of national nutrition programs than have the data from previous nutrition surveys in other developing countries. USAID reported that four of the nine countries were surveyed within the last year. Of the other five, the first was finished in 1975, the last in 1977. One of these five has not yet taken any action on the basis of the data collected. In the four other countries, the use of the BFS has already had an impact on the results of ongoing nutrition programs and are being used in food and nutrition planning. One country has implemented new programs based

on the BFS findings. Two countries have instituted ongoing nutrition surveillance activities to assess the impact of their revised or new activities.

COMMENTS

Certain principles pertain to national nutrition surveillance. The first relates to whether nutritional surveillance activities are warranted. Such activities are only warranted when the information collected is likely to affect public policy. This concern has evidently been a major determinant in USAID's funding of the BFS activities. The present BFS document was not meant to address this issue nor did the committee judge how adequately the concern was met. However, the committee believes that the use of the BFS should continue to be conditional, based on the probability that the data collected will be used in food and nutrition policy. This, of course, depends upon how the BFS is implemented: the involvement of the appropriate authorities in the planning, and interpretation of the surveys and in the analysis, presentation and interpretation of the data and the authorities' concern about the countries' nutritional problems. Again, while not addressed specifically in this BFS document, the involvement of local authorities has apparently been a major concern of those managing BFS surveys. However, since the committee had no firsthand knowledge of the level of current involvement, it could not judge its adequacy, although it approves of this emphasis.

The second issue relates to the appropriateness of the BFS instrument within nutrition surveillance. The committee believes that nutrition surveillance implies a system that couples data collection to policy decisions and program management. No single instrument can fill all the needs of such a system, nor is it likely that any one instrument will fill a similar need in different countries. This BFS document does not define its probable utility within a national

surveillance system in relation to the existence of other data and other data collection instruments, and to the possibilities of coupling the information gathered to the various types and kinds of nutrition intervention, e.g., supplementation.

The committee believes that the BFS is a probabilistic sampling survey instrument of most use in areas where little is known about the national or regional prevalence of stunting, wasting, and anemia of children and where such information is needed rapidly. In this situation, the BFS has practical application as a nutritional assessment instrument. The measurement techniques suggested in the BFS for anemia, stunted growth, and wasting are accepted practice. Other types of malnutrition can be and have been measured with these sampling procedures, but the committee did not review any of these measurements. The sampling and quality control techniques described in the BFS protocol and used by the BFS teams are advances on previous practice. If rigorously applied, this (BFS) protocol will indeed "assess the magnitude of stunting, wasting, and anemia in early childhood" as it claims to do at the national level.

Not only could this BFS protocol deliver reliable national estimates, but it could also provide reliable comparative estimates across geographic, demographic, socioeconomic, and environmental gradients, if these are properly measured. The measurements for each variable will vary. The committee did not examine such measurements, but it appraised the stratified sampling across administrative units involved in nutrition planning activities. This stratification could be expanded to obtain regional data and data across groups of similar characteristics within a national Basic Field Survey.

The committee reviewed neither the actual data from BFS surveys nor the inferences drawn from them. Therefore, it did not assess the adequacy of data analysis or data presentation. Nevertheless, it determined that insight into mechanisms leading to inadequate nutritional status must be derived from <u>data other</u> than those collected

by this BFS. These other data (e.g., information about infant and child feeding patterns, illnesses, mortality, etc.) must be collected either concurrently with the BFS as part of the same survey or in subsequent studies. Even these efforts will probably not be sufficient for all nutrition planning needs and will have to be complemented by further data-gathering as new questions resulting from earlier data come into focus. The iterative nature of nutrition surveillance is implied in the BFS document, but is not yet adequately recognized in contractual arrangements. Consequently, continuity of information-gathering is not fostered.

The prevalence data in the BFS could be compared with similar data collected at some later time. This requires exacting sampling and measuring methods which far exceed those necessary for assessment data described above. The protocol of the BFS would probably deliver data of this quality. The committee could not assess the utility of such longitudinal information without knowing the details and adequacy of a surveillance system that includes such repetitive surveys.

CONCLUSIONS

The committee concluded that rigorous application of the BFS will produce reliable estimates of the prevalence of different degrees of wasting, stunting, and anemia at national and local levels and that these estimates will be useful in nutrition planning. With appropriate modifications it could also deliver such information across demographic, socioeconomic, and environmental gradients. It is probably the best cross-sectional survey instrument available to collect and report such reliable information quickly. This virtue tends to be attained at the expense of indigenous involvement in the management and analytic aspects of the survey, if not necessarily in the planning stages or in the presentation and interpretation of the data. This may be appropriate where indigenous management and analytic resources cannot be spared

for such a survey, but not appropriate under other conditions.

The BFS protocol was developed and has been used as an initial stage in collecting national nutrition data. Depending on the circumstances, it may or may not be the appropriate instrument to use for this purpose. The data collected by the BFS must be complemented by other data before they can be used fruitfully in nutrition planning and policy. Thus, the BFS does not represent a national nutrition surveillance system, although its methodology could be incorporated into such a system.

RECOMMENDATIONS

1. The committee recommends that the data collection methods used for national nutrition surveillance be appropriate for a country's specific circumstances and for the policy decisions about food and nutrition that the country faces. If there is need for a national or regional probabilistic sampling survey to assess the prevalence of different degrees of stunting, wasting, and anemia, the BFS protocol permits more reliable estimates than have ever been possible with this type of survey. However, the users must be aware that implementation of the protocol may sometimes have to trade the advantages of quality and speed against those of extensive involvement by host government personnel in detailed planning, management, and analysis.

2. The committee commends USAID for fostering national nutrition surveillance activities and the Center for Disease Control for developing and testing this protocol in conjunction with the University of California at Los Angeles. The committee recommends that USAID continue to support the development of instruments for nutrition surveillance. In particular, it is important that the planned manuals relating to the BFS planning, organization, data

analyses, and data presentation be completed promptly to complement the present document, which deals only with some sampling and measuring methodology.

3. The committee recommends that the systems nature of nutrition surveillance be recognized when planning the use of this BFS. In particular, the needs for iterative nutrition assessment must be recognized during the planning stages and when institutional arrangements are made to implement the BFS to ensure subsequent data collection by the host country.

4. The committee commends the countries and agencies that have used the BFS for their concern that the data collected be used to institute and modify food and nutrition programs. It urges continuation of this emphasis.

5. The committee recommends that all sections of this document be distributed with the attachment, "Basic Field Surveys of Nutritional Status of Young Children (Monograph No. 1)," so that prospective users of the monograph are adequately informed of its place in nutrition planning.

REFERENCE

Joint FAO/UNICEF/WHO Expert Committee. 1976. Methodology of Nutritional Surveillance. World Health Organization Tech. Rep. Ser. No. 593, 66 pages.

ATTACHMENT

BASIC FIELD SURVEYS OF NUTRITIONAL STATUS OF YOUNG CHILDREN

(Monograph No. 1)

Office of Nutrition
Development Support Bureau
Agency for International Development
Department of State
Washington, D.C. 20523

BASIC FIELD SURVEYS OF NUTRITIONAL STATUS IN YOUNG CHILDREN (Monograph No. 1)

INTRODUCTION

This is the first in a series of documents to be developed by the U.S. Agency for International Development. The methodology described in this series of monographs is designed to assess the magnitude and location of probable malnutrition using selected anthropometric, biochemical, clinical, and demographic indices. It is not designed to identify and evaluate all possible causes of malnutrition, and in this context it may be a necessary but not sufficient step in the planning and implementation of nutrition improvement programs.

The need for effective programs to improve global nutrition and health becomes evermore urgent. Information regarding the magnitude of the problem of malnutrition, and the identification of population groups in greatest need of assistance, and the baseline data to assist in evaluation of future interventions can best be obtained by objective assessment of the nutritional status of representative communities.

In the past, national nutrition surveys have often been excessively costly and complex, as well as unrepresentative of the total population because of poor sampling techniques. The release of useful information from these surveys has also often been tardy so that the translation of survey results into practical programs for nutritional improvement has usually been unsatisfactory. Simpler methods must be developed and field tested which can provide better data with less expenditure of money, complex equipment, highly trained personnel, and time.

The outlines of such a simplified system are presented in this monograph. The system utilizes the prevalence of stunting, wasting, and anemia to assess the magnitude of stunting, wasting, and anemia in early childhood. The relatively few measurements recommended in this method can be performed by paraprofessional personnel who have been

specially trained. The results can be quickly analyzed and made available for practical program planning and evaluation.

This method is not a comprehensive nutritional assessment of an entire population and cannot be expected to detect all cases of malnutrition, nor all of its correlates, within a community or a country. It is not designed to identify and measure the many ecologic factors associated with malnutrition. Such analysis requires greater sophistication, the determination of many economic, sociologic, dietary, agricultural, and other variables, and could be undertaken concurrently or at a later stage in the development of nutrition improvement programs. The purpose of this simplified method is more to answer the question, "What is the magnitude and geographic extent of the problem?" rather than "What are its various causes?" It will generate valid and useful data bearing upon the prevalence of the most common nutritional problems of young children in developing nations, and thus provide indication of where, among whom, and what kind of nutritional problems require remedial action.

Since the physical growth of young children is so commonly threatened in the developing world by the interaction of infectious diseases and dietary deficiencies, simple body measurements of children between 3 months and 60 months of age constitute the core of the method. Since anemia also is widespread, determination of hemoglobin or hematocrit, or both, should be performed on a subsample of the children. These basic measurements may be supplemented by appropriate demographic, socioeconomic, laboratory, or clinical data based upon preliminary knowledge of the population to be studied and within the constraints of money, equipment, personnel, and time. For example, if deficiencies such as hypovitaminosis-A are believed to be a public health problem, appropriate supplemental studies may be performed on a selected subsample.

Rapidly growing children are at greatest risk of developing malnutrition, but that risk is lower, both under 3 months of age because of the still relatively high prevalence of breast-feeding in rural areas of developing countries, and over 60 months of age because of the

greater host resistance to infection and more varied dietary intake. In certain urbanized communities where traditional breast-feeding practices have declined, children younger than 3 months of age may optionally be included in the sampling frame and, for comparison, a subsample of younger babies should also be included from the countryside. For these small infants, weight alone, without length measurement, which is particularly difficult to perform accurately at this age, is to be measured. Also, where information is available in regard to the peak incidence of stunting, wasting, and anemia, it may be desirable to further limit the upper age limit of the children studied. Limiting the assessment to this narrow age range, in which male/female differences in most body measurements are minimal, facilitates statistical analysis of the data. For most analyses, the sexes can be combined, with a smaller number of children needing to be examined at each specific age level.

METHODS

The distinctive features of this simplified assessment are the statistical methods for representatively selecting the population to be studied, and the recommendations for employing a minimum core of objective nutritional indicators, uniformly measured. The recommendations provide reasonable assurance that valid comparisons can be made between defined subgroups within the total population. These sampling methods and nutritional indicators are presented briefly in the following two sections, followed by suggestions on training the survey teams in performing accurate and reproducible measurements, and on logistics of conducting the survey. Finally, suggestions are presented on methods for data processing, feedback of results, utilization of results for preventive action, and evaluation of action.

The original methodology, employed in an assessment of nutritional status of displaced persons in South Vietnam in 1973 (1), has been

revised and subsequently used in national nutrition assessments of Nepal (2), Sri Lanka (3), Liberia (4), Lesotho (5), and Togo (6).

Sample Selection

The sampling technique is designed to provide a representative sample of rural sedentary (nonmigrant) populations. People who do not reside in a recognized village or similar geographic entity will not be in the sample. The sampling technique is designed for simplicity of field operations. It should be useful in any nation or geographic area which does not have a true census. Where a recent census is available, it should be used as the sample frame.

General sampling recommendations, based upon field experience, consultations with authorities in sampling methodology, and a manual of sampling methods (7), are as follows:

1. Within a region for which reliable information is required, at least 30 sample sites are to be selected, using a self-weighting population-proportional technique. For comparisons between one region and another to be valid, at least 30 such sites are requred within each. Every effort must be made to examine the exact sites selected, and not to substitute others which may prove more convenient or cooperative.

2. Within each sample site, population proportional sampling methods are employed to select the first household. If population proportional sampling methods are achieved, no sampling biases are introduced. Minor departures from "random" selection of the starting point should not introduce major biases, but it should be clearly understood that the starting point should be selected by "chance" and not convenience. A population block of predetermined size (total people) is identified as the ultimate sample. All children within the age group covered by the survey within the sampled population block will be surveyed. Records are kept of children who are within the scope of the survey but who are not included for various reasons. The size of the sampled population block is designed to contain 30 children on the average. The minimum of 900 children sampled per region constitutes a representative

sample of children for the region. Departures from population proportional methods can invalidate precision estimation of survey data.

3. It may be desirable to draw larger samples of certain high-risk groups or of certain subregions to permit more thorough and detailed description of the nutritional status of a particular population group or geographic area. Such a decision will be dictated by careful study of available demographic, geoclimatic and clinical data during the preplanning phase. These adjustments to the sample are permissible provided they do not preclude making unbiased regional and country-wide estimates. Statistical consultation is provided to assure the primary survey objectives.

4. If country-wide estimates are prepared, regions must be weighted by their populations to provide unbiased estimates. It may be desirable to adjust the number of clusters selected by region to facilitate computer processing of the data for nation-wide estimations. A self-weighting sample of the country is possible if regions are of roughly equal size.

5. For those measurements which are to be performed on only a part of the sample, as with hemoglobin determination and certain other tests, the same systematically chosen subsample, e.g., 20 percent, should be employed for each measurement again to insure representativeness and to permit use of precision estimation formulae.

Assessment Methods

In the sample selected for study, the following set of measurements, those that related to the nutritional status of these chidren, constitute the core of key indicators. Those underlined are recommended to be done in all situations. The role of other optional measurements in the assessment methodology will be discussed, and their use dictated by the particular situation.

In outline form, these indicators are:

1. From mothers, or those who may substitute as mothers of children examined:
   a. age of children (total sample)
   b. basic identification (total sample)
   c. selected demographic and socioeconomic data (total sample)
2. From sample children, approximately 3 months to 60 months of age:
   a. body measures
      (1) length or height (total sample)
      (2) weight (total sample)
      (3) mid-upper arm circumference (subsample)
      (4) triceps fatfold thickness (subsample)
   b. clinical screening
      (1) bilateral pretibial edema (total sample)
      (2) selected signs associated with specific nutrient deficiency, such as hypovitaminosis A, as indicated by the local situation (total sample).
   c. laboratory determinations*
      (1) hemoglobin
      (2) additional determinations such as plasma or serum vitamin A as indicated by the local situation may be done on an appropriate subsample.

Further discussion of these suggested indicators, under the same subject headings, is presented below:

1. From mothers
   a. Basic identifying data should be coded to include, in addition to the region, site, family and child, the child's age and position in the family. His or her name (not to be coded), sex and age complete the identifying data. Each child's age should be carefully ascertained,

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*In addition to the indications noted, performance of these determinations is dependent upon the availability of adequate technical capability.

confirmed as feasible by existing records, popularly known astrological signs, or specially constructed local events calendars. The record should make clear whether the recorded age is a crude or a reliable estimate, so that appropriate categorization may be made for analysis of growth indices requiring accurate age.

b. Depending upon local geographic, ethnic, and socioeconomical conditions, further selected, relevant data may be collected, as feasible.

2. <u>From children</u>

a. Body measures

(1) Length or height (Ht). Supine length should be measured on all children 2 years or less of age, or if accurate age is unknown, children 85 cm or less in length. For children older than 2 years, or taller than 85 cm, standing height should be measured. In either case the measurement must be that of the child in full extension aligned with the measuring instrument, and with feet bare and head positioned so that the child's gaze is directed perpendicular to its body alignment.

For measurement of length, to accomplish proper positioning of an often uncooperative child, the measurer must be assisted by a full-time helper. The measuring instrument must have a fixed right angle headboard and a freely movable right angle footboard which slides along a clearly legible scale. One person holds the child's head in alignment with the body with the line of vision straight up and applies gentle traction to bring the top of the head into contact with the fixed headboard ensuring that it is maintained there. The other person holds the child's feet with the toes straight up an pushes down on the knees to fully extend the legs. With the other hand he brings the movable footboard firmly against the

heels, reading the measurement when the position is optimum.

For measurement of height the child should stand on a horizontal bare floor or platform with feet close together, with heels, buttocks and back of shoulders touching the wall or a vertical surface of a measuring divide, and with the line of vision straight ahead. He should be told to "stand up straight and tall and look straight ahead." A block squared at right angles against the wall should then be brought into firm contact with the crown of the head. When an assistant is available, this person should place one hand against the child's knees to detect any flexion of the legs and the other hand on the feet to detect any lifting of the heels. The measurement is read when the position is optimum.

(2) Weight (Wt). For children of this age, the Salter hanging scale,* which weighs up to 25 kg, marked at 0.1 kg intervals, has proven to be eminently satisfactory in field work. It can be hung from a tree branch or a door frame, but in desert conditions a portable tripod or walking stick can be substituted. Reliable and inexpensive beam balances which are now available may also be used. Accuracy of all scales should be checked periodically by weights of known mass. This may be done using large plastic bottles or jugs, which are easily transportable empty, and, filled with water in the field, always contain an exactly known volume.

(3) Mid-upper arm circumference (AC). Jelliffe and Jelliffe (8) have shown that this measure can provide an independent assessment of the severity of undernutrition, as manifested by wasting of muscle. As usually performed, its validity has been questioned because of the

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*Use of trade names is for identification only and does not constitute endorsement.

relatively large standard error of its measurement. With the use of insertion-type tapes developed by Zerfas (9), together with adequate training and quality control of the measurers, satisfactory precision and accuracy are possible. The midpoint of the upper arm must be accurately located, and the tape applied snugly, but not too tightly.

(4) Triceps fatfold thickness (Tri FF). To estimate the contribution of subcutaneous fat to the AC measure, and to provide an objective indication of children's caloric reserve, as described by Gurney et al. (10), the measurement of Tri FF may be considered. This consideration will be governed by the availability of an appropriate instrument such as the new Tanner-Holtain caliper,* and the ability to control, satisfactorily, measurement accuracy.

b. Clinical screening

(1) Pretibial edema. In diagnosing kwashiorkor it is of critical importance to establish the presence or absence of edema. This sign should be elicited with great care and consistency by applying bilateral firm thumb pressure over the lower tibiae for three seconds. Resultant bilateral pitting signifies edema of systemic origin. None or questionable pitting is to be graded 0, slight but definite pitting as 1, and moderate to marked pitting, 2.

(2) Other signs. Much more difficult than training for the detection of edema is the training necessary for nonmedical workers to recognize signs and symptoms of other micronutrient deficiencies. Although difficult, collection of such data should be considered when a

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high index of suspicion exists in regard to significant micronutrient deficiencies in the population.

c. Laboratory determinations

(1) Hemoglobin (Hgb). Anemias due to iron deficiency, and often other causes, are common throughout the world, and their detection in a subsample of children is recommended in all cases. Miale (11) has shown that Hgb, as measured by the photometric determination of cyanmethemoglobin, is preferred over hematocrit (Hcrit) since it is a more direct reflection of oxygen-carrying function of blood, and since the specimens can be more readily handled in the field and more reproducibly determined later in a central laboratory.

(2) Other determinations. If a high prevalence of such conditions as hypovitaminosis A or iodine deficiency goiter are suspected, laboratory measurement of these micronutrients may be indicated, when feasible. In field situations, however, problems of proper handling of specimens, and accurate performance of laboratory procedures are considerable, and usually militate against inclusion of such complex determinations in a simplified nutritional assessment of this kind.

Ensuring Measurement Accuracy

Since anthropometrics are the core of the simplified assessment methodology, sufficient time and effort must be taken for carefully training the paraprofessional personnel in simple anthropometry, and systematically checking their precision and accuracy at periodic intervals.

Group differences in body measurements which may be small but biologically meaningful are frequently obscured because of unacceptably large measurement errors which go unrecognized and uncorrected. To the degree that such errors can be minimized, the usefulness of anthropometric data, and of clinical and laboratory data as well, will be maximized.

Toward this end, a set of standardized but simple procedures has been developed for training in basic anthropometry, and for quality control of measurement accuracy in the field. These procedures include prepared forms for recording and quickly analyzing the data of standardization tests, which have been adapted from those proposed by Habicht (12). They have proven feasible and extremely useful. A monograph describing these procedures in detail is in preparation.

Laboratory data as well are useful to the extent that their precision and accuracy are known. Each technologist's performance should be tested periodically, at unannounced and irregular intervals. In addition to the capability and care of the technologist, factors such as proper collection, refrigeration, storage, and transport of specimens are crucial. Wherever possible reference laboratory standardization should be used.

Assessment Logistics

In the initial phases of planning it is essential to answer the following complex question: "To accomplish the nutritional assessment satisfactorily, how many teams, of what size, and with what equipment, must be transported to and from which villages, at what rate and over what period of time?"

Each situation calls for a balanced consideration of a host of variables of geography, time and weather; of personnel, equipment, supplies, and money. Such consideration will determine the logistic solutions which are most appropriate in a given situation. Although many details of plan and procedure must necessarily vary, certain principles remain relevant in all situations. Some of these will be mentioned.

Sampling requirements will dictate the number of sites to be visited, whether 30 or some multiple of 30. Experience indicates that each team should spend 2 days at each site, to have time to explain the assessment to the village leaders, to learn accurate details of the

information sought, and to find the children selected for examination. Each team must therefore be equipped to remain overnight in or near each village.

Adequate transportation is always difficult and costly. With problems of bad weather and poor roads which are common in many countries, the teams may be required to do considerably walking, which is costly in time and salary. For the most part, the mainstay of transportation is likely to be a number of sturdy vehicles of the Jeep or Landrover type.

Data Handling

Examination forms should be designed to facilitate subsequent computer analysis. Before sending the forms to the local data processing center, probably in the capital city, all forms should be edited for error and completeness in the field by the project director. Insofar as feasible, local statistical personnel and computer facilities should be employed. The Center for Disease Control (CDC) has developed a comprehensive computer program for handling the anthropometric and hematologic data input from these surveys on an IBM 370/145 computer. Software for this program is available at nominal charge* to qualified facilities. The program usually can be translated into appropriate language for a local computer, but in past experience it has been advantageous to send a duplicate computer tape or set of cards to a reference computer facility for dual processing.

Data Presentation

The interpretation of anthropometric data, and the choice of reference populations for making appropriate comparisons of children's growth are problems whose complexity is often unsuspected. One might think that the analysis of children's height and weight should be

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reasonably simple, with methods long since agreed upon. Such, however, is not the case.

Of the several anthropometric indices, weight-for-age (Wt-for-Age), as advocated by Gomez et al. (13), has been used most commonly. It is of particular value in evaluating the growth of younger children or individual children over time, and in usual clinical situations.

Besides weight-for-age, Seoane and Latham (14) and Waterlow (15) have recommended that the two indices (Height-for-Age) and (Weight-for-height), be determined and presented separately in comparing groups of children examined only once. This is because Wt-for-Age is not able to distinguish stunting in linear growth, particularly of bones, from wasting of other body tissues, mainly muscle and fat. A child, or a group of children, with low Wt-for-Age may be low by virtue either of low height-for-age (Ht-for-Age; stunting) or low weight-for-height (Wt-for-Ht; wasting), or some combination of both. The implications of the two conditions may be quite different.

Other problems in presenting anthropometric data include the choice of a reference population for making comparisons with the study population, and whether to compare the two populations by centile levels of Ht-for-Age and Wt-for-Ht, or by determining the percentage of persons in the study group whose values for either index are below an arbitrary percentage of the reference population's median (50th centile) value.

Standardization of presentation requires the use of an internationally accepted reference such as the one recommended by the World Health Organization (WHO) for comparison in international studies (16). In this context it is important that the reference population be considered not a "standard" but simply a measurement tool which provides a baseline for comparison among diverse groups, with no implication of "normality." For comparisons with the well-to-do-within the country involved, measurements may be made on a small group of children, with perhaps 100 in each year of age, chosen deliberately from the "elite", well-nourished segment of the population. Such a special group would not be representative nor

composed of as many children as required for a true reference population, but Walker and Richardson (17) have shown that their observed Ht and Wt can indicate the growth potential of the ethnic group under study.

The decision whether to present anthropometric data by centiles, or by percent of a study population below an arbitrary percent of a reference median value, will depend mainly upon the nature of the study population. Centiles are usually more appropriate for data from industrialized nations, where observed distributions of values are similar to those of available reference populations. The percent of a population below a certain percent of a reference median value as is done for Wt-for-Age (13) (for Ht-for-Age this is usually selected at 90 percent of median, and for Wt-for-Ht, at 80 percent) is more appropriate for less-developed nations, where observed median values in many rural regions and urban slums may be well below the 5th, or the 3rd, centiles of Western reference populations.

It is useful to present Ht-for-Age and Wt-for-Ht data as percentages of the study population above and below 90 percent and 80 percent, respectively, of reference median values, in a cross-tabulation form proposed by Waterlow (15). With this technique the degrees of long-term stunting and shorter-term wasting in a population are readily discernible. The limitations of such a presentation must be recognized, especially when attempting to draw etiologic inferences. Exactly how long in the past undernutrition may have been operative in causing stunted growth cannot be determined by data from one examination. The effect of causative factors other than undernutrition, such as infectious diseases, cannot be determined from simple anthropometrics alone, and interpretation of results should be confined mainly to the distribution and degree of abnormal growth, without speculating upon its causes. A monograph describing data methods of presentation in detail is in preparation by the U.S. Agency for International Development.

Feedback of assessment results should be made promptly to the sponsoring health and governmental agencies whose task it is to develop realistic plans for indicated remedial action. What type of action

program may be most appropriate and where it should be implemented will depend upon the nature of these results, further investigation into etiology, and the availability of needed resources.

Reassessment of the study villages may be considered in order to evaluate the effectiveness of subsequent intervention programs. Such reassessment would constitute one form of nutritional surveillance, but repeated surveys should not be considered the sole form of nutritional surveillance. In other situations different forms of surveillancy may be more feasible and equally useful. It is important to reiterate that this simplified survey of indices related to nutritional status can provide valid and relatively inexpensive answers to the questions of where, and how much stunting, wasting, and anemia may exist in a region or a nation. An action program based upon further knowledge of the etiologic correlates of malnutrition is likely to have the greatest effectiveness. Therefore, a more detailed ecological survey as a follow-up to the simplified assessment should be considered in areas where intervention is planned.

SUMMARY

A simple, inexpensive approach to the field assessment of nutritional status is proposed to determine the location and extent of stunting, wasting, and anemia in a defined geographic area. The approach is characterized by two principal features, a simple statistical method for randomly selecting the population samples to be studied, and a suggested core of objective nutrition-related indicators, uniformly measured, in young children.

The basic measurements, length or height, weight, and hemoglobin are recommended to be made on 30 randomly selected sites in each region for which valid nutritional inferences are desired. Children in this age range are assumed to be at maximum risk of malnutrition, and their categorization by degree of physical growth impairment and anemia will in most cases reflect a community's nutritional status. Additional

measurements may be performed, if indicated clinically or epidemiologically, and if feasible economically and technically.

The body measurements and collection of specimens for laboratory determinations are to be performed by especially trained paraprofessional personnel indigenous to the country. Their training in simple anthropometry and subsequent quality control of their measurement accuracy and precision are standardized by rigorous but simple field procedures. Interobserver measurements bias can thus be minimized, and valid comparability of results can be assured.

Data should be gathered on forms amenable to automatic data processing. Observed anthropometric values should be compared with those of accepted reference populations. The method of cross-classifying children by the indices height-for-age and weight-for-height helps provide an estimate of past and more recent influences upon physical growth.

In addition to providing baseline indications of where and to what extent common nutritional problems may exist in various regions of a nation, the assessment method, repeated periodically, will indicate changes with time, and thus may be used to evaluate effectiveness of remedial intervention. Because of the limitations of this type of assessment, if stunting and wasting appear to be a public health problem, a supplemental ecological analysis of possible causal factors may be indicated in order for appropriate remedial programs to be instituted.

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